

The Incidence and Cost of Falls Injury Among Older People in New South Wales 2006/07

A Report to NSW Health



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Abbreviations and Acronyms

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
APDC	Admitted Patients Data Collection
AR-DRG	Australian Refined - Diagnosis Related Groups
ED	Emergency Department
GP	General Practitioner
HOIST	Health Outcomes Information Statistical Toolkit
ICD-10-AM	International Classification of Diseases, Version 10, Australian Modification
RAC	Residential Aged Care
VAED	Victorian Admitted Episodes Dataset
VEMD	Victorian Emergency Minimum Dataset

List of Tables and Figures

Tables

Table 1: Case selection criteria for falls-related hospitalisations, persons aged 65 years and older, NSW, 2006/07.....	3
Table 2: Average length of stay in residential aged care by care type and gender, NSW, 2006/07.....	5
Table 3: Estimated number of falls requiring medical treatment by level of treatment, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.....	7
Table 4: Estimated health care costs of all medically treated fall-related injuries by gender, place of residence and level of care, persons aged 65 years and older, NSW, 2006/07.....	9
Table 5: Estimated health care costs of all medically treated fall-related injuries by gender and cost component, persons aged 65 years and older, NSW, 2006/07.....	11
Table 6: Estimated health care costs of fall-related injuries by residential status and cost component, people aged 65 years and older, NSW, 2006/07.....	12
Table 7: Estimated average health care costs of medically treated fall-related injuries by gender, place of residence and level of care, persons aged 65 years and older, NSW, 2006/07.....	13

Figures

Figure 1: Hospital admission rates per 100,000 population for fall injury by age, gender and residential status, NSW, 2006/07.....	8
Figure 2: Distribution of health care costs of all medically treated fall-related injuries by gender and place of residence, persons aged 65 years and older, NSW, 2006/07.....	9
Figure 3: Distribution of health care costs of all medically treated fall-related injuries by level of treatment and place of residence, persons aged 65 years and older, NSW, 2006/07.....	9
Figure 4: Distribution of health care costs by place of residence and age group, fall-related injuries to people aged 65 years and older, NSW, 2006/07.....	10
Figure 5: Distribution of health care costs for fall-related injuries by gender and age group, people aged 65 years and older, NSW, 2006/07.....	10
Figure 6: Percentage of total health care costs by component, medically treated fall-related injuries to people aged 65 years and older, NSW, 2006/07.....	11
Figure 7: Distribution of falls-related treatment costs by component and residential status, people aged 65 years and older, NSW, 2006/07.....	12
Figure 8: Distribution of average inpatient care costs for fall-related hospital admissions by age group and place of residence, persons aged 65 years and older, NSW, 2006/07.....	14
Figure 9: Distribution of average health care costs for medically treated fall-related injuries by age group and level of care, persons aged 65 years and older, NSW, 2006/07.....	14

List of Appendix Tables

Appendix Table 1: Estimated resident population by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07	21	Appendix Table 9: Estimated number of discharges to residential aged care following a fall-related hospital admission, people aged 65 years and older living in the community, NSW, 2006/07	29
Appendix Table 2: Estimated number of persons who fell, by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07	22	Appendix Table 10: Total estimated costs of health care for fall-related injury by age, gender and level of care, persons aged 65 years and older, NSW, 2006/07	30
Appendix Table 3: Estimated number of falls by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07	23	Appendix Table 11: Total estimated costs of health care for fall-related injury by age, gender and level of care for persons living in the community, aged 65 years and older, NSW, 2006/07	31
Appendix Table 4: Total estimated number of falls resulting in medical treatment (admissions, Emergency Department attendances and non-hospital treatment) by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07	24	Appendix Table 12: Total estimated costs of health care for fall-related injury by age, gender and level of care for persons living in residential aged care aged 65 years and older, NSW, 2006/07	32
Appendix Table 5: Estimated number of falls resulting in hospital admission by age, gender and place of residence, persons aged 65 years and older, NSW, 2006/07	25	Appendix Table 13: Average estimated treatment costs of all fall-related injury by age, gender and level of care, persons aged 65 years and older, NSW, 2006/07	33
Appendix Table 6: Estimated number of falls resulting in Emergency Department attendance by age, gender and place of residence, persons aged 65 years and older, NSW, 2006/07	26	Appendix Table 14: Average estimated treatment costs of all fall-related injury by age, gender and level of care, persons living in the community aged 65 years and older, NSW, 2006/07	34
Appendix Table 7: Estimated number of falls resulting in non-hospital treatment by a health professional by age, gender and place of residence, persons aged 65 years and older, NSW, 2006/07	27	Appendix Table 15: Average estimated treatment costs of all fall-related injury by age, gender and level of care, persons living in residential aged care aged 65 years and older, NSW, 2006/07	35
Appendix Table 8: Age-specific fall-related hospitalisation rates by five-year group, gender and place of residence and age-standardised hospitalisation rates for persons aged 65 years and older by gender and place of residence, persons aged 65 years and older, NSW, 2006/07	28		

Executive Summary

Introduction

Fall-related injury among older people is a major public health issue which, with the growth of the ageing population, threatens to place significantly increased demands on the public health care system. Around one in three older people living in the community are estimated to fall each year and many fall more than once. In Australia, almost half of all fall injuries among older persons resulting in hospital admission occur in the home and a further 22 per cent take place in residential care facilities.

In recent years there have been a number of international studies that have estimated the cost of fall injuries. 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 only been one population-level study conducted in NSW which estimated the cost of fall-related injury. 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. The current study was commissioned by NSW Health to provide comprehensive, up-to-date estimates of the costs associated with fall-related injury to underpin the next iteration of the state falls prevention plan and to provide input for cost-benefit analyses of falls prevention programs.

Objective

The aim of this study is to quantify the burden of injury associated with falls in individuals aged 65 years and over in NSW, in 2006/07, by developing comprehensive estimates of the:

- incidence of injurious falls treated in the health system
- cost of these injuries to the health system
- average cost of these injuries

Method

There is very little robust information available on the utilisation and costs of health services, following a fall, once a patient has been discharged from the emergency department or hospital. It is therefore difficult to establish a definitive cost estimate for injury associated with falls solely using a 'bottom-up' health services utilisation approach. This approach was used where there was reasonably solid health service utilisation and unit cost data available, such as for hospital inpatients, emergency department presentations, ambulance transport and residential aged care. However, for other areas of expenditure, the study had to rely on information derived from the literature and a number of assumptions had to be made where data was limited. Consequently, it was necessary to synthesise data from a variety of sources.

The study takes a societal perspective in that it attempts to include all costs associated with treatment and care, resulting from a fall-related injury that occurred in 2006/07, irrespective of who pays or the sector responsible for providing the services. All costs are expressed in 2006/07 dollars and were assumed to have occurred within the year following injury. The only exception was the cost of residential aged care which, in accordance with data from the Australian Institute of Health and Welfare, was assumed to have been incurred over several years and was discounted accordingly at five per cent per annum in line with current Australian practice.

Results

Incidence

In 2006/07, it was estimated that over 251,000 individuals aged 65 years or older (or 27% of the older NSW population) fell at least once. In total, there were an estimated 507,000 falls and, of these, almost 143,000 (28%) resulted in injuries requiring some form of medical treatment.

Overall, about 18 per cent of medically treated falls-related injuries resulted in admission to hospital with the majority of treatment (69%) occurring outside the hospital setting. Persons in residential aged care (6% of the older population) accounted for a disproportionate number of medically-treated falls injury (30% of the total).

Total health care costs

The total cost of health care associated with fall injuries in older people in NSW, in 2006/07, was estimated at \$558.5 million. Hospital admitted cases accounted for 84.5 per cent of total costs, emergency department presentations accounted for nine per cent and other non-hospital attendances for 6.5 per cent. Not surprisingly, falls by people living in the community accounted for the majority of the costs (85%). Women accounted for 69 per cent of total health care costs with women living in the community accounting for 58 per cent of total costs.

Hospital sector treatment (inpatient, emergency department and outpatient services) consumed the majority of costs associated with fall-related injury among older people accounting for 58 per cent of all treatment costs. Residential aged care accounted for a further 23 per cent, medical treatments (general practitioners and specialists) six per cent and ambulance transport four per cent.

People living in residential aged care accounted for 15 per cent of total health care costs for fall-related injury despite accounting for only six per cent of the population aged 65 years and older. In particular, residents of aged care, account for a disproportionate share of hospital inpatient costs. While representing only one in 18 of the older population, they account for more than one fifth (21%) of fall-related hospital inpatient costs.

Average health care costs

The average treatment cost for fall-related injuries, among older people in NSW, was \$3,906 per fall injury treated. The average cost of fall-related health care was 25 per cent higher for females than males (\$4,211 vs \$3,366).

Hospital admissions accounted for the highest average cost at \$18,454 followed by cases treated in the emergency department (\$2,721) and then non-hospital treatments (\$369).

The average cost of fall-related care was higher for community-dwelling older people than for those in residential aged care (\$4,722 vs \$1,979) mainly due to the large difference in costs associated with hospital admitted

cases (\$20,563 vs \$11,196). This was due to the fact that the costs of residential aged care and home services were not applicable to the latter group since they were already in care.

Discussion

This study highlights the significant cost of fall-related injury both to the health system and to the community. The total cost of health care associated with fall-related injury to NSW, in 2006/07, was estimated at \$558.5 million. Although these costs are not all borne by NSW Health, the estimated cost of falls among older people in NSW, in 2006/07, was equivalent to almost five per cent of the NSW health budget in that year.

Despite accounting for only six per cent of the NSW population aged 65 years and older, people in residential aged care are over-represented in the falls injury data. It is estimated that they account for 15 per cent of the total health care cost of fall injuries and 21 per cent of inpatient costs. However, the true impact of falls in residential aged care is likely to be higher given the data constraints and methodological limitations of the study.

Strengths

This is the most comprehensive estimate of the population burden of fall-related injuries in NSW established to date. The study includes the majority of cost components associated with the medical treatment and care of fall-related injuries for individuals aged 65 years and older in 2006/07. It is also the first study to disaggregate the costs of fall-related injuries between those occurring in the community and those in residential aged care. Other fall injury costing studies in the United States, the United Kingdom and Australia did not report separately on the cost of fall injuries in residential aged care.

Limitations

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 was quite dated. Where there were inadequacies in existing data, assumptions had to be made.

The limitations of this study highlight the inadequacies in the current NSW health data and in our understanding of the patient journey, beyond the hospital, following a fall.

Further work is needed to address these shortcomings and, in particular, the standardisation of data collection systems and coding in NSW emergency departments is essential to identify injury causes and facilitate the quantification of less severe injuries from falls and other causes.

Recommendations

Several recommendations have emerged from this study regarding fall injury prevention, data issues and further research.

- It is clear that falls injury is responsible for a significant burden on the NSW community which is equivalent, in economic terms, to five per cent of the NSW health budget. In order to reduce the impact of fall-related injury among older people on the health system, significant resources need to be directed towards the promotion of evidence-based falls prevention programs at the local level across the state.
- Residents of aged care facilities are significantly over-represented in the hospital data and also account for an excess proportion of the total cost. Consequently, urgent efforts should also be addressed to prevent falls in this setting.
- Data from this study should be used in cost-effectiveness studies on falls interventions, at the population level, to inform NSW falls prevention policy and the prioritisation of evidence-based prevention programs within the community.
- The introduction of a unique patient identifier and the date of injury in the hospital discharge dataset would facilitate the identification of incident cases of fall-related hospitalisations in the NSW Admitted Patients Data Collection.
- Standardisation of the NSW emergency department data collections across Area Health Services in terms of the coding of injury causes and diagnoses is essential to facilitate the quantification of the number of falls resulting in emergency department attendance and the associated costs.
- The linkage of health data both within and between collections would also facilitate a more precise enumeration of fall-related cases and the utilisation of health services and provide a clearer picture of the patient journey across services. In addition to enhancing the level of detail available on individual cases, linkage of data can also provide a significant quality control function.

