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Special issue: Falls prevention in NSW

Falls prevention in NSW: a big issue requiring sustained research, policy and practice initiatives

GUEST EDITORS

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The *NSW Public Health Bulletin* published its first falls prevention edition, *The Big Falls Issue*, in 2002.[1] Almost a decade on, falls prevention remains a 'big issue'; the current estimate of treatment costs in New South Wales (NSW) for 2006–07 is $558.5 million,[2] which is 2.5 times the previous estimate for 1998–99.[3] However, there have also been concerted efforts over the past 10 years by policy makers, researchers and the non-government sector to address the issue with the implementation of the *NSW Management Policy to Reduce Fall Injury Among Older People, 2003–2007*[4] and the creation of a falls prevention co-ordinator workforce in NSW.

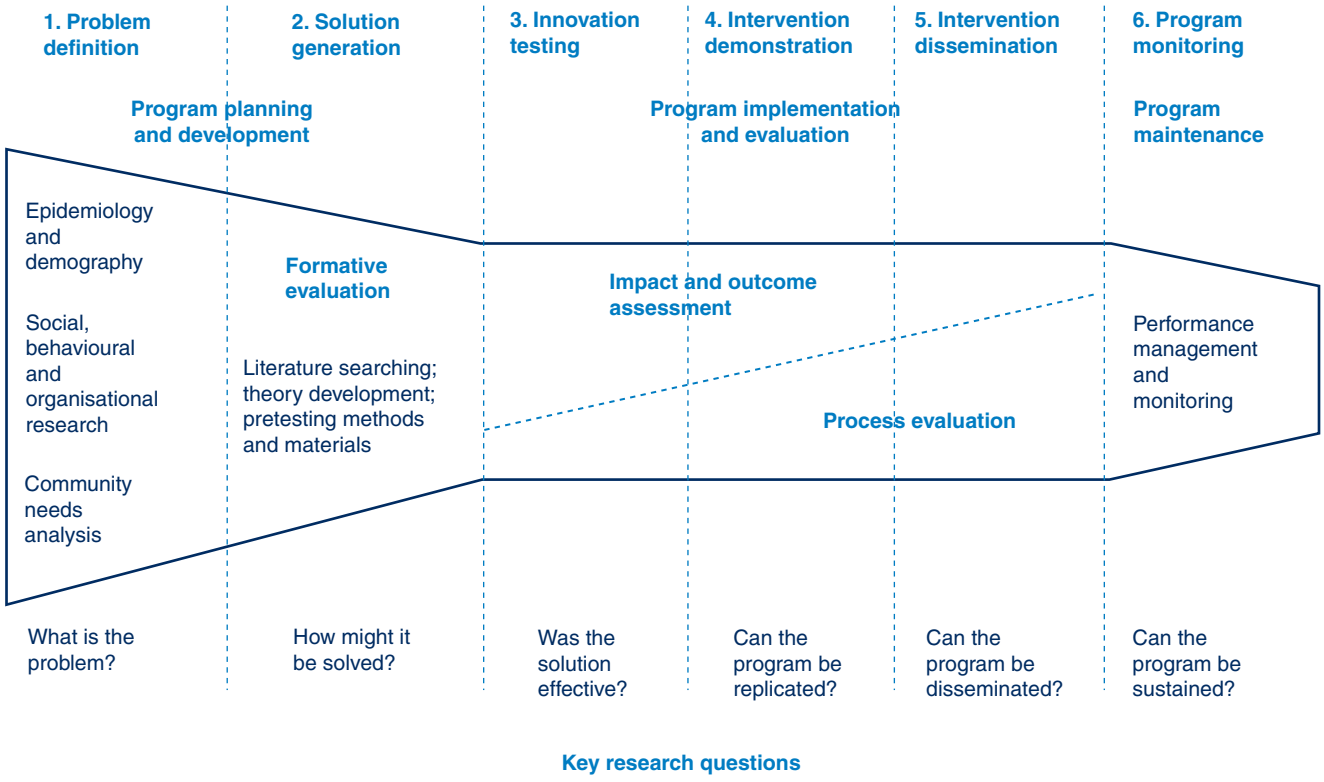

Figure 1. Stages of research and evaluation in public health.
Source: Nutbeam D and Bauman A. Evaluation in a Nutshell – A practical guide to the evaluation of health promotion programs. Sydney: McGraw-Hill; 2006.

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The papers span the full range of the 'Stages of research and evaluation in public health' continuum (Figure 1). This is crucial as advances at each level are important for informing direction at the next and indicate that the research, implementation, dissemination and evaluation projects recently completed and planned for the future are in line with best practice principles.

These papers demonstrate that we cannot afford to neglect the potential epidemic of falls. As treatment costs continue to rise, it will be even more difficult to find resources for prevention and the cycle of increased demand will be accelerated.

Over the past year, the NSW Department of Health has been working on developing a new *NSW Health Plan for Prevention of Falls and Harm from Falls Among Older People: 2011–2015*,[5] which is expected to influence health investment as well as policy and practice in the acute, residential care and community-based environments. There remain challenges but it is heartening to see how far falls prevention policy and practice has evolved over the past decade, to a place where more strategic and evidence-based practice is the norm rather than the exception. There is great determination amongst the field to halt and hopefully reverse what could be a public health crisis by the middle of this century.

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Prevalence, circumstances and consequences of falls among community-dwelling older people: results of the 2009 NSW Falls Prevention Baseline Survey

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Abstract: Aim: To describe the prevalence, circumstances and consequences of falls among community-dwelling older people in NSW using data from the 2009 NSW Falls Prevention Baseline Survey. **Methods:** Telephone interviews with a random sample of 5681 NSW residents aged 65 years and over were conducted in 2009. **Results:** Of those surveyed, 25.6% reported falling in the last year. Of those who fell, 61.2% fell once, 21.4% fell twice, 7.8% fell three times, and 9.5% fell four or more times in the last year. Sixty-six percent of those who fell in the last year were injured and 20.0% visited a hospital as a result of a fall. The most common injuries were cuts, grazes or bruises (71.0%) and sprains or strains (9.9%). **Conclusion:** The findings of this survey are consistent with previous findings in the published fall injury prevention literature. The results from the survey will assist in the design of community oriented fall injury prevention strategies and will form the baseline measure for the evaluation of the impact of these strategies in NSW.

With an ageing population, falls among older people are a significant public health issue.[1–5] No other single injury cause, including road trauma, costs the New South Wales (NSW) health system more.[2] Even non-injurious falls can have negative impacts such as loss of confidence and activity restriction.[3] Retrospective community-based studies and surveys consistently report that approximately 30% of older people experience one or more falls each year.[6–11] In addition, the prevalence of falls increases with age and older people who have suffered a fall are at increased risk of falling again.[12]

Previous studies in NSW and elsewhere have shown that about 50–60% of falls among community-dwelling older people occur within their own home and yard, with most falls occurring on level surfaces in commonly used rooms such as the bedroom, lounge and kitchen.[13–15] Depending on the population studied and the definition of injury used, 22–60% of older people suffer injuries from falls, 10–15% suffer serious injuries, 2–6% suffer fractures, and 0.2–1.5% suffer hip fractures.[12] The most commonly reported injuries are superficial cuts and abrasions, bruises and sprains.[12,14–18]

Although previous population health surveys have described the epidemiology of falls,[9–11] they have not been conducted with as large a sample and have not provided the breadth of data on falls history, circumstances surrounding falls, consequences, health status, falls risk and protective factors, contact with health professionals, falls prevention knowledge and exposure to preventative measures. Consequently the 2009 NSW Falls Prevention Baseline Survey (the Survey) was conducted to provide current and comprehensive data to assist in the evaluation of the impact of the *NSW Health Plan for Prevention of Falls and Harm from Falls Among Older People: 2011–2015*.[19]

The full results of the Survey are reported elsewhere.[20] This paper focuses specifically on falls prevalence and the circumstances and consequences of falls.

Methods

Survey instrument

The Survey instrument was developed by the Centre for Health Advancement (NSW Department of Health) and

the NSW Injury Risk Management Research Centre (University of NSW). Questions were field-tested prior to inclusion in the Survey. The Survey defined a fall as: 'an unexpected event in which the participant comes to rest on the ground or floor or a lower level'.[12] Multiple responses were allowed for questions pertaining to injuries suffered from the most recent fall and perceived causes of the most recent fall.

The instrument was translated into five languages: Arabic, Chinese, Greek, Italian and Vietnamese. A shorter version of the instrument was administered to the main carers of 361 participants unable to answer on their own behalf.

The target population for the Survey was all NSW residents aged 65 years and over living in households with private telephones. The target sample comprised a random sample of approximately 625 people in each of the eight former NSW area health services for a total sample of 5681.

The sampling frame was developed using records from the Australia on Disk[21] electronic white pages (phone book) which were geocoded using MapInfo[22] mapping software. The geocoded telephone numbers were assigned to statistical local areas and former area health services. The proportion of numbers for each telephone prefix by former area health service was calculated. All prefixes were expanded with suffixes ranging from 0000 to 9999. The resulting list was then matched back to the electronic phone book. All numbers that matched numbers in the electronic phone book were flagged and the number was assigned to the relevant geocoded former area health service. Unlisted numbers were assigned to the former area health service containing the greatest proportion of numbers with that prefix. Numbers were then filtered to eliminate contiguous unused blocks of greater than 10 numbers. The remaining numbers were checked against the business numbers in the electronic phone book to eliminate business numbers. Finally, numbers were randomly sorted.

Households were contacted using random digit dialling and one eligible person from the household was selected for inclusion in the Survey. Interviews were carried out continuously between March and July 2009 by trained interviewers at the NSW Health Survey Program computer-assisted telephone interviewing (CATI) facility and the McNair Ingenuity Research Ltd CATI facility.

Up to seven calls were made to establish initial contact with a household, and five calls were made in order to contact a selected respondent. A more detailed description of the Survey methods is available in the full report.[20]

The conduct of the Survey was approved by NSW Health's Population and Health Services Research Ethics Committee.

Data analysis

Call and interview data were analysed using SAS software (version 9.1.3, SAS Institute, Cary, NC, USA). The SURVEYFREQ procedure in SAS was used to analyse the data and calculate point estimates and 95% confidence intervals for the estimates. The SURVEYFREQ procedure calculates standard errors adjusted for the design effect factor (the variance for a non-random sample divided by the variance for a simple random sample). Comparisons against the overall statewide prevalence were made for each factor under investigation by gender, age group and urban versus rural health areas. For the purposes of the Survey, 'urban' meant that the respondent lived in one of the four former area health services designated as metropolitan: Northern Sydney Central Coast, South Eastern Sydney Illawarra, Sydney South West or Sydney West. 'Rural' meant that the respondent lived in one of the four former area health services designated as rural: Greater Southern, Greater Western, Hunter New England or North Coast.

Prevalence measures were calculated using weighted data. Further information on the weighting and data analysis process is provided elsewhere.[20,23]

Response rate

In total, 5681 interviews were conducted with NSW residents aged 65 years and over, with at least 675 interviews in each former area health service. The overall response rate was 60.8%, with 4.9% of interviews conducted in a language other than English. The majority of participants answered questions on their own behalf. However, proxy respondents were required for 361 participants (6.4%) unable to answer on their own behalf due to communication difficulties or cognitive impairment.

Results

Falls in the last 12 months

In 2009, 25.6% of older people in NSW reported falling at least once in the last 12 months (Table 1). There was no significant difference in falls prevalence in the last 12 months between males and females. A significantly lower proportion of older adults aged 65–69 years (21.5%, $p = 0.000004$), and a significantly higher proportion of older adults aged 85–89 years (34.0%, $p = 0.000743$) and 90 years and over (35.9%, $p = 0.024429$) had fallen in the last 12 months, compared with the overall older adult population.

Number of falls in the last 12 months

Among those older adults who had fallen in the last 12 months, the majority (61.2%) fell only once, 21.4% fell twice, 7.8% fell three times, and 9.5% fell four or more times. Overall, the average number of falls increased with

Table 1. Prevalence of falls, fall-related injury and level of treatment in the last 12 months, adults aged 65 years and over, NSW, 2009

Age (years)	Fell in last 12 months % (95% CI)	Persons injured and level of treatment			
		Injured % (95% CI)	Required a visit to hospital % (95% CI)	Required admission to hospital % (95% CI)	Required non-hospital treatment % (95% CI)
65–69	21.5 (19.3–23.6)	65.0 (59.7–70.4)	17.4 (12.9–21.9)	7.3 (4.4–10.2)	19.2 (14.7–23.7)
70–74	24.5 (21.9–27.1)	66.5 (60.8–72.2)	18.1 (13.5–22.6)	8.2 (4.9–11.5)	23.2 (18.1–28.3)
75–79	26.9 (23.9–29.9)	65.3 (59.1–71.5)	18.1 (13.1–23.1)	11.6 (7.5–15.6)	22.5 (17.2–27.9)
80–84	27.8 (24.4–31.2)	63.8 (57.0–70.6)	20.2 (14.6–25.8)	11.6 (7.1–16.1)	21.7 (16.0–27.5)
85–89	34.0 (28.9–39.2)	72.1 (63.9–80.4)	31.5 (22.6–40.4)	19.4 (11.7–27.1)	27.3 (18.6–36.0)
90+	35.9 (26.8–44.9)	70.1 (55.5–84.7)	26.3 (11.0–41.6)	14.8 (0.2–29.3)	34.9 (18.9–51.0)
All	25.6 (24.3–26.9)	66.1 (63.4–68.9)	20.0 (17.6–22.3)	10.7 (8.8–12.5)	22.7 (20.2–25.2)
No. of respondents on which estimates are based	$n = 5662$	$n = 1473$	$n = 1476$	$n = 1476$	$n = 1469$

Denominator is persons who fell at least once.
Source: NSW Falls Prevention Baseline Survey (HOIST). Centre for Epidemiology and Research and Centre for Health Advancement, NSW Department of Health.

Table 2. Injuries reported from most recent fall, adults aged 65 years and over who were injured in a fall in the last 12 months, NSW, 2009

Response	Males % (95% CI)	Females % (95% CI)	Persons % (95% CI)
Head injury (including eyes and teeth)	3.5 (1.2–5.9)	3.2 (1.6–4.8)	3.3 (2.0–4.7)
Spinal injury	1.6 (0.0–3.2)	0.6 (0.0–1.1)	1.0 (0.2–1.7)
Fractured arms or hands	1.6 (0.0–3.2)	0.6 (0.0–1.1)	1.0 (0.2–1.7)
Fractured ribs or sternum	2.2 (0.6–3.7)	3.1 (1.5–4.7)	2.7 (1.6–3.9)
Fractured hip, femur or pelvis	1.8 (0.1–3.5)	2.0 (0.8–3.3)	1.9 (0.9–2.9)
Fractured lower leg, knees or feet	2.9 (0.9–4.9)	3.7 (2.0–5.4)	3.4 (2.1–4.7)
Sprain or strain	12.1 (8.2–16.1)	8.4 (5.8–11.0)	9.9 (7.7–12.1)
Dislocation	1.2 (0.0–2.6)	1.1 (0.2–2.0)	1.2 (0.4–1.9)
Cuts, grazes or bruises	69.8 (64.2–75.5)	71.8 (67.5–76.1)	71.0 (67.6–74.5)
Other	13.2 (9.1–17.3)	14.9 (11.7–18.2)	14.2 (11.7–16.8)

Respondents could provide more than one response. Estimates are based on 915 respondents.
Source: NSW Falls Prevention Baseline Survey (HOIST). Centre for Epidemiology and Research and Centre for Health Advancement, NSW Department of Health.

age from 1.78 among those aged 65–69 years to 2.67 among those aged 90 years and over.

Persons injured as a result of falls

Of those persons who fell in the last 12 months, 66.1% sustained an injury as a result of a fall (Table 1). There was no significant difference between age groups; however, a significantly lower proportion ($p = 0.000111$) of males (60.0%) than females (71%), and a significantly higher proportion of adults ($p = 0.020515$) in metropolitan health areas (68.5%) than rural health areas (62.1%) experienced an injury as a result.

When asked about their most recent fall, the most common injuries reported were cuts, grazes or bruises (71%) and sprains or strains (9.9%) (Table 2). Respondents could report more than one type of injury.

Persons requiring a visit to hospital as a result of falls

Among older adults who had fallen in the last 12 months, 20% required a visit to hospital as a result of a fall (Table 1). There was no significant difference between males and females. Among those who fell, a significantly higher proportion of older adults aged 85–89 years (31.5%, $p = 0.006096$) required a visit to hospital, compared with the overall older adult population.

Persons admitted to hospital as a result of falls

Among older adults who had fallen in the last 12 months, 10.7% required admission to hospital as a result of a fall

Table 3. Activities reported being undertaken when most recent fall occurred, adults aged 65 years and over who had a fall in the last 12 months, NSW, 2009

Response	Males % (95% CI)	Females % (95% CI)	Persons % (95% CI)
Hurrying	4.7 (2.8–6.6)	7.8 (5.7–10.0)	6.4 (5.0–7.9)
Steps, stairs, kerb or gutter	9.8 (7.3–12.3)	11.6 (9.2–14.0)	10.8 (9.1–12.5)
Carrying or bending activities	14.4 (11.2–17.6)	17.0 (14.1–19.9)	15.8 (13.7–18.0)
Walking	38.9 (34.4–43.5)	47.6 (43.9–51.4)	43.8 (40.9–46.7)
Physical work or chores	17.5 (14.0–20.9)	16.2 (13.4–18.9)	16.7 (14.6–18.9)
Bathing, dressing or on toilet	5.2 (3.0–7.4)	4.1 (2.7–5.6)	4.6 (3.3–5.8)
Activity off the ground	5.7 (3.6–7.7)	2.6 (1.1–4.0)	3.9 (2.7–5.2)
Sports, exercise or physical activity	7.8 (5.4–10.2)	2.3 (1.1–3.5)	4.7 (3.5–6.0)
Effects of medication, dizziness, sleeping or fainting	3.2 (1.6–4.8)	5.5 (3.8–7.3)	4.5 (3.3–5.7)
Other	4.2 (2.4–6.0)	2.3 (1.2–3.5)	3.2 (2.2–4.2)

Respondents could provide more than one response. Estimates are based on 1465 respondents.
Source: NSW Falls Prevention Baseline Survey (HOIST). Centre for Epidemiology and Research and Centre for Health Advancement, NSW Department of Health.

(Table 1). There was no significant difference between males and females. Among those who fell, a significantly lower proportion of older adults aged 65–69 years (7.3%, $p = 0.011001$), and a significantly higher proportion of older adults aged 85–89 years (19.4%, $p = 0.016115$), required admission to hospital, compared with the overall older adult population. Among those who fell, a significantly higher proportion ($p = 0.011548$) of older adults in metropolitan health areas (12.2%) than rural health areas (7.9%) required admission to hospital as a result of a fall.

Persons requiring other non-hospital medical treatment as a result of falls

Among older adults who had fallen in the last 12 months, 22.7% required medical treatment without hospitalisation as a result of a fall. A significantly lower proportion ($p = 0.033542$) of males (19.7%) than females (25.1%) required medical treatment without hospitalisation as a result of a fall. There was no significant difference among age groups or between metropolitan and rural health areas.

Activities undertaken when most recent fall occurred

The most common activities undertaken when the most recent fall occurred were: walking (43.8%); physical work or chores (16.7%); carrying or bending activities (15.8%); and negotiating steps, stairs, kerbs or gutters (10.8%) (Table 3).

Perceived causes of most recent fall

The most common perceived causes of the most recent fall were: tripped or slipped (27.4%); surrounding hazards, for example wet or uneven floor (21.8%); misjudged, over-balanced, or over-reached (17.8%); and fainting, dizziness, illness, or legs gave way (17.7%). Respondents could report more than one cause.

