



This issue of Hazard provides an overview of fall-related injury incidence among persons aged 65 years and older as recorded in all 3 VISU held injury surveillance datasets, representing injury-related deaths, hospital admissions and emergency department presentations. This edition also features trend analysis modelling of 2004/05 to 2011/12, and co-morbidity analysis of fall-related injury admission data not previously reported in past Hazard publications.

Fall-related injury profile for Victorians aged 65 years and older

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Summary

Falls are the leading cause of injury-related deaths, hospital admissions and emergency department presentations (ED) in older Victorians (aged 65 years and over). Among older Victorians, the annual number of fall-related injury deaths increased by 9.7% per year on average, between 2006 and 2012. The annual number of hospital admissions for fall-related injury increased by +3.6% per year on average, between 2004/05 and 2013/14.

The following includes analysis of the latest available 3 years of Victorian data from the three VISU-held injury surveillance datasets covering deaths (2010-2012), hospital admissions and emergency department presentations (both 2011/12-2013/14). The frequency, distribution and pattern of fall-related injury incidence among people aged 65+ years across these periods is summarised below:

- In 2010-2012, fall-related injury deaths accounted for 70% of all injury deaths for persons aged 65 years and above. In 2011/12-2013/14, fall-related injury admissions accounted for 75% of all injury admissions among persons aged 65+ years while fall-related ED presentations represented 47% of all ED presentations among persons aged 65+ years.
- Over the 3-year period, there were 1,931 deaths, 63,981 hospital admissions and 33,802 non-admitted ED presentations due to falls (ED presentations subsequently

- admitted to hospital were excluded from the ED presentations to prevent over-counting)
- The annual average age-standardised rate for fall-related injury deaths was 75/100,000 persons; the hospital admission rate was 2,478/100,000 persons and the rate for ED presentations was 1,346/100,000 persons
- Females were over-represented in fall-related injury deaths (57%), hospital admissions (69%) and ED presentations (65%)
- Figure A compares the distribution of falls for deaths, hospital admissions and ED presentations:
 - o The number of fall-related injury deaths was highest among adults aged 85-94 years (52% of cases)
 - o Hospital admissions occurred more frequently among the older age group (85-94 years) representing 39% of admissions compared with those aged 65-74 years (21%)
 - o Those presenting to the ED were most commonly in the age group 65-74 years (38%), followed by 75-84 years (36%)
- Figure B compares the distribution of broad injury types for hospital admissions and ED presentations:
 - o Fractures accounted for just over half (56%) of admissions, followed by open wound injuries (12%), superficial injuries (8%) and intracranial injuries (5%)
 - o Fractures accounted for 26% of ED presentations, followed by

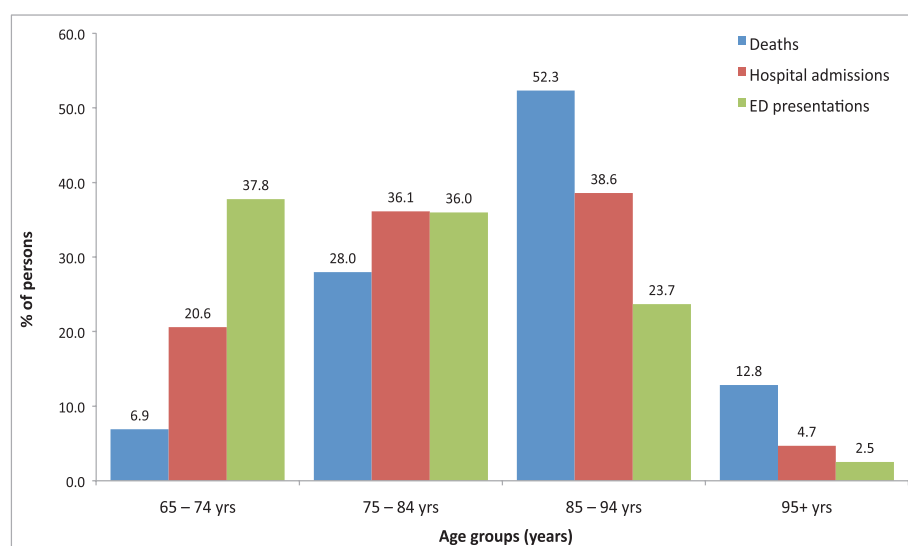
- dislocations, sprains and strains (21%), open wounds (18%) and superficial injuries (16%)
- Specifically, femur fractures accounted for 20% of admissions, followed by open head wounds (8%) and elbow/forearm fractures (7%)
- ED presentations were most commonly for open head wounds (12%), wrist/hand fractures (10%) and superficial head injuries (8%)
- Figure C compares the distribution of place of occurrence for fall-related injury deaths, hospital admissions and ED presentations:
 - o 45% of fall-related injury deaths occurred in residential institutions, followed by the home area (33%)
 - o Close to half (48%) of hospital admission injuries occurred in the home, particularly in outdoor areas (9%) and bathrooms (5%), followed by residential institutions accounting for 22%
 - o Over half (56%) of fall-related ED presentations occurred in the home, followed by residential institutions (11%)
- Fall-related injury deaths were commonly due to falls on the same level as a result of slipping/tripping or stumbling (44%); 31% of fall-related injury admissions were attributed to the same cause, with the majority due to slipping (20%)
- Fall-related injury admissions accounted for 602,234 hospital bed days (83% of all injury-related hospital bed days for persons aged 65+ years)
- Of all incident hospital admissions in



relation to a fall, 76% were for 7 days or less; length of stay ranged between 0 to 179 days with an average length of stay of 5.2 days

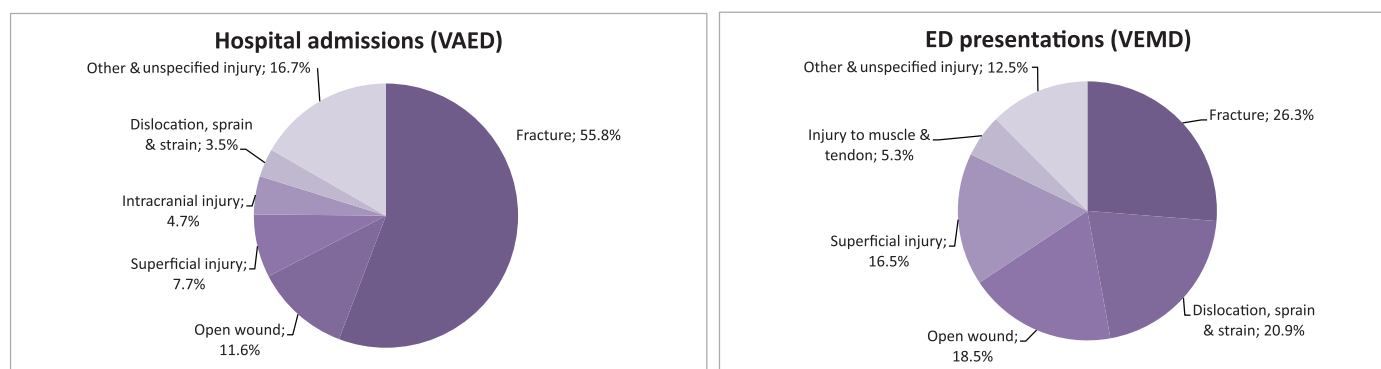
- Among persons aged 65+ years admitted to hospital for a fall-related injury, commonly listed comorbidities were diabetes with (5.8%) and without complications (8.9%), dementia (7.2%) and renal disease (5.7%).
- Among persons admitted to hospital for a fall-related *hip fracture*, the prevalence of mild liver disease, hemiplegia/paraplegia, congestive heart failure and chronic pulmonary disease were associated with longer hospital stay; *dementia* was associated with significantly less time in hospital.
- Metastatic cancer, congestive heart failure, myocardial infarction, renal disease, chronic pulmonary disease and dementia were all associated with risk of death during hospital stay, among those admitted to hospital for a fall-related *hip fracture*. *Diabetes had no impact on the risk of death while in hospital, in this group.*

Figure A Proportion (%) of fall-related injury incidence by age group among people aged 65+ years, Victoria



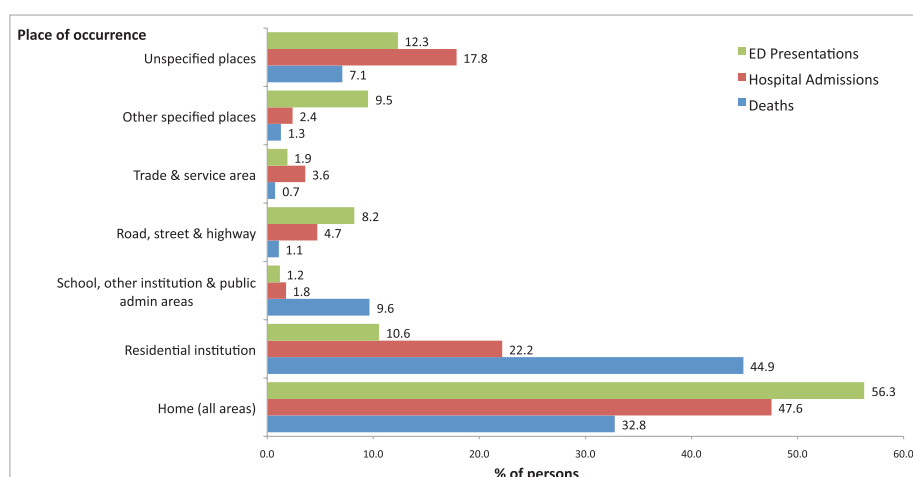
Sources: COD (2010-2012), VAED, VEMD (both 2011/12-2013/14)

Figure B Comparison of injury type for falls among persons aged 65+ years, Victoria (2011/12-2013/14)



Sources: VAED, VEMD (2011/12-2013/14)

Figure C Proportion (%) of fall-related injury incidence by place of occurrence among people aged 65+ years, Victoria



Sources: COD (2010-2012), VAED, VEMD (both 2011/12-2013/14)

Introduction

In 2014, persons aged 65 years and over comprised 15% (3.5 million) of the Australian population; this is expected to increase to 19% (5.8 million) in 2031 and 25% (11.1 million) in 2061 (ABS 2013, 2015). Persons aged 85 years and over will also increase significantly with current Australian population levels of 454,225 (2%) predicted to double to 842,500 in 2031 and double again in 2045 (to 1.7 million) (ABS 2015). The ageing population continues to represent a significant health and economic issue requiring wide-ranging measures to address its ongoing impact on the growing demand for sufficient health and aged care services.

Hospital treated injury is a significant health concern among older persons. In Victoria



2012/13, 6.4% of emergency department (ED) presentations by older men (aged 65 years and over) were for unintentional injury; for older women this was 7.5%. The percentage of ED presentations that were for unintentional injury was 8.4% in the 65-74 year age group, 6.0% for the 75-84 year age group and 6.1% among those aged 85 years or more. During that same period 2.6% of hospital admissions by older men and 4.9% of those by older women were for unintentional injury. Among admissions, the percentage that was for unintentional injury showed a steep increase with age from 2.1% in the 65-74 year age group to 8.8% in the 85 years or more age group (based on: Victorian Injury Surveillance Unit 2014 and Australian Institute of Health and Welfare 2013, 2014).