- The costing of falls in the hospital setting has not yet been attempted in Australia, despite the fact that falls are the most common adverse event experienced during inpatient care. It is therefore recommended that research be undertaken to establish the impact of these events within the hospital system in terms of additional resources consumed.
- Linking data from the Australian National Sub-Acute and Non-Acute Patient data collection, the NSW Emergency Department Data Collection and the NSW Admitted Patients Data Collection will assist in the identification of persons receiving rehabilitation services as the result of a fall, and facilitate a more complete costing of the health services utilised following a fall.

Significance

In addition to the standard measures of morbidity and mortality, the provision of information on the estimated cost of fall-related injury is an essential step in advocating for the need for prevention strategies in this area. This study provides data to inform the cost-effective analyses of falls prevention interventions. The cost data provided here can be used in conjunction with information on the cost of fall-prevention strategies to aid policy makers and practitioners in selecting the best value countermeasures from the growing number of proven falls prevention interventions.

Despite its limitations, the study provides the most comprehensive population-level estimate of the economic cost of falls among older people in NSW and is the first to attempt to disaggregate these costs between the community and residential aged care. It highlights the significant over-representation of residents of aged care facilities in the data and their disproportionate contribution to the health care costs associated with the treatment of fall injuries.

The study also highlights the considerable cost of these injuries to the NSW health system and underscores the significant investment in falls injury prevention necessary, in both the community and residential aged care settings, to reduce these costs. While research has identified a number of effective interventions that can significantly decrease the incidence of fall-related injuries, the implementation of fall injury prevention programs at the population level remains limited. Further efforts are necessary in NSW to promote these programs and to support their uptake at the local level.

SECTION 1

Introduction

Injuries resulting from falls represent a major public health problem which, with the ageing of the population, threatens to place significantly increasing demands on the health system over coming years. Injuries (mainly hip fractures and other fractures) resulting from falls in older persons, consume a disproportionate share of hospital resources for trauma care and no other injury cause, including road trauma, costs the NSW health system more.¹

In addition to the health care costs, there is the hidden burden of falls on older people, their relatives and carers. An injurious fall can have significant personal and economic consequences for the individual and their family. As well as the injury, associated pain and disability suffered, falls can also result in fear of falling,² decreased levels of activity,^{3,4} loss of independence,⁵ raised levels of anxiety and depression,⁶ post-traumatic stress disorder,⁷ admission to residential care⁸ and sometimes death.

Based on the fall injury rate in 2001, it has been estimated that the expenditure on treatment in Australia each year for these injuries would almost triple by 2051 solely due to the demographic change associated with the ageing population.⁹

The falls hospitalisation rate has, however, continued to increase since 2001 and the growing burden of these injuries on the health system underscores the urgent need for resources to be directed towards falls prevention for people in older age.

In recent years there have been a number of international studies that have estimated the cost of fall injuries.¹⁰⁻¹² Estimates of the cost of injuries and other conditions 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 falls and reducing fall-related injury.

To date, there has only been one population level study, conducted in NSW, which estimated the broader health care costs of fall-related injury.¹ This cost was established in the context of a broader all-age, all-injury study which included limited cost components and, being based on 1998/99 data, is now quite dated. The current study was commissioned by NSW Health to provide comprehensive, up-to-date estimates of the costs associated with fall-related injury 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 is to quantify the burden of injury associated with falls in individuals aged 65 years and over in NSW, in 2006/07, by developing comprehensive estimates of the:

- incidence of injurious falls treated in the health system
- cost of these injuries to the health system
- average cost of these injuries

Methods

Incidence estimation

Beyond hospitalisation data, there is little routine recording of injury treatment where the cause of the injury can be reliably identified.

Without the benefit of linked hospital admissions and Emergency Department (ED) data and, in the absence of population-level datasets that identify treatment for injury outside the hospital system, it was necessary to draw on several data sources, and the published literature, to estimate the incidence of medically treated fall-related injuries. While this is not ideal, the estimates developed here are based on the best data currently available for this purpose in NSW.

Estimates of the incidence of medically treated fall-related injuries were developed using data from several sources. These include:

■ *NSW Admitted Patients Data Collection (APDC)*

Data from the NSW APDC was used to estimate the total number of incident hospital admissions due to falls among older people in NSW for 2006/07. The APDC is an administrative dataset which records all inpatient separations from all public and private hospitals in NSW. It uses the National Centre for Classification in Health's International Classification of Diseases, Version 10, Australian Modification (ICD-10-AM)¹³ to classify diagnoses and external causes of injury. This data was accessed through the NSW Department of Health's Health Outcomes Information Statistical Toolkit (HOIST) data warehouse.

■ *Victorian Admitted Episodes Dataset (VAED) and Victorian Emergency Minimum Dataset (VEMD)*

Data from Victoria were used to establish the ratio of admitted to non-admitted ED presentations which was then applied to NSW hospitalisation data. The VAED is the Victorian equivalent of the NSW APDC. It records inpatient separations from all public and private hospitals in Victoria and uses the ICD-10-AM¹³ to classify diagnoses and external causes of injury. In contrast to the NSW Emergency Department Information System, the VEMD covers all

38 public hospitals with 24-hour EDs in Victoria and uses consistent coding across all facilities.

■ *2009 NSW Falls Prevention Survey*

Preliminary data from this survey was supplied by the NSW Health Population Health Survey Unit. The NSW Falls Prevention Survey was conducted in 2009, using computer assisted telephone interviewing, to provide baseline information for the evaluation of the state falls policy. Over 5,000 people aged 65 years and older were included in the survey. Weighting of the sample is undertaken to adjust for differences between the age and sex structure of the NSW population, and for differences in the probability of selection among respondents, thereby enabling the calculation of prevalence estimates for the state population for the various conditions, health behaviours and risk factors under examination. The differences in the probability of selection are due to the varying number of people living in each household, the number of residential telephone connections for the household, and the varying sampling fraction in each Area Health Service. Data from this survey were used to estimate the number of people who fell, the number of falls, and the number of falls requiring medical treatment experienced among older people living in the community.

■ *Population data*

Population estimates, by gender and five-year age groups, at December 31 2006, were derived from Australian Bureau of Statistics (ABS) data.¹⁴ The population in residential aged care (RAC) was derived from the Australian Institute of Health and Welfare (AIHW) data.¹⁵

The selection of cases from these datasets was confined to persons aged 65 years and older. Three mutually exclusive categories of care were identified for the purpose of this study:

- hospital admissions
- ED presentations (not admitted)
- non-hospital treatment (including General Practitioners (GPs) and allied health professionals)

Estimates for each treatment level were made separately

for the two main settings in which older people reside, that is, in the community and in RAC.

Hospital admissions

To establish an estimate of the incident number of falls resulting in hospital admissions, a falls admissions dataset was constructed by merging the 2006/07 and 2007/08 NSW APDC files for all persons aged 65 years and older and extracting all records with an admission date during 1 July 2006 to 30 June 2007 (that is 2006/07) and a fall (ICD-10-AM: W00-W19) recorded in any external cause field (Table 1).

Taking into account previous recommendations for deriving the incidence of hospitalised falls,¹⁶⁻¹⁸ an incident case was defined if the first external cause recorded was a fall (ICD-10-AM: W00-W19) and the principal diagnosis was an injury (S00-T75 or T79). Transfers from other hospitals and changes in care-type within the same hospital were excluded so as to minimise the double-counting of cases. Consequently, all episodes of care that met the selection criteria for Group 1 in Table 1 were counted as incident admissions. Episodes of care that fell into Groups 2 (transfers) and 3 (follow-up care) were also used to cost the inpatient treatment of fall-related injury. Episodes of care identified in Group 4 were not included in the enumeration of incident cases, or in the costing, since the fall injury was not identified as the primary cause of admission.

According to coding guidelines, the 'readmission within 28 days' flag should be used to indicate a readmission for the

same problem/condition. However, work conducted at the NSW Injury Risk Management Research Centre on methods used to estimate the incidence of falls hospitalisations, suggests that, compared with the incidence obtained using data record linkage (the 'gold standard'), exclusion of readmissions within 28 day results in a decrease in incidence of 5.6 per cent.¹⁹ This suggests that some hospitals/coders may be using this flag even when a previous admission is related to other injuries or health conditions. Consequently, given the risk of subsequent falls in this older age group, these records were included in the enumeration of incident cases.

Falls sustained by nursing home residents were identified using the 'place of occurrence' code supplemented by any additional cases identified using the 'referral source' code. All falls identified as occurring in a RAC facility were assumed to be by residents. These were supplemented by a small number of additional cases identified using the 'referral source' code. All other cases were assumed to have been community dwelling older persons. It should be noted that, since almost 20 percent of records did not have a specified 'place of occurrence' code, this may represent a source of over-estimation in the incidence of fall admissions in this group and an under-enumeration of falls admissions from RAC facilities.

Emergency Department presentations

The incidence of non-admitted ED presentations was estimated by applying ratios of ED presentations to hospital

Table 1: Case selection criteria for falls-related hospitalisations, persons aged 65 years and older, NSW, 2006/07

Selection criteria	Males	Females	Persons
1. Incident admissions:	7,798	17,763	25,561
<ul style="list-style-type: none"> ■ Principal diagnosis is ICD-10-AM: S00-T75 or T79 ■ First external cause is ICD-10-AM: W00-W19 ■ Mode of admission is not an inward transfer or change in care type 			
2. Transfers:	1,278	3,042	4,320
<ul style="list-style-type: none"> ■ Principal diagnosis is ICD-10-AM: S00-T75 or T79 ■ First external cause is ICD-10-AM: W00-W19 ■ Mode of admission is a: <ul style="list-style-type: none"> – transfer from another acute hospital or – change in care type within the same hospital 			
3. Fall-related follow-up care:	3,191	8,633	11,824
<ul style="list-style-type: none"> ■ Principal diagnosis is ICD-10-AM: Z47, Z48, Z50 or Z75.1 ■ First external cause is ICD-10-AM: W00-W19 			
All episodes of care due to a fall	12,267	29,438	41,705
4. Remaining admissions with fall & injury in record:	3,324	4,456	7,780
<ul style="list-style-type: none"> ■ Injury (ICD-10-AM: S00-T75 or T79) in any diagnosis field (not principal cause of admission) ■ Any external cause is a fall (ICD-10-AM: W00-W19) 			
All episodes of care with a fall & injury	15,591	33,894	49,485

Source: Health Outcomes and Information Statistical Toolkit (HOIST): NSW Admitted Patients Data Collection (APDC)

admissions, derived from the VAED and the VEMD, and applied to NSW APDC data. To establish robust ratios, three years of data (2005, 2006 and 2007) were used. Fall hospitalisation records were selected from the VAED using the same method as that described above for NSW APDC data. ED presentations were selected from the VEMD if the cause of the ED presentation was recorded as a fall, if the record was classed as an 'initial' visit and if the person injured was not admitted to a ward following the presentation. The annual average number of admissions and presentations were calculated by gender and five-year age groups and the ratio of admissions to presentations determined for each group. These ratios were then applied to the incidence of fall injury admissions derived from the NSW APDC to estimate the incident number of fall-related ED presentations to NSW hospitals. Estimates of the number of ED presentations were calculated separately for community and RAC residents.

Non-hospital treatments

The number of falls which resulted in treatment outside the hospital system was estimated separately for community dwelling older people and residents of aged care facilities.

Data from the 2009 NSW Falls Prevention Survey was used to estimate the total number of falls resulting in medical treatment outside the hospital setting for older people living in the community. This was derived by applying the weighted population proportions from the 2009 NSW Falls Prevention Survey to the 2006/07 estimated community population, by gender and five-year age groups. The estimated community population was calculated by subtracting the population residing in RAC¹⁵ from the ABS estimated resident population of NSW at December 31, 2006.¹⁴

The total number of nursing home fall injuries was estimated by calculating the number of falls per year based on the RAC population in NSW at June 30, 2007.¹⁵ A multiplier of 1.7 [based on a summary of five published and two unpublished studies by Rubenstein et al²⁰] was applied to the RAC population data to establish an estimate of the total number of falls in RAC in NSW in 2006/07. The number of falls requiring medical treatment for males and females was then estimated using proportions derived from Baranzini et al.²¹ RAC fall injuries attended by other health professionals were calculated by subtracting the hospital admissions and ED attendances from the total estimate of fall injuries.