Discussion

The results of the 2009 NSW Falls Prevention Baseline Survey[20] are consistent with findings reported in the Australian and international literature. For example, in NSW in 2009, 25.6% of older adults reported falling in the last 12 months compared with approximately 30% in the published literature.[6–11] The Survey also confirmed that many older people living in the community fall more than once and that the frequency of falls experienced by older people increases with age.[10,11] The most common injuries reported in the Survey by older people who had fallen were similar to those reported in the literature (relatively minor cuts, grazes or bruises). Fractured hips were a relatively uncommon outcome with only 1.9% of persons in the Survey injured as the result of a fall reporting a fractured hip, femur or pelvis compared to a range of 0.2–1.5% for hip fractures in the literature.[12] However, it is possible that the Survey underestimated the frequency of these serious injuries as older people who had moved to residential care or died as a result of such injuries would not be included in the data. Consistent with the literature, most falls occurred in the home environment.[13–15]

There were, however, some exceptions to the homogeneity of these results. Of those who fell, 66.1% reported experiencing an injury compared to estimates in the literature ranging between 22% and 60%.[12] While the prevalence of injury may vary depending on the population under study, the definition of an injury also varies considerably between studies. In this case, minor injuries such as bruises, cuts and abrasions were included and this may account for the higher prevalence of injury reported here.

These findings on the prevalence, type and place of injury can assist in falls prevention program design and implementation. Importantly, the Survey also provides a

baseline for the evaluation of the impact of *NSW Health Plan for Prevention of Falls and Harm from Falls Among Older People: 2011–2015*[19] by providing not only much needed data on falls prevalence, but state and area measures of risk and protective factors, contact with health professionals, falls prevention knowledge and exposure to preventative interventions. Together these measures are a central part of the NSW Falls Plan Evaluation Framework. This framework will also include the ongoing monitoring of a subset of fall-related questions in the continuous NSW Population Health Survey and a follow-up survey in 2015.

Despite the representative nature of the Survey sample, there are a number of limitations which should be noted. The falls status data from the Survey may be subject to recall bias as respondents were asked to report on falls and treatment for fall-related injuries in the previous 12 months. However, a review of cohort studies by Ganz et al[24] showed that, in three studies for which data were available, recall of any fall in the previous year is relatively specific (91–95%), but somewhat less sensitive (80–89%) than intensive prospective data collection involving postcards or diaries. One study conducted in Australia also showed that individuals who suffered an injurious fall were significantly more likely to recall their falls than those who were not injured.[25]

Despite the large sample size, caution should be used in interpreting results where wide confidence intervals are reported. As the Survey relied on self-reporting, age-related cognitive deficits may have compromised accurate reporting in some respondents. To minimise this risk interviewers were trained in the delivery of surveys to older people and proxy respondents were allowed when eligible participants were unable to complete interviews themselves.

Despite these limitations it is encouraging that the 2009 Survey results, for the most part, are consistent with the literature. The consistency in findings may suggest that the aetiology of falls in community-dwelling older people in developed countries remain relatively stable over time, as evidenced by the fact that some of the data in the literature was generated over three decades.

Conclusion

Despite the different methodologies described in the literature to ascertain fall prevalence, circumstances and the consequences of falls, the findings from this large, representative, population level survey of community-dwelling older people are similar to the body of evidence in this area. The results of this Survey provide information relevant to the design of falls prevention programs and an important set of measures of the impact of falls prevention policy implementation in NSW.

The *New South Wales Falls Prevention Baseline Survey: 2009 Report* is available in both HTML and PDF versions from the NSW Department of Health website at: www.health.nsw.gov.au.

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Characteristics of fall-related injuries attended by an ambulance in Sydney, Australia: a surveillance summary

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Abstract: In NSW, fall-related injury costs the health system more than any other single cause of injury. A public health surveillance database containing information routinely recorded by the Ambulance Service of NSW was used to define the epidemiology and characteristics of fall-related calls in the Sydney metropolitan area in 2008. The dataset contained 37 488 fall-related calls, representing a crude rate of ambulance call-outs for falls of 843 per 100 000 population. Females accounted for 57% of all fall-related calls, and the female rate of injury to the 'hip to foot' region increased with age. Males in all age groups reported 'head and neck' injury most often. In an analysis of a random sample of 1200 calls, 70% of ambulance dispatches were to a home or residential institution. The findings of this study on the risks for fall-related injury can be used to guide policy for ambulance service delivery. Expansion of data linkage to emergency department and admitted patient databases would provide information to further describe the epidemiology of falls in NSW.

Falls account for approximately one-third of all injury-related hospitalisations and one-fifth of all fatal injuries[1] and contribute substantially to the burden on health services in Australia. Each year, one in three older people will experience a fall and will then be at risk of experiencing further falls.[2] In the period 2003–2004, falls in older Australians that required hospitalisation were estimated to cost $566 million. Indirect costs such as lost productivity and costs borne by the patient, family and community were estimated to exceed $1 billion annually.[1]

In 2005–2006, the number of new cases of fall injuries in people aged 65 years and over that resulted in hospitalisation was more than 66 800, which represents a 10% increase since 2003–2004. Age-standardised rates of fall injuries for older people have also risen since 2003–2004, despite screening and prevention programs.[3]

In New South Wales (NSW), fall-related injury costs the health system more than any other single cause of injury.[4] Falls accounted for 38% of injury-related hospitalisations in NSW in the period 2004–2005 to 2006–2007. In 2006–2007, there were 43 762 hospitalisations and an age-standardised rate of 587 per 100 000 population. More than half of those hospitalised were aged over 65 years (a rate of 2747 per 100 000). In this age group, the rate of hospitalisation was higher for females (3073 per 100 000) than males (2275 per 100 000).[4]

Falls are the second most common reason for emergency ambulance calls in Sydney[5] however there is limited published information on ambulance call-outs for falls in NSW. We used a public health surveillance database containing information routinely recorded by the Ambulance Service of NSW to describe the epidemiology and characteristics of fall-related ambulance calls in the Sydney metropolitan area in 2008.

Methods

Data source

The Ambulance Service of NSW uses Medical Priority Dispatch System™ (MPDS) software to gather data systematically from 000 callers to prioritise responses. Details of computer-aided ambulance dispatches are recorded in a database at the regional ambulance headquarters. The NSW Department of Health receives hourly updates of these data from the Sydney Ambulance Operations Region, which are used to supplement near-real-time emergency department surveillance of communicable and non-communicable conditions.[6]

For this study, we extracted the records of all emergency ambulance calls assigned a problem category of 'fall' in 2008. After 1218 exclusions for cancellations, transfers to other regions, duplicates and hoaxes, we were left with a dataset of 37 488 calls for which an ambulance was dispatched. Age and gender were known for 93% of calls.

The variables used in the analysis were: age, gender, time of call, local government area, call priority (1 or 2), the person's consciousness and breathing status at the time of the call and the description of the location of the patient. The comment text field, which contains a description of the problem by the caller, was also included to permit analysis of the body region of the injury. The time of the call was categorised as 'daytime' (0800–1800 inclusively) or 'out of hours'.

Manual categorisation of a random sample of records

To categorise the place of the fall and reported injuries sustained, a random sample of 1200 (3.2%) call records was selected from the complete data set with the SAS RANUNI function. Descriptions of the patients' location and comment texts were reviewed and manually categorised. To be consistent with reports on hospitalisations for falls injuries,[3] we based our categorisation of place of fall on the external cause of morbidity and mortality rubrics of the International Classification of Diseases, Revision 10, Australian Modification (ICD-10-AM).[7] We grouped the body locations of injury into 'head and neck', 'hip to foot', 'shoulder to hand', 'trunk/back/pelvis', 'multiple body regions', 'no injury' or 'unspecified'. 'No injury' was based on comments that the person had no injuries. We also classified whether the call was to request a 'lift only', where assistance was required only for getting up after a fall. Information on the type of fall was missing for approximately 40% of calls.

Counts from the random sample were scaled to estimate counts for the Sydney region, and confidence intervals for proportions were calculated by exact binomial methods.

Data analysis

Analysis was performed with SAS statistical software (version 9.2, SAS Institute, Cary, NC, USA). Age-specific

Table 1. Age and gender of patients who had a fall-related ambulance call in the Sydney metropolitan area, 2008

Age group (years)	Male			Female			Total		
	n	%	Crude rate per 100 000	*n*	%	Crude rate per 100 000	*n*	%	Crude rate per 100 000
0–4	783	2.2	543	590	1.7	432	1373	3.9	489
5–9	473	1.4	367	254	0.7	207	727	2.1	289
10–14	547	1.6	416	325	0.9	259	872	2.5	339
15–19	390	1.1	283	318	0.9	241	708	2.0	263
20–24	413	1.2	258	405	1.2	257	818	2.3	257
25–29	412	1.2	251	379	1.1	229	791	2.3	239
30–34	419	1.2	260	364	1.0	221	783	2.2	240
35–39	442	1.3	274	430	1.2	261	872	2.5	267
40–44	521	1.5	347	549	1.6	361	1070	3.1	354
45–49	580	1.7	399	519	1.5	353	1099	3.2	376
50–54	711	2.0	554	832	2.4	625	1543	4.4	590
55–59	608	1.7	535	729	2.1	623	1337	3.8	580
60–64	915	2.6	931	986	2.8	996	1901	5.5	964
65–69	789	2.3	1148	920	2.6	1305	1709	4.9	1228
70–74	1246	3.6	2347	1576	4.5	2674	2822	8.1	2519
75–79	1411	4.1	3382	1955	5.6	3853	3366	9.7	3640
80–84	1978	5.7	6435	3344	9.6	7482	5322	15.3	7055
85+	2477	7.1	11 570	5221	15.0	11 542	7698	22.1	11 551
Total	**15 115**	**43.4%**	**741**	**19 696**	**56.6%**	**943**	**34 811**	**100.0%**	**843**
	Age standardised rate for males		**821**	**Age standardised rate for females**		**839**	**Age standardised rate for total population**		**833**

Of a total 37 488 calls, 2677 (7.1%) were excluded from this analysis because of missing age or sex.
Australian standard population Census 2001 used to calculate population rates.
Confidence intervals were not calculated because this analysis used fully enumerated ambulance calls and because of the very large counts.

rates were calculated from the total age-specific populations of the local government areas included in the Sydney Ambulance Operations region, which includes areas from the Hawkesbury River in the north, to Bowral in the south and Mount Victoria in the west. To compare overall rates in males and females independently of age, direct age-standardised rates were calculated for each gender from the Australian standard population in the 2001 census.[8]

Results

The crude rate of call-outs for falls was 843 per 100 000 population. The lowest rates were for people aged 25–34 years, with higher rates for children aged under 5 years. The rates increased dramatically from age 50, from around 585 to 11 551 per 100 000 in people aged 85 years and over (Table 1).

Females accounted for 57% of fall-related calls, and 25% of all calls were for women aged 80 years and over. For people aged under 50 years, the rates were generally higher for males, but women over this age had higher rates, until over 85 years when the rates in the two sexes were similar. The crude rates for females were higher than for males (943 and 741 per 100 000, respectively). After direct age standardisation, the rates were similar, with 839 and 821 per 100 000 for females and males, respectively (Table 1).

Fifty-six percent (21 048) of calls were assigned a priority code 1, requiring an immediate response. The patient was reported as conscious in 92% (34 601) and breathing in 94% (35 116) of calls. Sixty percent (22 420) of calls were received during 'daytime hours'.

In the random sample, 58% (95% confidence interval (CI), 55–61) of ambulance dispatches were to a home, 14% (95% CI, 12–16) to a trade or service area and 12% (95% CI, 10–13) to a residential institution (Table 2).

Twenty-nine percent (95% CI, 26–32) of callers reported 'head and neck' injuries; 20% (95% CI, 18–23) reported injuries to the 'hip to foot' region; and 9% (95% CI, 7–10)

Table 2. Estimated incidence of falls by location of patient from a random sample of 1200 fall-related ambulance calls in the Sydney metropolitan area, 2008

Location of patient	*n*	% (95% CI)
Home	21 694	58 (55–61)
Residential institution	4308	12 (10–13)
School/public administrative area	1654	4 (3–6)
Sports/athletic area	312	1 (0–2)
Street/highway	3246	9 (7–10)
Trade/service area	5306	14 (12–16)
Industrial/construction area	125	0 (0–1)
Other specified	593	2 (1–2)
Unspecified place	250	1 (0–1)
Total	**37 488**	

Table 3. Estimated incidence of injury by body region from a random sample of 1200 fall-related ambulance calls in the Sydney metropolitan area, 2008

Body location of injury		*n*	% (95% CI)
Head and neck	Head	10 675	99 (97–100)
	Neck	156	1 (0–3)
	Sub-total	10 831	29 (26–32)
Trunk, back and pelvis	Thorax	468	17 (10–26)
	Abdomen, lower back, lumbar spine and pelvis	2310	83 (74–90)
	Sub-total	2778	7 (6–9)
Shoulder to hand	Shoulder and upper arm	936	30 (21–40)
	Elbow and forearm	312	10 (5–17)
	Wrist and hand	780	25 (17–34)
	Arm unspecified	1124	36 (26–46)
	Sub-total	3153	8 (7–10)
Hip to foot	Hip and thigh	2247	29 (24–36)
	Knee and lower leg	1873	22 (17–28)
	Ankle and foot	1498	20 (15–25)
	Leg unspecified	2029	29 (23–35)
	Sub-total	7647	20 (18–23)
Multiple body regions		2872	8 (6–9)
Reported no injury		3280	9 (7–10)
Unspecified		6904	18 (16–21)

Table 4. Comparison by age and gender of body region of injury reported by callers, from a random sample of 1200 fall-related ambulance calls in the Sydney metropolitan area, 2008

Sex	Body region	0–4 years		5–16 years		17–64 years		65+ years		Total	
		n	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)
Male	Head and neck	469	68 (45–86)	437	37 (22–54)	2093	40 (32–47)	1781	24 (19–30)	4873	33 (29–37)
	Hip to foot	0	0.0	219	18 (8–34)	968	18 (13–25)	1343	18 (13–23)	2530	17 (14–21)
	Multiple body regions	0	0.0	125	11 (3–25)	406	8 (4–13)	469	6 (4–10)	1031	7 (5–10)
	No injury	0	0.0	0	0	312	6 (3–11)	1437	19 (14–25)	1749	12 (9–15)
	Shoulder to hand	125	18 (5–40)	219	18 (8–34)	531	10 (6–16)	469	6 (4–10)	1343	9 (7–12)
	Trunk, back and pelvis	31	5 (0–23)	31	3 (0–14)	469	9 (5–14)	406	5 (3–9)	937	6 (4–9)
	Unspecified	62	9 (1–29)	156	13 (4–28)	500	9 (6–15)	1593	21 (16–27)	2437	16 (13–20)
	Sub-total	687	52 (36–68)	1187	56 (43–68)	5280	47 (42–53)	7498	36 (32–40)	14 901	42 (39–44)
Female	Head and neck	562	90 (68–99)	250	28 (13–47)	1468	25 (19–32)	2968	22 (19–27)	5405	26 (23–29)
	Hip to foot	0	0.0	219	24 (10–44)	1562	27 (21–34)	3030	23 (19–27)	4811	23 (20–26)
	Multiple body regions	31	5 (0–25)	125	14 (4–32)	437	7 (4–12)	1156	9 (6–12)	1749	8 (6–11)
	No injury	0	0.0	0	0	312	5 (3–10)	1187	9 (6–12)	1500	7 (5–9)
	Shoulder to hand	0	0.0	156	17 (6–36)	437	7 (4–12)	1093	8 (6–11)	1749	8 (6–11)
	Trunk, back and pelvis	0	0.0	94	10 (2–27)	656	11 (7–17)	906	7 (5–10)	1718	8 (6–11)
	Unspecified	31	5 (0–25)	62	7 (1–23)	968	17 (12–23)	2874	22 (18–26)	3999	19 (16–22)
	Sub-total	625	48 (32–64)	906	43 (31–55)	5842	53 (47–58)	13 215	64 (60–67)	20 931	58 (56–61)
Total		**1312**	**4 (3–5)**	**2093**	**6 (4–7)**	**11 121**	**30 (27–32)**	**20 712**	**55 (52–58)**	**35 832**	**100**

Total does not include 2677 missing values for age and sex.

reported 'no injury' (Table 3). Six percent (2247; 95% CI, 5–7) were calls for a 'lift only'.

For males, calls reporting injuries to the 'head and neck' region dominated all age groups. In females, injuries to the 'hip to foot' region were just as common as injuries to the 'head and neck' region. Among children aged under 5 years, calls for 'head and neck' injuries comprised a far greater proportion than for other age groups, with 68% (95% CI, 45–86) of calls for boys and 90% (95% CI, 68–99) of those for girls relating to the head or neck (Table 4).

Discussion

We found a high rate of fall-related ambulance calls in the Sydney region, particularly for the elderly population, which confirms the high burden of falls injury. The rate of fall-related calls increased from age 50 years onwards. Older women experienced falls requiring an ambulance at a higher rate than men and had higher rates of reported injuries to the 'hip to foot' region. Hip injury or hip fracture may account for many of these injuries, and the greater risk of older women may reflect their higher prevalence of osteoporosis.[9]

The high rate of fall-related ambulance calls for older persons, particularly older women, is consistent with the epidemiology of fall-related hospital admissions in NSW.[4]

Our finding that 70% of fall-related calls among people of all ages occurred at home or in a residential institution is similar to the national figure of 71% of falls by older persons requiring hospitalisation taking place in the home or in an aged-care facility.[3]

The high priority assigned to most falls reinforces the fact that falls can be responsible for serious injury and that rapid assistance is often required; nevertheless, many people may experience little or no injury. Some calls were to request a 'lift only'. The use of ambulance services by people who only require assistance to get up warrants further consideration owing to its resource implications.

Ambulance services are well placed to explore a variety of service options related to falls, such as assessment, screening and treatment, and to direct referrals to general practitioners or community health services. Such strategies may meet the needs of patients and prevent unnecessary trips to an emergency department. An ambulance dispatch database could expand the range of information available for public health surveillance of fall-related injuries in the population, and could provide valuable information for guiding the development of a fall-related ambulance service delivery policy.

Once paramedics arrive on the scene, a 'patient health care record' is completed which documents the assessment, findings and treatment. This information is transcribed into a database by Ambulance Service of NSW data coders. These records contain information that could add to the understanding of falls in the community, the response of ambulance services and the overall picture of the burden of falls. Linking these two databases would greatly expand the range of information available to study the characteristics and outcomes of fall injuries. An electronic version of the patient health care record is being developed, which will improve its timeliness. Further linkage to emergency department and admitted patient databases would clearly provide the optimal information for further describing the epidemiology of falls in NSW.

This study has some limitations. The dataset we used had some missing values, perhaps due to the nature of 000 calls, as the callers may be injured, stressed or confused. As a substantial proportion of records lacked information on the circumstance of the fall and whether the patient was transported to hospital, we could not analyse these factors. The time-critical nature of 000 calls may obviate the collection of more detailed information, but consideration should be given to incorporating a simple cause-of-injury classification into call-taking. The lack of information on patient transport may improve with advances in database technology for collecting the information.

Conclusion

As the population ages and both the number and the age-standardised rate of fall injuries increases, falls and fall-related injuries will account for an increasing number of ambulance calls. The findings of this study could be used to guide policy for ambulance service delivery.

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The cost of fall-related injuries among older people in NSW, 2006–07

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Abstract: This study aimed to establish comprehensive estimates of the cost of fall-related injury among older people in NSW. A health service utilisation approach was used to estimate the cost of hospital treatment, residential care and ambulance transport. Other costs were estimated by deriving ratios of inpatient costs to other services from the literature. In the 2006–07 financial year, 251 000 (27%) of older people fell at least once and suffered, in total, an estimated 507 000 falls. An estimated 143 000 medically treated fall-related injuries among older people resulted in lifetime treatment costs of $558.5 million. Although only 18% of these injuries resulted in hospital admission, the cost of care associated with these cases accounted for 84.5% of the total cost. The cost of fall-related injury among older people in NSW in 2006–07 is a significant increase over earlier estimates and underscores the urgent need for effective preventive efforts across the state.