In terms of hospital treated injury, the population of Victoria is fairly representative of the Australian population. In 2009/10, the Victorian age-standardised hospital treated injury rates were close to the overall Australian rates, at 1,814 and 1,859 per 100,000 population, respectively (Tovell et al 2012). Northern Territory and Queensland had the highest rates at 3,023 and 2,014, and Tasmania the lowest at 1,532 per 100,000 population. Victoria ranked fourth in a high-to-low ranking of hospitalised community injury rates per jurisdiction in Australia (Tovell et al 2012). The rate of death due to external causes in Victoria was 31.2 per 100,000 population in 2013 (standardised rate); this was slightly lower than the Australian external cause death rate, which was in 36.6 per 100,000 population in 2013 (Australian Bureau of Statistics 2015).

It was estimated that in the US, falls accounted for approximately two-thirds of unintentional injury deaths in older adults (Rubenstein 2006). Falls among Australian residents aged 65 years and over accounted for 69% of all injury-related hospital admissions (AIHW 2009). A study in the United Kingdom reported that following ED presentation in relation to a fall, the percentage admitted to hospital increased with age: 13% at 60-64 years, 18% at 65-69 years, 25% at 70-74 years and 39% at ≥75 years (Scuffham et al 2003).

Falls can have widespread physical and psychological consequences, namely avoidance of activity, loss of functional ability, loss of confidence, worry about loss of independence, and perceived poor health (Udell et al 2011, ACSQHC 2009).

A fall is defined as “an unexpected event in which the participant comes to rest on the ground, floor, or lower level” (Lamb et al 2005). World-wide, it is estimated that

approximately 28-35% of people aged 65 years and over have a fall event while this proportion increases to 32-42% for persons aged 70 years and over (WHO 2007). The number of falls a person has increases with age and with their level of frailty. Whilst the majority of fall-related injuries are minor, serious injuries and deaths can occur (Gillespie et al 2009, AIHW 2013b). The incidence of falls depends on the setting in which they occur and is lowest among community-dwelling older adults with a fall rate in the range of 30-40% (Udell et al 2011, Gillespie et al 2009). It is reported that the incidence of falls in residential institutions is around three times that (30-50%) in the community with approximately 50% experiencing recurrent fall events (Cameron et al 2012, WHO 2007).

Physiological changes related to ageing as well as other risk factors can contribute to an increased risk or rate of falling. Problems associated with cognitive ability, muscle strength, joint range of motion, gait and balance, depression, history of falls, and arthritis can all contribute to an increased falls risk (Howe et al 2011, AIHW 2009). The rate of fall-related injuries increases with age, as older adults exhibit a tendency to over- or under-respond when their balance is interrupted, and diminished ability to maintain balance may be associated with an increased risk of falling (Gillespie et al 2009, ACSQHC 2009, Howe et al 2011). The risk of falling is also increased among certain high risk groups, such as those with Parkinson’s disease or a history of stroke (Cameron et al 2012, ACSQHC 2009).

Risk factors for falling can either be intrinsic or extrinsic. Intrinsic risk factors (internal to the individual) include age-related changes such as mobility, strength, illness, cognitive impairment, urinary continence, and medication. Extrinsic risk factors are those associated with the physical environment, such as footwear, environmental conditions, and flooring type (Udell et al 2011, Cameron et al 2012, ACSQHC 2009).

Numerous studies have reported that females fall at a higher rate than males. Fall-related injuries increase with age. Increasing age of the injured individual corresponds with increased severity of injury and increased likelihood of death; sustaining an intracranial injury following a fall also becomes more common with increasing age (AIHW 2009, Schumacher et al 2013, Stevens et al 2014, Moudouni 2012).

The most common specific injury type due to falls is a hip fracture (or fracture to the neck

of the femur); however, fractures of other body regions, including the skull, also occur frequently. The occurrence of injuries to the hip and lower limbs increase with age whereas shoulder and upper limb injuries are more common among younger age groups (AIHW 2009, Moudouni 2012).

Comorbidity is an important factor to consider in relation to falls. Comorbidity can increase the risk of a fall, increase the risk of serious injury resulting from a fall, increase the risk of complications, and prolong recovery time. Examples of each of these are (1) cardiac arrhythmias that cause syncope (transient loss of consciousness) resulting in a fall; (2) osteoporosis increase the risk of bone fractures resulting from a fall (3) clotting disorders or the use of anti-coagulant medication such as warfarin can lead to excessive bleeding after a fall; (4) diabetes can be expected to increase service use needs and delay recovery through increased need for monitoring in the acute phase, and delayed wound healing.

This issue of Hazard aims to provide a detailed up-to-date profile of fall-related injury incidence for older Victorians aged 65 years and over. Fall-related injury deaths, hospital admissions and emergency department (ED) presentations were examined and described. Trend modelling analysis was conducted for injury rates to identify trends over time. Comorbidity analysis provides insight into the impact of common comorbidities on injury severity and recovery from a fall-related injury, in terms of days spent in hospital and risk of in-hospital death.

Data extraction and analysis methods for all sections are described in detail in Box 1.

Overview of fall-related injury

Deaths

N=1,931 (3 years), annual average: 644 deaths

Fall-related deaths accounted for over two-thirds (70%, n=1,931) of injury deaths among persons aged 65 years or more in Victoria, as recorded in the Cause of Death (COD) dataset for the reference years 2010-2012 (Table 1). This represents an average of 644 deaths per year and an average annual rate of 78.1 per 100,000 population; the age-standardised rate was 74.9 per 100,000 population (Table 2). Over the 7-year period from 2006 to 2012,



the average annual percentage change in fall-related deaths was +9.7%. During this 7-year period, the corresponding crude rate increased by +6.3%, on average (Table 2); the age-standardised rate increase by +5.9%.

Sex and age

Overall, females accounted for just over half (54%, n=1,104) of fall-related injury deaths (Table 1). The age-standardised fall-related injury death rate for females was slightly higher at 78.4/100,000 compared with the rate for males (69.6/100,000); however, when stratified by age group, age group-specific crude rates were higher for males in every age group (Figure 1).

The ages ranged from 65 to 104 years with an average of 86.5 years (\pm 7.2 years). Adults aged between 85 and 94 years represented 52% (n=1,010) of fall-related deaths, followed by persons aged 75-84 years accounting for 28% (n=540) (Table 1). Fall-related death rates increased with age with the highest rates observed for persons aged 95 years and over (1,139 per 100,000 population).

Country of birth/geographic region

Almost two-thirds (64%, n=1,236) of older persons who died as a result of a fall were Australian-born, 30% (n=577) were born in Europe and a smaller proportion (3%, n=63) were Asian born. A large proportion (67%, n=1,297) resided in the Melbourne metropolitan region, while the remainder resided in regional and rural Victoria (33%, n=629) (Table 1).

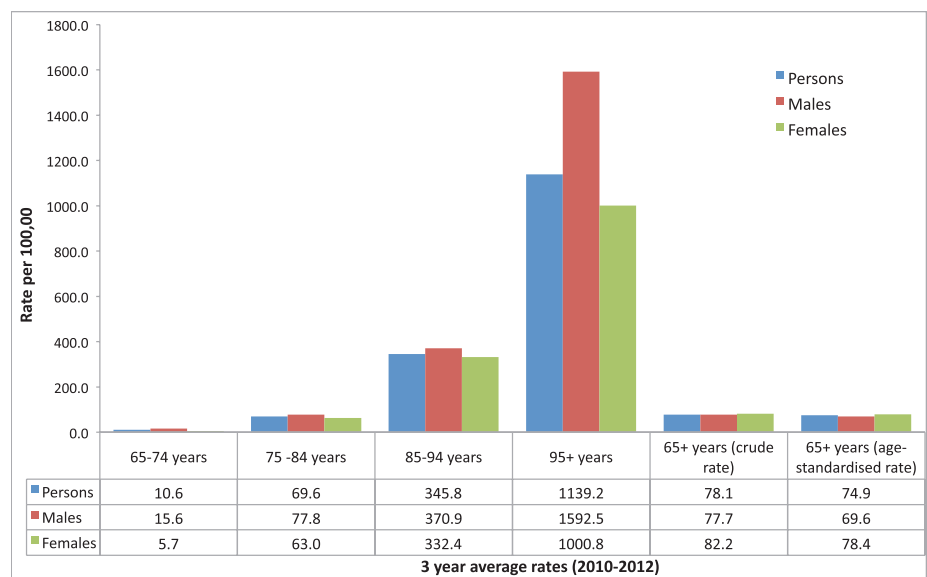
Causes of fall-related injury deaths

Table 1 lists all of the International Classification of Diseases-Australian Modification (ICD-10-AM) external cause sub-categories for fall-related deaths. A large proportion (44%, n=858) were attributed to falls occurring on the same level due to slipping, tripping or stumbling, followed by falls involving beds (4%, n=72) and falls on or from stairs and steps (2%, n=43). It should be noted, however, that a large proportion (43%, n=828) of fall-related deaths were coded to the non-specific category of: "Fall, other unspecified (W19)", thus providing very little insight into the circumstances of these fall-related deaths.

Place of occurrence

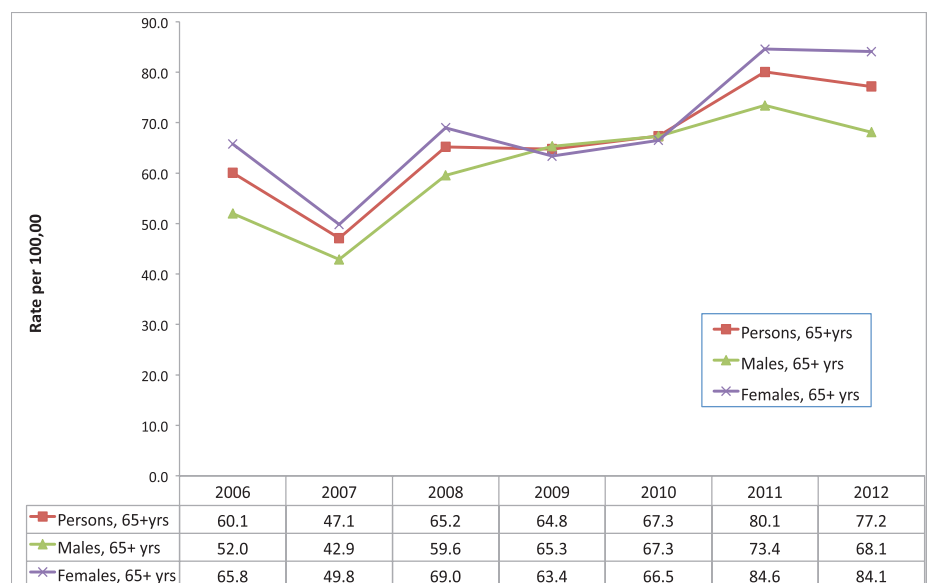
Just under half (45%, n=867) of fall-related deaths occurred in residential institutions, while a third (33%, n=633) occurred in

Figure 1 Average fall-related death rates by age group and sex among people aged 65+ years, Victoria, 2010-2012



Source: Cause of Death Data (2010-2012)

Figure 2 Age-standardised fall-related injury death rates by sex among people aged 65+ years, Victoria, 2006-2012



Source: COD (2006-2012)

the home and a small proportion (10%, n=186) took place in other institution/public administrative areas which includes health service areas such as hospitals and hospices. Fall-related injury deaths occurring in residential institutions were most often females (66%, n=575), aged 85-94 years (59%, n=515), and residing in the Melbourne metropolitan region (64%, n=558). Almost half of these fall-related deaths (49%, n=421) were the result of a fall on the same level from

slipping, tripping or stumbling, followed by falls involving beds (5%, n=39) and chairs (2%, n=19). As mentioned previously, a large proportion of falls in residential settings were coded to the non-specific fall code category (41%, n=359).