Cost estimation

There is very little robust information available on the utilisation and costs of health services, following a fall, once a patient has been discharged from the ED or hospital. While there have been two studies^{22,23} which have followed patients prospectively following a fall, both were limited by small sample sizes which makes extrapolation to the population level problematic. It is therefore difficult to establish a definitive cost estimate for injury associated with falls solely using a 'bottom-up' health services utilisation approach. Where there was reasonably solid health service utilisation and unit cost data available, such as for hospital inpatients, ED presentations, ambulance transport and RAC, this approach was used. However, for other areas of expenditure the study relied mainly on the 1999 Mathers & Penm²⁴ study with additional components from Hall & Hendrie.²²

The study takes a societal perspective in that it attempts to include all costs associated with treatment and care resulting from a fall-related injury irrespective of who pays or the sector responsible for providing the services. All costs, associated with treatment and care, are expressed in 2006/07 dollars and were assumed to have occurred within the year following injury. The only exception was the cost of RAC which, in accordance with data from the AIHW¹⁵ was assumed to have been incurred over several years and was discounted accordingly using a five per cent discount rate as recommended by the National Health and Medical Research Council.²⁵

Costs are presented for NSW separately for older people living in the community and in RAC.

Hospital inpatient

Inpatient hospital costs for all admitted patients were calculated using the Australian-Refined – Diagnostic Related Group (AR-DRG) codes recorded in the NSW APDC for each episode of care defined by groups 1-3 in Table 1. All calculations were undertaken in SPSS Version 17.0 with costs applied at the unit record level.

Average AR-DRG Version 5.0 costs were applied to each acute episode of care, in SPSS, using a look-up table of data from the *NSW Cost of Care Standards 2006/2007*.²⁶ These costs include all in-hospital medical and allied health treatment (including the ED cost), nursing, diagnostics and pharmaceuticals. Adjustments were made for transfers and same-day episodes in accordance with the methods outlined in the *NSW Cost of Care Standards*.²⁶

Costs for AR-DRG rehabilitation codes Z60A and Z60B were derived from the *National Hospital Cost Data Collection 2006/07*.²⁷ Since no value was provided by either source for episodes coded Z60C (Rehabilitation – same day), the average cost for a Tier 2 outpatient rehabilitation clinic (\$415) was applied.²⁶

Emergency Department

The number of cases estimated to have attended the ED, without admission to hospital, in each age and gender grouping, was calculated as outlined in the section *Emergency Department presentations*. These figures were then multiplied by the average value of an ED presentation (\$380), as defined in the *NSW Cost of Care Standards 2006/2007* (p15)²⁶ to establish the total cost of ED treatment for each age and gender grouping. These values were then summed to arrive at the total cost of ED treatment for fall-related injuries among older people in NSW for 2006/07.

Residential aged care

Estimates of the number of community-dwelling older persons discharged to RAC, following a hospital admission for a fall, were made to facilitate the calculation of the cost of this type of care. The proportion of transfers from hospital to RAC, following a fall-related admission, was derived by age group and gender, from tables in Karmel et al.²⁸ These proportions were then applied to the estimates of community hospital admissions from the NSW APDC. Estimates were calculated separately for respite and permanent RAC (Appendix E: Table 9).

The cost of respite and permanent RAC was estimated using average lengths of stay by gender and care type (Table 2) and average cost per place-day (\$142) from the AIHW publication, *Residential aged care in Australia 2006-07: A statistical overview*.¹⁵ Total costs for each gender group were estimated using these data then the costs were proportionally distributed into age groups based on the total years of potential life remaining for the number of cases in each group. Costs beyond one year were discounted

at five per cent per annum in line with current Australian practice.²⁵

Ambulance transport

The average costs of emergency (\$528) and non-emergency (\$311) ambulance transport, in 2006/07, were supplied by the Ambulance Service of NSW (Unit cost data supplied by Catherine Hutton, Ambulance Service NSW, 21/5/09). These costs were applied to the estimated number of fall-related ambulance trips in NSW in 2006/07. This was calculated by applying the proportion of emergency and non-emergency trips (by gender and five-year age group) for presentations and admissions from the VEMD to the NSW incident estimates for ED presentations and hospital admissions. In addition, all transfers in the NSW APDC were assumed to involve non-emergency ambulance transport between hospitals as were patients transferred to nursing homes. Nursing home residents were also assumed to have arrived and departed the hospital by ambulance.

Non-hospital treatment

The Mathers and Penm study provides the only available population-based health service utilisation and costs of falls injury in Australia.²⁴ It used a prevalence based, top down approach, which allocated total recurrent health expenditures for 1993/94, by sector, using health utilisation data from a variety of sources.

The study provided utilisation estimates and costs, for 1993/94, for the following post-discharge services related to falls injury: hospital outpatient occasions of service, GPs, specialists, prescriptions and allied health consultations.²⁴ The ratio of the cost for each service category to the total fall-related, AR-DRG derived inpatient cost was calculated from this study by age group and gender. These ratios were then multiplied by the inpatient cost of fall-related hospital admissions in NSW in 2006/07, to obtain an estimate of the total cost of each of these health services for each age and gender group.

This method assumes that the relationship between the cost of each of these health services utilised by older persons

Table 2: Average length of stay in residential aged care by care type and gender, NSW, 2006/07.

Gender	Average length of stay (weeks)	
	Permanent	Respite
Male	107.2	3.8
Female	164.4	3.8

Source: Tables 3.10 and 3.11 AIHW. Residential aged care in Australia 2006-07: A statistical overview¹⁵.

who have fallen, and the cost of fall-related hospital admissions has remained constant between 1993/94 and 2006/07 and was the same for NSW as for Australia. This is a strong assumption, but unavoidable given that there is no other population level data available on these costs and data on the changes in costs for each component over time were not available for the entire period.

The cost of outpatient services was distributed proportionally between admissions and ED presentations. Costs for pharmaceuticals, GPs, specialists and allied health professionals were distributed proportionally between admissions, ED presentations and other health professional attendances.

Community nursing and domiciliary services

The cost of community nursing and domiciliary services associated with fall injuries occurring among community dwelling older people was also calculated. Hall and Hendrie²² provide the only published figures for the utilisation of these services for a sample of 79 older persons who sought medical treatment at a hospital ED following a fall. The proportional cost of these services compared to inpatient hospital costs was derived by age group and gender from Hendrie and Hall^{29,30} and then applied to the cost of AR-DRG derived inpatient costs for community fall-related injury in older people in NSW in 2006/07.

Again, the current study assumes that the relationship between the cost of these services, as estimated by Hendrie et al^{29,30} and the cost of fall-related hospital admissions has remained constant between 2001/02 and 2006/07. There is no other available data on the relative change in these cost components over time.

It was also assumed that persons admitted to hospital for treatment, for example hip and other serious fractures, would require a greater proportion of community nursing and domiciliary services than those who attended other services. Consequently, half of these costs were assigned to hospital-admitted patients and the remainder was distributed proportionally between ED presentations and other medically treated injuries.

Results

The results following are presented in three sections. The first presents the estimated number of falls and fall-related injuries among older people in NSW in 2006/07. The second section describes the estimated total costs associated with fall injuries and the third presents the average costs. Detailed tables by age, gender and setting are provided in the Appendices.

Incidence estimates

In 2006/07, the NSW population aged 65 years and older was estimated to be just over 931,000 people.¹⁴ Females accounted for 55 per cent of this figure. While the vast majority of older people lived independently in the community, almost 52,000, or around 5.6 per cent of the older population, resided in aged care facilities (Appendix A: Table 1). While there were 1.2 times as many females as males living in the community, there were 2.6 times as many females as males living in RAC.

It was estimated that over 251,000 older people (27% of the older population) fell at least once (Appendix B: Table 2). Females accounted for 58 per cent of the total number of older persons who fell, due to the higher number of

females in this age group and the fact that they had a slightly higher risk of falling than males (28% vs 25%).

As the majority (94.4%) of the older population live in the community, it is not surprising that most falls occur in this group. It was estimated that just over 225,000 older people (25.6% of the population living in the community) experienced a fall in 2006/07 accounting for 90 per cent of all those who fell (Appendix B: Table 2). Despite representing only 5.6 per cent of the total NSW population, aged 65 years and older, people living in RAC accounted for 10 per cent of all those who fell.

In NSW, in 2006/07, there was an estimated total of over 507,000 falls (an average of two falls per person who fell), among older people, with 83 per cent of these occurring in the community (Appendix B: Table 3). Again, the proportion of falls occurring in RAC (17%) was over-represented relative to the population living in RAC.

Of the total number of falls among older people that occurred in NSW in 2006/07, it was estimated that about 28 per cent (n=143,000) resulted in injuries requiring some form of medical treatment (Table 3). Almost one-third of all medically

Table 3: Estimated number of falls requiring medical treatment by level of treatment, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Place of residence by level of care		Male		Female		Persons	
		Number	Column %	Number	Column %	Number	Column %
Community	Hospital admissions	6,397	12.4	13,408	14.7	19,805	13.9
	ED attendances	4,267	8.3	7,211	7.9	11,478	8.0
	Non-hospital treatments	28,577	55.4	40,579	44.4	69,156	48.4
	Total Community	39,241	76.1	61,198	67.0	100,439	70.3
Residential Aged Care	Hospital admissions	1,401	2.7	4,355	4.8	5,756	4.0
	ED attendances	1,465	2.8	5,523	6.0	6,988	4.9
	Non-hospital treatments	9,451	18.3	20,339	22.2	29,790	20.8
	Total Residential Aged Care	12,317	23.9	30,217	33.1	42,534	29.7
All NSW	Hospital admissions	7,798	15.1	17,763	19.4	25,561	17.9
	ED attendances	5,732	11.1	12,734	13.9	18,466	12.9
	Non-hospital treatments	38,028	73.8	60,918	66.6	98,946	69.2
	TOTAL NSW	51,558	100	91,415	100	142,973	100

Note: Tables throughout the report are subject to small rounding errors.

treated injuries presented to a hospital ED for treatment (n=44,026) and of these, 58 per cent (n=25,561) were admitted. Women accounted for 69 per cent of all falls-related hospital admissions while persons in RAC accounted for 22.5 per cent of all falls hospitalisations among older people.

Appendix C provides detailed tables of all medically treated fall injuries by age, gender and place of residence. Appendix C: Table 4 presents this data for all medically treated fall injuries and Appendix C: Tables 5-7 further disaggregate this information by level of care.

Hospital admission rates increased with age and were higher among people living in RAC than those living in the community (Figure 1). Overall, the rate of hospital admitted falls cases for residents of aged care facilities was 3.3 times the rate of those living in the community. The age-standardised rate of fall-related hospitalisations for persons aged 65 years and older living in RAC was estimated at 7,804 per 100,000 population compared to 2,370 per 100,000 population for persons living in the community.

Among people living in the community, fall-related hospitalisations rates were higher for females than males at all ages and the difference in the rate increased with advancing age. In RAC, the falls hospitalisation rate was also higher among females until the 90-94 year age group when a reversal in the trend occurs (Figure 1). A table of hospitalisation rates by age, gender and place of residence is provided in Appendix D: Table 8.