Injuries from falls represent a significant public health problem. Around one in three older adults living in the community are estimated to fall each year and many individuals fall more than once.[1–4] An injurious fall can have significant personal consequences as often individuals are not able to return to their pre-fall activities.[5] As well as the injury, associated pain and disability suffered, falls can instil a fear of falling,[6] decrease levels of activity,[7] raise levels of anxiety and depression,[8] and result in post-traumatic stress disorder,[9] loss of independence,[6] admission to residential care[10] and sometimes death.

As the New South Wales (NSW) population ages, fall-related injuries among older adults (aged 65 years and over) will place increased demand on the health system.[11–13] Fall-related injuries among older people – mainly hip and other fractures – consume a disproportionate share of hospital resources; no other injury cause, including road trauma, costs the NSW health system more.[14]

In recent years there have been a number of international studies that have developed comprehensive estimates of the cost of fall injuries.[15–17] Estimates of the cost of injuries are necessary to guide decision makers in determining funding priorities and to support cost-effectiveness and cost-benefit analyses of the most effective means of preventing injury.

To date, there has been only one population-level study conducted in NSW which estimated the cost of fall-related injuries.[14] However, these costs were established in the context of a broader all-age, all-injury study which included limited cost components and is now quite dated. Consequently, a study was commissioned by NSW Health to provide comprehensive, up-to-date estimates of the costs associated with fall-related injuries to underpin the next iteration of the state falls prevention plan and to provide input for cost-benefit analyses of falls prevention programs.

The aim of this study was to quantify the economic burden of injuries associated with falls in people aged 65 years and over in NSW during the 2006–07 financial year. This paper summarises the findings from the study report.[18]

Methods

The methods are outlined briefly here. A detailed description of the methods can be found in the study report.[18]

Incidence estimation

In order to develop cost estimates it was necessary to establish the incidence of fall-related injuries for which treatment was sought. Estimates of the incidence of medically treated fall-related injuries were developed using data from several sources. These included the:

- NSW Admitted Patients Dataset to estimate the total number of incident hospital admissions due to falls in older people.
- Victorian Admitted Episodes Dataset and Victorian Emergency Minimum Dataset to establish the ratios of

admitted to non-admitted emergency department presentations for each gender and 5-year age-group. These ratios were then applied to the estimated number of fall-related incident hospital admissions to derive an estimate of emergency department attendances for NSW.
- 2009 NSW Falls Prevention Survey, in combination with the NSW estimated resident population, at 31 December 2006, by gender and 5-year age group, derived from Australian Bureau of Statistics online population data[19] to estimate the number of people who fell, the number of falls experienced and the number of fall-related injuries that were treated in a non-hospital setting.

The selection of the cases from these datasets was confined to persons aged 65 years and over and the following three mutually exclusive categories of care were identified for the purpose of this study: hospital admissions; emergency department presentations (not admitted); and non-hospital treatment (including general practitioners and allied health professionals).

Estimates of the number of emergency and non-emergency ambulance trips and the number of older people living in the community who were transferred to residential aged care following a fall-related hospital admission were also developed to facilitate cost estimation.

Cost estimation

Costs were estimated separately for each category of care defined in the previous section. Estimated costs included all relevant treatment and care services such as inpatient care (admitted cases only), ambulance, emergency department treatment, outpatient treatment, pharmaceuticals, medical and other health service provision, and residential aged care or home nursing, domestic services and home modifications.

For cost components where there were reasonably solid health service utilisation data available, such as for hospital inpatient care, emergency department treatment, ambulance transport and residential aged care, a 'bottom-up' health service utilisation approach was used.

Inpatient hospital costs were calculated using the Australian-Refined–Diagnosis-Related Group (AR-DRG) codes. Average AR-DRG Version 5.0 costs were applied to each episode of care using data from the *NSW Cost of Care Standards 2006/07*.[20] Individuals who attended the emergency department but were not admitted were assigned an average cost and the average cost of emergency and non-emergency ambulance transport was assigned to the estimated number of trips in each category. The cost of respite and permanent residential aged care was calculated using estimates of the number of community-dwelling older people discharged to aged-care facilities following a fall injury and applying average lengths of stay and average cost per place-day.[21] Costs beyond 1 year were discounted at 5% per annum in line with current Australian practice. The cost of residential aged care was not included for those already residing in an aged-care facility when they fell.

The cost of other health care services were estimated using ratios developed from the literature of the cost of each service relative to the cost of inpatient care. The ratios for hospital outpatient services, pharmaceuticals, general practitioner, specialist and allied health consultations were derived from falls-specific costs using Australian health expenditures for 1993–94.[22] The ratios for community nursing and domiciliary services were calculated from Hall and Hendrie.[23]

Results

Incidence

In 2006–07, the NSW population aged 65 years and over was estimated to be just over 931 000 people. It was estimated that around 251 000 (27%) older people fell at least once and suffered, in total, an estimated 507 000 falls. Almost 28% (143 000) of these falls resulted in an injury requiring some form of medical treatment and, of these, 18% were serious enough to warrant admission to hospital (Table 1).

While women accounted for 55% of the population, they accounted for 58% of all falls. Overall, women were

Table 1. Estimated resident population, number of people who fell and number of medically treated fall injuries by gender, persons aged 65 years and over, NSW, 2006–07

	Men		Women		Persons	
	n	%	*n*	%	*n*	%
Estimated resident population	417 027	44.8	514 305	55.2	931 332	100.0
Number of people who fell	105 088	41.8	146 365	58.2	251 453	100.0
Total number of falls	218 156	43.0	289 051	57.0	507 207	100.0
All medically treated fall injuries	51 558	36.0	91 415	64.0	142 973	100.0

Medically treated fall injuries refer to those injuries that received some form of medical treatment either in a hospital or outside the hospital setting (including general practitioners and other health service providers).

slightly more likely to fall than men (28.5% of older women fell compared to 25% of older men).

Women accounted for 64% of all medically treated fall-related injuries (Table 2). They were also more likely than men to suffer an injury requiring medical treatment as a result of a fall (62.5% of women who fell compared to 49% of men who fell) and to be hospitalised following a fall (12% of women who fell compared to 7% of men who fell).

Direct health care costs

The total direct cost of health care associated with fall-related injuries in older adults was estimated at $558.5 million (Table 3). Although only 18% of medically treated injuries resulted in hospital admission, the cost of care associated with these cases accounted for 84.5% of the total cost. Treatment costs associated with emergency department presentations accounted for 9% of the total cost and other non-hospital attendances, which accounted for the 69% of all medically treated falls, accounted for an estimated 6.5% of treatment costs.

While women accounted for 64% of all medically treated fall-related injuries (Table 2), they accounted for 69% of total treatment costs (Table 3). Total health care costs for women were 2.2 times higher than for men.

Table 4 presents the total treatment and care costs of fall-related injuries among older people in NSW by cost component and level of treatment. The majority of total costs (57.9%) were associated with hospital treatment and care (inpatient, emergency department and outpatient) followed by residential aged care (22.9%) and non-hospital medical (general practitioner and specialist) treatment (6.1%).

The total cost of treatment and care associated with falls among community-dwelling older people in the current study (excluding the cost of any subsequent residential aged care) was compared against that derived by scaling up the costs obtained in a prospective NSW study by Tiedemann et al.[24] The total estimate derived from this small study was only 5.7% higher than that of the current study.

Discussion

This study highlights the significant cost of fall-related injuries among older people in NSW. Although these costs are not all borne by NSW Health, the estimated lifetime cost of treating fall-related injuries among older people in NSW in 2006–07 was equivalent to almost 5% of the NSW health budget in that year.[25] In order to reduce the impact on the health system of fall-related injuries among older people, significant resources need to be directed towards the promotion of evidence-based fall-related injury prevention programs at the local level across the state.

At $558.5 million, the current estimate of treatment costs for 2006–07 is 2.5 times the previous estimate for 1998–99 of $224.7 million.[14] This is due in part to inflation in health care costs (total health price index) which increased by

Table 2. Estimated number of falls requiring medical treatment by gender and level of treatment, persons aged 65 years and over, NSW, 2006–07

Level of treatment	Men		Women		Persons	
	n	%	*n*	%	*n*	%
Hospital admissions	7798	15.1	17 763	19.4	25 561	17.9
Emergency department attendances	5732	11.1	12 734	13.9	18 466	12.9
Non-hospital treatments	38 028	73.8	60 918	66.7	98 946	69.2
All medically treated fall injuries	**51 558**	**100.0**	**91 415**	**100.0**	**142 973**	**100.0**

Table 3. Estimated health care costs for all medically treated fall-related injuries by gender and level of treatment, persons aged 65 years and over, NSW, 2006–07

Level of treatment	Men		Women		Persons	
	($ millions)	% of total	($ millions)	% of total	($ millions)	% of total
Hospital admissions	141.17	81.4	330.43	85.8	471.60	84.4
Emergency department attendances	21.76	12.5	28.38	7.4	50.16	9.0
Non-hospital treatments	10.59	6.1	26.12	6.8	36.71	6.6
Total NSW	**173.52**	**100.0**	**384.93**	**100.0**	**558.46**	**100.0**
Average cost ($)	3336		4211		3906	

NB: All values correct to two decimal places but rounding may result in components not adding up exactly to totals.

Table 4. Estimated health care costs for all medically treated fall-related injuries by level of treatment and cost component, persons aged 65 years and over, NSW, 2006–07

Cost component	Total cost			
	Admissions ($ millions)	Emergency department attendances ($ millions)	Non-hospital treatments ($ millions)	Total
Hospital inpatient[a]	262.68	–	–	262.68
Emergency department and outpatient[b]	35.16	25.73	–	60.89
Total hospital sector	*297.84*	*25.73*	–	*323.57*
Residential aged care	127.90	–	–	127.90
Medical treatments	10.96	7.14	16.06	34.16
Pharmaceuticals	2.92	2.01	4.26	9.19
Allied health	6.16	4.04	8.86	19.06
Ambulance	14.56	7.50	–	22.04
Community nursing	4.56	1.51	3.05	9.12
Domiciliary services	6.71	2.23	4.49	13.42
Total	**471.60**	**50.16**	**36.71**	**558.46**

[a]Includes emergency department costs associated with admitted patients.
[b]Outpatient costs only for admitted patients.
NB: All values correct to two decimal places but rounding may result in components not adding up exactly to totals.

28% over that period,[26] the impact of the ageing population (the number of people aged 65 years and over in NSW increased by 14.5%[19]) and an increase in the age-standardised rate of falls hospitalisations by a similar magnitude over the same period.[27] The earlier study also did not include all episodes of hospital care (only the index admission), the cost of residential aged care, outpatient costs, community nursing, domiciliary services or the costs associated with people who did not attend the hospital system for treatment.

The main limitation of this study lies in the lack of health service utilisation data in which falls and other conditions can be comprehensively identified. Where data was unavailable, particularly for more minor injuries, researchers had to rely on data from various sources or the literature, some of which is quite dated. Where there were inadequacies in existing data, assumptions had to be made.

The limitations of this study highlight the inadequacies in current NSW population health data and several recommendations are made to address these shortcomings. These include: the introduction of a unique patient identifier and the date of injury in the hospital discharge dataset to facilitate the identification of incident cases of fall-related hospitalisations in the NSW Admitted Patients Dataset; and the standardisation of the NSW emergency department data collections across all hospitals in terms of the coding of injury causes and diagnoses to facilitate the quantification of the number of falls resulting in emergency department attendance and their associated costs.

The study also highlighted the limitations in our understanding of the patient journey, beyond the hospital, following a fall. While there has been some research into the costs associated with falls in small samples of the population,[23,24] there is an urgent need for research at the population level to establish the utilisation of services beyond the hospital door.

Despite these limitations, the study represents the most comprehensive estimate of the cost of falls in NSW to date as it includes the majority of cost components associated with medical treatment and care following a fall-related injury. The estimates derived in this study were also validated against those derived by scaling up from a small, community-based study.

Conclusion

This study demonstrates the high economic cost of falls in older people and underscores the need for a strategically focused falls prevention strategy for NSW and for the support of cost-effective falls prevention in this population. It also highlights the need for improvements in population health data in NSW to facilitate the estimation of incidence and costs for the different levels of care provided.

The full report, *The Incidence and Cost of Falls Injury Among Older People in New South Wales 2006/07*, is available at: http://www.health.nsw.gov.au/pubs/2010/costoffall.html

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An economic evaluation of community and residential aged care falls prevention strategies in NSW

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Abstract: Aim: To evaluate the cost-effectiveness of strategies designed to prevent falls amongst people aged 65 years and over living in the community and in residential aged-care facilities. **Methods:** A systematic review and meta-analysis of the literature was conducted. The pooled fall rate ratio was used in a decision analytic model that combined a Markov model and decision tree to estimate the costs and outcomes of potential interventions and/or strategies. The resulting cost per quality-adjusted life year was estimated. **Results:** The most cost-effective falls prevention strategy in community-dwelling older people was Tai Chi. Expedited cataract surgery and psychotropic medication withdrawal were also found to be cost-effective; however, the effectiveness of these interventions is less certain due to small numbers of trials and participants. The most cost-effective falls prevention strategies in residential aged-care facilities were medication review and vitamin D supplementation.

A fall is defined as 'an unexpected event in which an individual comes to rest on the ground, floor or lower level'.[1] Falls are common among older people; up to one in four people aged 65 years and over fall at least once in a year, with many falling more than once. Falls are even more common among residents of aged-care facilities, with up to half of all residents falling at least once in a year.[2,3]

Fall-related injury is a major cause of morbidity and mortality for older people. In New South Wales (NSW) each year, falls lead to approximately 30 000 hospitalisations and at least 300 deaths in people aged 65 years and over.[4] Even non-injurious falls can have negative impacts such as depression and mobility restrictions and reduced activities of daily living leading to reductions in quality of life.[5,6] Projections indicate that without preventative action, and assuming that individuals continue to fall and be injured at the current rate, the costs to the health care system from injurious falls are likely to escalate, reflecting the expected ageing NSW population. The estimated treatment cost associated with falls in NSW is $558.5 million, which includes all medical and associated costs occurring in the 12 months following injury and any residential aged-care facility costs beyond the initial fall.[7]

The majority of the economic literature concerning falls prevention strategies use cost per fall avoided as the outcome measure. Consequently, determining whether these interventions are a cost-effective use of resources is problematic since knowledge of society's willingness to pay for an avoided fall is required. A common way of avoiding this complication is to use a generic outcome measure, such as quality-adjusted life years (QALYs). Using cost per QALY gained enables interventions with disparate outcome measures to be compared to a societal value threshold. Using the cost per QALY approach within a randomised controlled trial design, Hendricks et al found a multidisciplinary intervention to be not cost-effective compared to usual care;[8] Sach et al found cataract surgery in the first eye was not cost-effective;[9] and Busbee et al (using a analytic model design) found cataract surgery in the second eye to be cost-effective.[10] To date only one study has compared multiple falls prevention interventions in a single study. Frick et al, comparing seven falls prevention interventions, concluded that psychotropic medication withdrawal and Tai Chi were cost-effective interventions.[11] A review of economic evaluations by Davis et al reported three falls prevention strategies to be cost-saving: a multifactorial program; a home-based exercise program for people older than 80 years; and a home safety program for those who have had a previous fall.[12]

A number of strategies have been used to prevent falls and fall-related injuries. These include: group-based exercise; home-based exercise; Tai Chi; vitamin D supplementation; education; clinical medication review; vision and eye examinations; expedited cataract surgery; cardiac

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pacing; psychotropic medication withdrawal; and various multiple and multifactorial interventions representing combinations of the above. The overall aim of this study was to determine which of these interventions is most cost-effective using a decision analytic model.

Methods

A systematic review and meta-analysis were conducted. The results were then used to produce an economic evaluation comparing the costs and outcomes of the aforementioned falls prevention strategies with evidence of effectiveness.

Systematic review and meta-analysis

A systematic review of the literature was undertaken in September 2008. The objective was to identify interventions that are effective at reducing falls in older people. The review was undertaken prior to the release of the Cochrane review of falls.[13] Searches were conducted in a number of electronic databases including: PubMed (Medline and PreMedline); EMBASE; the Cochrane Library; the Centre for Reviews and Dissemination databases; Database of Abstracts of Reviews of Effects; National Health Service Economic Evaluation Database; Health Technology Assessment database; and Web of Science. Data were extracted from the included studies by one researcher and checked by a second researcher using standardised extraction tables developed *a priori*.

Descriptive statistics relating to the number of falls were extracted and rate ratios calculated from each individual trial. A pooled measure of effectiveness was calculated using a random effects model for each falls prevention intervention identified. The analysis was based on an 'intention to treat' principle. Data were entered into Excel and transformed into the required input for statistical analysis. The pooled statistical analysis was conducted using Review Manager 5, a meta-analysis software program available through the Cochrane Collaboration. Only randomised controlled trials with a population mean age of 65 years and over and with more than 20 participants were included in the study. All inclusion/exclusion criteria and a list of all references used in the meta-analysis has been published elsewhere.[14]

During the development of this study, a meta-analysis conducted by the Cochrane Collaboration was released.[13] The results from the Cochrane review were used for the community-dwelling analysis. Results of both meta-analyses are presented in Table 1.

Economic evaluation

A decision analytic model was developed to assess the cost-effectiveness of falls prevention strategies. The rationale for the model is that falls prevention strategies lead to reductions in the number of individuals who fall, which consequently reduces the number of individuals injured or hospitalised due to a fall. Falls resulting in injury and hospitalisation can lead to a reduction in both length of life and quality of life. Consequently, a reduction in the number of fall-related injuries will result in measureable improvements in terms of QALYs.

QALYs are the most common and convenient outcome measure used in economic evaluation. They combine quality of life and life expectancy into one metric, therefore enabling comparison of multiple strategies across different interventions and settings. Such an approach, termed a cost-utility analysis, was adopted in this project. The usual approach to economic evaluation is first to determine the incremental effectiveness and incremental cost and combine these to calculate the incremental cost-effectiveness ratio (ICER) using the following ratio:

$$\text{ICER} = \frac{(\text{Cost}_{\text{New}}) - (\text{Cost}_{\text{Comparator}})}{(\text{Effectiveness}_{\text{New}}) - (\text{Effectiveness}_{\text{Comparator}})}$$

Model

The decision analytic model was designed to capture the transition of people between various health states. Five Markov states were assigned as follows:

- low risk (individuals who have never fallen)
- medium risk (individuals who have previously fallen but incurred no injury)
- high risk (previously injured individual who fell)
- residential aged care
- death.