Fall-related deaths in the home setting involved males and females almost equally, 50% (n=314) and 50% (n=319), respectively. Almost half (45%, n=285) were aged between



Table 1
Number of fall-related injuries
among people aged 65+ years,
Victoria: distribution and pattern

85 and 94 years, and just over a third (37%, n=231) were aged between 75 to 84 years of age. Almost three-quarters (n=446) resided in the Melbourne metropolitan region.

Almost half of home location fall-related deaths (45%, n=287) were the result of falls on the same level from slipping, tripping or stumbling, followed by falls involving stairs and steps (6%, n=36) and equal proportions (3%, n=20) involving falls from beds and falls from ladders. Approximately a third of falls in home settings were coded to the non-specific fall code category (37%, n=236).

Changes over time (2006 – 2012)

Statistical modelling of trends has been conducted and described in a separate section of this report entitled: “Trend Analysis Modelling – Deaths and Hospital Admissions”. However, figures have been provided here as well to give an indication of changes over time in fall-related injury deaths among older Victorians aged 65 years or more.

Table 2 describes average annual percentage changes in fall-related death frequencies and rates overall and stratified by age group over the 7-year period of available data. Overall, the average annual percentage change in the number of fall-related injury deaths was +9.6%, and the average annual percentage change in the rate of fall-related injury deaths +6.3%. Those aged 95+ years had the highest average annual percentage change in fall-related injury death rate (+10.8%). These findings were consistent with the age-standardised fall-related injury death rates overall or when stratified by sex, for the 7-year period (Figure 2).

Sources: COD, VAED, VEMD

* Frequencies less than 5 have been suppressed.

VEMD (ED presentation data) does not include ICD10-AM cause codes. Falls are either coded as “falls-low (same level or less than 1 metre) or falls-high (greater than 1 metre)”.

Characteristics	Deaths (COD)		Hospital Admissions (VAED)		ED Presentations (VEMD)	
	(2010 – 2012) (n=1,931)		(2011/12 – 2013/14) (n=63,981)		(2011/12 – 2013/14) (n=33,802)	
	N	%	N	%	N	%
Year						
Year 1	562	29.1	22,614	35.3	10,884	32.2
Year 2	683	35.4	20,503	32.0	11,327	33.5
Year 3	686	35.5	20,864	32.6	11,591	34.3
All 3 years	1,931	100.0	63,981	100.0	33,802	100.0
Sex						
Male	827	42.8	19,548	30.6	11,975	35.4
Female	1,104	54.2	44,433	69.4	21,827	64.6
Age group						
65 – 74 years	133	6.9	13,169	20.6	12,768	37.8
75 – 84 years	540	28.0	23,123	36.1	12,169	36.0
85 – 94 years	1,010	52.3	24,677	38.6	8,008	23.7
95+ years	248	12.8	3,012	4.7	857	2.5
Mean age (SD), (Range)	86.5 (7.2)	(65 – 104)	82.1 (8.2)	(65 – 112)	78.2 (8.5)	(65 – 105)
<i>Mean age (SD) – Males, Females</i>	<i>84.9 (7.7)</i>	<i>87.8 (6.5)</i>	<i>80.9 (8.2)</i>	<i>82.6 (8.2)</i>	<i>77.8 (8.2)</i>	<i>78.5 (8.6)</i>
Major causes of injury#						
Fall on same level from slipping, tripping and stumbling (W01)	858	44.4	19,595	30.6	NA	-
<i>Fall on same level: slipping (W01.0)</i>	<i>NA</i>	<i>-</i>	<i>5,263</i>	<i>8.2</i>	<i>NA</i>	<i>-</i>
<i>Fall on same level: tripping (W01.1)</i>	<i>NA</i>	<i>-</i>	<i>12,577</i>	<i>19.7</i>	<i>NA</i>	<i>-</i>
<i>Fall on same level: stumbling (W01.2)</i>	<i>NA</i>	<i>-</i>	<i>1,755</i>	<i>2.7</i>	<i>NA</i>	<i>-</i>
Fall on same level: collision with, or pushing by, another person (W03)	< 5*	<1.0*	194	0.3	NA	-
Fall involving wheelchair (W05)	19	1.0	391	0.6	NA	-
Fall involving bed (W06)	72	3.7	2,625	4.1	NA	-
Fall involving chair (W07)	34	1.8	2,011	3.1	NA	-
Fall on and from stairs & steps (W10)	43	2.2	3,914	6.1	NA	-
Fall on and from ladder (W11)	22	1.1	1,265	2.0	NA	-
Fall from, out of or through building or structure (W13)	7	0.4	308	0.5	NA	-
Other fall from one level to another (W17)	< 5*	<1.0*	672	1.1	NA	-
Other fall on same level (W18)	38	2.0	12,159	19.0	NA	-
Fall: other specified (W00, W02, W04, W08, W09, W12, W14-W16)	6	0.3	512	0.8	NA	-
Fall: other unspecified (W19)	828	42.9	20,335	31.8	NA	-
Body region injured						
Head	NA	-	13,804	21.6	9,202	27.2
Neck	NA	-	1,123	1.8	291	0.9
Thorax	NA	-	4,458	7.0	1,782	5.3
Lumbar spine & pelvis	NA	-	6,757	10.6	1,232	3.6
Shoulder and upper arm	NA	-	6,481	10.1	3,498	10.3
Elbow and forearm	NA	-	5,829	9.1	2,349	6.9
Wrist & hand	NA	-	1,536	2.4	5,550	16.4
Hip & thigh	NA	-	16,105	25.2	1,799	5.3
Knee & lower leg	NA	-	6,271	9.8	3,005	8.9
Ankle & foot	NA	-	923	1.4	2,439	7.2
Multiple body regions	NA	-	18	0.0	2,261	6.7
Unspecified body region	NA	-	301	0.5	337	1.0
Body region not relevant	NA	-	375	0.6	57	0.2
Type of injury						
Superficial injury	NA	-	4,947	7.7	5,584	16.5
Open wound	NA	-	7,442	11.6	6,258	18.5
Fracture	NA	-	35,690	55.8	8,874	26.3
Dislocation, sprain & strain	NA	-	2,221	3.5	7,064	20.9
Injury to nerves & spinal cord	NA	-	104	0.2	28	0.1
Injury to blood vessels	NA	-	32	0.1	77	0.2
Injury to muscle & tendon	NA	-	888	1.4	1,803	5.3
Eye injury (excluding foreign body)	NA	-	194	0.3	77	0.2
Intracranial injury	NA	-	2,994	4.7	637	1.9
Injury to internal organs	NA	-	290	0.5	52	0.2
Other & unspecified injury	NA	-	9,179	14.3	3,348	9.9
Location of injury event						
Home (all areas)	633	32.8	30,424	47.6	19,027	56.3
<i>Driveway to home</i>	<i>NA</i>	<i>-</i>	<i>586</i>	<i>0.9</i>	<i>NA</i>	<i>-</i>
<i>Outdoor areas</i>	<i>NA</i>	<i>-</i>	<i>5,838</i>	<i>9.1</i>	<i>NA</i>	<i>-</i>
<i>Garage</i>	<i>NA</i>	<i>-</i>	<i>359</i>	<i>0.6</i>	<i>NA</i>	<i>-</i>
<i>Bathroom</i>	<i>NA</i>	<i>-</i>	<i>3,085</i>	<i>4.8</i>	<i>NA</i>	<i>-</i>
<i>Kitchen</i>	<i>NA</i>	<i>-</i>	<i>2,330</i>	<i>3.6</i>	<i>NA</i>	<i>-</i>
<i>Bedroom</i>	<i>NA</i>	<i>-</i>	<i>2,739</i>	<i>4.3</i>	<i>NA</i>	<i>-</i>
<i>Laundry</i>	<i>NA</i>	<i>-</i>	<i>183</i>	<i>0.3</i>	<i>NA</i>	<i>-</i>
<i>Other Indoor living areas</i>	<i>NA</i>	<i>-</i>	<i>2,136</i>	<i>3.3</i>	<i>NA</i>	<i>-</i>
<i>Other specified & unspecified places in the home</i>	<i>NA</i>	<i>-</i>	<i>13,168</i>	<i>20.6</i>	<i>NA</i>	<i>-</i>
Residential institution	867	44.9	14,177	22.2	3,567	10.6
School, other institution & public administrative area (incl. hospitals)	186	9.6	1,130	1.8	401	1.2
Sports & athletic areas	< 5*	<1.0*	341	0.5	191	0.6
Road, street & highway (incl. footpaths)	21	1.1	3,021	4.7	2,779	8.2
Trade & service area	14	0.7	2,293	3.6	641	1.9
Industrial & construction area	< 5*	<1.0*	39	0.1	41	0.1
Farm	< 5*	<1.0*	99	0.2	148	0.4
Other specified places	18	0.9	1,040	1.6	2,846	8.4
Unspecified places	137	7.1	11,417	17.8	4,161	12.3
Country/region of birth						
Australia	1236	64.0	41,070	64.2	21,042	62.3
Africa	21	1.1	794	1.2	367	1.1
Americas	8	0.4	316	0.5	205	0.6
Asia	63	3.3	2,116	3.3	933	2.8
Europe	577	29.9	17,834	27.9	10,207	30.2
Middle East	11	0.5	503	0.8	288	0.9
Other countries (incl. not stated)	15	0.8	1,348	2.1	760	2.2
Geographic region of residence						
Melbourne metropolitan area	1297	67.2	48,175	75.3	21,089	62.4
Regional/rural Victoria	629	32.6	15,806	24.7	12,713	37.6
Overseas/Unknown	5	0.3	-	-	-	-



Hospital admissions

N=63,981 (3 years), annual average: 21,327 admissions

There were 63,981 hospital admissions recorded in the VAED for fall-related injuries incurred by persons aged 65 years and above, over the 3-year study period from 2011/12 to 2013/14. Over the study period, fall-related injury incident admissions accounted for 75% of all injury incident admissions. The average number of fall-related hospital admissions was 21,327 per year, with an average annual rate of 2,597.2 per 100,000 population; the age-standardised rate was 2,477.7 per 100,000 population (Table 2). Over the 10-year period from 2004/05 to 2013/14, the average annual percentage change in the number of fall-related hospital admissions was +3.6% while the corresponding crude rate only increased by +0.7% (Table 2). Excluding same-day admissions over the 10-year period yielded very similar average annual percentage changes in both admission frequencies and rates, at +3.5% and +0.7%, respectively (Table 2).

Figure 3 shows fall-related injury hospital admission rates from July 2004 to June 2014 for persons aged 65 years and over. Both crude rates and age-standardised rates follow a similar pattern over the 10-year period with all rates peaking in the same financial year (2011/12) where they appear to drop off to lower levels in subsequent years. This reduction in rates could be due to a significant change made to the Victoria hospital admission policy whereby an episode of care delivered entirely within a designated ED or urgent care centre (UCC) which lasted four or more hours from the time of first treatment was no longer classified as an admission. This policy had the effect of reducing the number of admissions recorded in the VAED for the financial year 2012/13 to the present. Excluding same-day admissions over the 10-year study period reduces the effect on admissions this change in policy may have. Rates excluding same-day admissions still show a decrease from the financial year 2012/13 onwards (Figure 3). Statistical modelling of the trend in rates is reported in a separate section in this issue of Hazard.