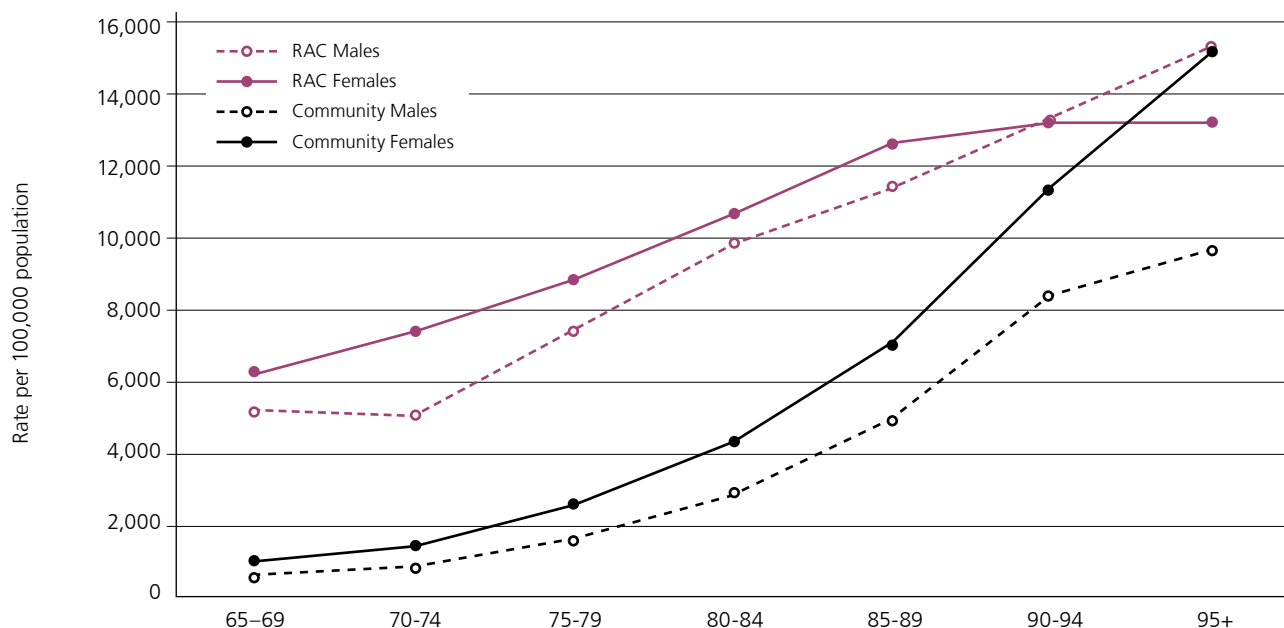
Of those persons admitted to hospital from the community following a fall injury, seven per cent (n=1,473) were estimated to have been transferred directly to RAC. The majority of these (68%; n=997) were permanent admissions (Appendix E: Table 9).

Total health care cost estimates

The estimates provided here represent the total lifetime costs of care associated with fall-related injuries that occurred in 2006/07 among older people in NSW. They are based on the assumption that the treatment and other ancillary costs associated with fall-related injuries occur in the year following injury. The only exception to this was the costing of RAC, which has been projected across the estimated remaining lifetime of community-dwelling patients transferred from hospital to RAC and discounted accordingly.

The total estimated cost of health care associated with medically treated fall injuries in older people in NSW in 2006/07, was estimated at \$558.5 million (Table 4). As the majority of older people live in the community (94%), it is not surprising that the majority of fall-related health care costs (85%) are associated with this group (Figure 2). However, the 15 per cent of costs related to fall injuries among residents of RAC is significant given that this group accounts for only 5.6 per cent of the NSW population aged 65 years and older.

Figure 1: Hospital admission rates per 100,000 population for fall injury by age, gender and residential status, NSW, 2006/07.



Overall, women accounted for 69 per cent of all fall-related health care costs with women living in the community accounting for 58 per cent of the total (Table 4 & Figure 2). Health care costs associated with the 18 per cent of medically treated falls injuries resulting in hospital admission accounted for the majority (84.5%) of total treatment costs (Table 4 & Figure 3).

Table 4: Estimated health care costs of all medically treated fall-related injuries by gender, place of residence and level of care, persons aged 65 years and older, NSW, 2006/07.

Place of residence by level of care		Male		Female		Persons	
		Cost (\$ mil)	Column %	Cost (\$ mil)	Column %	Cost (\$ mil)	Column %
Community	Hospital admissions	124.60	71.8	282.66	73.4	407.26	72.9
	ED attendances	17.58	10.1	18.80	4.9	36.37	6.5
	Non-hospital treatments	8.39	4.8	22.28	5.8	30.67	5.5
	Total Community	150.56	86.8	323.74	84.1	474.30	84.9
Residential Aged Care	Hospital admissions	16.54	9.5	47.90	12.4	64.44	11.6
	ED attendances	4.14	2.4	9.73	2.5	13.87	2.5
	Non-hospital treatments	2.28	1.3	3.56	0.9	5.84	1.0
	Total Residential Aged Care	22.96	13.2	61.19	15.9	84.16	15.1
All NSW	Hospital admissions	141.14	81.3	330.56	85.9	471.70	84.5
	ED attendances	21.72	12.5	28.53	7.4	50.25	9.0
	Non-hospital treatments	10.66	6.1	25.85	6.7	36.51	6.5
	TOTAL NSW	173.52	100	384.93	100	558.46	100

Figure 2: Distribution of health care costs of all medically treated fall-related injuries by gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

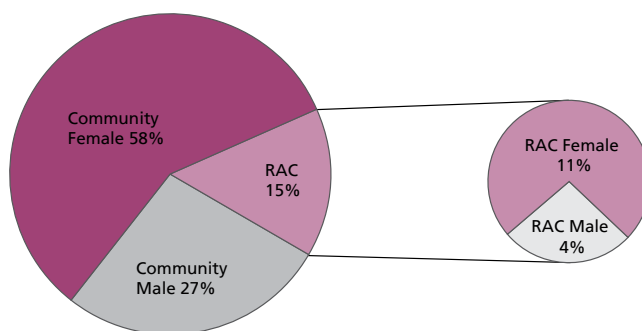
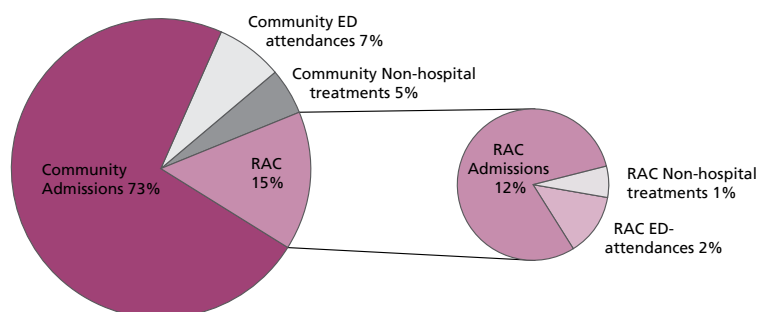


Figure 3: Distribution of health care costs of all medically treated fall-related injuries by level of treatment and place of residence, persons aged 65 years and older, NSW, 2006/07.



Overall, health care costs associated with the treatment of fall-related injuries among older people in NSW peak in the 80-84 year age group as do the costs of these injuries for community dwelling older people. Costs associated with falls injury in older people living in RAC peak in the 85-89 year age group (Figure 4).

The distribution of health care costs associated with fall-related injury by age group and gender is shown in Figure 5. The costs associated with the treatment of fall-related

injuries in females are higher across all age groups. Costs for females peak in the 85-89 year age group and for males in the 80-84 year age group.

Appendix F provides detailed tables of the total health care costs of fall injuries among older people in NSW by age, gender and level of care. Appendix F: Table 10 presents the costs for all NSW and Appendix F: Tables 11 and 12 further disaggregate this information by place of residence.

Figure 4: Distribution of health care costs by place of residence and age group, fall-related injuries to people aged 65 years and older, NSW, 2006/07.

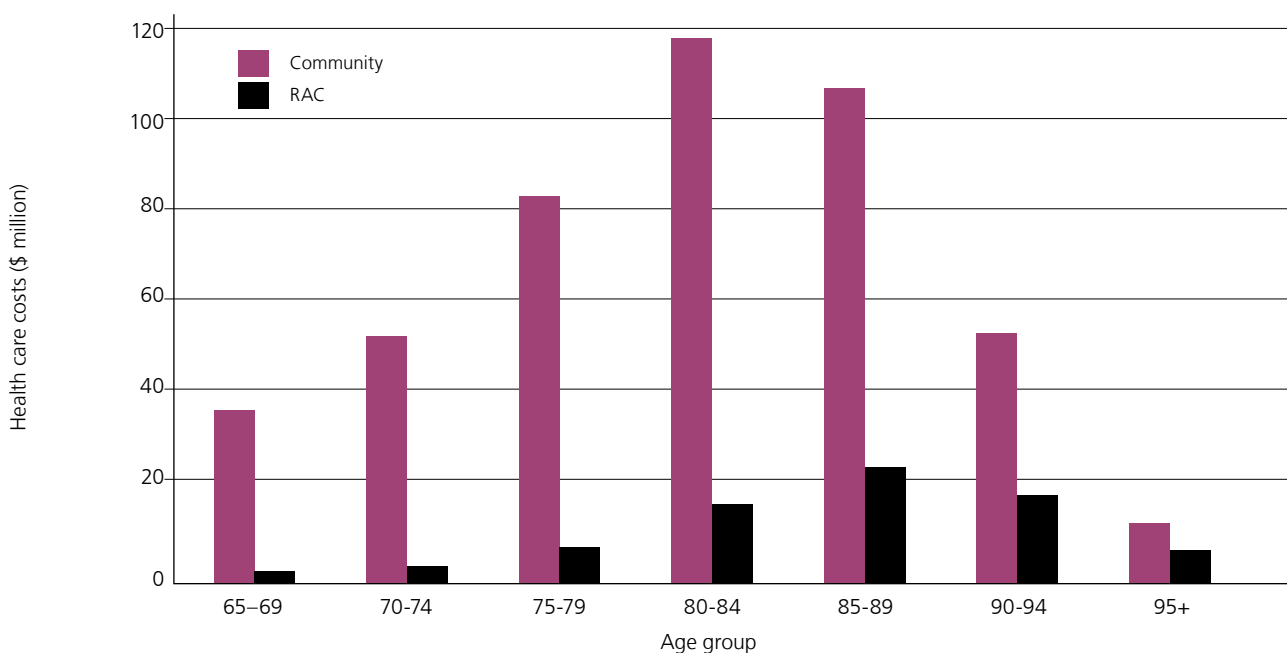


Figure 5: Distribution of health care costs for fall-related injuries by gender and age group, people aged 65 years and older, NSW, 2006/07.

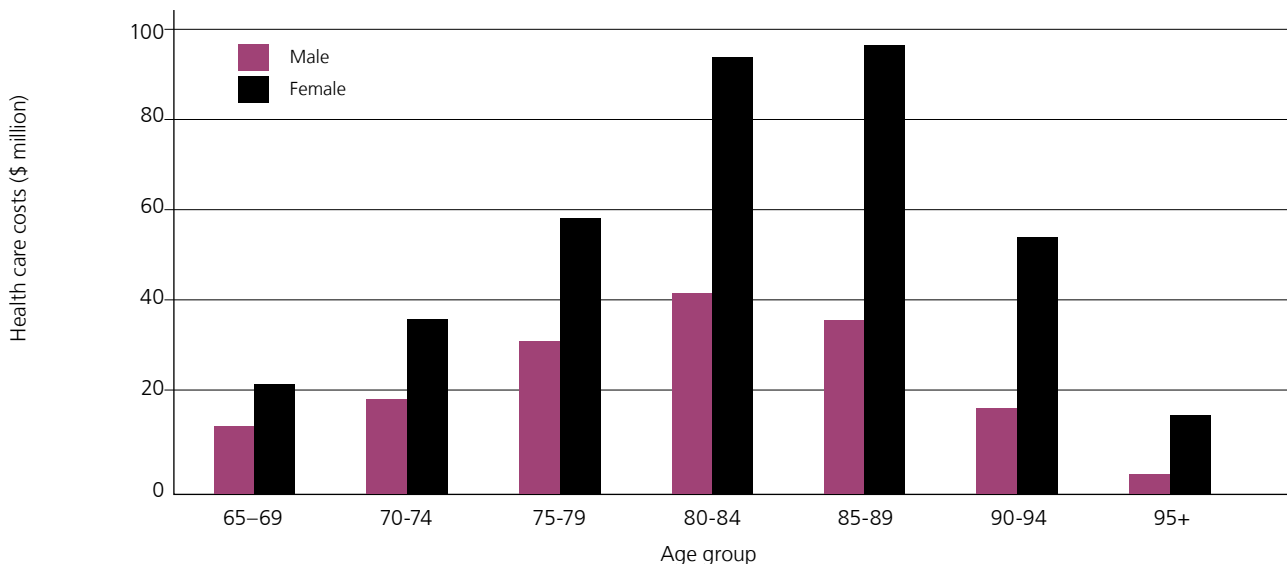


Figure 6 shows the distribution of total health care costs associated with fall-related injuries by cost component. Hospital sector costs (inpatient, outpatient and ED costs) accounted for the majority of these costs (58%) with the cost of inpatient services dominating (47%). The cost of RAC was also significant (23%), followed by medical treatments (GP and specialist) (6%) and ambulance transport (4%).