The Markov model is summarised in Figure 1. The Markov model was built using TreeAge Pro Suite 2009 and a decision tree was embedded between each Markov state. Within the decision tree, the probability of transitioning to another state depends on the occurrence of various events, such as presenting at the emergency department and being admitted to hospital. Costs and outcomes were incorporated into the model as a mean value per state per cycle. Expected values for costs and outcomes in the intervention and control are calculated by summing the costs and outcomes accrued by everyone in the model under both intervention and comparator, then dividing by the number of people in the model to produce a mean cost and outcome for each intervention. The starting cohort age in the community-dwelling model was 75 years (85 years in the residential aged-care facility model), the cycle length of the model was 1 year and costs and benefits were measured over 10 years. All costs and outcomes were discounted at a rate of 5%.[15]

Model inputs

The data used in the model were obtained from different sources including published literature on falls prevention,

Table 1. Meta-analysis of interventions to prevent falls in community dwellings and residential aged-care facilities

Intervention	CHERE community-dwelling results (rate ratio, 95% CI)	Cochrane community-dwelling results (rate ratio, 95% CI)	CHERE residential aged-care facilities results (rate ratio, 95% CI)
Group-based exercise	**0.79 (0.70, 0.86)**	**0.78 (0.71, 0.86)**	0.79 (0.56, 1.11)
Home-based exercise	0.81 (0.58, 1.14)	**0.66 (0.53, 0.82)**	–
Tai Chi	**0.66 (0.57, 0.77)**	**0.63 (0.52, 0.78)**	0.96 (0.79, 1.17)
Vitamin D supplementation	0.95 (0.85, 1.07)	0.95 (0.80, 1.14)	**0.86 (0.83, 0.90)**
Education	0.85 (0.73, 1.00)	–	–
Home hazard assessment and modification	0.73 (0.52, 1.03)	0.90 (0.79, 1.03)	–
Psychotropic medication withdrawal	**0.40 (0.23, 0.70)**	**0.34 (0.16, 0.73)**	–
Clinical medication review	Not estimable	Not estimable	**0.59 (0.49, 0.70)**
Expedited cataract surgery	**0.66 (0.49, 0.90)**	**0.66 (0.45, 0.75)**	–
Vision and eye exam	1.57 (1.39, 1.76)	–	–
Cardiac pacing	**0.33 (0.28, 0.38)**	**0.42 (0.23, 0.75)**	
Multiple interventions[a]	**0.80 (0.70, 0.90)**	**0.69 (0.50, 0.96)**[b]	**0.76 (0.59, 0.97)**
Exercise and home hazard	**0.76 (0.65, 0.90)**	–	–
Exercise and falls advice	0.86 (0.71, 1.03)	–	–
Exercise and supplementation	0.57 (0.27, 1.20)	–	–
Multifactorial interventions[b]	**0.72 (0.62, 0.83)**	**0.75 (0.65, 0.86)**	**0.76 (0.59, 0.97)**
Assessment and referral	**0.81 (0.72, 0.92)**	**0.84 (0.72, 0.98)**	1.34 (1.06, 1.69)
Assessment and active intervention	**0.67 (0.52, 0.85)**	**0.70 (0.55, 0.90)**	**0.68 (0.53, 0.87)**

Only interventions that were statistically significant (bold) were modelled.
CHERE = Centre for Health Economics Research and Evaluation.
[a]'*Stepping on* Program' includes exercise program, falls prevention education and occupational therapy home visit. In the Cochrane review,[13] Swanenburg[28] was also found to be significant in favour of falls reduction, but was not modelled due to the low number of participants. In the economic model the rate ratio was derived from the Cochrane review.
[b]Include a multifactorial assessment and a referral for further treatment based on individual participant scoring. Those with an active component (e.g. an exercise program or occupational therapy visit) were modelled separately.

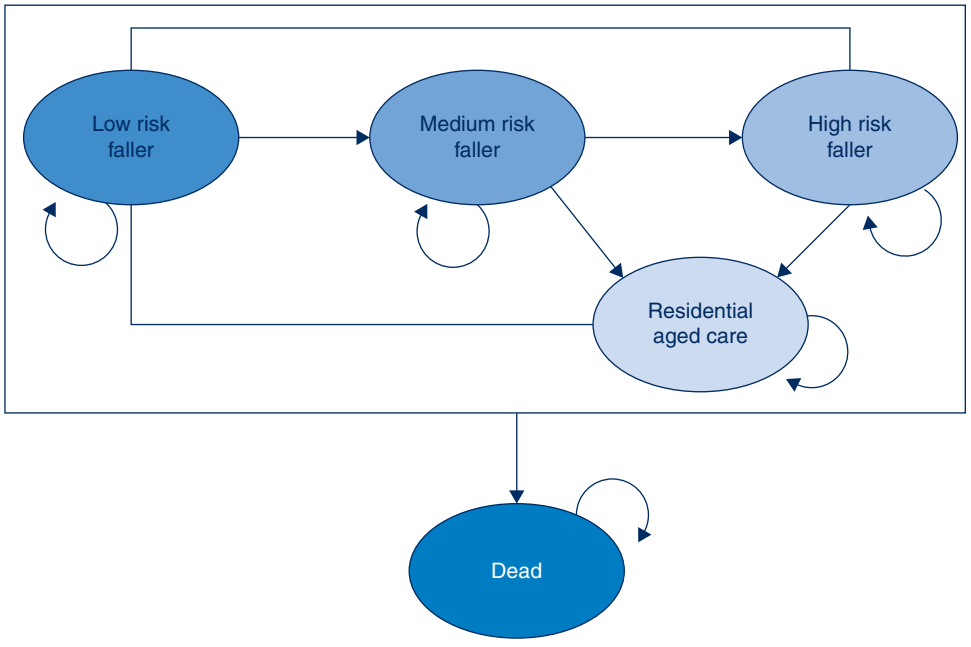

Figure 1. Community-dwelling Markov model showing the pathway between faller risk group, residential aged-care facilities and death.

expert opinion, the Australian Bureau of Statistics, the Australian Institute of Health and Welfare, and reports released by the NSW Government, specifically a report by Dr Wendy Watson from the Injury Risk Management Research Centre at the University of NSW.[7] In the absence of suitable data, assumptions were made and tested in the model. Specific details about the derivation of inputs are presented below. Further details have been published elsewhere.[14]

Table 2. Probability of falling adjusted for prior history of falling and age group

Age group (years)	Low risk[a]	Medium risk[b]	High risk[a]
Community-dwelling			
65–69	0.18	0.25	0.39
70–74	0.18	0.25	0.39
75–79	0.23	0.35	0.50
80–84	0.26	0.40	0.57
85+	0.31	0.50	0.68
Residential aged care			
65–69	0.26	0.36	0.57
70–74	0.26	0.36	0.57
75–79	0.32	0.50	0.72
80–84	0.37	0.57	0.82
85+	0.44	0.71	0.97

[a]Based on estimate that the absolute risk of being a faller if you fell in the past year was 71% and 32% if you had not fallen in the past year.
[b]Personal communication from Professor Stephen Lord.
Low risk = no previous fall, Medium risk = previously fallen but did not suffer a serious injury, High risk = previously fallen and suffered a previous injury that required hospitalisation.

Transition probabilities

The initial population distributions for the low, medium and high risk states were derived from Lord et al (1993) and the probability of falling was derived by Lord, broken down by age (Table 2).[16] The transition probabilities to emergency, other medical, hospital, residential aged-care facilities, respite care or death due to a fall were taken from the report by Watson et al (2009) (Table 3).[7] The Australian Bureau of Statistics life tables[17] were used to obtain data on all cause mortality and the probability of entering residential aged-care facilities from 'all causes' was estimated from a study by Wang et al (2001).[18]

Effectiveness

The effectiveness of each intervention was based on the pooled rate ratio obtained from the Centre for Health Economics Research and Evaluation meta-analysis and the Cochrane review.[13] Only interventions with a statistically significant reduction in the risk of falling were included in the model. For the community-dwelling population, the results from the Cochrane review were used unless otherwise specified. The results from the meta-analysis conducted during this study were used for the residential aged care population. The estimated rate ratio was used to adjust the probability of falling for each intervention compared to no intervention. In the model, each time an individual falls, the rate ratio was increased by a fall rate multiplier to take into account that individuals may fall multiple times in any given year.

Each intervention is described below. Further details of each intervention have been published elsewhere.[14]

- Group-based exercise – two group classes and one home exercise session per week for 26 weeks.

Table 3. Transition probabilities post fall, adjusted for age

Age group (years)	Emergency	Other medical	Admitted to hospital	Death due to a fall	Discharge to residential aged-care facility	Discharge to respite care
Community-dwelling						
65–69	0.09	0.13	0.26	0.008	0.008	0.004
70–74	0.14	0.21	0.18	0.01	0.02	0.01
75–79	0.18	0.22	0.19	0.02	0.03	0.02
80–84	0.25	0.31	0.28	0.03	0.05	0.03
85+	0.35	0.31	0.30	0.06	0.09	0.04
Residential aged care						
65–69	0.04	0.44	0.57	0.01	–	–
70–74	0.07	0.40	0.46	0.01	–	–
75–79	0.10	0.39	0.46	0.02	–	–
80–84	0.13	0.32	0.44	0.03	–	–
85+	0.15	0.27	0.44	0.06	–	–

Source: Watson W, Clapperton A, Mitchell R. The cost of fall injuries among older people in NSW, 2006–07. NSW Injury Risk Management Research Centre, University of New South Wales; 2009.

Table 4. Cost of falls prevention interventions

Intervention	Costs $	Source
Community-dwelling interventions		
Group-based exercise	563	Estimated from Sherrington et al[29]
Home-based exercise	1091	Day et al[18]
Tai Chi	648	Estimated from Sherrington et al[29]
Psychotropic medication withdrawal	604	Day et al[19]
Cardiac pacing	13 526	Day et al[19]
Expedited cataract surgery	2050	DRG hospital data, MBS code 23, MBS code 10900
Multiple intervention	785	NSW Health personal correspondence and Clemson et al[30]
Multifactorial – assessment and referral	855	Day et al[19]
Multifactorial – assessment and active	1244	Day et al[19]
Residential aged care interventions		
Vitamin D	138	www.pharmacyonline.com.au
Clinical medication review	228	MBS code 903, Pharmacy Guild
Multiple intervention	775	Based on Becker et al,[31] Department of Veterans' Affairs, Vitamin D (as above), Kainos printing, NSW Health Award Wage rates
Multifactorial – assessment and active	1244	Day et al[19]

- Home-based exercise – five district nurse home visits in the first week, followed by home visits at week 2, 4 and 8 weeks with a booster at 6 months. Costs include nurse and physiotherapist time.
- Tai Chi – 6-month instructed classes twice a week for 12 participants.
- Expedited cataract surgery – patients receive the cataract procedure within 4 weeks versus the usual 12-month waiting period. Costs include a general practitioner (GP) visit, surgery and two specialist visits.
- Cardiac pacing – screening by carotid sinus massage, cardiovascular assessment, insertion of a pacemaker and post-pacemaker visit.
- Psychotropic medication withdrawal – reduction of medication over 14 weeks with six GP visits and nurse time to check register.
- Multiple – based on the *Stepping On* Program. Two-hour weekly group information sessions on falls prevention run by an occupational therapist for 7 weeks with a follow-up home visit and a 3-month booster.
- Multifactorial (referral only) – falls risk assessment and follow-up by a physician, 1-hour occupational therapy home visit and a 2-hour nurse interview.
- Multifactorial (referral and active) – falls risk assessment (as per above) plus an exercise program once a week, home hazard modification by an occupational therapist, a vision assessment, a medication review (as per above) and counselling.
- Vitamin D supplementation (residential aged-care facility model) – daily dose of Vitamin D (1000 IU) plus 600 mg of calcium.
- Clinical medication review (residential aged-care facility model) – medication management review by a GP and a residential medication management review by an accredited pharmacist.
- Multiple intervention (residential aged-care facility model) – physiotherapist visit, consultation with a residential aged care nurse, falls prevention information, occupational therapist visit, participation in a group-exercise program and hip protectors.
- Multifactorial intervention (residential aged-care facility model) – falls risk assessment and follow-up visit by a physician, hip protectors and hazard modifications by an occupational therapist.

Costs

The cost of each intervention was estimated from the published literature (if available), personal correspondence with NSW Health and online sources (Table 4). The majority of intervention costs were obtained from Day et al.[19] All health-care-related costs were obtained using Watson et al.[7] All health-care-related costs were inflated to 2009 costs using the average health price index for government expenditure on hospitals and nursing homes from the Australian Institute of Health and Welfare report *Health expenditure Australia 2008–09*.[20]

Utility

The baseline utility estimates used in the model were based on the UK Population Norms using the EQ-5D.[21] The EQ-5D is a generic measure of health status where 0 represents death and 1 represents full health. For example, the average utility of a individual aged 75 years is 0.731. In the model, a utility decrement was incurred once an individual attended an emergency department (−0.014), was admitted to hospital (−0.144) or entered residential aged care (−0.06). Individuals who received a fracture and attended hospital also received a utility decrement in each of the

Table 5. Community-dwelling: incremental cost per fall avoided, hospitalisation avoided and QALY gained

Intervention	Incremental cost per fall avoided ($/fall)	Incremental cost per hospitalisation avoided ($/hospitalisation)	Incremental cost per QALY ($/QALY)
General population			
Tai Chi	239	5172	44 879
Group-based exercise	4925	104 318	72 765
Multiple – *Stepping On* Program	5957	129 231	74 186
Home-based exercise	1987	41 944	96 205
Multifactorial – active	9774	216 250	130 139
Multifactorial – referral	2270	47 586	172 009
Specific populations			
Expedited cataract surgery	153	3281	2211
Psychotropic medication withdrawal	1123	24 048	16 584
Cardiac pacing	4545	68 167	80 257

All incremental results are relative to no intervention.
Estimates of effectiveness were taken from the Centre for Health Economics Research and Evaluation meta-analysis.

Table 6. Residential aged care: incremental cost per fall avoided, hospitalisation avoided and QALY gained

Intervention	Incremental cost per fall avoided ($/fall)	Incremental cost per hospitalisation avoided ($/hosp)	Incremental cost per QALY ($/QALY)
Medication review	Dominant	Dominant	Dominant
Vitamin D	6	80	106
Multiple – exercise and home hazard modification	2658	33 993	45 287
Multifactorial – active	3334	42 648	56 752

subsequent years following a fall (−0.072). These utility measures were estimated from a variety of published literature based on the utility loss of a wrist fracture, vertebral fracture, hip fracture, previous fracture and residential aged care.[21–25] A utility decrement for the fear of falling (−0.045) was also included in the model regardless of any injury or hospitalisation; this estimate was obtained from Iglesias et al.[26] Loss in utility due to fear of falling was calculated as a weighted proportion from three studies that categorised fear of falling over six categories: none of the time; a little of the time; some of the time; a good bit of the time; most of the time; and all of the time.

Results

Each of the interventions was analysed over a 10-year period for a cohort of individuals aged 75 years. This is the average age of those older than 65 years in NSW and was used as our base case. The base case for the residential aged-care facility model was individuals aged 85 years. Exercise, Tai Chi, psychotropic medication withdrawal and multiple and multifactorial interventions were all assumed to incur both costs and benefits of the intervention in year one only. Expedited cataract surgery and cardiac pacing were assumed to incur costs in year one only, but the benefits would be experienced for as long as the model was run. Interventions such as vitamin D supplementation and medication review were assumed to be ongoing interventions and both the costs and benefits would be incurred for as long as the model was run.

Outcomes from the model were measured in terms of falls avoided, hospitalisations avoided and QALYs gained. Tables 5 and 6 summarise the cost-effectiveness results which show the additional costs and benefits of providing the intervention. This includes the actual cost of providing the intervention minus the cost of avoided medical treatment due to falls averted. In this respect, the 'do nothing' option against which all interventions are compared is not costless because this option incurs the maximum fall-related treatment costs.

Sensitivity analysis

Using group-based exercise as an example (with the comparator defined as no intervention), each possible parameter was tested in a sensitivity analysis. Where

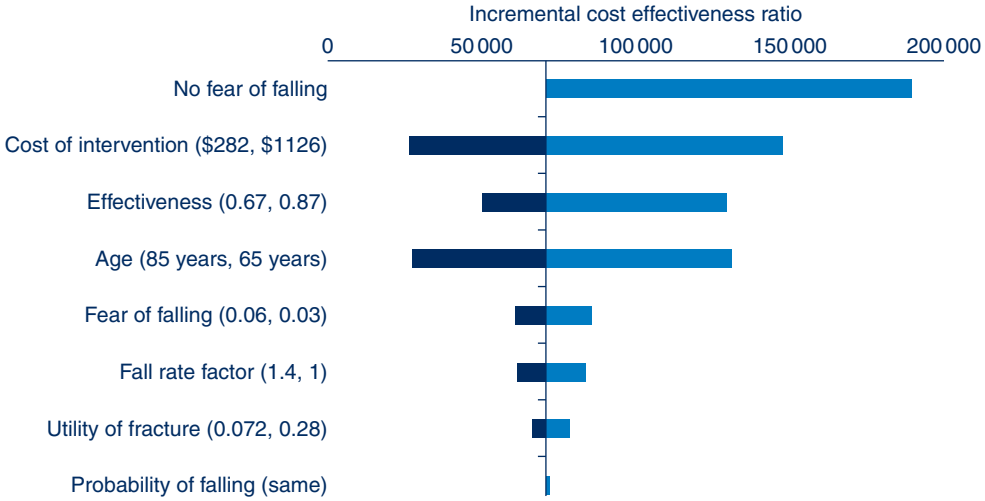

Figure 2. Sensitivity analysis: tornado plot of group-based exercise versus no intervention (base case cost per QALY gained = $72 765).

possible, the confidence interval was used as the range for the analysis; if this was not available, the best estimate of possible ranges was used or the parameter was adjusted up and down by 25%. A tornado plot illustrating the results of the sensitivity analysis is presented in Figure 2. The fear of falling is the main driver of the model. This is expected as each time a fall is avoided the QALY decrement associated with a fall is also avoided. The effectiveness of the intervention and cost of the intervention are also drivers in the model.

Discussion

Incremental cost per fall avoided or hospitalisation avoided were presented in this analysis. However, using surrogate outcomes such as these makes it difficult to judge whether an intervention represents value for money in terms of the total health care budget. In order to make this decision it is necessary to either value society's willingness to pay to avoid a fall or hospitalisation; or alternatively, a generic outcome measure, such as life years gained or QALYs gained, can be used. The advantage of using the latter approach is that interventions targeting different health conditions (not just falls prevention) can be compared and the most cost-effective interventions can be adopted. The results presented in this analysis compare each intervention to the 'do nothing' option.

Currently there is no cost-effectiveness threshold in Australia. An implicit threshold of between $50 000 and $60 000 per QALY gained is often mentioned as being appropriate.[27] However, this threshold relates to pharmaceutical products and consequently may not be suitable for falls prevention strategies. Yet, if this threshold represents society's willingness to pay for a QALY gained, the following community-dwelling interventions would be considered cost-effective: expedited cataract surgery; psychotropic medication withdrawal; and Tai Chi. Group-based exercise and a multiple intervention combining exercise, education and occupational therapy would be approaching cost-effectiveness. The following residential aged-care interventions would be considered cost-effective: medication review; and vitamin D supplementation and a multiple intervention.

There are some limitations to this analysis. The point estimates used in the economic model are based on a meta-analysis of falls prevention interventions. Therefore, they do not take account of the heterogeneity of similar interventions. For example, the pooled cost and pooled effectiveness estimates may mask the fact that high cost interventions (e.g. exercise three times a week compared to once a week) are more effective relative to the cheaper equivalent. Also, while using a random effects model may widen the confidence intervals around a particular parameter, it does not explain the heterogeneity that exists between the studies. The pooling of study results may not be the most appropriate means of deriving an estimate of effectiveness. Furthermore, the costs of the interventions are estimated based on mean duration and intensity, hence a higher cost intervention could indicate a more effective intervention.

The evidence for the effectiveness of some interventions is based on limited data from a small number of studies or studies with few participants. Sensitivity analysis has been conducted to test any uncertainty but caution is still warranted in interpreting the results. Another consideration is that some interventions are targeted at specific patient groups; therefore extrapolating the effectiveness results to a general population may yield different results. Finally, most studies quote a 30% fall rate in the community and 50% fall rate in residential aged care. However, further research is required to determine the exact fall rate in different age groups and by fall risk profile.

Conclusion

The most cost-effective falls prevention strategy in community-dwelling older people was Tai Chi. Expedited cataract surgery and psychotropic medication withdrawal were also found to be cost-effective in specific populations however the effectiveness of these interventions is less certain due to small numbers of trials and participants. The most cost-effective falls prevention strategies in residential aged care were medication review and vitamin D supplementation.