Sex and age

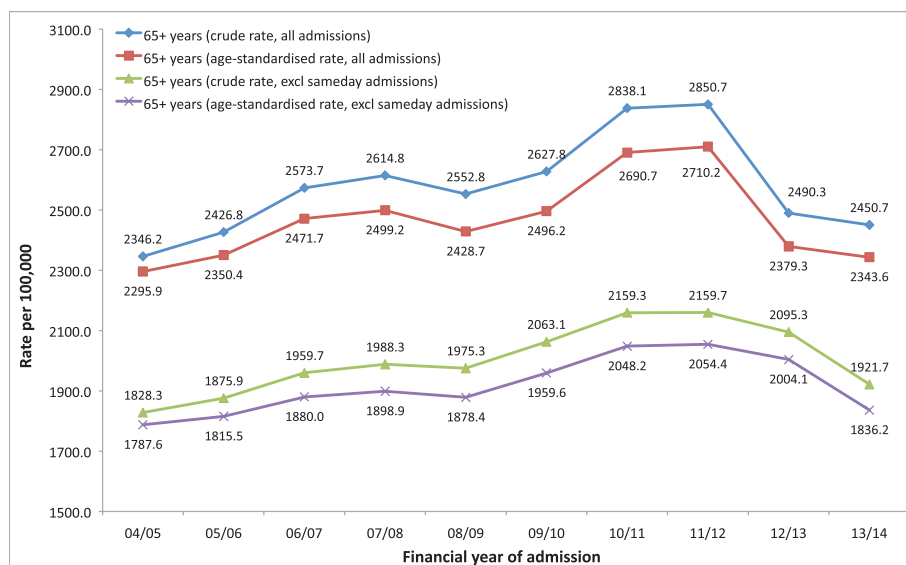
Over the 3-year study period, females accounted for 69.4% (n=44,433) of fall-related injury hospital admissions. The age-standardised admission rate for females was much higher at 3,210.2/100,000 compared

Table 2 Summary of fall-related injury incidence among persons aged 65+ years, Victoria

Age (years)	65+	65 – 74	75 – 84	85 – 94	95+
Deaths					
Average annual frequency (last 3 years)	644	44	180	337	83
Average annual crude rate/100,000 (last 3 years)	78.1	10.6	69.6	345.8	1,139.2
Average annual standardised rate/100,000 (last 3 years)	74.9				
Average annual % change: frequency (last 7 years)	+9.7%	+13.8%	+6.0%	+11.5%	+15.8%
Average annual % change: crude rate (last 7 years)	+6.3%	+9.6%	+4.8%	+6.4%	+10.8%
Hospital admissions (all)					
Average annual frequency (last 3 years)	21,327	4,390	7,708	8,226	1,004
Average annual crude rate/100,000 (last 3 years)	2,597.2	984.2	2,917.0	7,951.9	13,279.3
Average annual standardised rate/100,000 (last 3 years)	2,477.7				
Average annual % change: frequency (last 10 years)	+3.6%	+4.3%	+1.4%	+5.5%	+4.7%
Average annual % change: crude rate (last 10 years)	+0.7%	+0.8%	+0.1%	+0.5%	+0.4%
Hospital admissions (excl. same day admissions)					
Average annual frequency (last 3 years)	16,915	3,428	6,175	6,549	762
Average annual crude rate/100,000 (last 3 years)	2,058.9	768.1	2,336.9	6,326.9	10,071.6
Average annual standardised rate/100,000 (last 3 years)	1,964.9				
Average annual % change: frequency (last 10 years)	+3.5%	+4.8%	+1.4%	+5.2%	+4.2%
Average annual % change: crude rate (last 10 years)	+0.6%	+1.3%	0.0%	+0.3%	-0.2%
ED Presentations					
Average annual frequency (last 3 years)	11,267	4,256	4,056	2,669	286
Average annual crude rate/100,000 (last 3 years)	1,369.7	952.0	1,533.8	2,577.3	3,767.9
Average annual standardised rate/100,000 (last 3 years)	1,345.6				
Average annual % change: frequency	+3.3%	+3.7%	+2.5%	+4.4%	+3.9%
Average annual % change: crude rate	+0.4%	+0.2%	+1.1%	-0.4%	-0.4%

Sources: COD, VAED, VEMD

Figure 3 Fall-related injury admission rates for persons aged 65+ years, Victoria (2004/05 to 2013/14)



Source: VAED (2004/05-2013/14)

with the rate for males (1,617.1/100,000) representing a ratio of 2:1 hospital admissions (Figure 4). Similar patterns were noted when stratifying rates by age and sex with females recording higher rates in each 10-year age group. Female to male ratios of fall-related

injury admission rates started at 1.6:1 for the 65-74 year age group, 1.7:1 for 75-84 year olds and then lower for older age groups with ratios of 1.5:1 and 1.4:1 for 85-94 and 94+ year olds, respectively (Figure 4).



The average age among fall-related injury incident admissions was 82.1 years (SD 8.2), with a range in age from 65 to 112 years. Persons aged 85 years and over comprised 43% (n=27,689) of fall-related injury admissions, followed by persons aged 75-84 years (36%, n=23,123) (Table 1). Fall-related hospital admission rates increased with age with the highest rates noted for persons aged 95 years and over (13,279.3/100,000) (Figure 4).

Country of birth/geographic region/marital status

Almost two-thirds (64%, n=41,070) of admitted patients were Australian-born, 28% (n=17,834) were born in Europe and a smaller proportion (3%, n=2,116) were Asian born. Three-quarters (75%, n=48,175) of admitted patients resided in the Melbourne metropolitan region, while half (50%, n=31,967) reported being widowed, divorced or separated (Tables 1 & 3).

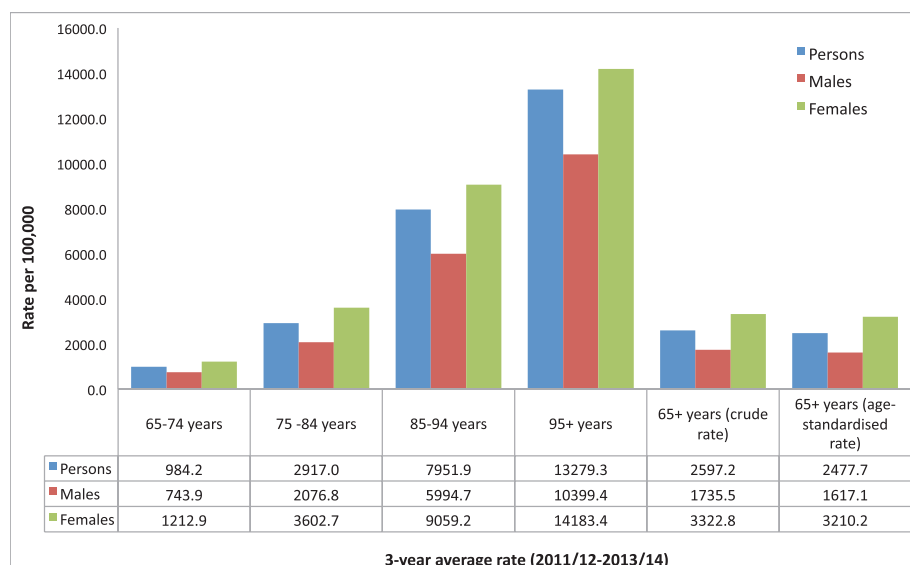
Causes of fall-related injury incidents

Table 1 lists all ICD-10-AM external cause sub-categories for fall-related incident hospital admissions over the 3-year study period. Almost a third of admissions (31%, n=19,595) were due to falls occurring on the same level from slips, trips and stumbles with the majority (20%, n=12,577) resulting from tripping. Other causes of falls involved stairs and steps (6%, n=3,914), falls involving beds (4%, n=2,625) and chairs (3%, n=2,011). Almost a third (32%, n=20,335) of fall-related injury admissions were coded to the non-specific category of "fall, other unspecified (W19)" while 19% (n=12,159) were coded as "other fall on same level (W18)". Both codes provide limited information regarding the circumstances of the fall event.

Nature of injury and body site injured

Fractures accounted for just over half (56%, n=35,690) of fall-related hospital admissions, followed by open wounds (12%, n=7,442), superficial injuries (8%, n=4,947) and intracranial injuries (5%, n=2,994) (Table 1). Body regions most commonly injured were the hips/thigh (femur) (25%, n=16,105), followed closely by the head region (22%, n=13,804), the lumbar spine/pelvic area (11%, n=6,757) and the shoulder and upper arm area (10%, n=6,481) (Table 1). Analysing injuries by 10-year age group showed very little difference in the rank order or corresponding proportions of fall-related injuries. The ranking of injuries was the same for both sexes (fractures, open wounds, superficial injuries); however, the

Figure 4 Average fall-related injury admission rates by age group and sex among people aged 65+ years, Victoria, 2011/12 to 2013/14



Source: VAED (2011/12-2013/14)

Table 3 Fall-related injury hospital admissions for persons aged 65+ years, Victoria

Hospital Admissions (VAED) - (2011/12 – 2013/14) (n=63,981)		
	N	%
Length of stay in hospital (days)		
< 2 days	25,776	40.3
2 – 7 days	22,616	35.3
8 – 30 days	14,822	23.2
31+ days	767	1.2
Total bed days (all persons)	334,841 days	
Mean (SD, Range) bed days (per person)	5.2 (7.0), (0 – 179 days)	
Type of separation (from hospital)		
Transfer to mental health residential facility	10	0.0
Transfer to Transition Care bed-based program	554	0.9
Private residence/accommodation	32,266	50.4
Transfer to aged care residential facility	6,648	10.4
Transfer to Restorative Care bed-based program	<5*	0.0
Transfer to acute hospital/extended care	19,882	31.1
Statistical separation	4,461	7.0
Left against medical advice	156	0.2
Marital status		
Never married	4,229	6.6
Widowed/divorced/separated	31,967	50.0
Currently married/de-facto	26,326	41.1
Not stated/inadequately described	1,459	2.3

Source: VAED (2011/12-2013/14)

* Frequencies less than 5 have been suppressed.

proportion of fractures for females was slightly higher at 60% (n=26,610) compared to 46% (n=9,080) for males. Open wound injury admissions were higher among males (16%, n=3,045) than among females (10%, n=4,397).

The top ten most commonly occurring specific injury types (among fall-related

injury admission) are provided in Table 4. Fractures to the hip/thigh (femur) accounted for 20% (n=12,602) of admissions, followed by open wounds to the head (8%, n=5,076), elbow/forearm fractures (7%, n=4,772), shoulder/upper arm fractures (7%, n=4,483) and fractures of the lumbar spine/pelvis (7%, n=4,419).