Table 5 presents the total health care cost of fall injuries among older people by cost component and gender. Hospital sector costs for women accounted for 38.5 per cent (\$215.10 million) of all costs associated with the treatment of fall-related injuries among older people, with inpatient costs for women dominating (33% of total costs or \$183.44 million).

Figure 6: Percentage of total health care costs by component, medically treated fall-related injuries to people aged 65 years and older, NSW, 2006/07.

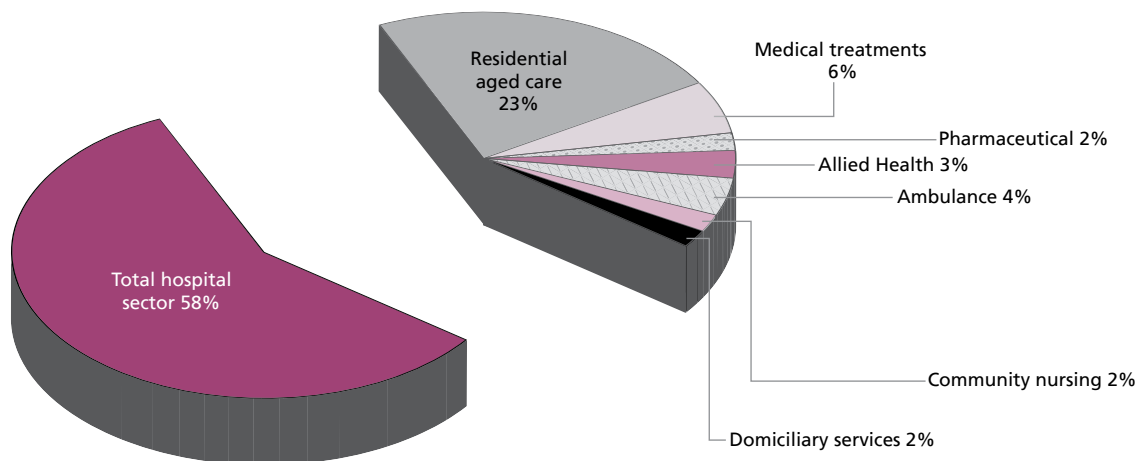


Table 5: Estimated health care costs of all medically treated fall-related injuries by gender and cost component, persons aged 65 years and older, NSW, 2006/07.

Cost component	Male		Female		Persons	
	Cost (\$mil)	Column %	Cost (\$mil)	Column %	Cost (\$mil)	Column %
Hospital inpatient	79.24	45.7	183.44	47.7	262.68	47.0
ED & outpatient	29.24	16.9	31.66	8.2	60.90	10.9
Total hospital sector	108.48	62.5	215.10	55.9	323.58	57.9
Residential aged care	28.52	16.4	99.38	25.8	127.90	22.9
Medical treatments	10.19	5.9	23.97	6.2	34.16	6.1
Pharmaceuticals	3.12	1.8	6.07	1.6	9.19	1.6
Allied Health	9.78	5.6	9.28	2.4	19.06	3.4
Ambulance	6.27	3.6	15.77	4.1	22.04	3.9
Community nursing	2.90	1.7	6.22	1.6	9.12	1.6
Domiciliary services	4.27	2.5	9.16	2.4	13.43	2.4
TOTAL	173.53	100	384.93	100	558.46	100

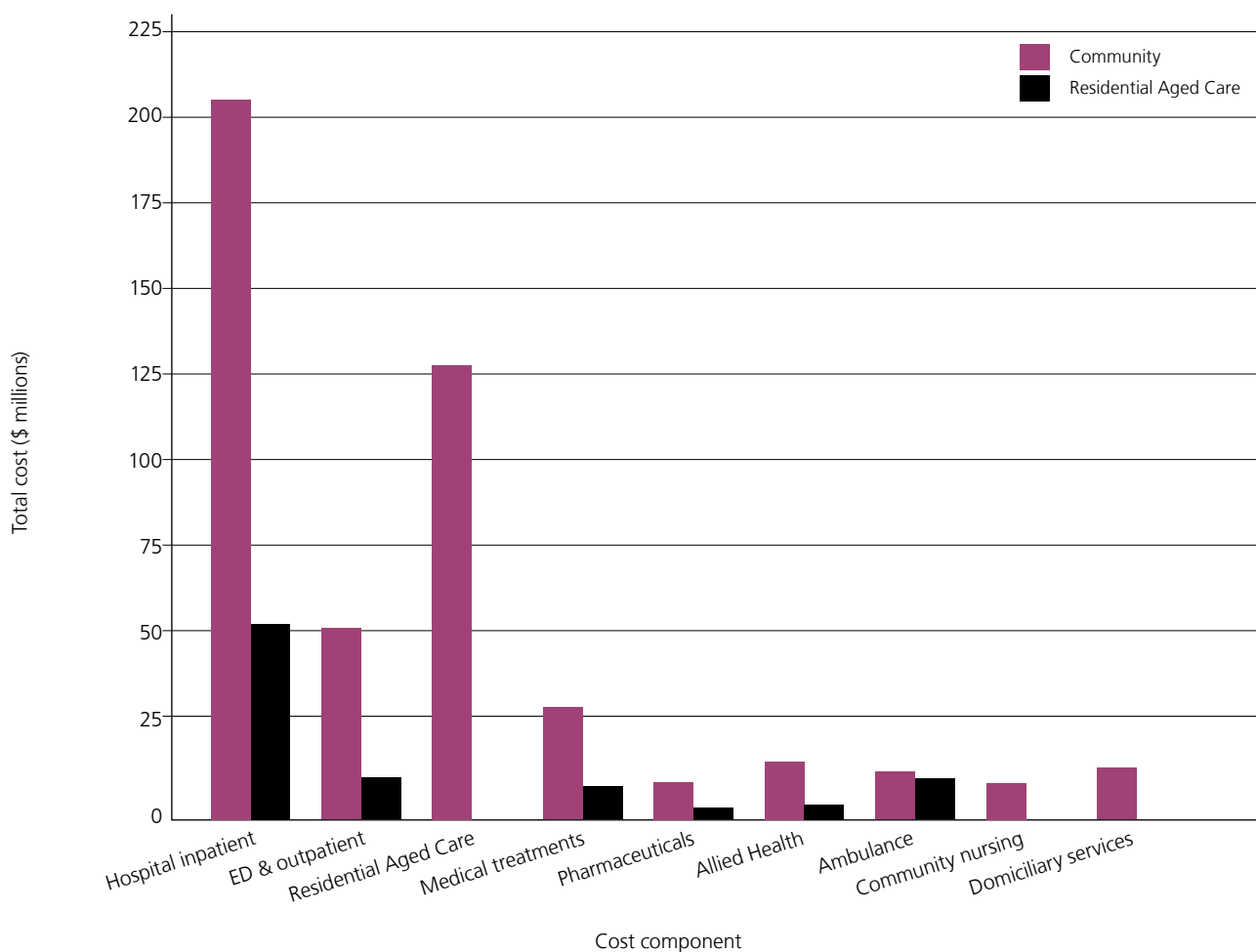
Table 6 and Figure 7 present the total health care costs by cost component and place of residence. Hospital sector costs associated with older people living in the community account for the largest proportion of the total cost (47% of total costs or \$259.98 million) with inpatient costs accounting

for 37 per cent (\$208.14 million) of the total. It should be noted, however, that persons in RAC account for 21 per cent of all inpatient costs despite representing only 5.6 per cent of the population.

Table 6: Estimated health care costs of fall-related injuries by residential status and cost component, people aged 65 years and older, NSW, 2006/07.

Cost component	Community		RAC		NSW	
	Cost (\$mil)	Column %	Cost (\$mil)	Column %	Cost (\$mil)	Column %
Hospital inpatient	208.14	43.9	54.54	64.8	262.68	47.0
ED & outpatient	51.84	10.9	9.05	10.8	60.90	10.9
Total hospital sector	259.98	54.8	63.59	75.6	323.58	57.9
Residential aged care	127.90	27.0	-	-	127.90	22.9
Medical treatments	28.11	5.9	6.05	7.2	34.16	6.1
Pharmaceuticals	7.68	1.6	1.50	1.8	9.19	1.6
Allied Health	15.97	3.4	3.09	3.7	19.06	3.4
Ambulance	12.12	2.6	9.92	11.8	22.04	3.9
Community nursing	9.12	1.9	-	-	9.12	1.6
Domiciliary services	13.42	2.8	-	-	13.43	2.4
TOTAL	474.30	100	84.15	100	558.46	100

Figure 7: Distribution of falls-related treatment costs by component and residential status, people aged 65 years and older, NSW, 2006/07.



Average health care cost estimates

Average health care costs of medically treated, fall-related injuries by gender, place of residence and level of treatment are presented in Table 7. Appendix G provides detailed tables of the average health care costs of fall injuries among older people in NSW by age, gender and level of care. Appendix G: Table 13 presents the costs for all NSW and Appendix G: Tables 14 and 15 further disaggregate this information by place of residence.

The average treatment cost for fall-related injuries, among older people in NSW, was \$3,906 per fall injury treated (Table 7). The average cost of fall-related health care was 25 per cent higher for females than males (\$4,211 vs \$3,366).

Hospital admissions accounted for the highest average cost at \$18,454 followed by cases treated in the ED (\$2,721) and then non-hospital treatments (\$369).

The average cost of fall-related care was higher for community-dwelling older people than those in RAC (\$4,722 vs \$1,979) mainly due to the large difference in costs associated with hospital admitted cases (\$20,563 vs \$11,196). This was due to the fact that the costs of RAC and home services are not applicable to the latter group since they are already in care.

The difference between the two groups is less pronounced when hospital inpatient costs are considered separately. The average cost of inpatient care for a person living in the community was \$10,509 compared to \$9,476 for a person in RAC. The distribution of these costs by age group and place of residence is shown in Figure 8. Generally speaking, average inpatient costs for community-dwelling older people tend to increase with age whereas those for people in RAC appear to trend down slightly with increasing age.

Table 7: Estimated average health care costs of medically treated fall-related injuries by gender, place of residence and level of care, persons aged 65 years and older, NSW, 2006/07.

Place of residence by level of care		Average cost (\$)		
		Male	Female	Persons
Community	Hospital admissions	19,478	21,081	20,563
	ED attendances	4,119	2,607	3,169
	Non-hospital treatments	327	549	462
	Total Community	4,147	5,290	4,722
Residential Aged Care	Hospital admissions	11,808	10,999	11,196
	ED attendances	2,826	1,762	1,985
	Non-hospital treatments	241	175	196
	Total Residential Aged Care	1,864	2,025	1,979
All NSW	Hospital admissions	18,100	18,609	18,454
	ED attendances	3,789	2,241	2,721
	Non-hospital treatments	280	424	369
	TOTAL NSW	3,336	4,211	3,906

The distribution of average health care costs by level of care and age group is shown in Figure 9. Average total health care costs increase with age to the 90-94 year age group then drop in the 95+ age group. The distribution of average total costs follows a similar distribution to the average admission costs which are driving the overall distribution.

The average costs associated with non-hospital treatment appear fairly stable across age groups while costs associated with cases presenting to EDs initially increase to age 70-74 years and then decline with age. This may reflect a greater propensity to admit persons as they get older, for injuries which may have been treated in the ED in a younger person.

Figure 8: Distribution of average inpatient care costs for fall-related hospital admissions by age group and place of residence, persons aged 65 years and older, NSW, 2006/07.