Acknowledgments

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Evaluation of the *NSW Management Policy to Reduce Fall Injury Among Older People, 2003–2007*: implications for policy development

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Abstract: Aim: To retrospectively evaluate the *NSW Management Policy to Reduce Fall Injury Among Older People, 2003–2007*. **Methods:** The process evaluation was conducted by interviewing stakeholders regarding the implementation of the Policy. A document review was also undertaken to identify activities and initiatives undertaken during the implementation process. **Results:** Key achievements in the implementation of the Policy and significant early events, decisions and contextual factors which acted as barriers to the implementation were identified. Results included the: identification of the need for the prioritisation of evidence-based interventions; application of consistent best practice guidelines for implementing falls prevention strategies in the community; and development of an evaluation and monitoring framework concurrent with the development of policy. **Conclusion:** Subsequent policy initiatives must be strategically focused and coordinated if future activities are to have a significant impact on the increasing burden of fall-related injury.

The *NSW Management Policy to Reduce Fall Injury Among Older People, 2003–2007*[1] (the Policy) was developed to address the increasing burden of fall-related injury on the New South Wales (NSW) health system. The launch of the Policy by NSW Health in 2004 gave priority to the prevention of falls across all settings (i.e. community residents, acute care and residential aged care) in NSW. NSW Health committed $8.5 million to fund the implementation of the Policy during the 2003–2007 period. The Policy was developed following extensive consultation across the health sector, including consultation with non-government organisations.

The Policy focused on developing a comprehensive, long-term approach to fall-related injury reduction by addressing the risk to older persons both before and when they are at their greatest risk, as well as in the major settings in which they spend their time. The key areas and goals of the Policy are shown in Figure 1. The Policy formed part of *Healthy People 2005*,[2] a NSW Department of Health public health initiative, as well as the *NSW Chronic Disease Prevention Strategy*.[3] While essentially a health policy, it also identifies roles for other sectors and organisations in reducing the risk of falls and fall-related injuries in the older population.

A number of positions were created under the umbrella of the NSW Falls Prevention Program to support the implementation of the Policy across the state. These included: a State Leader, based at the Clinical Excellence Commission, to coordinate the implementation of the Policy at a statewide level; and Area Falls Prevention Coordinators, appointed in each of the eight former NSW area health services (AHSs), to assist in area-wide planning and implementation.

The aim of this evaluation was to provide information describing the successes and challenges of the implementation phase of the Policy, including: an overview of progress on the implementation of the Policy; identification of any gaps in progress; and information to inform future policy directions. This paper describes the process evaluation of the Policy implementation.

Methods

Views of key informants and other stakeholders were obtained on: the implementation of the Policy; barriers and challenges to progress; and the ways that structures and processes created in response to the Policy might be altered to enhance its impact and influence.

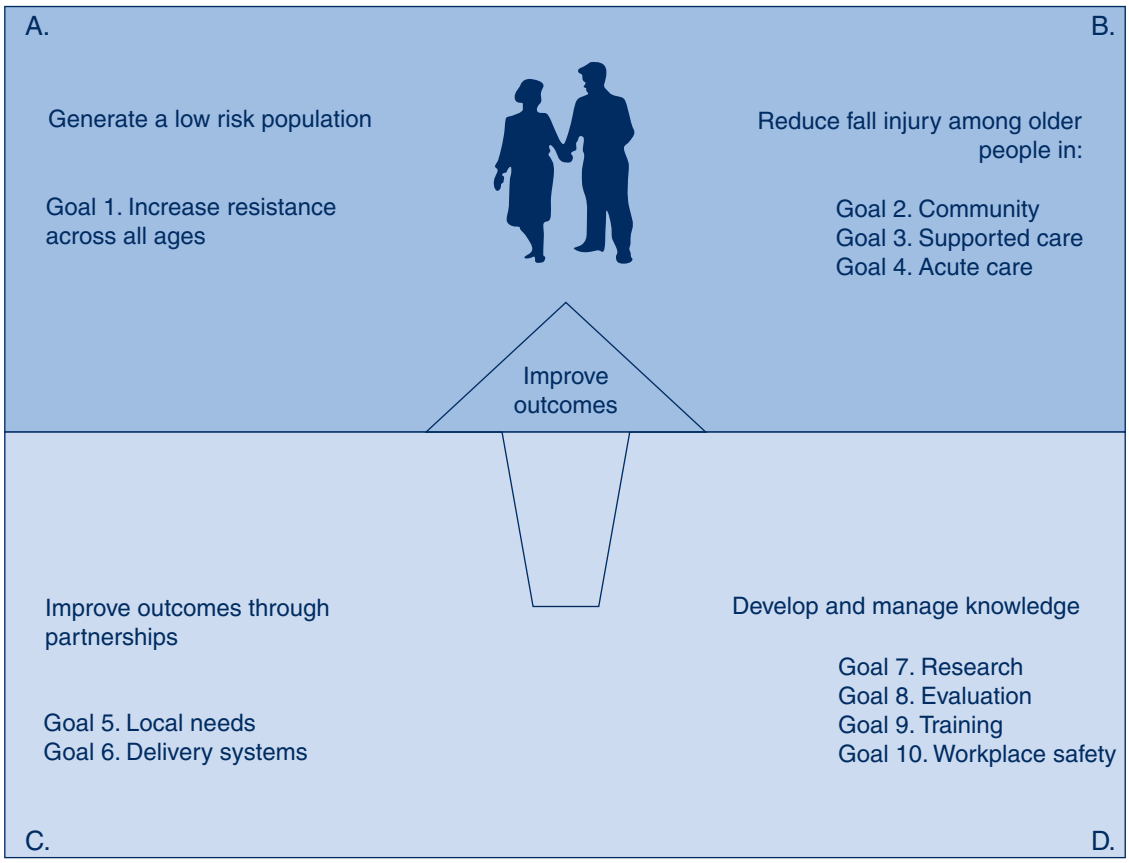

Figure 1. Key areas and goals addressed in the *NSW Management Policy to Reduce Fall Injury Among Older People, 2003–2007*.
Source: NSW Health. *NSW Management Policy to Reduce Fall Injury Among Older People, 2003–2007*.

Information for the process evaluation was obtained from key informant interviews. These were conducted face-to-face with each AHS Area Falls Prevention Coordinator and, where possible, their manager; senior and middle-level staff in the NSW Department of Health's Centre for Health Advancement; and the state leader of the NSW Falls Prevention Program. Other informants including AHS health promotion managers and other stakeholders in the AHSs completed by email a self-administered version of the key informant interview. Information about activities and initiatives was obtained from a document review of meeting notes and progress reports produced at both the AHS and state level.

Results

A total of 24 of 33 invited respondents participated in the consultation (72.7% response rate). Of these interviewees, 16 (66.7%) participated in face-to-face interviews, and eight (33.3%) responded by email to the same questions in a self-administered survey. Three state-level personnel and all the Area Falls Prevention Coordinators completed face-to-face interviews, as did some of their line managers and a health promotion officer. Five of the Area Health Promotion Managers invited to participate in the survey responded to the self-administered questionnaire by email. Others who responded by email included chairs of area-level fall prevention sub-committees and a health promotion officer.

Interviews with key informants and the document review identified a number of important achievements in the implementation of the Policy. These were the:

- recruitment of an experienced program director to the role of state falls leader and a strong, skilled team of AHS falls coordinators
- establishment of AHS implementation plans and governance structures
- strengthening of the NSW Falls Network through additional funding support
- support for research to provide evidence to inform falls prevention policy and practice
- significant progress in the implementation of falls prevention policy, guidelines and interventions in the acute care setting
- development of innovative falls prevention programs to address the challenges created by a lack of workforce capacity
- significant achievements in developing local policy within AHSs.

Respondents acknowledged that the Policy was large and complex to implement and that implementation could have been assisted by the development of a statewide,

coordinated implementation strategy. The lack of a statewide strategy resulted in the implementation planning and development phases taking longer than expected. Respondents identified that progress with Policy implementation was also hampered due to contextual factors including:

- organisational and leadership changes at both the AHS and state level
- the need for a clear distinction between the roles of the Clinical Excellence Commission and the NSW Department of Health in relation to the governance of the Policy
- the absence of prioritisation of interventions identified in the Policy for implementation in AHSs
- a lack of standardised resources (e.g. best practice guidelines, standard screening and assessment tools) and the absence of a timetable for Policy implementation
- the need to build new stakeholder relationships across three different settings (i.e. community, acute and residential care)
- the absence of workforce capacity, particularly in the community setting (e.g. allied health staff and physical activity leaders) to implement prevention programs
- a lack of evidence-based guidelines for community falls prevention.

Overall, respondents believed that in relation to the falls policy there was a strong need for:

- executive support within AHSs for policy implementation
- a formal support structure for area falls coordinators who were coordinating programs across several different settings
- the development of process and impact indicators to monitor short- to medium-term implementation goals
- identification of culturally appropriate strategies and resources for falls prevention in consultation with indigenous and culturally and linguistically diverse populations.

Discussion

There is a compelling imperative to reduce the rate of fall-related injury among older people in all settings given the rapidly ageing population. This process evaluation identified that much has been achieved during the formative phase of the implementation of the Policy in NSW. Structures, relationships and processes are now in place, at both the state and AHS level, to support future capacity building and the sustainability of many fall injury prevention programs.

The evaluation identified that progress has been made in the implementation of the Policy and in the introduction of guidelines and interventions, largely in the acute care setting. However, the great majority of injurious falls occur in the community and in residential aged care and there is a need to concentrate future falls prevention policy and activities in these settings.

While there is a need to reduce the immediate fall risk of older persons in the community, there is also a need to take a longer-term public health approach to generating a future low fall-risk population. The foundation of this proactive approach lies in the promotion and maintenance of lifelong healthy diet and exercise. A recent systematic review of the perceptions of enablers and barriers to the participation of older people in falls prevention interventions[4] has shown that participation in, and adherence to, physical activity programs is more likely among those with a history of exercise.[5–7] Further, the 'habit' of exercise was the strongest predictor of future physical activity.[8]

Any decisions about the composition of an optimal portfolio of evidence-based fall injury interventions for community residents should take into account the threshold of investment required to impact on the rate of fall-related injury. This decision will be assisted by research that identifies the different cost-effectiveness thresholds of falls interventions at the population level for NSW.[9]

In light of the findings of this evaluation, consideration needs to be given to a number of issues to inform future policy directions. These include the:

- development of a statewide, coordinated approach to falls prevention which prioritises evidence-based interventions and includes an implementation plan and reporting milestones
- need for consistent best practice guidelines that provide details on implementing fall injury prevention strategies in the community; the publication of national community falls prevention guidelines by the Australian Commission on Safety and Quality in Health Care[10] since the completion of this evaluation study provides a solid foundation for the development of the new state falls management plan
- need to clearly define the areas of responsibility for falls prevention across the community, acute and residential age care sectors
- recognition of the diversity of the older population and the need for the development of population-level interventions for healthy older people, along with targeted activities to address the varying degrees of risk within frailer groups
- clear definition of roles and responsibilities for the implementation of the falls management policy between NSW Department of Health, the Clinical Excellence Commission and AHSs
- creation of a concurrent evaluation framework and a reporting framework that incorporates achievable performance indicators without imposing an onerous data collection load on staff
- development of supporting, standardised resources in conjunction with future policies
- identification of specific funding allocations for falls prevention activities at the AHS level by the NSW Department of Health and a requirement for AHSs to

report annually on their own contribution to falls prevention activities in each of the three settings.

Conclusion

Although much has been achieved during the formative phase of the implementation of the *NSW Management Policy to Reduce Fall Injury Among Older People, 2003–2007*, subsequent policy initiatives must be strategically focused and coordinated if future activities are to have a significant impact on the increasing burden of falls injury. This study identified a number of actions that will assist future policy development in this area.

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The strategic development of the *NSW Health Plan for Prevention of Falls and Harm from Falls Among Older People: 2011–2015*; translating research into policy and practice

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Abstract: With our rapidly ageing population there is an urgent imperative to minimise the rate of falls and associated injuries. A key challenge to public health is to better conceptualise and contextualise falls prevention evidence for more effective policy making and practice. This paper describes how NSW Health adopted the Nutbeam and Bauman Stages of Research and Evaluation Model in the strategic development of the *NSW Health Plan for Prevention of Falls and Harm from Falls Among Older People: 2011–2015.* Research evidence has been comprehensively applied to every stage of the development of the Plan and research and evaluation is a key action area within the new Plan. The Stages of Research and Evaluation Model provides a useful overarching framework for policy makers to contextualise and more effectively apply research evidence throughout the policy making process from problem definition to program monitoring.

With the rapid ageing population[1] there is an urgent imperative to reduce rates of falls and fall-related injuries to reduce harm to older people and the burden on the health and aged-care systems. It is now widely accepted that research evidence can enhance policy and practice by assisting in the identification and definition of priorities, informing decisions on policy development and implementation and by evaluating their impact.[2–5] Falls prevention is no exception. Recent years have seen growth in research evidence on preventing falls in older people, however the question remains how best to achieve this objective when the transfer of new knowledge from research to practice continues to be less than optimal.[6–10]

A key challenge to public health is to better conceptualise and contextualise evidence for more effective policy making and practice.[11,12] Nutbeam and Bauman provide an overarching framework, the Stages of Research and Evaluation Model, that can assist policy makers in their efforts to more effectively apply research evidence to the policy making process.[12] Figure 1 shows the different research and evaluation questions and research methods that are applied stage by stage in the planning, evaluation and dissemination of a comprehensive set of health promotion interventions. The initial stages focus on defining the problem and testing interventions, while later stages are concerned with dissemination and adoption of effective practice, all matters vital to comprehensive policy and program development. This paper describes how the NSW Health Centre for Health Advancement (the Centre) adopted this framework in the strategic development process for the *NSW Health Plan for Prevention of Falls and Harm from Falls Among Older People: 2011–2015* (the Plan).[13]

The following is a description of how the Centre addressed each of these stages in the strategic development process.

Problem definition

The Centre commissioned the NSW Injury Risk Management Research Centre at the University of New South Wales (NSW) to conduct two pieces of work to define the scope of the problem. The first of these was *The Incidence and Cost of Falls Injury in New South Wales 2006/07* study[14] which quantified the burden of injury associated with falls in older persons in NSW. The second was the *Evaluation Report: Implementation of the NSW State Falls Management Policy*.[15] It reviewed the epidemiology of

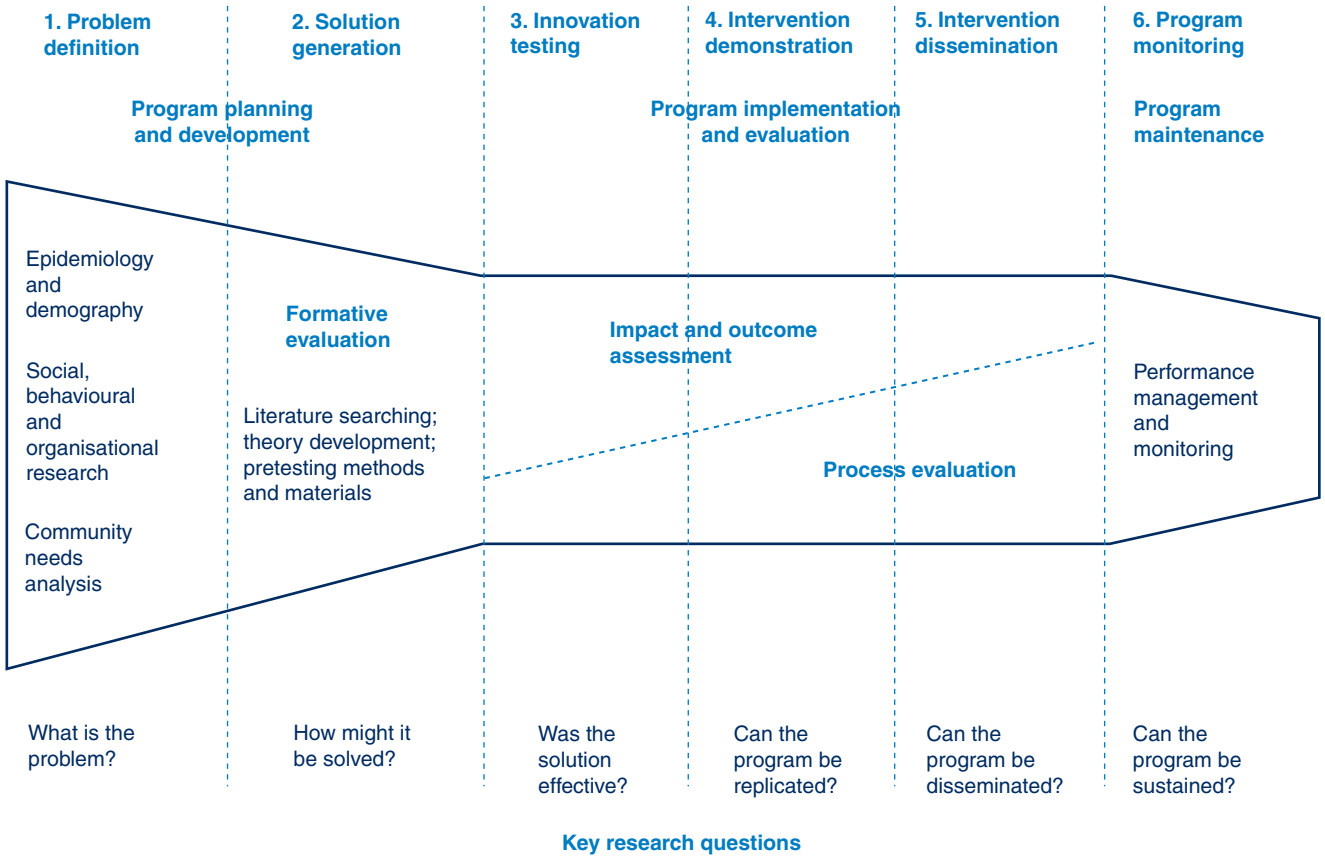

Figure 1. Stages of research and evaluation in public health.
Source: Nutbeam D and Bauman A. Evaluation in a Nutshell – A practical guide to the evaluation of health promotion programs. Sydney: McGraw-Hill; 2006.

falls in NSW and interviewed a range of internal and external stakeholders to ascertain the relative success of the previous policy. Key recommendations of the review were the identification of priority evidence-based interventions, the development of consistent best practice guidelines for implementing key strategies and the development of an evaluation and monitoring framework.[15] In response to these recommendations the Centre established a comprehensive research and evaluation investment strategy to fill gaps in evidence to inform the development of the Plan.[13]

Solution generation

The Centre invested in 'solution generation' by commissioning systematic reviews, best practice recommendations, service reviews, stakeholder and expert consultation, and formative research and pre-testing of social marketing approaches and materials. For example, the Centre identified exercise as a priority intervention due to strong evidence of its role in preventing falls in older people.[16] In 2008 the Centre commissioned work to inform the development of a falls prevention physical activity strategy for older people which involved interviews with key stakeholders and experts, and a review of Australian and international literature.[17] Recommendations included: the development of evidence-based minimum standards for community-based falls prevention physical activity programs for older people; the provision of training to exercise providers about these standards; developing a directory of exercise programs that meet the required minimum standards; and commissioning of formative research with older people to better understand what exercise older people are willing to undertake, and the specific enablers and barriers for exercise among this population group.

Following from these recommendations the Centre commissioned *Best Practice Recommendations for physical activity to prevent falls in older adults* through the Sax Institute's evidence-check commissioning process.[18] This work was important because despite the large numbers of trials of different forms of exercise for falls prevention[19] the literature was devoid of specific recommendations on how best to translate this evidence into clear recommendations on the type, frequency and intensity of physical activity programs to prevent falls that could be used by service delivery agencies. Following this piece of work the Centre commissioned a review of the *Characteristics of NSW Area Health Service Physical Activity Falls Prevention Programs*[20] to determine what proportion adhered to best practice and to provide recommendations

on improving the alignment between the evidence and program delivery.