Injury severity (length of stay, separation)

The average length of stay in hospital for persons aged 65 years and over with a fall-related incident injury was 5.2 days (SD 7.0) and ranged from 0 (same day stay) to 179 days in hospital. Total bed days for all fall-related injury incident admissions was 334,841. Bed days were grouped into 4 categories with 40% (n=25,776) in hospital for less than 2 days, 35% (n=22,616) staying for 2-7 days, 23% (n=14,822) for 8-30 days and the remainder (1%, n=767) in hospital for more than 30 days (Table 3). Stratifying by age group yielded proportions for each age group similar to those for all patients aged 65 years and over. Breaking down length of stay groups by type of injury showed that for short stays (<2 days), fractures accounted for 36% (n=9,205) of admissions, followed by open wounds (19%, n=4,992) and superficial injuries (11%, n=2,918). In the 2-7 day category, there was a much higher proportion (65%, n=14,803) of fracture-related fall-related injury admissions followed by open wounds (7%, n=1,565). Similar proportions were noted within the 8-30 day sub-category. Longer stay admissions (31+ days) were again dominated by fractures (75%, n=573), followed by intracranial injuries (6%, n=46) and open wounds (5%, n=36).

Analysing specific injury types by total bed days showed that hip fractures, which accounted for 20% (n=12,602) of fall-related incident admissions comprised 33% (n=110,476) of total days spent in hospital. Fractured pelvis injuries were recorded for 7% (n=4,419) of admissions and accounted for 10% (n=33,889) of total hospital bed days. Overall, fall-related injury admissions resulting in fractures of all types, which represented 56% (n=35,690) of admissions, accounted for 72% (n=240,580) of total hospital bed days.

Separations to private residences accounted for 50% (n=32,226) of admission patients, while 31% (n=19,882) were transferred to acute hospitals/extended care. A small proportion were transferred to an aged care residential facility (10%, n=6,648) (Table 3).

Table 5 compares key indicators for fall-related hospital admissions for both incident injuries and all injury-related admissions (including readmissions, transfers and deaths) to illustrate the overall burden of fall-related injury admissions in Victoria. Fall-related injury incident admissions accounted for a significant proportion (75%) of all injury incident admissions for resident Victorians aged 65 years and over. In addition, females had a much higher fall-related injury admission

Table 4 Summary of fall-related injury incidence among persons aged 65+ years, Victoria

Rank	Hospital admissions (n=63,981)	ED presentations (n=33,802)
1	Fracture to hip/thigh (femur) [19.7%, 12,602]	Open wound to the head [12.0%, n=4,060]
2	Open wound to the head [7.9%, n=5,076]	Fracture to the wrist/hand [9.9%, n=3,342]
3	Fracture to elbow/forearm [7.5%, n=4,772]	Superficial injury to the head [7.9%, n=2,656]
4	Fracture to shoulder/upper arm [7.0%, n=4,483]	Fracture to shoulder/upper arm [4.1%, n=1,378]
5	Fracture to lumbar spine/pelvis [6.9%, n=4,419]	Dislocation/sprain/strain to shoulder/upper arm [4.0%, n=1,351]
6	Fracture to knee/lower leg [5.4%, n=3,460]	Dislocation/sprain/strain to wrist/hand [3.3%, n=1,107]
7	Intracranial injury [4.7%, n=2,994]	Fracture to ankle/foot [3.1%, n=1,064]
8	Fracture to thorax (ribs) [4.6%, 2,959]	Dislocation/sprain/strain to ankle/foot [3.0%, n=1,018]
9	Superficial injury to the head [3.8%, n=2,435]	Dislocation/sprain/strain to knee/lower leg [3.0%, n=1,009]
10	Fracture (skull) [2.0%, n=1,273]	Fracture to elbow/forearm [2.8%, n=943]

Sources: VAED, VEMD (2011/12-2013/14)

Table 5 Key Indicators for hospitalised fall-related injury, people aged 65+, Victoria 2011/12 - 2013/14

Key indicators (65+ yrs)	Total & (average) - 3 years		
	Males	Females	Total
Community injury incident admissions*			
All injury incident admissions	29,750 (9,917)	55,835 (18,612)	85,585 (28,528)
Fall incident admissions	19,548 (6,516)	44,433 (14,811)	63,981 (21,327)
Fall-related injury admissions as a percentage of all injury admissions (%)	65.7%	79.6%	74.8%
Length of stay			
Total bed days (all incident injuries)	133,463 (44,488)	282,249 (94,083)	415,712 (138,571)
Total bed days (falls incident injuries)	99,469 (33,156)	235,372 (78,457)	334,841 (111,614)
Fall bed days as a percentage of all injury admissions bed days (%)	74.5%	83.4%	80.5%
Average length of stay and range for fall-related injury incident admissions (days)	5.1 (0-179)	5.3 (0-147)	5.2 (0-179)
Community injury admissions (incl. readmissions, transfers, deaths)			
All injury admissions	37,648 (12,549)	70,845 (23,615)	108,493 (36,164)
Fall-related injury admissions	25,484 (8,495)	57,036 (19,012)	82,520 (27,507)
Fall-related injury admissions as a percentage of all injury admissions (%)	67.7%	80.5%	76.1%
Length of stay			
Total bed days (all injuries)	229,936 (76,645)	494,127 (164,709)	724,063 (241,354)
Total bed days (fall injuries)	180,224 (60,075)	422,010 (14,0670)	602,234 (200,745)
Fall bed days as a percentage of all injury admissions bed days (%)	78.4%	85.4%	83.2%
Average length of stay and range for fall-related injury admissions (days)	7.1 (0-299)	7.4 (0-161)	7.3 (0-299)

Source: VAED (2011/12-2013/14)

*Excludes readmissions, transfers and deaths in hospital;

NB. Community injuries fall within the ICD10-AM code range of S00-T75, T79 (excludes medical injuries & late effects)

rate (80%) compared to males (66%) (Table 5). Fall-related injury incident admissions also accounted for a sizeable proportion (81%) of all injury incident bed days among this age group. Including readmissions, transfers and

deaths in hospital due to falls and all injuries yielded similar pattern with proportions slightly higher, taking into account additional admissions in terms of overall numbers and additional days spent in hospital.



Place of occurrence

Almost half (48%, n=30,424) of fall-related injury hospital admissions were a result of falls occurring in the home. Areas in the home where these injuries occurred included outdoor areas (9%), bathrooms (5%), bedrooms (4%) and kitchen areas (4%) (Table 1). Residential institutions accounted for 22% (n=14,177) of fall-related injury admissions while a smaller proportion (5%, n=3,021) occurred on roads, streets and highways (including footpaths). Location of the injury event differed slightly when broken down by 10-year age groups with older persons (85 years and over) more likely to have sustained their fall-related injury in residential institutions (35%, n=9,632) compared with 6% (n=788) in the 65-74 year age group.

Comorbidity analysis

In a previous study by Finch et al. (2015), it was shown that among Victorians aged ≥65 years and admitted to hospital in relation to a fall, comorbidity was common and associated with longer hospital stay and disproportionate use of hospital resources. The population of Victoria is ageing and the prevalence of comorbidity can be expected to increase: for this edition of Hazard, analysis of comorbidity in relation to fall-related hospital admissions was therefore carried out. Comorbidities were defined as those medical conditions that were included in the Charlson comorbidity index (Charlson et al., 1987). Comorbidities that were recorded as a complication of the injury or admission were not included. The methodology is further described in Box 1.

The prevalence of Charlson's seventeen comorbidities among all fall-related injury admissions, and per injury group, are shown in Table 6. The results are shown for all fall-related incident admissions among Victorians aged 65+ years, and for the five most commonly occurring specific injuries in this group. These injuries were femur fracture, open head wound, forearm fracture, shoulder or upper arm fracture, and lumbar spine or pelvis fracture. Together, these injury types accounted for almost half (49%) of all injuries.

Overall, the four most common comorbidities were diabetes without chronic complication, dementia, diabetes with chronic complication, and renal disease, respectively. These were also the four most common comorbidities across the most common injury types listed in Table 6. Dementia, however, was relatively common among those with a femur fracture (14% in this group had dementia), and relatively uncommon among those with a forearm fracture (3% in this group had dementia).

Table 6 Prevalence of Charlson's comorbidities, as recorded in the VAED incident injury admissions for falls in 2011/12 to 2013/14.

Comorbidities	All initial admissions		Main Injury†				
	N	%	Fracture of femur Col %	Open wound of head Col %	Fracture of forearm Col %	Fracture of shoulder & upper arm Col %	Fracture of lumbar spine & pelvis Col %
Myocardial infarction	396	0.6	1.2	0.3	0.2	0.4	0.6
Congestive heart failure	1687	2.6	4.9	1.4	0.7	2.0	3.1
Peripheral vascular disease	225	0.3	0.5	0.3	0.2	0.3	0.4
Cerebrovascular disease	759	1.2	1.3	0.7	0.6	1.0	1.5
Dementia	4717	7.2	14.2	6.5	3.1	5.5	7.7
Chronic pulmonary disease	1335	2.0	3.7	0.8	0.8	1.5	2.9
Rheumatic disease	143	0.2	0.2	0.1	0.2	0.3	0.5
Peptic ulcer disease	51	0.1	0.1	*	*	*	*
Mild liver disease	247	0.4	0.5	0.2	0.1	0.5	0.5
Diabetes without chronic complication	5828	8.9	8.4	7.7	5.9	10.3	8.9
Diabetes with chronic complication	3788	5.8	7.4	3.8	2.7	6.3	6.0
Hemiplegia or paraplegia	527	0.8	0.8	0.4	0.3	0.6	1.0
Renal disease	3710	5.7	9.4	3.0	2.8	5.0	6.7
Malignancy‡	734	1.1	1.6	0.6	0.3	1.2	1.6
Moderate or severe liver disease	56	0.1	0.2	0.0	0.0	0.0	0.1
Metastatic solid tumour	388	0.6	0.9	0.3	0.1	0.6	0.7
AIDS/HIV	6	0.01	*	*	*	*	*
Total admissions:	65379	100	13164	5102	4786	4547	4506

Source: VAED, (2011/12-2013/14)

Table 7 Prevalence of Charlson's comorbidities, as recorded in the VAED incident injury admissions for falls in 2011/12 to 2013/14, per sex and age groups.

Comorbidities	Sex		Age Groups (years)				Aged care‡	
	Male %	Female %	65-74 %	75-84 %	85-94 %	95+ %	Other %	Yes %
Myocardial infarction	0.7	0.6	0.2	0.5	1.0	0.7	0.6	0.7
Congestive heart failure	2.9	2.4	1.1	2.4	3.4	4.0	2.6	2.7
Peripheral vascular disease	0.5	0.3	0.3	0.4	0.4	0.4	0.4	0.2
Cerebrovascular disease	1.7	0.9	1.1	1.4	1.0	0.6	1.2	1.0
Dementia	6.9	7.4	1.6	6.3	10.5	11.3	6.8	15.4
Chronic pulmonary disease	2.9	1.7	2.1	2.4	1.8	0.8	2.1	1.5
Rheumatic disease	0.1	0.3	0.3	0.3	0.1	0	*	*
Peptic ulcer disease	0.1	0.1	0.1	0.1	0.1	0	*	*
Mild liver disease	0.6	0.3	0.9	0.4	0.2	*	0.4	0.2
Diabetes without chronic complication	10.4	8.3	10.4	10.6	7.2	4.1	8.9	8.5
Diabetes with chronic complication	7.3	5.1	6.5	7.1	4.7	2.5	5.9	4.6
Hemiplegia or paraplegia	1.3	0.6	1.0	1.0	0.6	0.3	0.8	0.5
Renal disease	7.4	4.9	3.5	5.7	6.7	6.6	5.7	5.6
Malignancy†	1.9	0.8	1.0	1.4	1.0	0.5	1.2	0.6
Moderate or severe liver disease	0.1	0.1	0.2	0.1	0.1	0	*	*
Metastatic solid tumour	1.1	0.4	0.5	0.8	0.5	0.2	0.6	0.2
AIDS/HIV	*	*	*	*	*	*	*	*

Source: VAED (2011/12-2013/14)

Note: Comorbidities recorded as a complication of the injury of admission, are not included.