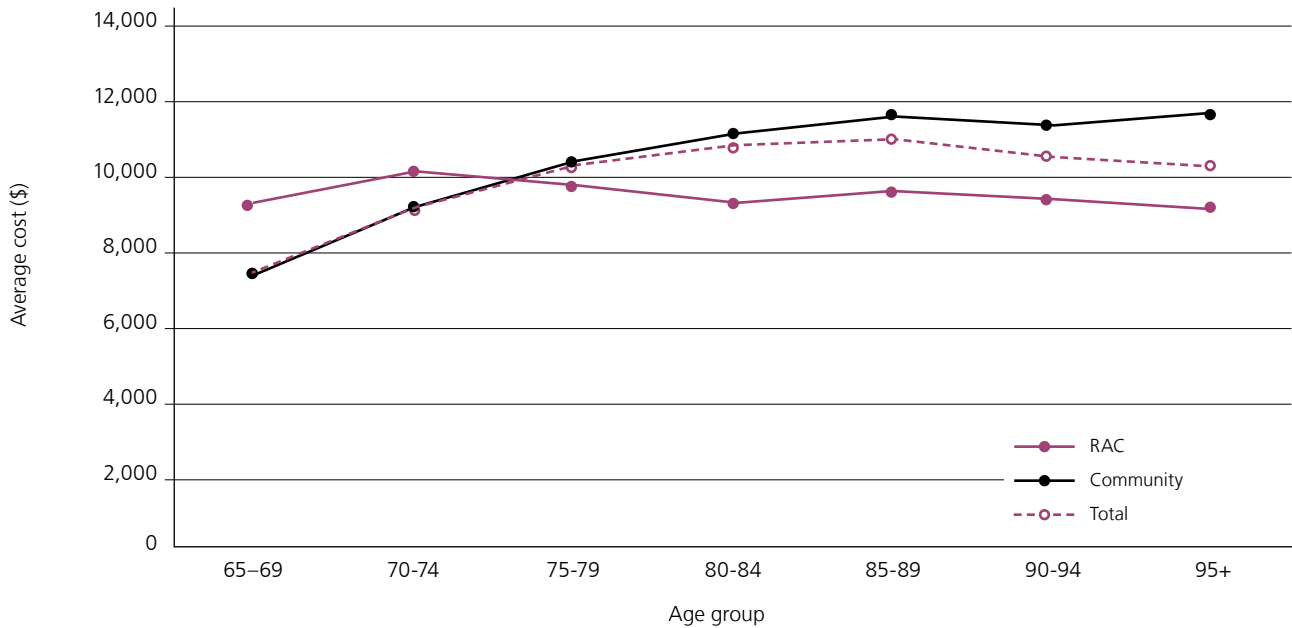
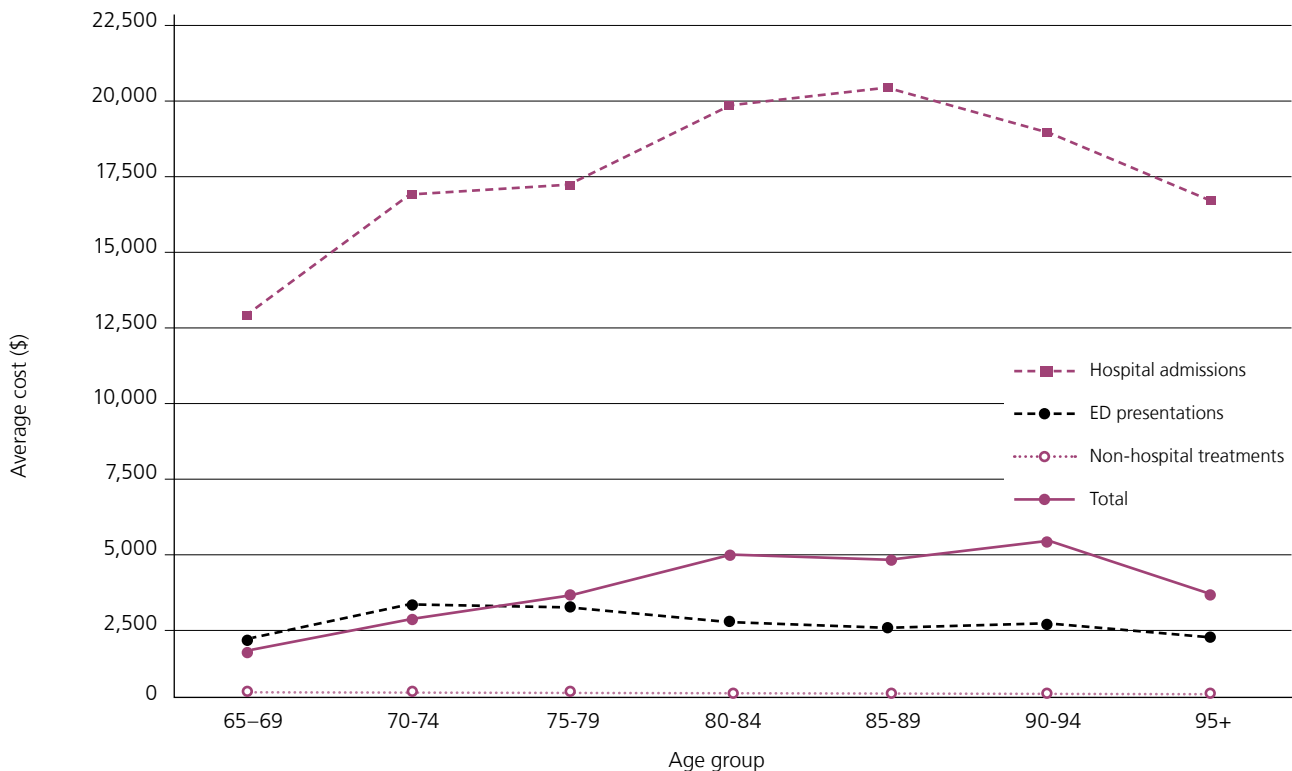


Figure 9: Distribution of average health care costs for medically treated fall-related injuries by age group and level of care, persons aged 65 years and older, NSW, 2006/07.



SECTION 4

Discussion

This study demonstrates the significant cost of fall-related injury to the NSW health system in particular, and to the community more generally. The total lifetime cost of treatment and care for fall-related injury in NSW in 2006/07 was estimated at \$558.5 million. However, the total burden of falls injury is likely to be significantly higher because this estimate does not include the intangible and indirect costs of fall injuries among older people.

Although these costs are not all borne by NSW Health, the estimated cost of treating falls among older people in NSW in 2006/07, was equivalent to almost five per cent of the NSW health budget in that year.³¹

Total health care costs for women, who made up 55 per cent of the older adult population, were 2.2 times higher than for men overall and 2.4 times higher for hospital admitted cases.

Not surprisingly, the vast majority of this cost is associated with falls in the community where the majority of older people live. However, nursing home residents are significantly over-represented in ED attendances and hospital admissions (23% of admissions for only 5.6% of the population aged 65 years and older) and consequently, contribute disproportionately to the total health care costs of fall-related injury.

Strengths

The strength of this study lies in its comprehensive nature. It is the first study of its kind in NSW to include the majority of cost components associated with the medical treatment and care associated with fall-related injuries. The inclusion of the costs associated with RAC alone has had a significant impact on the overall cost estimate. It is also the first study to disaggregate the costs of fall-related injuries between those occurring in the community and those in RAC. Other fall injury costing studies in the United States,^{12,32} the United Kingdom¹¹ and Australia^{1,29} did not report separately on the cost of fall injuries in RAC.

While there are limitations around some of the estimates, as described below, the majority of total health care costs are based on reliable incidence estimates and unit cost data.

Limitations

Incidence

It has been necessary to draw on several data sources to estimate the incidence of fall-related injury treated in NSW. It is assumed that the estimates of hospital admissions derived from the NSW APDC are reliable given that the NSW APDC provides the basis for case-mix funding of hospitals. However, the extent to which the external cause and injury diagnoses are correctly coded is not known.

The large proportion of 'unspecified' location of occurrence codes means that there will be some error in separating the hospitalisation data into falls in the community and falls in RAC. Where the location of the fall was not specified, the case was designated a community fall and therefore hospitalised falls among community-dwelling older people may have been over-estimated at the expense of those in RAC.

While readmissions within 28 days are flagged in the NSW APDC, research suggests that some hospitals/coders may be assigning this variable even when a previous admission is related to other injuries or health conditions¹⁹. Consequently, these records were included in the enumeration of incident cases and, as discussed in the Methods, may result in a slight over-estimation of the number of fall injury incidents that lead to hospitalisation. The introduction of a unique patient identifier and the date of injury in the hospital discharge dataset would facilitate the identification of incident cases of fall-related hospitalisations¹⁹.

The use of proportions from Victorian hospital data to estimate the number of ED attendances is not ideal as the relationship between the distribution of services in the two states is unknown. The accuracy of these estimates will be affected by several factors including differences in accessibility and in admission policies between the two states. However, in the absence of reliable NSW data for identifying falls in

ED presentations, the use of Victorian data represents the best approach currently available.

The data from the 2009 Falls Prevention Survey may also 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 al³³ 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.³⁴

Health care costs

As noted in the previous section, due to deficiencies in the coding of the 'place of occurrence' variable in the hospitalisation data, and the decision to assign all cases missing this variable to the community group, it is likely that falls in the community, resulting in hospitalisation, have been over-enumerated and those in RAC under-enumerated. While this does not impact on the overall costs, it will result in an overestimation of community health care costs and an underestimation of the costs of falls in RAC.

The majority of treatment costs (75%) were calculated on the basis of estimated health care utilisation of inpatient, ED, ambulance and RAC services. The estimate of the cost of RAC for community dwelling older people who are transferred to RAC following a fall injury may be an overestimate as the only data available on average length of stay in RAC relates to all admissions irrespective of the reason for entry into care. On the other hand, the estimated number of people moving to RAC following a fall-related admission may be under-enumerated. This estimate does not take into account those who may have returned home, and may not have recovered sufficiently to remain at home, or those who may have gone into care following an injurious fall that did not result in hospital admission.

Due to the lack of reliable health utilisation data following a fall, the remaining 25 per cent was estimated using ratios derived from Mathers & Penm²⁴ and Hendrie et al^{29,30} under the assumption that the ratios of inpatient to other costs have not changed since these studies were undertaken. While this is unlikely and therefore far from ideal, there is no other information currently available that would provide reliable estimates at the population level for these components.

Comparison with previous studies

This study attempted to establish the most comprehensive estimate of the population burden of fall-related injury among older people in NSW to date. Consequently, the results presented here are not directly comparable with other falls injury costing studies undertaken in Australia, or even in NSW, due to the types of costs considered and the various methods used to estimate them. However, an attempt at validating the results of this study is made by comparing estimates of the common cost components with two previous NSW studies.

The estimates provided here represent a significant increase over those from the only other population level study conducted to estimate the lifetime cost of falls in NSW. The Potter-Forbes and Aisbett study¹ established estimates of the lifetime cost of falls injuries, occurring in 1998/99, in the context of an all-age, all-injury costing study. The total cost of health care, associated with falls in persons aged 65 years and older, in that study, was estimated at \$224.7 million in contrast to the \$558.5 million estimated in the current study for 2006/07. There are several explanations for the contrasting cost estimates. The previous study did not include:

- all episodes of care but only the index admission in their inpatient costing (in the current study the index admission only accounted for 61% of all episodes of care)
- the significant cost of RAC (23% of total health care costs in the current study)
- outpatient costs, community nursing or domiciliary services or the costs associated with people who did not attend the hospital system for treatment (that is, attended GPs or other health professionals)

The effect of inflation over the period from 1998/99 to 2006/07 also adds significantly to the original estimates. Applying a deflator of 0.7587 (Table F1, AIHW, 2008)³⁵ to the common cost components in the current study (Inpatient, ED, Ambulance, Medical, Allied Health and Pharmaceuticals) to convert these estimates to 1998/99 prices, produces a total of \$268.7 million compared to the previous study's \$224.7 million estimate for this age group. The most significant discrepancy between this study and the Potter-Forbes and Aisbett study surrounds the calculation of the inpatient care costs. As noted earlier, transfers and follow-up episodes of care, associated with fall-related injury, were not included in their costing.