While exercise that improves balance and strength is a key evidence-based intervention for falls prevention, systematic reviews have identified a range of additional interventions that reduce falls among certain sub-sets of older people.[18] Therefore, in addition to the work focused specifically on exercise, the Centre commissioned the Centre for Health Economic Research and Evaluation, the University of Technology, Sydney, to evaluate the cost-effectiveness of implementation within NSW of each strategy found to be effective in preventing falls amongst people aged 65 years and over living in the community and in residential aged-care facilities.[21]

Social marketing strategies will become an important part of NSW Health action in the area of falls prevention. In support of developing effective communication strategies, the Centre commissioned extensive formative research with older people and carers and health and aged care workers across NSW.[22] This work provides information about awareness and salience of falls prevention for older people, physical activity participation, general health and wellbeing, and communication needs and preferences.[22] Formative research is also integral in developing programs and improving existing and ongoing programs.[23] This type of research assists policy makers to identify and understand the characteristics, interests and needs of target populations that influence their decisions and actions.[23]

With respect to solution generation in clinical settings, the Plan explicitly focuses on implementation of the 2009 evidence-based best practice guidelines from the Australian Commission on Safety and Quality in Health Care, *Preventing Falls and Harm From Falls In Older People: Best Practice Guidelines For Australian Hospitals, Residential Aged Care Facilities And Community Care 2009*.[24]

Innovation testing and intervention demonstration

The Centre established the NSW Health Promotion Demonstration Research Grants Scheme in 2000 to fund the former area health services to conduct rigorously designed health promotion intervention research with falls prevention one of three funding priority areas.[25] This type of research is rarely funded through other existing public health research schemes.[25] Under the scheme a number of falls prevention randomised controlled trials have been funded to assess the effectiveness of falls prevention interventions focusing on tai chi,[26] group-based exercise[27] and walking[28] in community settings, as well as multi-strategic interventions in residential aged-care settings.[29] Funded research[26,27] has demonstrated that effective overseas interventions can be replicated in Australian community settings, and by doing so providing local confirmatory evidence on which to base NSW government physical activity recommendations.

The NSW Department of Health also provided funds to support the implementation and evaluation of the *Stay on Your Feet* project in the former Northern Sydney Central Coast Area Health Service. This community-based initiative seeks to translate and evaluate the application in urban settings of the principles of an earlier North Coast Area Health Service program of the same name which demonstrated success in a rural community.[30] The Centre has also funded the replication of promising interventions found to be effective internationally such as the evidence-based Otago home-based exercise program in sentinel health areas.[31]

Finally, the Centre has also provided funds to the Clinical Excellence Commission to work with the Ambulance Service of NSW and researchers to better understand fall patterns and develop and test assessment and referral pathways for the management of older people attended to by the Ambulance Service of NSW following a fall but not transported to hospital.[32]

Intervention dissemination

The Centre has moved to assess whether interventions demonstrated to be effective in randomised controlled trials can be effectively disseminated using different delivery models under 'real world' conditions in the community. *Stepping On*[33] is one such program and is currently undergoing a staged roll out across NSW with a particular emphasis on process evaluation to inform future program implementation models. The program is currently being run in five Local Health Districts with plans to roll it out further in 2012. Once established across NSW the *Stepping On* program will move from an evaluation frame to a performance management and monitoring phase.

Program monitoring

A fundamental consideration in the development of the Plan was performance management and monitoring. The Centre commissioned the Injury Risk Management Research Centre to develop an Evaluation and Monitoring Framework for the Plan[34] in collaboration with an Expert Advisory Committee. The framework comprises process, impact and outcome measures at both the state and local level. The process evaluation focuses on: the resources applied (funds, staff, materials); the activities undertaken (training, services, education, interventions); the processes by which these activities are implemented; and the immediate outputs (staff trained, clients served, assessments conducted) of these activities. The impact evaluation examines the intermediate impacts of the implemented strategies (e.g. risk knowledge and behaviours) and outcome evaluation will assess the overall performance

against the aims of the Plan (e.g. rate of fall-related hospitalisations and deaths).

The NSW Falls Prevention in Older People Survey series is a central part of the Evaluation and Monitoring Framework, providing process and impact measures over the life of the new Plan. The Falls Survey series includes: a baseline survey conducted with 5681 people aged 65 years and older in 2009,[35] ongoing monitoring modules of a subset of fall-related questions in the continuous NSW Population Health Survey; and a follow-up survey in 2015. To inform question development for the baseline survey a review of options for measuring physical activity beneficial for falls prevention using computer-assisted telephone interviewing surveys was commissioned, resulting in the adoption of new balance-specific activity measures.[36] These surveys are the most comprehensive suite of measures of their kind in Australia, providing information on fall rates and fall-related injury, physical activity participation, nutritional status, risk and protective factors, mental health, social support and exposure to falls interventions amongst community-dwelling older people.[35] In addition to the measures already described the Centre's performance-monitoring efforts will be informed by fall-related data derived from ongoing research infrastructure investments such as the Health Outcomes Information and Statistical Toolkit (Centre for Epidemiology and Research, NSW Department of Health), the *45 and Up Study*[37] and the Centre for Health Record Linkage.[38]

Conclusion

Research evidence has been comprehensively applied to the development of the NSW Health falls prevention strategy; this focus on research and evaluation continues as a key action area within the Plan. The Stages of Research and Evaluation Model provides a useful overarching framework for policy makers to more effectively apply research evidence throughout the policy making process from problem definition to program monitoring.

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Exercise to prevent falls in older adults: an updated meta-analysis and best practice recommendations

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Abstract: This systematic review update includes 54 randomised controlled trials and confirms that exercise as a single intervention can prevent falls (pooled rate ratio 0.84, 95% CI 0.77–0.91). Meta-regression revealed programs that included balance training, contained a higher dose of exercise and did not include walking training to have the greatest effect on reducing falls. We therefore recommend that exercise for falls prevention should provide a moderate or high challenge to balance and be undertaken for at least 2 hours per week on an ongoing basis. Additionally, we recommend that: falls prevention exercise should target both the general community and those at high risk for falls; exercise may be undertaken in a group or home-based setting; strength and walking training may be included in addition to balance training but high risk individuals should not be prescribed brisk walking programs; and other health-related risk factors should also be addressed.

The prevention of falls and mobility-related disability among older people is an urgent public health challenge in Australia and internationally. Falls and fractures already have a major impact on older individuals, their carers, health services and the community. This impact will grow substantially in the near future due to the increased proportion of older people in the population. The proportion of Australians aged 65 years and over is predicted to increase from 14% (3 million people) in 2010 to 23% (8.1 million people) by 2050.[1] By 2051, the Australian total annual health costs from fall-related injury are predicted to increase almost threefold to $1.4 billion.[2]

Many older individuals and their families are affected by falls. One-third of people aged 65 years and over fall once or more annually.[3] Falls can result in injuries, a loss of confidence and a subsequent reduction in physical activity and community participation. Falls are associated with a threefold increase in the risk of being admitted to a residential aged-care facility after adjusting for other risk factors.[4]

Exercise can prevent falls

Trials and systematic reviews[5,6] now provide clear evidence that falls in older people can be prevented with appropriately designed intervention programs. The recently updated Cochrane systematic review[5] concluded that exercise interventions reduce the risk and rate of falls. Although many risk factors for falls have been identified,[7] intervention trials have found that the effects of exercise as a single falls prevention intervention are comparable to those from multifaceted interventions.[5,8] Therefore, widespread implementation of exercise as a single intervention seems to be the best approach to falls prevention at a population level. Our previous meta-analysis[6] found that up to 42% of falls can be prevented by well-designed exercise programs and that the exercises which had the biggest effect on fall rates involved a challenge to balance abilities and were undertaken frequently (e.g. for more than 2 hours a week over a 6-month period).

Both home-based and group-based programs have been shown to prevent falls.[5,6] Group-based Tai Chi has been found to be effective for falls prevention in several trials.[9,10] Other well-designed group-based interventions can also prevent falls.[11,12] The availability of home-based programs is also important as many older people are reluctant to or unable to attend group exercise classes.[13] The home-based Otago Exercise Programme has been shown to reduce rates of falls and injurious falls by 35%.[14] It involves five home visits from a physiotherapist

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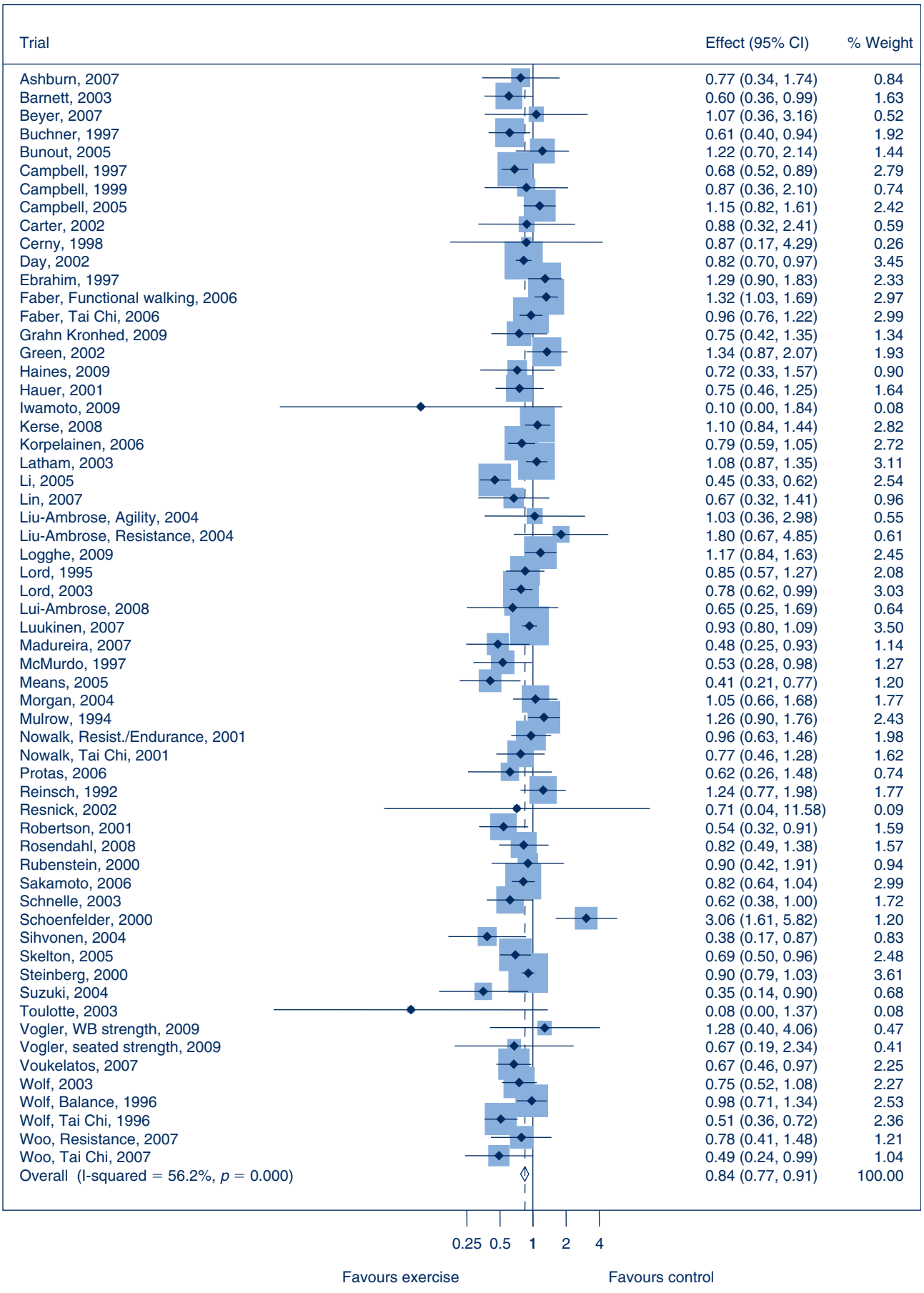

Figure 1. Summary of meta-analysis results: forest plot showing effects of exercise on fall rates in individual trials and the pooled effects of exercise on fall rates.

or trained nurse to teach exercises to be undertaken at home and monthly phone calls to encourage ongoing adherence. As this program requires a relatively small investment to implement (approximately $1000 per person[15]) it appears to be a cost-effective approach to falls prevention.[16,17] As a result, this program was implemented across New Zealand by the Accident Compensation Corporation.

Updated systematic review: methods

We updated our previously published systematic review using the same approach to searching electronic databases used in the original review.[6] For this update, databases were searched up to May 2010. The methodology used in the original review[6] was then used to determine whether studies were eligible for inclusion in this updated review, extract falls data, code the components of exercise programs and combine data in a meta-analysis. We undertook meta-regression analysis to establish whether the inclusion of different features of the exercise programs tested explained the variability between the study findings. We tested the features found to be associated with different effects in our previous analysis[6] (exercise which challenged balance, higher dose of exercise, inclusion of a walking program, trial conducted on a high risk population). Details of these methods are given in our original publication on this meta-analysis.[6] For this update we also conducted an exploratory analysis which only included the trials conducted in residential care settings.

Updated systematic review: results

Ten additional eligible trials were included in this update of our meta-analysis. The findings of the meta-analysis remain essentially unchanged. The pooled estimate of the effect of exercise on the rate of falls indicates a 16% reduction (pooled rate ratio from random effects meta-analysis 0.84, 95% CI 0.77–0.91, 54 trials). The estimates of the effect of exercise on falls from each of the individual trials are shown in the forest plot in Figure 1. There was a moderate amount of variability between the findings of the included trials ($I^2 = 56\%$). The updated meta-regression analysis confirmed that features of exercise program design and trial population can explain some of this between-trial variability. As Table 1 outlines, the programs that included balance training, a higher dose of exercise and did not include walking training had the greatest effect on reducing falls. The effect on falls of programs with and without these features is also shown in Table 1. Table 2 shows the effect on falls of different combinations of features. Two-thirds (64%) of the variability between different findings of included trials was explained by the inclusion of balance training, a higher dose of exercise and walking training. However, trials with and without walking training led to a reduction in falls if they also included balance training and a high dose of exercise.

The exploratory meta-analysis which included only the 15 comparisons from trials conducted in residential care settings found that exercise resulted in a 7% reduction in

Table 1. Summary of meta-analysis results: reductions in falls from exercise programs with different components

Component	Reduction in falls in studies with this component			Reduction in falls in studies without this component			Variability explained (%)
	Reduction %	95% CI	Studies *n*	Reduction %	95% CI	Studies *n*	
Exercise that aims to provide a moderate or high challenge to balance	22	14–30	43	0	0–14	17	15
Exercise that aims to provide a high challenge to balance	25	15–34	30	6	0–17	30	16
Total exercise dose more than 50 hours	23	13–32	30	7	0–8	30	19
Inclusion of walking training	10	0–22	30	23	11–32	30	8
A high risk study population	10	0–20	39	27	14–37	21	15

CI = confidence interval.

Table 2. Summary of meta-analysis results: reductions in falls from exercise programs with different combinations of components

Component	Reduction in falls in studies with this combination of components		
	Reduction %	95% CI	Studies *n*
Balance training, no walking training and a higher exercise dose	38	27–46	8
Balance training, walking training and a higher exercise dose	21	11–30	14

CI = confidence interval.

fall rates (rate ratio 0.93, 95% CI 0.78–1.11) which was not statistically significant ($p = 0.446$). However, the features of exercise programs which were associated with bigger reductions in falls in all the trials were also associated with bigger effects in the residential care trials. The reductions in falls in studies in which interventions provided a challenge to balance, a high dose of exercise and no walking program were close to being statistically significant (rate ratio 0.64, 95% CI 0.40–1.02, $p = 0.057$). Further trials are required in residential aged care to clarify the effect of exercise but we suggest that, at this stage, the following recommendations also apply to people in residential aged care.

Few trials have been conducted specifically in people with cognitive impairment yet it is likely that many individuals with cognitive impairment participated in the trials included in this review. Thus we also suggest that, at this stage, the recommendations also apply to people with cognitive impairment.

Modification of implementation approaches are required to ensure safety and efficacy of exercise interventions in residential care settings and for those with cognitive impairment.

Best practice recommendations

On the basis of the updated systematic review we have formulated the following best practice recommendations to guide the use of exercise for falls prevention.

Recommendation 1. Exercise must provide a moderate or high challenge to balance

Table 1 shows that programs which do not aim to challenge balance are not effective in preventing falls.

Exercises should aim to challenge balance in three ways:

1. Reducing the base of support (e.g. standing with both legs close together, standing with one foot directly in front of the other, i.e. a tandem stance position and, if possible, standing on one leg).
2. Movement of the centre of gravity – control of the body's position while standing (e.g. reaching safely, transferring the body weight from one leg to the other, stepping up onto a block).
3. Reducing the need for upper limb support with exercises in standing that do not use the arms for support. If this is not possible the aim should be to decrease reliance on the arms (e.g. hold onto a bar with one hand instead of both hands, rest one finger on a table rather than the whole hand).

Care should be taken with exercise to challenge balance to ensure it is carried out in a manner that does not increase the risk of falling.

Recommendation 2. Exercise must be of a sufficient dose to have an effect

Table 1 shows that there were bigger effects on falls from programs that involved a higher dose of exercise. For the analysis we used a cut-off of 50 hours over the trial period to dichotomise the total prescribed dose of exercise in the included trials into 'high' and 'low' dose. This would equate to around 2 hours a week for a 6-month period. However, the literature does not provide a clear cut-off and there is an indication from other sources[18] that there are greater benefits from higher doses of exercise. Therefore we suggest that exercise should be undertaken for at least 2 hours per week. This can include a mixture of group-based and home-based exercise.

Recommendation 3. Ongoing exercise is necessary

Unfortunately, the benefits of exercise are rapidly lost when exercise is ceased. Therefore ongoing exercise would be necessary for a lasting falls prevention effect.

Recommendation 4. Falls prevention exercise should be targeted at the general community as well as those at high risk for falls

Table 1 shows that the trials to date have found a larger relative effect from programs offered to the general community than programs offered to high risk groups. Yet high risk groups actually have more falls so a greater number of falls can be prevented in this population. Different groups of people will require different exercise delivery strategies. For example, those at higher risk may require smaller group sizes and closer supervision.

Recommendation 5. Falls prevention exercise may be undertaken in a group or home-based setting

Exercise can prevent falls when delivered in a group or home-based setting. Some individuals are likely to prefer one or the other and we suggest that both options be available. The supplementation of group sessions with additional home-based exercise is a strategy used in several of the effective trials.[11]

Recommendation 6. Walking training may be included in addition to balance training but high risk individuals should not be prescribed brisk walking programs

Table 1 shows that programs both with and without walking training were effective in preventing falls, yet the inclusion of walking training in the falls prevention programs was associated with a lesser effect on falls. We suggest that the inclusion of walking training may not be a crucial feature of program design and therefore recommend that walking training be included in a program as long as it is not at the expense of balance training.

One trial found that prescription of fast walking programs for people at high risk of falls can increase the rate of falls.[19] However, there are many health benefits of physical activity.[20] The Otago Exercise Programme can be effective in preventing falls and includes the prescription of a walking program if the exercise provider considers the individual participant to be safely able to undertake such a program. We suggest that this approach be used for participants in falls prevention exercise programs.