* Omitted because the number was too low to be represented. † Any malignancy, including lymphoma and leukemia, except malignant neoplasm of skin ‡ Transferred from aged care residential facility

The prevalence of Charlson's seventeen comorbidities by sex, age group, and aged care (whether the person was admitted from an aged care residential facility), is shown in Table 7. In both men and women, diabetes with and without complication, renal disease and dementia were the most common comorbidities. Among those residing in residential aged care facilities, dementia was relatively common (15%). Among those admitted in relation to a fall, the prevalence of dementia increased with age, from 2% among those aged 65 to 74 years to 11% among those aged 95+ years. The prevalence of renal disease also increased with increasing

age. Diabetes, with or without complications, decreased with age. This could reflect survivor bias: those with diabetes may be more likely to die before reaching older age. This is further illustrated in Figure 5, which shows the prevalence of the four most commonly listed comorbidities: renal disease, diabetes with and without complication, and dementia; by five-year age groups.

To gain insight into the effect of comorbidity on injury outcomes, further analysis was conducted on a subset of persons with fall-related injury: those with hospital admission for a hip fracture. This was a common injury among fall-related injury admissions in



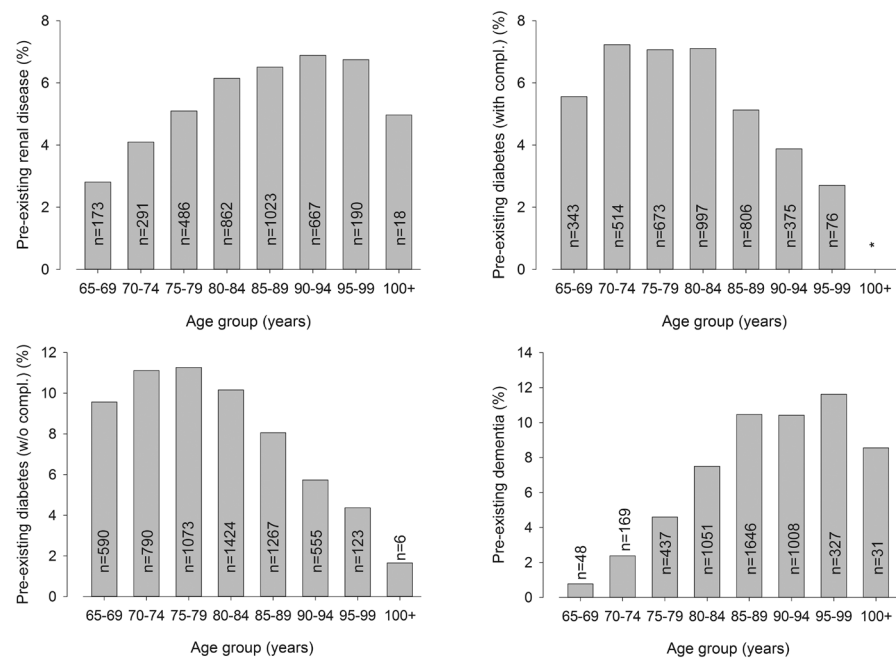
older persons, and generally associated with substantial morbidity and mortality. Length of stay and death were considered *injury outcomes*: these were determined from the initial admission as well as transfers and referrals to the same hospital, within twelve months of the initial admission. Length of stay was calculated as the mean number of days as well as the percentage of cases that had a stay of ten days or longer. Only incident admissions in 2011/12 and 2012/13 were considered, to allow for twelve months of follow-up (2013/14).

In Victoria, 2011/12 – 2012/13, there were 7947 new admissions for fall-related hip fractures among persons aged 65 years and older. Most (94%) were admitted from a private residence; 5.6% were transferred from an aged care residential facility. Of these, 62% were admitted (to the same hospital) only once, 31% were admitted/transferred twice, and 7% were admitted/transferred three times or more within 12 months of the initial admission. In total, 5.5% died while in hospital: 4.4% died during the first admission and a further 1.1% died after readmission/transfer (considering admissions to, and transfers within, the same hospital only). The mean length of stay of the first admission was 8.8 days; the summed length of stay taking same-hospital readmissions and transfers into account was 18.5 days.

The relationship between Charlson's comorbidities and length of stay and risk of death during admission for fall-related hip fracture is shown in Table 8. Each of the comorbidities listed in Table 8 were (statistically significantly) associated with longer hospital stay, with exception of dementia which was associated with *less days in hospital*. Death while in hospital was more likely to occur among those with (previous) myocardial infarction, congestive heart failure, dementia, chronic pulmonary disease, renal disease, and metastatic solid tumour. The remaining listed comorbidities were not statistically significantly associated with the occurrence of death while in hospital.

These associations were further examined in logistic regression models, taking age, sex, and all listed comorbidities into account. The results are shown in Figure 6: results are presented as odds ratios. An odds ratio of 1 implies that the presence of the comorbidity did not affect the outcome (outcomes were: 10 or more summed hospital days; death while in hospital). An odds ratio of greater than 1 implies that the presence of the comorbidity was associated with higher odds of the outcome. The figures also show

Figure 5 Prevalence of comorbidity, as recorded in the VAED incident injury admissions for falls in 2011/12 to 2013/14, 5-year age groups



Source: VAED, (2011/12 - 2013/14)

Shown are renal disease (top left), diabetes with complications (top right), diabetes without complications (bottom left) and dementia (bottom right)

Table 8 Prevalence of Charlson's comorbidities, as recorded in the VAED incident injury admissions for hip fractures in 2011/12 to 2012/13, and the association with length of stay and in-hospital death

Comorbidities	Length of stay		Death in hospital
	Length of stay‡ (days)	Length of stay‡ ≥10 days	Death in hospital‡
	Mean	%	%
Myocardial infarction	22.3	64.4	19.7
Congestive heart failure	24.4	72.5	20.2
Peripheral vascular disease	22.1	62.8	*
Cerebrovascular disease	30.8	78.6	6.9
Dementia	17.8	49.9	7.4
Chronic pulmonary disease	21.5	65.9	12.7
Rheumatic disease	*	*	*
Peptic ulcer disease	*	*	*
Mild liver disease	30.7	*	*
Diabetes without chronic complication	22.7	66.1	5.8
Diabetes with chronic complication	23.0	67.7	7.7
Hemiplegia or paraplegia	33.7	82.8	*
Renal disease	21.7	65.1	13.4
Malignancy†	21.8	68.9	15.2
Moderate or severe liver disease	*	*	*
Metastatic solid tumour	21.9	72.7	21.2
AIDS/HIV	*	*	*
All hip fractures admissions:	18.5	55.6	5.5

Source: VAED, (2011/12 - 2013/14)

* Omitted because the prevalence was too low to be analysed in relation to the outcomes. † Any malignancy, including lymphoma and leukemia, except malignant neoplasm of skin

‡ Based on initial admissions and transfers & readmissions to the same hospital (within 12 months of the initial admission) only. Readmissions and transfers to other hospitals are not included.

95% confidence intervals. Larger confidence intervals indicate lower levels of precision of the odds ratio. If the confidence interval *does not overlap the value of one*, this suggests that the association between the comorbidity and the outcome is statistically significant.

The associations between comorbidities and outcomes that are shown in Figure 6 are ranked. Among persons admitted to hospital for a fall-related hip fracture, the prevalence of mild liver disease, hemiplegia/paraplegia, congestive heart failure and chronic pulmonary disease were associated with longer (total



hospital stay, after taking age, sex and other comorbidity into account. Diabetes, with and without chronic complications, and renal disease, were mildly associated with longer hospital stay. Myocardial infarction and peripheral vascular disease had little impact on the summed length of stay. Dementia was statistically significantly associated with shorter hospital stay.

Metastatic solid tumour, congestive heart failure, myocardial infarction, renal disease, chronic pulmonary disease and dementia were all associated with risk of death during hospital stay among hospital admissions for fall-related hip fracture. These were ranked from greatest to smallest effect size. Malignancy, diabetes, with or without complication, and cerebrovascular disease had no statistically significant impact on the risk of death while in hospital, in this group.

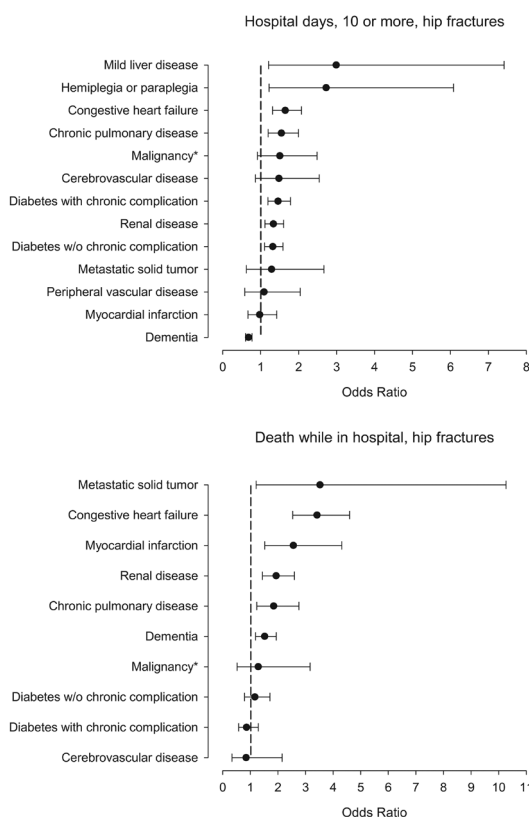
Emergency department (ED) presentations (non-admissions only)

N=33,802 (3 years), annual average: 11,267 ED presentations

Fall-related injury incident emergency department (ED) presentations for persons aged 65 years and over accounted for almost half (47%, n=33,802) of all incident injury ED presentations in Victoria for the 3-year period 2011/12 to 2013/14. This represents an annual average of 11,267 ED presentations and an annual average rate of 1,369.7 per 100,000 population; the age-standardised rate was 1,345.6 per 100,000 population (Table 2). Over the 10-year period from 2004/05 to 2013/14, the average annual percentage change in fall-related injury incident ED presentations was +3.3% while the corresponding crude rate increased by +0.4%, on average (Table 2). These ED presentation numbers do not include those who were subsequently admitted to hospital.

Figure 7 presents fall-related ED presentation rates from July 2004 to June 2014 for persons aged 65 years and over. Both crude rates and age-standardised rates follow a very similar pattern over the 10-year period with both rates peaking in the same financial year (2006/07) with values 1477.2 and 1445.9 per 100,000 resident population, respectively. A second, lower, peak occurs in 2009/10 while rates decrease thereon to 1,361.5 per 100,000 (crude rate) and 1,342.0 per 100,000 (age-standardised rate) (Figure 7).