In 2008 Tiedemann et al published the results of a study which determined the cost of fall-related health care in a cohort of community-dwelling people in NSW.²³ In this study, people aged 75 years and over were randomly drawn from a private health insurance database and invited to participate in a randomised controlled falls intervention trial. As part of this trial, the 578 participants were monitored for falls and related health-care costs for one year. Although the numbers of people hospitalised (n=13) and attending the ED (n=13) for treatment were relatively small, a total of 122 people sought medical treatment for a fall-related injury. The study included the same comprehensive range of cost components covered in the current study although there was no usage of RAC in this cohort. It should be noted that the selection criteria for this study required the selection of high risk fallers and therefore the study cohort is not representative, in terms of both the age and falls risk of the general population, aged 65 years and over, which is the subject of the current study.

Despite these differences, it is possible to make a comparison between the two studies by applying the average costs (using 2006 dollars) for each level of treatment (admissions, ED and other health care) derived from the Tiedemann study to the number of community cases estimated in the current study for 2006/07. The overall cost of treatment for this group, using these average costs, totalled \$366.2 million compared to a total of \$346.4 million (excluding RAC) in the current study, a difference of 5.7 per cent.

Recommendations

Several recommendations have emerged from this study regarding fall injury prevention, data issues and further research.

Falls prevention

It is clear that, in terms of economic cost alone, falls injury is responsible for a significant burden to the NSW community equivalent to five per cent of the NSW health budget. In order to reduce the impact of fall-related injury among older people, significant investment is required to promote evidence-based falls prevention programs at the local level across the state.

Although the majority of fall injuries occur among older people living in the community and falls in this setting account for the majority of the costs, residents of aged care facilities are significantly over-represented in the hospital data and also account for an excess proportion of the total cost. Consequently, urgent efforts should also be addressed to prevent falls in this setting.

Data from this study should be used in cost-effectiveness studies on falls interventions, at the population level, to inform NSW falls prevention policy and the prioritisation of evidence-based prevention programs within the community.

Data issues

The introduction of a unique patient identifier and the date of injury in the hospital discharge dataset would facilitate the identification of incident cases of fall-related hospitalisations in the NSW APDC.

Standardisation of the NSW ED data collections across Area Health Services in terms of the coding of injury causes and diagnoses is essential to facilitate the quantification of the number of falls resulting in ED attendance and the associated costs.

The linkage of health data both within and between collections would also facilitate a more precise enumeration of fall-related cases and the utilisation of health services and provide a clearer picture of the patient journey across services. In addition to enhancing the level of detail available on individual cases, linkage of data also provides a significant quality control function.

Further research

It should be noted that the cost of falls occurring within the hospital setting is not included in this study. The costing of falls in this setting involves a different set of challenges. The excess costs relating to the fall injury, above those associated with the reason for hospital admission must be calculated. To date, this has not been attempted in Australia, yet falls are the most common adverse event experienced during inpatient care. It is therefore recommended that research be undertaken to establish the impact of these events within the hospital system in terms of additional resources consumed.

Rehabilitation can assist individuals to recover mobility following a fall. However, population level rehabilitation outcomes have not been reported for fallers because of the difficulty associated with identifying them in the data. Linking data from the Australian National Sub-Acute and Non-Acute Patient data collection, the NSW ED Data Collection and the NSW APDC will assist the identification of persons receiving rehabilitation services as the result of a fall and facilitate a more complete costing of the health services utilised following a fall.

Significance

This report demonstrates the extremely high economic cost of falls in older people and underscores the significant need for cost-effective prevention of injury associated with falls in this population.

Despite its limitations, the study provides the most comprehensive population-level estimate of the economic cost of falls among older people in NSW and is the first to attempt to disaggregate these costs between the community and RAC. It highlights the significant over-representation of residents of aged care facilities in the data and their disproportionate contribution to the health care costs associated with the treatment of fall injuries.

The real benefit of costing fall-related injury is to assist policy makers and practitioners to select the best value countermeasures from the growing array of proven falls prevention interventions. This study provides data to inform the cost-effective analyses of falls prevention interventions in this area. Preliminary data from this study has already been used in work undertaken by the Centre for Health Economic Research and Evaluation at the University of Technology Sydney which modelled the impact, costs and benefits of evidence-based falls prevention measures at the population level in NSW.³⁶

Research has identified a number of effective interventions that can significantly decrease the incidence of falls and fall-related injuries. However, the implementation of fall injury prevention programs remains too limited to impact at the population level. Further efforts are necessary in NSW to promote these programs and to support uptake at the local level.

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Appendix A: Population estimates

Appendix Table 1: Estimated resident population by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Community	RAC	NSW
Persons	65-69	263,487	1,683	265,170
	70-74	214,956	2,973	217,929
	75-79	184,120	6,586	190,706
	80-84	130,639	11,744	142,383
	85-89	62,767	14,377	77,144
	90-94	19,851	10,369	30,220
	95+	3,760	4,022	7,782
Total persons 65+		879,578	51,754	931,332
Males	65-69	129,440	868	130,308
	70-74	102,949	1,421	104,370
	75-79	84,237	2,470	86,707
	80-84	54,706	3,581	58,287
	85-89	23,770	3,496	27,266
	90-94	6,487	1,957	8,444
	95+	1,075	571	1,646
Total males 65+		402,663	14,364	417,027
Females	65-69	134,047	815	134,862
	70-74	112,007	1,552	113,559
	75-79	99,883	4,116	103,999
	80-84	75,934	8,163	84,097
	85-89	38,997	10,881	49,878
	90-94	13,364	8,412	21,776
	95+	2,685	3,451	6,136
Total females 65+		476,915	37,390	514,305

Sources:

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Appendix B: Falls estimates

Appendix Table 2: Estimated number of persons who fell, by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Community	RAC	NSW
Persons	65-69	56,421	1,165	57,586
	70-74	52,491	2,063	54,554
	75-79	49,358	3,378	52,736
	80-84	37,054	6,049	43,103
	85-89	21,197	6,793	27,990
	90-94	6,866	4,915	11,781
	95+	2,188	1,515	3,703
Persons 65+		225,575	25,877	251,453
Males	65-69	27,891	583	28,474
	70-74	23,220	954	24,174
	75-79	21,860	1,218	23,078
	80-84	14,345	1,766	16,111
	85-89	7,724	1,575	9,299
	90-94	2,240	882	3,122
	95+	625	204	829
Males 65+		97,906	7,182	105,088
Females	65-69	28,530	582	29,112
	70-74	29,272	1,109	30,381
	75-79	27,499	2,160	29,659
	80-84	22,709	4,283	26,992
	85-89	13,472	5,217	18,689
	90-94	4,625	4,033	8,658
	95+	1,562	1,311	2,873
Females 65+		127,670	18,695	146,365

Appendix Table 3: Estimated number of falls by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Community	RAC	NSW
Persons	65-69	99,774	4,016	103,790
	70-74	91,035	7,094	98,129
	75-79	91,191	11,544	102,735
	80-84	66,149	20,586	86,735
	85-89	48,277	23,028	71,305
	90-94	17,303	16,609	33,912
	95+	5,496	5,105	10,601
Persons 65+		419,225	87,982	507,207
Males	65-69	47,998	2,071	50,069
	70-74	47,101	3,391	50,492
	75-79	40,923	4,330	45,253
	80-84	28,772	6,277	35,049
	85-89	22,098	5,600	27,698
	90-94	4,164	3,135	7,299
	95+	1,571	725	2,296
Males 65+		192,627	25,528	218,156
Females	65-69	51,776	1,945	53,721
	70-74	43,934	3,703	47,637
	75-79	50,268	7,215	57,483
	80-84	37,377	14,309	51,686
	85-89	26,179	17,429	43,608
	90-94	13,138	13,474	26,612
	95+	3,924	4,380	8,304
Females 65+		226,596	62,454	289,051

Appendix C: Estimates of falls requiring medical treatment

Appendix Table 4: Total estimated number of falls resulting in medical treatment (admissions, Emergency Department attendances and non-hospital treatment) by age group, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Community	RAC	NSW
Persons	65-69	19,147	1,955	21,102
	70-74	17,435	3,455	20,890
	75-79	20,627	5,517	26,144
	80-84	17,418	9,850	27,268
	85-89	17,019	10,877	27,896
	90-94	5,999	7,851	13,850
	95+	2,794	3,029	5,823
Persons 65+		100,439	42,534	142,973
Males	65-69	8,215	1,009	9,224
	70-74	6,783	1,652	8,435
	75-79	7,992	2,072	10,064
	80-84	7,311	3,011	10,322
	85-89	6,181	2,658	8,839
	90-94	2,006	1,485	3,491
	95+	753	430	1,183
Males 65+		39,241	12,317	51,558
Females	65-69	10,932	946	11,878
	70-74	10,652	1,803	12,455
	75-79	12,635	3,445	16,080
	80-84	10,107	6,839	16,946
	85-89	10,838	8,219	19,057
	90-94	3,993	6,366	10,359
	95+	2,041	2,599	4,640
Females 65+		61,198	30,217	91,415

Appendix Table 5: Estimated number of falls resulting in hospital admission by age, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Community	RAC	NSW
Persons	65-69	2,136	96	2,232
	70-74	2,477	187	2,664
	75-79	3,829	545	4,374
	80-84	4,868	1,228	6,096
	85-89	3,921	1,780	5,701
	90-94	2,063	1,374	3,437
	95+	511	546	1,057
Persons 65+		19,805	5,756	25,561
Males	65-69	829	45	874
	70-74	897	72	969
	75-79	1,290	181	1,471
	80-84	1,565	357	1,922
	85-89	1,165	399	1,564
	90-94	547	260	807
	95+	104	87	191
Males 65+		6,397	1,401	7,798
Females	65-69	1,307	51	1,358
	70-74	1,580	115	1,695
	75-79	2,539	364	2,903
	80-84	3,303	871	4,174
	85-89	2,756	1,381	4,137
	90-94	1,516	1,114	2,630
	95+	407	459	866
Females 65+		13,408	4,355	17,763

Source: NSW Admitted Patients Dataset.

Appendix Table 6: Estimated number of falls resulting in Emergency Department attendance by age, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Community	RAC	NSW
Persons	65-69	2,571	72	2,644
	70-74	2,081	215	2,297
	75-79	2,421	616	3,036
	80-84	2,079	1,502	3,582
	85-89	1,360	2,100	3,460
	90-94	736	1,703	2,439
	95+	230	778	1,008
Persons 65+		11,478	6,987	18,465
Males	65-69	916	23	939
	70-74	803	66	869
	75-79	906	185	1,091
	80-84	807	391	1,198
	85-89	528	403	931
	90-94	245	317	562
	95+	62	80	143
Males 65+		4,268	1,465	5,732
Females	65-69	1,655	49	1,704
	70-74	1,278	150	1,428
	75-79	1,515	431	1,945
	80-84	1,273	1,111	2,384
	85-89	832	1,697	2,529
	90-94	490	1,387	1,877
	95+	168	698	865
Females 65+		7,211	5,522	12,733

Appendix Table 7: Estimated number of falls resulting in non-hospital treatment by a health professional by age, gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Community	RAC	NSW
Persons	65-69	14,440	1,787	16,227
	70-74	12,877	3,052	15,929
	75-79	14,377	4,356	18,733
	80-84	10,470	7,121	17,591
	85-89	11,739	6,997	18,736
	90-94	3,202	4,773	7,975
	95+	2,053	1,705	3,758
Persons 65+		69,158	29,790	98,949
Males	65-69	6,470	941	7,411
	70-74	5,083	1,514	6,597
	75-79	5,796	1,706	7,502
	80-84	4,939	2,263	7,202
	85-89	4,488	1,856	6,344
	90-94	1,214	908	2,122
	95+	587	263	850
Males 65+		28,577	9,451	38,028
Females	65-69	7,970	846	8,816
	70-74	7,794	1,538	9,332
	75-79	8,581	2,650	11,231
	80-84	5,531	4,857	10,388
	85-89	7,250	5,141	12,391
	90-94	1,987	3,865	5,852
	95+	1,466	1,442	2,908
Females 65+		40,579	20,339	60,918

Appendix D: Hospitalisation rates

Appendix Table 8: Age-specific fall-related hospitalisation rates by five-year group, gender and place of residence and age-standardised hospitalisation rates for persons aged 65 years and older by gender and place of residence, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Rate per 100,000 population		
		Community residents	NSW RAC residents	Total
Persons age-specific	65-69	811	5,704	842
	70-74	1,152	6,290	1,222
	75-79	2,080	8,275	2,294
	80-84	3,726	10,456	4,281
	85-89	6,247	12,381	7,390
	90-94	10,392	13,251	11,373
Persons 65+ age-standardised		2,370	7,804	2,620
Males age-specific	65-69	640	5,184	671
	70-74	871	5,067	928
	75-79	1,531	7,328	1,697
	80-84	2,861	9,969	3,298
	85-89	4,901	11,413	5,736
	90-94	8,432	13,286	9,557
	95+	9,679	15,236	11,607
Males 65+ age-standardised		1,579	6,719	1,768
Females age-specific	65-69	975	6,258	1,007
	70-74	1,411	7,410	1,493
	75-79	2,542	8,844	2,791
	80-84	4,350	10,670	4,963
	85-89	7,067	12,692	8,294
	90-94	11,344	13,243	12,078
	95+	15,158	13,300	14,113
Females 65+ age-standardised		2,991	8,656	3,289

Source: NSW Admitted Patients Dataset

Appendix E: Transfers to residential aged care

Appendix Table 9: Estimated number of discharges to residential aged care following a fall-related hospital admission, people aged 65 years and older living in the community, NSW, 2006/07.