Recommendation 7. Strength training may be included in addition to balance training

Although the inclusion of strength training does not seem to be crucial for an effect of exercise on falls, there are many benefits from strength training.[20] As reduced muscle strength is an important risk factor for falls[21] there may also be longer-term falls prevention benefits from strength training which are not detected in falls trials with relatively short follow-up periods. To be effective, strength training needs to overload the muscles by providing an amount of resistance (e.g. with a weight or exercise band) that ensures that an exercise can only be done 10–15 times before muscles fatigue.[20]

Recommendation 8. Exercise providers should make referrals for other risk factors to be addressed

This review focuses on exercise as a single falls prevention intervention. There is also evidence that multifaceted intervention programs can prevent falls and that non-exercise-based single interventions can prevent falls in people with particular risk factors.[5] Trials included in the Cochrane review[5] have found that: cataract surgery can prevent falls in people with cataracts; home safety advice and modification are effective in higher risk people; psychoactive medication reduction can prevent falls; and cardiac pacemaker insertion has a role in some individuals. A recent trial also found that the use of single lens rather than multifocal glasses can prevent falls in people who regularly participate in outdoor activites.[22] We suggest that exercise providers be made aware of these risk factors and evidence-based interventions and suggest that older people affected by one or more of these risk factors receive a full assessment at a falls clinic or ask their general practitioner for appropriate referrals.

Conclusion

This updated systematic review confirms that exercise as a single intervention can prevent falls. This review includes sufficient trials to allow the development of best practice guidelines which highlight features of exercise programs which are likely to be associated with greater falls prevention effects. The widespread implementation of these recommendations presents an important and urgent challenge for health policy and practice.

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Implementing falls prevention research into policy and practice: an overview of a new National Health and Medical Research Council Partnership Grant

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Abstract: Preventing falls and fall-related injuries among older people is an urgent public health challenge. This paper provides an overview of the background to and research planned for a 5-year National Health and Medical Research Council Partnership Grant on implementing falls prevention research findings into policy and practice. This program represents a partnership between key Australian falls prevention researchers, policy makers and information technology companies which aims to: (1) fill gaps in evidence relating to the prevention of falls in older people, involving new research studies of risk factor assessment and interventions for falls prevention; (2) translate evidence into policy and practice, examining the usefulness of new risk-identification tools in clinical practice; and (3) disseminate evidence to health professionals working with older people, via presentations, new evidence-based guidelines, improved resources and learning tools, to improve the workforce capacity to prevent falls and associated injuries in the future.

Falls in older Australians are a significant public health issue. With at least one-third of people aged 65 years and over falling one or more times every year, the health burden within the community associated with falls is enormous. Falls are the leading cause of injury-related death and hospitalisation in persons aged 65 years and over. Furthermore, falls can result in permanent disability, restriction of activity, loss of confidence and fear of falling, all of which reduce quality of life and independence. It has been projected that by 2051 the total annual Australian health bill for fall-related injury will increase almost threefold to $1.4 billion.[1] The ageing of Australia's population – estimates suggest that by 2021 more than 5 million Australians will be aged 65 years and over – means that this problem is increasing.[1] Developing and implementing strategies to prevent falls and fall-related injuries among older people is therefore an urgent public health challenge and one of the key priority areas previously identified by Commonwealth and state health departments.

This paper describes a new National Health and Medical Research Council Partnership research program. This grant scheme encourages collaboration between researchers and partner organisations to identify research needs, conduct research, and promote the use of research findings to influence the design and evaluation of health and health care policy and practice. The current program brings together researchers, policy makers, educational institutions and the information technology industry with three specific themes:

- conducting research where gaps in evidence have been identified
- identifying strategies for translating evidence into practice
- disseminating evidence to inform policy and practice.

The program has the potential to provide health professionals with the knowledge and resources to better identify people at risk of falling and to implement strategies for the prevention of falls and associated injuries in this group.

Participants

This program is directed by Professor Stephen Lord (Neuroscience Research Australia (NeuRA)) and has seven other Chief Investigators: Professor Ian Cameron (Rehabilitation Studies Unit, University of Sydney), Associate Professor Jacqueline Close (Prince of Wales Hospital and NeuRA), Dr Kim Delbaere (NeuRA), Dr Catherine Sherrington (The George Institute for International

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Health), Dr Stuart Smith (NeuRA), Dr Daina Sturnieks (NeuRA) and Dr Anne Tiedemann (The George Institute for International Health).

The co-funding organisations are the New South Wales (NSW) Department of Health, the Australian Commission on Safety and Quality in Health Care, Kinetics Foundation, NeuRA and the University of NSW.

There are four Associate Investigators who bring clinical and research expertise from a broad range of backgrounds including medical technology, emergency medicine, public health and health promotion. They are: Professor Caroline Finch (Monash Injury Research Institute), Dr Roslyn Poulos (University of NSW), Ms Elizabeth King (NSW Health) and Dr Paul Middleton (Ambulance Service of NSW).

Research projects

There are now encouraging findings from well planned and executed studies which indicate that many falls are preventable.[2,3] The research projects within this partnership will focus on four current gaps in the literature.

1. Early identification of older people at risk for falls living within the community

Patients presenting to emergency departments and/or the Ambulance Service of NSW represent an easily identifiable high-risk population. The evidence to date suggests that these people benefit from a multi-disciplinary falls risk assessment[4,5] to guide them towards targeted multifactorial interventions.[4] This project will develop screening tools for use in emergency departments and by the Ambulance Service of NSW, as well as associated referral protocols to allow for the identification of those most at risk of falls and to allow a more cost-effective approach to intervention and prevention.

2. Including fear of falling in falls risk assessment tools

There is now strong evidence that the inclusion of psychological and cognitive factors will potentially improve the accuracy of established falls risk assessment tools in the prediction of future falls.[6] This project will develop and validate clinical diagnostic tools for screening older people for excessive fear of falling, risk taking behaviour and physical activity levels. Additionally, the utility of these tools for evaluating treatment effects will be evaluated in two experimental studies. Results of these experiments will be incorporated into new proposals to external funding bodies, aiming to develop accessible, individually-tailored cognitive-behavioural treatment methods to reduce fear of falling.

3. Telehealth technology for cost-effective delivery of quality health care

Telehealth technology, which combines digital data acquisition and communication technologies to monitor health status in the home, is gaining attention as a promising strategy for acquiring accurate and reliable data of health markers.[7] This project will explore the use of four different telehealth technologies in a falls-related context. It will: (1) validate a device for measuring and monitoring balance and gait in older people's homes; (2) develop prototypes of mobile internet devices to enhance independent living; (3) develop and validate activity monitors and automated fall detection software applications for the iPod Touch; and (4) develop age-appropriate Nintendo Wii-style 'exergames' for in-home exercise.

4. Predictors of adherence to prescribed exercise interventions

Current best evidence indicates that exercise plays a crucial role in the widespread prevention of falls and disability.[2,8,9] While randomised control trials have been successful, adherence with exercise interventions is often disappointing, suggesting some reluctance on the part of older adults to take part in such programs. This project aims to establish predictors of adherence to home-based exercise programs in people recently discharged from hospital. This study has the potential to enhance clinical and public health practice by enabling exercise programs to be designed with these factors in mind and strategies for maximising adherence to be developed.

Translation projects

The translation of research findings into sustainable improvements in clinical practice and patient outcomes remains a substantial obstacle to improving the quality of health care. As indicated above, in one of the research projects we will develop falls risk screening tools for use in ambulance and emergency department settings. In addition, with NSW Health funding we have recently developed a falls risk screening tool for rehabilitation units.[10] As part of this partnership project we will undertake further validation of these tools and assess their usefulness in daily clinical practice. Large implementation studies will investigate whether these falls risk screening tools can be incorporated into routine practice by the Ambulance Service of NSW, emergency department staff and rehabilitation units. These tools have the potential to prevent falls by providing a valid yet quick indication of an individual's risk of falling so that preventive strategies can be put in place.

Dissemination projects

A key aspect of the program is the dissemination of the results of research to clinicians from a range of disciplines, health promotion practitioners, policy officers and members of the community. Researchers are increasingly recognising the need to take steps to facilitate the translation of research findings into practice. Five different strategies will be employed as part of this project to

actively disseminate available evidence-based research findings.

1. Development of evidence-based guidelines

Evidence-based guidelines are crucial to provide health practitioners with relevant and up-to-date information about falls and falls injuries in older people and appropriate treatment options. By improving the knowledge, and therefore, practice of clinicians, the guidelines can also improve the health outcomes for older people. This project will assist the Australian Commission on Safety and Quality in Health Care to review the current Falls Prevention Guidelines (2009–2012),[11] taking into account National Health and Medical Research Council Clinical Practice Guidelines.[12]

2. Enhancement of the Australian and New Zealand Falls Prevention Society

The Australian and New Zealand Falls Prevention Society (ANZFPS) was officially launched at the 2008 Australian Falls Prevention Conference. The objectives of the ANZFPS are to organise biennial conferences and to promote the broad discipline of falls prevention research.[13] As part of this project, the ANZFPS will be enhanced so that it provides a nationwide one-stop source for the provision of falls prevention information and resources for researchers, clinicians and older people. This will include the development of an internet-based clinical assessment and intervention tool for use as an educational resource and guide for health practitioners.

3. Policy round tables

As part of a recent National Health and Medical Research Council Population Health Capacity Building Grant, a Falls Translation Task Group was trialed as one mechanism to improve the dissemination and uptake of falls research into policy and practice, and to foster the development of policy-appropriate research.[14,15] This project will establish and maintain a National Falls Translation Task Group with broad membership comprising falls researchers, policy makers from state, territory and Commonwealth Departments of Health, health professionals including allied health practitioners and clinicians, and representatives from non-government sectors such as the aged care and fitness industries. The National Falls Translation Task Group will provide the infrastructure necessary to actively promote dialogue between falls researchers, policy makers and stakeholders. This will encourage a policy-sensitive research agenda and enhance capacity for evidence-informed policy and practice in falls management.

4. Presenting falls prevention evidence to clinical groups

One of the major barriers in the implementation of falls prevention research into clinical practice is communicating the current evidence to medical practitioners involved in the routine and specialist care of older people. The chief investigators of this project will present up-to-date evidence-based falls research in symposia, breakfast sessions and proffered presentations to general practitioners, medical specialists and optometrists at their annual scientific meetings.

5. Curriculum development

Allied health professionals, including physiotherapists and occupational therapists, have a crucial role to play in falls prevention. These professionals can prescribe appropriate exercise for people with specific needs, such as frailty and co-morbidities. Curricula for allied health professionals needs to be scoped and modified accordingly to build a workforce that is equipped to provide necessary services to prevent falls in older people.[16,17] This project will involve researchers working with university departments to assess current physiotherapy and occupational therapy curricula in relation to the provision of exercise interventions for falls prevention. We will develop and implement new curricula appropriate to these needs and evaluate outcomes in terms of improvements in knowledge and skills.

Conclusion

This project represents a partnership between Australian falls prevention researchers, policy makers and information technology companies. The proposed projects comprise: new studies aimed at filling the gaps in falls prevention research (i.e. refining and developing falls assessments and intervention strategies that can be readily applied in the community); translation and implementation research which will determine how best to incorporate research evidence into routine clinical practice; and dissemination projects aimed at ensuring policy makers and clinicians can be informed of research findings, in order to improve the workforce capacity to prevent falls and associated injuries in the future.

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Rotavirus

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Globally, rotavirus is the leading cause of severe diarrheal disease and dehydration in infants and children under the age of 5 years. It is estimated that 600 000 children die from rotavirus worldwide each year.[1]

What is rotavirus?

Rotaviruses are nonenveloped, double-shelled RNA viruses that belong to the Reoviridae family.[2] Rotavirus has a distinct ultrastructural appearance that resembles a wheel (the Latin for wheel is 'rota') and the virus was first identified as a cause of infant gastroenteritis by Australian researchers in 1973.

Clinical presentation/mode of transmission

The incubation period for rotavirus is usually 24–72 hours. Rotavirus infects the mature villous epithelial cells of the small intestine and presents with a range of clinical symptoms from mild, watery diarrhoea of limited duration to severe, dehydrating diarrhoea with vomiting, fever and shock. Symptoms generally resolve in 3–7 days. The infectious period usually lasts 4–8 days from the onset of symptoms but the virus can be shed for up to 30 days.[2]

The mode of transmission of rotavirus is predominately faecal–oral and the virus remains viable on surfaces for many hours.[2] Transmission of rotavirus can be reduced by hand washing but despite good standards of hygiene the disease is endemic; almost all children have at least one infection by the age of 5 years.

Current epidemiology of rotavirus in Australia

Rotavirus is the most common cause of severe gastroenteritis in young children in Australia, causing around half of all hospitalised cases of gastroenteritis in children less than 5 years of age. Prior to vaccine availability approximately 10 000 children were hospitalised with rotavirus each year, costing an estimated $30 million in direct costs. In addition, an estimated 115 000 children aged less than 5 years visited a general practitioner and 22 000 children visited an emergency department.[3] Death caused by rotavirus disease is uncommon in Australia; it is estimated that there is one death attributed to rotavirus each year.[4]

Rotavirus was not notifiable under the New South Wales (NSW) *Public Health Act 1991* until late 2009; consequently it has been difficult to ascertain the number of cases. In NSW, rotavirus infection is seasonal with most infections occurring from June to October.[5]

National Immunisation Program

From 1 July 2007 rotavirus vaccination was added to the Australian National Immunisation Program schedule. There are two vaccines currently licensed for use in Australia: RotaTeq®, a live attenuated human–bovine reassortant vaccine, and Rotarix®, a live attenuated human rotavirus strain. RotaTeq® is a three dose oral vaccine, given at 2, 4 and 6 months of age, and Rotarix® is a given in a two dose schedule orally at 2 and 4 months of age.[6] Both RotaTeq® and Rotarix® provide approximately 70% protection against any rotavirus disease and are more effective against preventing severe disease (range 85–100%). Rotarix® has been chosen for use in the NSW vaccination program.

Policy directions

In NSW under category 3, schedule 1 of the Public Health Act, rotavirus is notifiable by laboratories on diagnosis by positive stool testing. Notification will provide data which can be used to monitor the impact of vaccination on the epidemiology of rotavirus disease and to better understand the burden of rotavirus disease in NSW. In addition, submission of stools to the National Rotavirus Strain Surveillance Program will help monitor any variations in serotypes that might occur as a result of using the vaccine.[5]

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Communicable Diseases Report, NSW, January and February 2011

Communicable Diseases Branch
NSW Department of Health

For updated information, including data and facts on specific diseases, visit www.health.nsw.gov.au and click on **Public Health** and then **Infectious Diseases**. The communicable diseases site is available at: http://www.health.nsw.gov.au/publichealth/infectious/index.asp.

Figure 1 and Tables 1 and 2 show reports of communicable diseases received through to the end of January and February 2011 in New South Wales (NSW).

Enteric infections

Outbreaks of foodborne disease

Eighteen outbreaks of suspected foodborne disease were investigated in January and February 2011. These outbreaks were identified through surveillance of laboratory notifications, or complaints to the NSW Food Authority or the local public health unit (PHU). In seven of these outbreaks the causative organism was identified as *Salmonella* enterica serovar Typhimurium and in another, *S.* Singapore.

Four of the *S.* Typhimurium outbreaks were identified through laboratory notifications. Interviews with the affected people found likely food items and sources in each of these outbreaks. For one of these outbreaks, illness was found to be associated with a dessert containing partially cooked eggs served in a restaurant over 3 nights. Another outbreak, with 82 confirmed cases, was associated with Vietnamese pork rolls containing a raw egg product from a Vietnamese bakery. A third outbreak was found to be associated with cake, possibly cross-contaminated with a piping bag, from a bakery. The fourth outbreak was found to be associated with fried ice-cream made with raw egg from a Chinese restaurant.

The remaining three *S.* Typhimurium outbreaks were identified by the NSW Food Authority or the local PHU following reports of gastrointestinal illness. The first report was from several separate groups who were ill after eating a chicken caesar salad with a dressing made from raw eggs at a café. The second report was from a boarding school where 26 out of 260 students developed illness. A cohort study found the only food associated with illness to be apple turnover. The association was weak (odds ratio = 4.6, 95% CI 1.4–15.4) and no high risk ingredients were included in this apple turnover. The third report was from a family who ate battered lamb at a restaurant. One person in the family was reported to be unwell and the PHU could not rule out other possible exposures.

The *S.* Singapore outbreak occurred on a cruise and affected two party groups. A cohort study revealed roast chicken to be the likely pathogen source (odds ratio = 26.4, 95% CI 2.9–244.4). The cooked chicken was purchased from a supermarket, where it was potentially contaminated by raw chicken.

Salmonella infections can occur after eating undercooked food made from eggs, meat or poultry.[1] Sometimes it can be spread by contact with a person with the infection, or if an infected person has prepared food for others. Thorough cooking of food kills *Salmonella* bacteria. The best way to avoid contracting a *Salmonella* infection is to avoid raw or undercooked meat, poultry or eggs. Poultry and meat – such as hamburgers, sausages and rolled roasts – should not be eaten if pink in the middle.

An outbreak of *Campylobacter* enteritis in guests attending a birthday party function at a restaurant was epidemiologically linked to poultry liver pate. Eleven guests developed symptoms consistent with *Campylobacter* enteritis and stool culture confirmed this for two. The dish was prepared by briefly flash frying intact chicken livers then mixing these with other ingredients but not cooking further. Poultry liver tissue is frequently contaminated with *Campylobacter* bacteria and deliberate undercooking has been implicated in previous outbreaks.

Outbreaks of gastroenteritis in institutional settings

During January and February, 61 outbreaks of gastroenteritis in institutions were reported, affecting 614 people. Thirty outbreaks occurred in child care centres, 26 in aged care facilities, four in hospitals, and one in a residential care facility. The majority of outbreaks (93%) appeared to have been caused by person-to-person spread of a viral illness. In 28 outbreaks (46%) one or more stool specimens were collected. In six of these outbreaks (21%) norovirus

was detected, in two outbreaks (7%) *Giardia* bacteria was detected and in one outbreak (4%) stool specimens tested positive for both rotavirus and *Clostridium difficile*. Stool specimens were not available for laboratory testing for the remaining 33 outbreaks.

Sixty-one outbreaks is about double the average number of outbreaks for January and February combined for the last 5 years (which was 32). Viral gastroenteritis tends to decline in warmer months. The increase in reports of gastroenteritis in this period was largely attributable to an increased number of reports from child care centres at 240% the previous 5-year average for the same time period. In contrast, the increase in aged care facility outbreaks was only 170% the previous 5-year average and in hospitals, a 7% decrease. The apparent increase in outbreaks from child care may be due to improved reporting from centres. Public health units are encouraging parents to submit stool specimens from their children for laboratory testing to determine the cause of the infections.

Respiratory and other infections

Influenza

During January and February influenza activity was low in NSW, as measured by the number of patients who presented to 56 of the state's largest emergency departments with influenza-like-illness. There were 110 emergency department presentations of patients with influenza-like illness (1.0 per 1000 presentations) for January and 76 presentations (0.5 per 1000 presentations) for February.

The number of patients who tested positive for influenza at diagnostic laboratories was slightly above the usual level for this time of year. There were 58 cases of influenza confirmed by direct immunofluorescence or polymerase chain reaction testing in January and 43 cases in February. Of these, 68% were identified as the pandemic (H1N1) 2009 virus.

For a more detailed report on respiratory activity in NSW see: http://www.health.nsw.gov.au/PublicHealth/Infectious/influenza_reports.asp

Vaccine-preventable diseases

Measles

Twenty cases of measles were reported in January and February (one in January and 19 in February), compared to five for the same period in 2010. Five cases in this period were associated with overseas travel (two from the Philippines, two from Italy and one from France).

Fourteen linked cases were identified in Western Sydney. The first case notified (whose source remains unknown) attended a social gathering while infectious. From this case, two further cases were reported in the community from child contacts who were unvaccinated or who had received only one dose of measles-containing vaccine. Five subsequent cases were reported from a local high school and six cases from the local community with no identified links to known cases of measles.