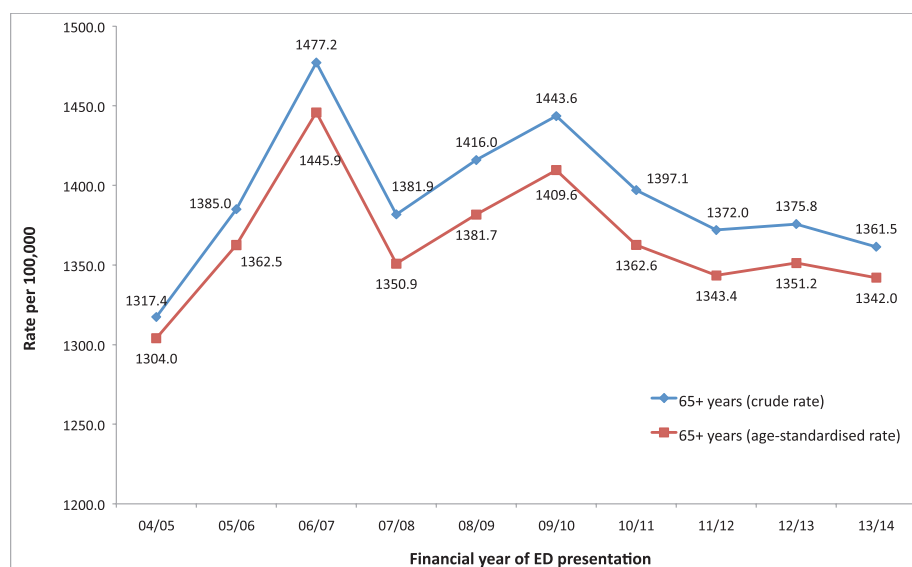
Figure 6 The association between Charlson's comorbidities and length of stay (top figure) and in-hospital death (bottom figure), among hip fracture related hospital admissions 2011/12 and 2012/13.



Source: VAED, (2011/12-2013/14)

Logistic regression modelling results are given as odds ratios (closed circles) and 95% confidence intervals (error bars). Confidence intervals that do not include 1 indicate a statistically significant association between the comorbidity and the outcome. The models were adjusted for age group, sex, and all listed Charlson's comorbidities.

Figure 7 Comparison of ED presentation rates (non-admissions) for falls among persons aged 65+ years, Victoria (2004/05-2013/14)



Source: VEMD (2004/05-2013/14)



Sex and age

Over the 3-year study period, females accounted for 65% (n=21,827) of fall-related injury incident ED presentations (Table 1). The age-standardised ED presentation rate for females was higher at 1613.1/100,000 persons compared to the rate for males (1345.6/100,000 persons) representing a female to male ratio of 1.6:1 in ED presentations. Similar patterns were noted when stratifying rates by age group and sex with female: male ratios of 1.6:1 for the 64-74 year age group and 1.4:1 for those aged 75-84 years (Figure 8). The difference in rates from age 85 years onwards was less pronounced as age advanced with ratios of 1.1:1 for 85-94 year olds and almost equal rates for those in the 95+ year age group.

Agers ranged from 65 to 105 years with an average age of 78.2 years (SD 8.7). In terms of frequencies, adults aged between 65-74 years represented 38% (n=12,768) of fall-related incident ED presentations, followed by persons aged 75-84 years accounting for 36% (n=12,169) (Table 1). Fall-related incident ED presentation rates increased with age with the highest rates observed for persons aged 95 years and over (3767.7/100,000) (Figure 8).

Country of birth/geographic region

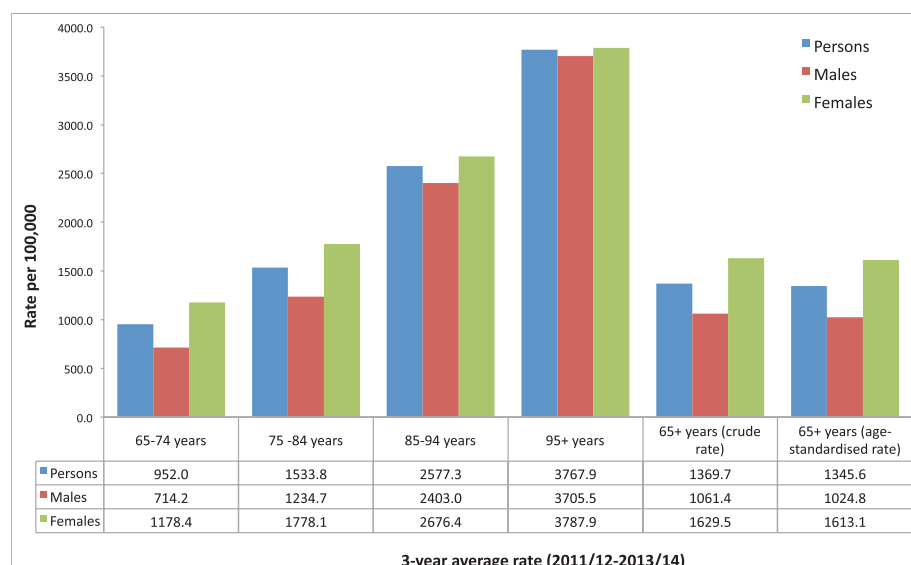
Almost two-thirds (62%, n=21,042) of older persons were Australian-born, 30% (n=10,207) were born in Europe and a smaller proportion (3%, n=933) were Asian born. A large proportion (62%, n=21,089) resided in the Melbourne metropolitan region, while the remainder resided in regional and rural Victoria (38%, n=12,713) (Table 1).

Causes of fall-related injury incidents

In the ED presentations data collection, causes of falls are limited to two categories: falls (low), defined as a fall on the same level or from less than a metre or unknown while the second category; and falls (high), which includes falls from heights greater than 1 metre. The overwhelming majority (96%, n=32,510) of fall-related ED presentations were due to low-level falls. High-level falls accounted for only 4% (n=1,292) of all fall-related ED presentations. One-line case narratives can provide detailed information on the cause and circumstances of the fall but they were of variable quality and generally yielded limited additional information.

In a 5% random sample (n=1,634) of ED presentations for low-level falls, the text narrative was analysed. Only 29% of the sample (n=478) provided any additional

Figure 8 Average fall-related ED presentation rates (non-admissions only) by age group and sex among people aged 65+ years, Victoria, 2011/12 to 2013/14



Source: VEMD (2011/12-2013/14)

information on the mechanism/circumstances of the fall in the text narrative. Of these, 'trips' accounted for 48% of cases, followed by 'slips' (12%). Falls from beds (10%), steps (10%), chairs (6%), stairs (3%), and ladders (2%) were also identified as well as vehicle-related falls (e.g., alighting from cars or being knocked down by bicycles) (4%).

Thirty-five percent (n=81) of the sample of low-fall 'trips' narratives (n=231) provided detail on the mechanism of the trip. The tripping hazards included: uneven or broken public footpaths, road and gutters; mats, rugs and carpets in the home; power cords in the home; kerbs/borders in home gardens; household pets; and a wide variety of moveable/portable items in and around the house and garden.

Thirty-seven percent of the sample of low-fall 'slip' narratives (n=57) provided details on the circumstances of the slip. Wet or 'slippery' household floors, built outdoor surfaces (footpaths) and 'natural' surfaces (grass, gravel) were commonly mentioned slip hazards. Other slip hazards included loose rugs, mats and carpets.

All (n=1,292) of high-level falls text narratives were analysed: only 45% of the sample (n=575) providing any additional information on the mechanism/circumstances of the fall. Of these, falls from ladders accounted for 20% of cases, and falls from stairs (3%), steps (3%), beds (3%), vehicles (2%), chairs

(2%), trees (1%) and roofs (1%) were also identified. 'Trips' (7%) and 'slips' (2%) were less common among high falls than low falls.

Nature of injury and body site injured

Fractures accounted for just over a quarter (26%, n=8,874) of fall-related injury ED presentation injuries, followed by dislocations (21%, n=7,064), open wounds (18%, n=6,258) and superficial injuries (16%, n=5,584) (Table 1). The body sites most commonly injured were the head (27%, n=9,202), wrist and hand (16%, n=5,550), shoulders and upper arms (10%, n=3,498) and knees/lower leg (9%, n=3,005) (Table 1).

The most common specific injuries were open wounds to the head, accounting for 12% (n=4,060) of all fall-related ED presentations, followed by wrist/hand fractures (10%, n=3,342), superficial injuries to the head (8%, n=2,656), as well as shoulder/upper arm fractures (4%, n=1,378) and shoulder/upper arm dislocations/sprains (4%, n=1,351) (Table 4).

Place of occurrence

The home was the most common place of occurrence for a fall (56%, n=19,027), followed by residential institutions (11%, n=3,567), road/street/highways (8%, n=2,779), and trade/service areas (2%, n=641) (Table 1). Stratifying by age showed a strong association between the location of the injury



event and advancing age. A much higher proportion (25%, n=2,216) of people aged 85 years and over compared with the 65-74 year age group (2%, n=292) sustained their fall-related injury in a residential institution. Alternatively, 65-74 year olds had a higher proportion of falls occurring on a road, street or highway (included footpaths) compared with people aged 85 years and over (9%, n=1,206 vs 5%, n=465). There was very little difference in the proportion of older people in each 10-year age group who sustained their fall-related injury at home (proportions ranged from 58% to 51%).

Admission rates via the emergency department

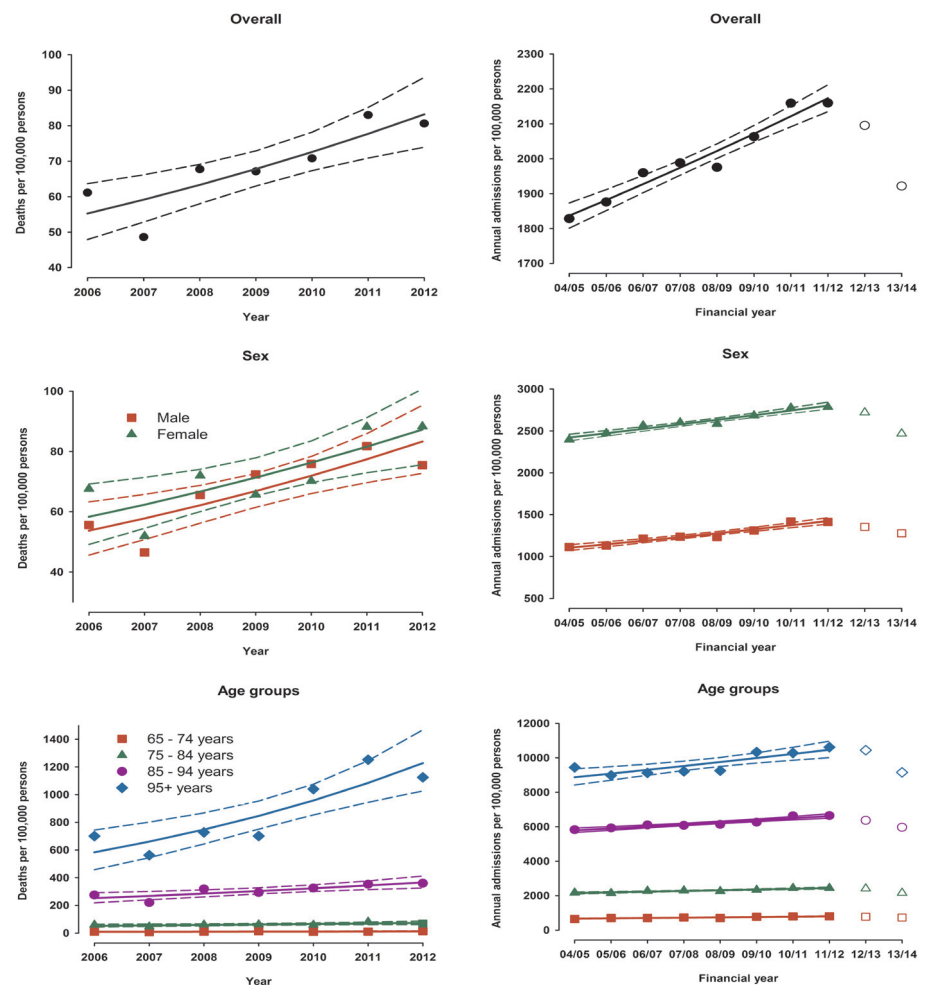
Just over half (53%, n=38,217) of fall-related ED presentations of persons aged 65 years and over were subsequently admitted to hospital. By comparison, only 15% (n=19,602) of fall-related injury ED presentations for persons aged 15 to 64 years were admitted to hospital. The proportion of fall-related injury ED presentations for older people increased with advancing age, starting at 39% (n=8,076) for the 65-74 year age group, 53% (n=14,007) for the 75-84 year age group, 64% (n=14,313) for the 85-94 year age group through to 68% (n=1,821) for those aged 95 years and over. Admission rates were similar for both males and females, at 50% and 54% of ED presentations, respectively. Over two-thirds (69%, n=19,479) of fall-related ED presentations admitted to hospital were due to fractures, then followed by dislocations, sprains and strains (12%, n=4,775) and open wounds (9%, n=3,577). Specific injury types commonly admitted to hospital via the ED (ranked, starting with the most common) were: fractures to the hip/thigh (femur) (22%, n=8,571), fractures to the shoulder/upper arm (5%, n=1,969) and fractures to the wrist/hand (4%, n=1,842).