Gender	Age group	To permanent RAC	To respite RAC	Total transferred to RAC
Persons	65-69	16	9	25
	70-74	36	24	60
	75-79	105	76	181
	80-84	246	137	383
	85-89	317	126	443
	90-94	214	85	299
	95+	61	21	82
Persons 65+		997	479	1,473
Males	65-69	7	4	11
	70-74	13	10	23
	75-79	47	21	68
	80-84	71	33	104
	85-89	86	29	115
	90-94	53	24	77
	95+	11	3	14
Males 65+		287	124	412
Females	65-69	10	6	16
	70-74	23	15	38
	75-79	58	56	114
	80-84	175	104	279
	85-89	231	97	328
	90-94	161	61	222
	95+	50	18	68
Females 65+		709	355	1,065

Source: Proportions derived from Karmel et al²⁸ and applied to NSW APDC data.

Appendix F: Health care costs

Appendix Table 10: Total estimated costs of health care for fall-related injury by age, gender and level of care, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Total cost (\$)			
		Admissions	ED Presentations	Non-hospital treatments	Total
Persons	65-69	28,839,011	5,654,517	4,877,057	39,370,585
	70-74	45,305,330	7,573,871	5,640,851	58,520,052
	75-79	75,714,088	9,714,529	7,427,648	92,856,265
	80-84	121,637,876	9,689,281	6,634,497	137,961,654
	85-89	117,194,079	8,735,074	8,150,828	134,079,981
	90-94	65,210,016	6,487,699	2,708,630	74,406,345
	95+	17,799,913	2,390,473	1,071,424	21,261,810
Persons 65+		471,700,313	50,245,444	36,510,935	558,456,692
Males	65-69	11,475,971	3,327,344	720,535	15,523,850
	70-74	16,346,538	2,948,000	1,380,638	20,675,176
	75-79	27,323,962	4,120,090	1,686,734	33,130,786
	80-84	36,839,806	4,902,805	1,909,780	43,652,391
	85-89	30,523,243	3,515,612	3,520,592	37,559,447
	90-94	15,351,462	2,390,128	1,061,975	18,803,565
	95+	3,282,016	512,946	383,373	4,178,335
Males 65+		141,142,998	21,716,925	10,663,627	173,523,550
Females	65-69	17,363,040	2,327,173	4,156,522	23,846,735
	70-74	28,958,792	4,625,871	4,260,213	37,844,876
	75-79	48,390,126	5,594,439	5,740,914	59,725,479
	80-84	84,798,070	4,786,476	4,724,717	94,309,263
	85-89	86,670,836	5,219,462	4,630,236	96,520,534
	90-94	49,858,554	4,097,571	1,646,655	55,602,780
	95+	14,517,897	1,877,527	688,051	17,083,475
Females 65+		330,557,315	28,528,519	25,847,308	384,933,142

Appendix Table 11: Total estimated costs of health care for fall-related injury by age, gender and level of care for persons living in the community, aged 65 years and older, NSW, 2006/07.

Gender	Age group	Total cost (\$)			
		Admissions	ED Presentations	Non-hospital treatments	Total
Persons	65-69	27,549,604	5,331,959	4,587,349	37,468,912
	70-74	42,691,622	6,680,192	5,102,327	54,474,141
	75-79	69,409,842	8,463,105	6,838,079	84,711,026
	80-84	108,127,373	6,823,419	5,474,161	120,424,953
	85-89	97,218,005	4,742,549	6,497,873	108,458,427
	90-94	50,220,375	3,308,388	1,526,217	55,054,980
	95+	12,040,140	1,024,591	644,347	13,709,078
Persons 65+		407,256,961	36,374,203	30,670,353	474,301,517
Males	65-69	10,928,775	3,224,754	612,751	14,766,280
	70-74	15,271,316	2,647,435	1,176,766	19,095,517
	75-79	24,997,338	3,580,649	1,373,966	29,951,953
	80-84	32,812,054	3,871,280	1,383,089	38,066,423
	85-89	26,006,337	2,415,629	2,920,289	31,342,255
	90-94	12,439,986	1,572,680	691,545	14,704,211
	95+	2,144,190	264,474	227,011	2,635,675
Males 65+		124,599,996	17,576,901	8,385,417	150,562,314
Females	65-69	16,620,829	2,107,205	3,974,598	22,702,632
	70-74	27,420,306	4,032,757	3,925,561	35,378,624
	75-79	44,412,504	4,882,456	5,464,113	54,759,073
	80-84	75,315,319	2,952,139	4,091,072	82,358,530
	85-89	71,211,668	2,326,920	3,577,584	77,116,172
	90-94	37,780,389	1,735,708	834,672	40,350,769
	95+	9,895,950	760,117	417,336	11,073,403
Females 65+		282,656,965	18,797,302	22,284,935	323,739,203

Appendix Table 12: Total estimated costs of health care for fall-related injury by age, gender and level of care for persons living in residential aged care aged 65 years and older, NSW, 2006/07.

Gender	Age group	Total cost (\$)			
		Admissions	ED Presentations	Non-hospital treatments	Total
Persons	65-69	1,289,407	322,558	289,708	1,901,673
	70-74	2,613,708	893,679	538,524	4,045,911
	75-79	6,304,246	1,251,424	589,569	8,145,239
	80-84	13,510,503	2,865,862	1,160,336	17,536,701
	85-89	19,976,074	3,992,525	1,652,955	25,621,554
	90-94	14,989,641	3,179,311	1,182,413	19,351,365
	95+	5,759,773	1,365,882	427,077	7,552,732
Persons 65+		64,443,352	13,871,241	5,840,582	84,155,175
Males	65-69	547,196	102,590	107,784	757,570
	70-74	1,075,222	300,565	203,872	1,579,659
	75-79	2,326,624	539,441	312,768	3,178,833
	80-84	4,027,752	1,031,525	526,691	5,585,968
	85-89	4,516,906	1,099,983	600,303	6,217,192
	90-94	2,911,476	817,448	370,430	4,099,354
	95+	1,137,826	248,472	156,362	1,542,660
Males 65+		16,543,002	4,140,024	2,278,210	22,961,236
Females	65-69	742,211	219,968	181,924	1,144,103
	70-74	1,538,486	593,114	334,652	2,466,253
	75-79	3,977,622	711,983	276,801	4,966,405
	80-84	9,482,751	1,834,337	633,645	11,950,732
	85-89	15,459,168	2,892,542	1,052,652	19,404,362
	90-94	12,078,165	2,361,863	811,983	15,252,011
	95+	4,621,947	1,117,410	270,715	6,010,073
Females 65+		47,900,350	9,731,217	3,562,371	61,193,938

Appendix G: Average health care costs

Appendix Table 13: Average estimated treatment costs of all fall-related injury by age, gender and level of care, persons aged 65 years and older, NSW, 2006/07.

Gender	Age group	Total cost (\$)			
		Admissions	ED Presentations	Non-hospital treatments	Total
Persons	65-69	12,921	2,139	301	1,866
	70-74	17,007	3,298	354	2,801
	75-79	17,310	3,200	396	3,552
	80-84	19,954	2,705	377	5,059
	85-89	20,557	2,525	435	4,806
	90-94	18,973	2,660	340	5,372
	95+	16,840	2,372	285	3,651
Persons 65+		18,454	2,721	369	3,906
Males	65-69	13,130	3,542	97	1,683
	70-74	16,869	3,394	209	2,451
	75-79	18,575	3,777	225	3,292
	80-84	19,167	4,092	265	4,229
	85-89	19,516	3,777	555	4,249
	90-94	19,023	4,253	500	5,386
	95+	17,183	3,598	451	3,532
Males 65+		18,100	3,789	280	3,366
Females	65-69	12,786	1,365	471	2,008
	70-74	17,085	3,239	457	3,039
	75-79	16,669	2,876	511	3,714
	80-84	20,316	2,008	455	5,565
	85-89	20,950	2,064	474	5,065
	90-94	18,958	2,183	281	5,367
	95+	16,764	2,170	237	3,682
Females 65+		18,609	2,241	424	4,211

Appendix Table 14: Average estimated treatment costs of all fall-related injury by age, gender and level of care, persons living in the community aged 65 years and older, NSW, 2006/07.

Gender	Age group	Total cost (\$)			
		Admissions	ED Presentations	Non-hospital treatments	Total
Persons	65-69	12,898	2,074	318	1,957
	70-74	17,235	3,210	396	3,124
	75-79	18,127	3,496	476	4,107
	80-84	22,212	3,282	523	6,914
	85-89	24,794	3,487	554	6,373
	90-94	24,343	4,495	477	9,175
	95+	23,562	4,455	314	4,907
Persons 65+		20,563	3,169	462	4,722
Males	65-69	13,183	3,520	95	1,798
	70-74	17,025	3,297	232	2,815
	75-79	19,378	3,952	237	3,748
	80-84	20,966	4,797	280	5,207
	85-89	22,323	4,575	651	5,070
	90-94	22,742	6,419	569	7,329
	95+	20,617	4,266	387	3,501
Males 65+		19,478	4,119	327	4,147
Females	65-69	12,717	1,273	499	2,077
	70-74	17,355	3,156	504	3,321
	75-79	17,492	3,223	637	4,334
	80-84	22,802	2,319	740	8,149
	85-89	25,839	2,797	493	7,115
	90-94	24,921	3,542	420	10,105
	95+	24,314	4,525	285	5,426
Females 65+		21,081	2,607	549	5,290

Appendix Table 15: Average estimated treatment costs of all fall-related injury by age, gender and level of care, persons living in residential aged care aged 65 years and older, NSW, 2006/07.

Gender	Age group	Total cost (\$)			
		Admissions	ED Presentations	Non-hospital treatments	Total
Persons	65-69	13,431	4,463	162	973
	70-74	13,977	4,150	176	1,171
	75-79	11,567	2,033	135	1,476
	80-84	11,002	1,908	163	1,780
	85-89	11,223	1,901	236	2,356
	90-94	10,909	1,867	248	2,465
	95+	10,549	1,756	250	2,494
Persons 65+		11,196	1,985	196	1,979
Males	65-69	12,160	4,460	115	751
	70-74	14,934	4,554	135	956
	75-79	12,854	2,916	183	1,534
	80-84	11,282	2,638	233	1,855
	85-89	11,321	2,729	323	2,339
	90-94	11,198	2,579	408	2,761
	95+	13,078	3,106	595	3,588
Males 65+		11,808	2,826	241	1,864
Females	65-69	14,553	4,501	215	1,210
	70-74	13,378	3,959	218	1,368
	75-79	10,928	1,652	104	1,442
	80-84	10,887	1,651	130	1,747
	85-89	11,194	1,704	205	2,361
	90-94	10,842	1,703	210	2,396
	95+	10,070	1,602	188	2,313
Females 65+		10,999	1,762	175	2,025