Measles virus is especially infectious and is easily spread among unvaccinated or partially vaccinated people. The virus is spread through the air by someone who is unwell with the disease. Symptoms include fever, sore eyes and a cough followed a few days later by a rash.[1]

Many people who were born during or since 1966 may not be immune to measles because they have neither been infected with measles nor received two doses of a measles-containing vaccine. People who are planning overseas travel should ensure they have received two doses of the free measles-mumps-rubella vaccine (at least 1 month apart) from their general practitioner (GP) or at a travel health clinic. Measles vaccine is recommended for infants at 12 months and at 4 years of age, and this provides long-lasting immunity in 99% of recipients.[2]

Meningococcal disease

Twelve cases of meningococcal disease were reported in NSW in January and February (seven in January and five in February). No links were identified between cases. The age of cases in this period ranged from 0 to 61 years and included five cases aged less than 5 years. No deaths were reported in this period. Five cases were caused by *Neisseria meningitidis* serogroup B, one case by *N. meningitidis* serogroup W135, and for six cases the serogroup was unable to be determined. In 2010, 73 cases of meningococcal disease were reported in NSW (including five deaths).

A free vaccine for serogroup C meningococcal disease is available for infants at 12 months of age. Consequently, serogroup C meningococcal disease is now mainly seen in adults and in unimmunised children. In NSW in 2010, 82% of cases of meningococcal disease (where the serogroup was known) were caused by *N. meningitidis* serogroup B, for which there is no vaccine.

Pertussis (whooping cough)

During January and February, 2698 cases of pertussis were reported in NSW. This followed an increase in late 2010, with 1860 cases reported in November and 1590 cases in December. The number of reported cases was highest in children aged 0–4 years and 5–9 years. In total, 9244 cases were reported in 2010 compared with 12 577 in 2009.

A free vaccine is available for infants at 2, 4 and 6 months (although the first dose can be given as early as 6 weeks of

age) with a booster dose at 4 years (which can be given as early as 3 years and 6 months of age).[3] Immunisation reduces the risk of infection, however the vaccine does not provide lifelong protection, and re-infection can occur.[2] Because pertussis immunity wanes over time, many older children and adults are susceptible to infection and can be the source of new infections in infants.[4] For a limited time, NSW Health is providing free pertussis (dTpa) vaccine via GPs to all new parents, grandparents and any other adults who will regularly care for infants less than 12 months of age. Free vaccine boosters are also provided in high school as part of NSW Health's School-Based Vaccination Program.

Sexually transmissible infections

Gonorrhoea

Notifications of gonorrhoea continued to decrease during January and February 2011, following a downward trend reported at the end of 2010. There were a total of 379 notifications of gonorrhoea reported (195 in January and 184 in February) in this period, compared to 445 (244 in January and 201 in February) in the same period in 2010.

Gonorrhoea is a bacterial infection spread through vaginal, oral or anal sex without a condom. Infection in men can present as discharge from the penis, irritation or pain on urinating. Infections of the cervix, anus and throat usually cause no symptoms.[1]

Syphilis

Notifications of infectious syphilis continued to decrease during January and February 2011, following a significant decrease at the end of 2010. In total, 46 cases of infectious syphilis were reported in this period (28 in January and 18 in February). This is a decrease of approximately 40% compared to the same time period in 2010 (45 in January and 36 in February). The majority of notifications continue to occur in males aged between 20 and 50 years.

Syphilis is a highly infectious sexually transmitted disease that is spread through vaginal, anal or oral sex through skin-to-skin contact. Syphilis is highly contagious during the primary and secondary stages when the sore or rash is present.[1] Those most at risk include men who have sex with men, people with HIV/AIDS, and people living in Aboriginal communities that are remote or have poor access to health care services.

Lymphogranuloma venereum

An outbreak of lymphogranuloma venereum (LGV) was identified in NSW in 2010 with a peak in notifications reported between May and August when 32 cases were reported. Since then, the number of notifications dropped significantly but increased during January and February 2011 with 10 cases reported.

LGV is a sexually transmitted infection. It is caused by a rare, severe strain of *Chlamydia trachomatis* which generally causes more severe symptoms than chlamydia. LGV is spread through unprotected vaginal, anal or oral sexual contact.[1]

Mosquito-borne infections

During January and February 2011, mosquitoes were found at very high levels in many parts of rural NSW, especially in southern parts of the state. Mosquitoes potentially carry a number of different viruses that can cause human disease.

The most common mosquito-borne infections of humans in NSW are Ross River virus and Barmah Forest virus infection, both of which can cause a prolonged illness with fever, rash, sore joints and fatigue.[1]

In this period 147 cases of Ross River virus infection were reported (64 in January and 83 February) compared to 184 cases for the same period in 2010. In total, 154 cases of Barmah Forest virus infection were reported in this period (96 in January and 58 February) compared to 49 cases for the same period in 2010.

A number of sentinel chicken flocks are located around western NSW and Victoria to help monitor the risk of more serious mosquito-borne infections such as Murray Valley encephalitis (MVE) and Kunjin virus disease. MVE was detected in sentinel chickens in the Victorian towns of Mildura, Robinvale, Kerang and Barmah, and also in Tooleybuc in NSW.[5] Although a number of people have been tested for these infections, no human cases have been confirmed at this stage.

In response to the infections in chickens, NSW Health commissioned a print and radio-based community awareness campaign to inform the public about how best to avoid mosquito bites to prevent mosquito-borne diseases. PHUs are maintaining regular contact with health facilities in western NSW to identify possible cases early and ensure that appropriate investigations are performed. PHUs have also disseminated information about MVE to local clinicians. The last human case of MVE detected in NSW was reported in 2008.

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3. Australian Technical Group on Immunisation (ATAGI). 41st Meeting: 15–16 October 2009, summary of outcomes. Available from: http://immunise.health.gov.au/internet/immunise/publishing.nsf/Content/E7E989916C4FCAD8CA2576BF007D6B6E/$File/ATAGI-41-bulletin.pdf (Cited 30 March 2010.)

4. Wendelboe AM, Njamkepo E, Bourillon A, Floret D, Gaudelus J, Gerber M. Transmission of *Bordetella pertussis* to young infants. *Pediatr Infect Dis J* 2007; 26: 293–9. doi:10.1097/01.inf.0000258699.64164.6d

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Figure 1. Reports of selected communicable diseases, NSW, January 2004 to February 2011, by month of onset.
Preliminary data: case counts in recent months may increase because of reporting delays.
Laboratory-confirmed cases only, except for measles, meningococcal disease and pertussis.
BFV, Barmah Forest virus infection; RRV, Ross River virus infections; lab conf, laboratory confirmed;
Men Gp C and Gp B, meningococcal disease due to serogroup C and serogroup B infection;
other/unk, other or unknown serogroups.
NB: Multiple series in graphs are stacked, except gastroenteritis outbreaks.
NB: Outbreaks are more likely to be reported by nursing homes & hospitals than by other institutions.

NSW Population	
Male	50%
<5 y	7%
5–24 y	27%
25–64 y	53%
65+ y	13%
Rural	46%

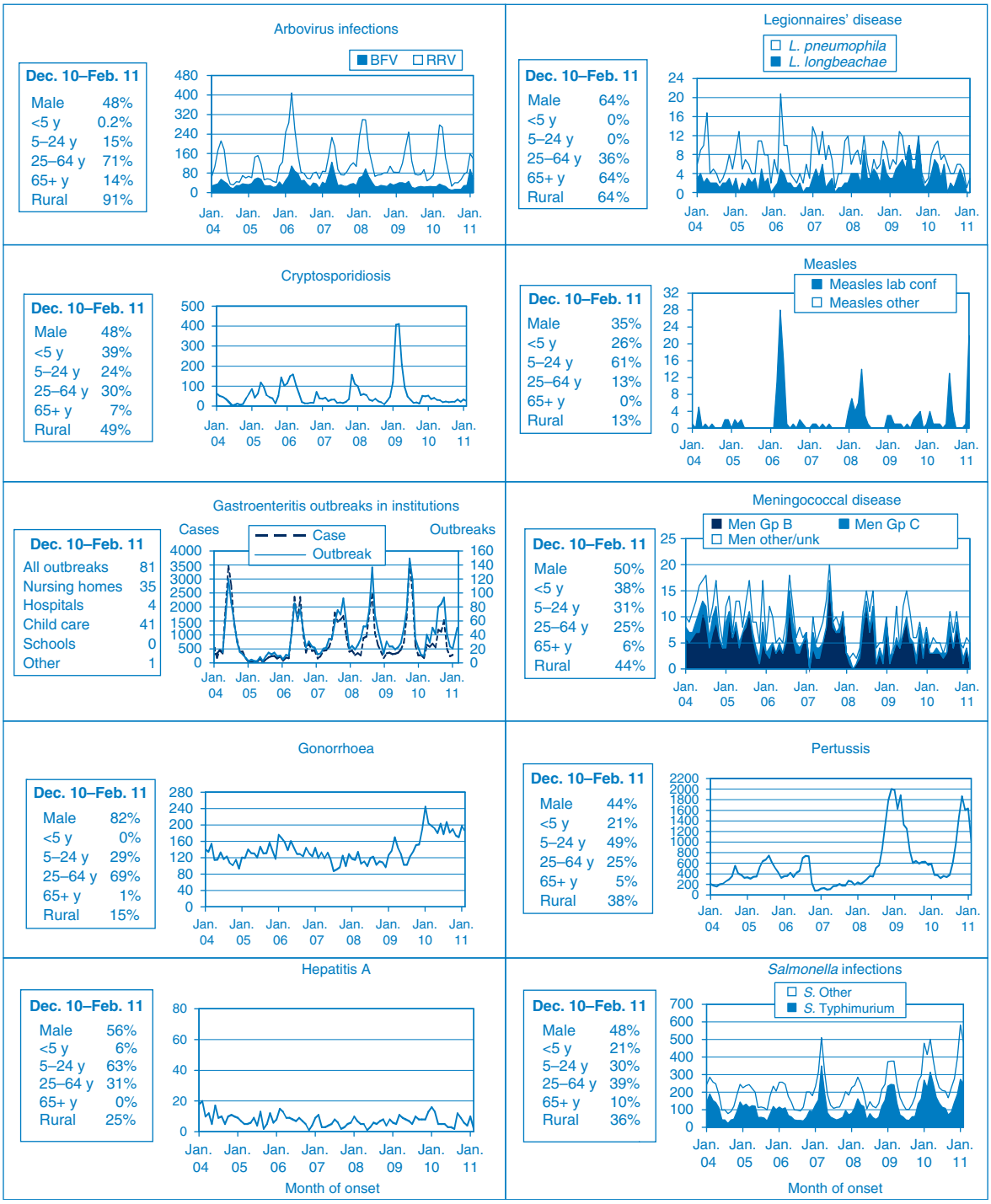

Table 1. Reports of notifiable conditions received in January 2011 by area health services

Condition	Area Health Service (2011)																			Total	
	Greater Southern		Greater Western			Hunter New England		North Coast		Northern Sydney Central Coast		South Eastern Sydney Illawarra		Sydney South West		Sydney West				For Jan[b]	Year to date[b]
	GMA	SA	FWA	MAC	MWA	HUN	NEA	MNC	NRA	CCA	NSA	ILL	SES	CSA	SWS	WEN	WSA	JHS			
Bloodborne and sexually transmitted																					
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	47	31	11	18	34	160	20	28	71	63	98	60	232	128	118	73	131	8		1356	1356
Gonorrhoea[a]	2	–	–	1	–	10	–	2	1	5	13	6	83	37	12	5	15	–		198	198
Hepatitis B – acute viral[a]	–	1	–	–	–	–	–	–	–	–	1	–	–	–	2	–	–	–		5	5
Hepatitis B – other[a]	–	1	–	2	2	5	1	1	2	1	28	–	23	39	33	2	42	2		187	187
Hepatitis C – acute viral[a]	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–		2	2
Hepatitis C – other[a]	9	6	1	3	7	16	4	4	12	12	10	8	28	43	30	18	25	17		255	255
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Lymphogranuloma venereum	–	–	–	–	–	–	–	–	–	–	–	–	3	1	–	–	1	–		5	5
Syphilis	1	–	–	–	1	1	–	–	1	2	1	1	13	6	2	–	4	–		34	34
Vectorborne																					
Barmah Forest virus[a]	18	1	4	3	5	6	3	12	24	1	3	2	–	–	–	1	1	–		84	84
Ross River virus[a]	22	1	4	9	2	7	2	7	1	2	–	–	–	–	–	1	–	–		58	58
Arboviral infection (other)[a]	–	1	–	–	–	2	–	–	–	2	–	3	4	4	1	–	–	–		16	16
Malaria[a]	–	–	–	–	–	1	–	–	–	–	–	1	4	–	–	–	2	–		9	9
Zoonoses																					
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Brucellosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Leptospirosis[a]	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–		2	2
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Q fever[a]	1	1	–	2	–	5	–	2	1	–	–	1	–	–	–	–	–	–		13	13
Respiratory and other																					
Blood lead level[a]	7	–	–	2	1	2	–	–	–	–	–	–	1	–	1	–	–	–		3	3
Influenza[a]	–	2	1	–	9	4	3	3	8	–	16	6	23	2	2	14	21	–		115	115
Invasive pneumococcal infection[a]	1	1	–	2	4	–	–	–	1	–	4	–	1	2	–	1	3	–		20	20
Legionella longbeachae infection[a]	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	1	–	–		3	3
Legionella pneumophila infection[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–		2	2
Legionnaires' disease (other)[a]	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–		2	2
Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Meningococcal infection (invasive)[a]	1	–	–	–	1	1	–	–	–	–	–	1	1	–	1	–	–	–		6	6
Tuberculosis	–	–	–	–	1	1	–	–	–	1	1	–	14	8	1	–	7	–		34	34
Vaccine-preventable																					
Adverse event after immunisation	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	1	–	–		3	3
H. influenzae b infection (invasive)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Measles	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Mumps[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–		2	2
Pertussis	128	95	2	32	28	90	11	15	28	36	205	114	197	101	189	89	106	–		1469	1469
Rubella[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–		1	1
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Enteric																					
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Cholera[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Cryptosporidiosis[a]	–	2	–	–	–	8	2	2	2	–	2	1	1	1	1	2	3	–		27	27
Giardiasis[a]	–	3	–	–	6	19	–	4	2	11	30	5	40	20	9	10	15	–		175	175
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–		1	1
Hepatitis A[a]	–	–	–	1	–	–	–	–	–	–	–	–	1	1	–	–	4	–		7	7
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2	–		4	4
Listeriosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–		2	2
Rotavirus[a]	–	1	–	–	–	10	1	–	4	–	16	–	8	6	4	4	7	–		62	62
Salmonellosis[a]	15	7	2	2	11	50	6	29	20	21	48	20	77	76	134	20	66	–		610	610
Shigellosis[a]	–	1	–	1	1	–	–	–	–	–	4	1	3	5	–	–	1	–		18	18
Typhoid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–		4	4
Verotoxin producing *E. coli*[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Miscellaneous																					
Creutzfeldt–Jakob disease	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–		1	1
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–

[a]Laboratory-confirmed cases only. [b]Includes cases with unknown postcode.

NB: Data are current and accurate as at the preparation date. The number of cases reported is, however, subject to change, as cases may be entered at a later date or retracted upon further investigation. Historical area health service configurations are included for continuity/comparison purposes and to highlight regional differences.

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NB: HIV and AIDS data are reported separately in the Public Health Bulletin quarterly.

GMA, Greater Murray Area MAC, Macquarie Area NEA, New England Area CCA, Central Coast Area SES, South Eastern Sydney Area WEN, Wentworth Area SA, Southern Area MWA, Mid Western Area MNC, Mid North Coast Area.
NSA, Northern Sydney Area CSA, Central Sydney Area WSA, Western Sydney Area FWA, Far West Area HUN, Hunter Area NRA, Northern Rivers Area ILL, Illawarra Area SWS, South Western Sydney Area JHS, Justice Health Service.

Table 2. Reports of notifiable conditions received in February 2011 by area health services

Condition	Area Health Service (2011)																		Total	
	Greater Southern		Greater Western			Hunter New England		North Coast		Northern Sydney Central Coast		South Eastern Sydney Illawarra		Sydney South West		Sydney West			For	Year
	GMA	SA	FWA	MAC	MWA	HUN	NEA	MNC	NRA	CCA	NSA	ILL	SES	CSA	SWS	WEN	WSA	JHS	Feb[b]	to date[b]
Bloodborne and sexually transmitted																				
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	67	51	11	19	49	165	39	65	69	76	142	98	331	182	128	76	152	20	1760	3116
Gonorrhoea[a]	3	3	–	–	–	9	2	1	5	2	12	8	70	40	18	8	12	–	196	394
Hepatitis B – acute viral[a]	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	1	1	–	4	9
Hepatitis B – other[a]	1	6	3	1	–	2	–	1	2	3	16	5	36	31	55	6	45	10	225	412
Hepatitis C – acute viral[a]	–	–	–	1	–	3	–	–	–	–	–	–	1	–	1	–	1	–	7	9
Hepatitis C – other[a]	10	16	7	1	9	12	3	9	12	9	8	13	34	31	40	11	30	42	301	556
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	1
Lymphogranuloma venereum	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	2	7
Syphilis	–	3	–	1	–	2	–	1	–	–	–	2	9	9	2	–	2	–	31	65
Vectorborne																				
Barmah Forest virus[a]	15	4	4	3	1	6	3	15	10	3	1	1	1	–	1	–	–	–	68	152
Ross River virus[a]	25	4	13	7	2	9	3	6	3	1	3	1	–	–	–	1	1	–	79	137
Arboviral infection (other)[a]	–	1	–	–	–	1	–	–	–	1	4	–	3	1	1	–	1	–	14	30
Malaria[a]	–	–	–	–	–	1	–	1	–	–	1	–	2	–	–	–	1	–	6	15
Zoonoses																				
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brucellosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Leptospirosis[a]	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	2	4
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	1	1
Q fever[a]	1	–	–	–	–	2	–	3	–	–	–	–	–	–	–	–	–	–	6	19
Respiratory and other																				
Blood lead level[a]	–	1	–	6	1	1	–	–	–	–	–	–	2	2	5	–	–	–	18	32
Influenza[a]	3	10	2	1	7	13	–	3	4	11	38	6	35	28	78	26	230	3	507	622
Invasive pneumococcal infection[a]	–	–	1	–	–	–	2	1	1	2	4	–	4	–	2	2	2	–	21	41
Legionella longbeachae infection[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Legionella pneumophila infection[a]	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	4
Legionnaires' disease (other)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Meningococcal infection (invasive)[a]	–	–	–	1	–	1	–	–	–	–	–	1	–	2	1	–	–	–	5	11
Tuberculosis	1	–	–	–	–	1	–	–	–	–	–	1	5	4	–	–	3	–	15	49
Vaccine-preventable																				
Adverse event after immunisation	1	–	–	–	–	–	–	–	–	–	1	1	1	–	1	–	3	–	8	11
H. influenzae b infection (invasive)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Measles	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	10	–	14	14
Mumps[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Pertussis	74	57	7	17	36	83	11	27	42	29	186	93	130	77	140	76	144	–	1229	2698
Rubella[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	2
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Enteric																				
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cholera[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cryptosporidiosis[a]	–	–	–	–	–	2	–	2	–	4	7	2	3	3	2	5	1	–	31	58
Giardiasis[a]	6	9	1	2	15	16	7	4	1	8	51	8	49	27	17	11	21	1	254	429
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Hepatitis A[a]	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	2	–	5	12
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	5
Listeriosis[a]	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	1	–	–	3	5
Rotavirus[a]	–	–	–	3	1	6	2	1	5	1	11	–	7	17	4	5	3	–	67	129
Salmonellosis[a]	18	17	3	8	10	46	7	15	17	24	89	16	62	34	43	14	52	1	477	1087
Shigellosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	6	3	1	1	1	–	12	30
Typhoid[a]	–	–	–	–	–	–	–	–	–	–	–	–	2	3	–	1	4	–	10	15
Verotoxin producing *E. coli*[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Miscellaneous																				
Creutzfeldt–Jakob disease	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	1

[a]Laboratory-confirmed cases only. [b]Includes cases with unknown postcode.

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Contents

Special issue: Falls prevention in NSW