Trend Analysis Modelling – Deaths and Hospital Admissions

Time trends in death rates and hospital admission rates (same day admissions excluded) related to falls are shown in Figure 9. Crude rates and modelled trend lines are shown overall, per sex and by age groups.

Annual fall-related injury death rates increased from 61 per 100,000 persons in 2006 to 81

Figure 9 Trends in death rates (left) and hospital admission rates (right) due to falls



NB. Same day admissions were excluded. The annual incidence is shown as symbols; modelled trends shown as lines (solid=mean; dashed=95% confidence intervals). Admissions data for 2012/13 and 2013/14 (open symbols) are not included in modelling because of the discontinuity related to change in the admission policy.

per 100,000 persons in 2012. The modelled rate showed a statistically significant annual increase in rate of +7.1% (Figure 9). Among men, the modelled rate increased by +7.6% per year; among women the increase was +7.0% per year. The modelled trend in fall-related death rates showed an annual increase of +5.7% in the age group 75-84 years, +6.4% in the age group 85-94 years and +13.2% in the age group 95+ years. In the 65-74 year age group, the increasing trend in fall-related death rate between 2006 and 2012 was not statistically significant.

Annual rates of hospital admissions due to falls (same day admissions/separations excluded) increased from 1,828 per 100,000 persons in 2004/05 to 2,160 per 100,000 persons in 2011/12. Over this time period, the modelled trend showed a statistically significant annual

increase of +2.4%. Crude rates in 2012/13 and 2013/14 dropped but this could be attributable to the change in hospital admission policy. Because excluding same-day admissions may not fully eliminate the impact of the admission policy change on rates, the years 2012/13 and 2013/14 were not included in the trend modelling. Among men, there was a +3.7% annual increase in modelled rate between 2004/05 and 2011/12; among women the annual increase was +2.1%. The rate increase was statistically significant for both men and women. There was a statistically significant increase in rates of fall-related hospital admissions in all four age groups between 2004/05 and 2011/12: the annual increase in modelled rate was +2.7% in the 65-74 year age group, +1.8% in the 75-84 year age group, +1.9% in the 85-94 year age group and +2.4% in the 95+ year age group.



Discussion

Trends in fall-related injury

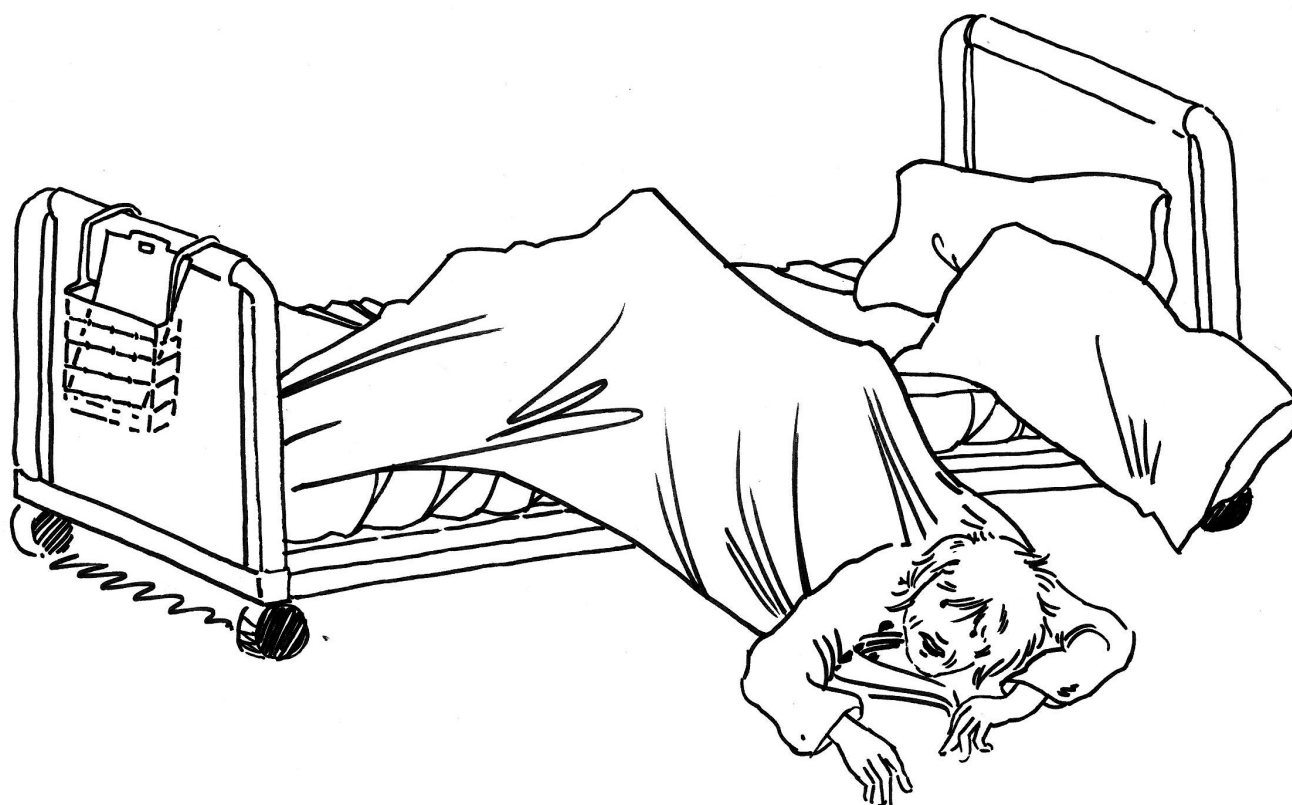
Several findings in this report are noteworthy as they have potential implications for injury prevention, planning and resource allocation. Falls are the leading cause of injury-related morbidity and mortality among Victorians aged 65 years and over, with 70% of injury deaths and 75% of injury-related hospital admissions in this age group being due to falls; furthermore, falls accounted for 83% of injury-related hospital bed days among Victorians aged ≥ 65 years. Fall rates, both in terms of ED presentations, hospital admissions and fatalities, increased steeply with increasing age. The fall-related injury death rate increased between 2006 and 2012, as did the rate of hospital admissions due to falls (in 2004/5 to 2011/12). In short, fall-related injury rates are increasing among older persons: together with the ageing of the population and an expected increase in the number of older persons in Victoria, this has a multiplicative effect. Based on these results, in the coming years the number of fall-related hospital admissions and injury deaths can be expected to increase more rapidly than might be expected based on population ageing alone. It should be noted that the recorded fall-

related hospital admission rates decreased in 2012/13 and 2013/14. The decrease in the rate of fall-related hospital admissions after 2012/13 could reflect effective recent falls preventive practices, however, this decrease could also be related to the hospital admission policy change in Victoria. Excluding same-day admissions may not have completely eliminated the effect of this, and until a more accurate method of adjusting for the Victorian admission policy change becomes available, a trend discontinuity in 2012/13 should be acknowledged. An alternative method to gain insight into the effectiveness of falls preventive measures in recent years, is to consider the cause of injury (falls) as a proportion of all injury admissions, over time. Effective recent falls prevention would result in a decrease in falls as a percentage of all injury admissions (assuming that falls prevention does not reduce non-fall related injury), regardless of the change in admission policy. For falls, this method is not very reliable, as falls are the leading cause of injury in persons aged 65 years and over. Other significant causes of injury, such as transport, are also sensitive to preventive actions and policy changes. While acknowledging these limitations, an overview of falls as a percentage of all incident injuries in Victoria is provided in the Appendix (Figure A1). Figures show the percentages over time: overall, per sex, per age group,

and per setting (a selection of two settings: residential institution and home only). These figures do not show a consistent decrease in fall-related injury as a proportion of all injury admissions after 2011/12. The availability of cause of death data for 2013 and 2014 will provide more robust evidence regarding the fall-related injury trend. If a decrease in fall-related death rates is observed for these years, this would suggest that fall-related (serious) injury rates have started to decrease. If the fall-related death rates have continued to increase in 2013 and 2014, there is cause for concern that current fall-preventive practices may not be sufficient.

Comorbidity and fall-related injury

The expected increase in fall-related injuries has implications for planning of resource allocation and targeting of preventive practices. In general, prevention can be targeted at those with the highest risk of falling; the highest risk for being injured in a fall; or the highest risk of complications after injury/ delayed or incomplete recovery. Ideally, all these factors should be measured and taken into account. In a study by Finch et al (2015), hospital bed days were used to explore factors associated with disproportionately (high) use of health care resources among those admitted to hospital for a fall-related injury. Patients



with comorbidities were reported to have longer length of stay in hospital. The current report supports these findings: comorbidities such as liver disease, congestive heart failure and pulmonary disease were associated with longer hospital stay; however, these findings are limited to fall-related *hip fracture admissions to hospital*. Overall, the prevalence of these comorbidities could be considered in the targeting of falls preventive measures for those at risk of adverse outcomes after a fall-related injury.

The number of days spent in hospital reflects several factors, such as injury severity, potential complications, and perceived service need (by the patient and the service provider). In the current report, dementia was associated with shorter hospital stay after a fall-related hip fracture. This was an unexpected finding, although similar patterns have been reported by studies from New South Wales: among those hospitalised for a hip fracture, dementia was associated with less days in hospital but increased mortality (Harvey et al 2016; Scandol et al 2013); although after age-adjustment, length was stay was greater among those with dementia, in studies in New South Wales on hip fracture hospital admissions (Mitchel et al 2016 and Harvey et al 2016). Overall, shorter length of stay could reflect service underutilisation among those with dementia (who may be considered less likely to respond to rehabilitation programmes), or early discharge as those with dementia are likely to have care arrangements in place. Evidence for service underutilisation was found in a New South Wales based study by Mitchel et al. (2016) who reported that after hip fracture, those with dementia had 4.3 times lower odds of receiving hospital based rehabilitation. To determine the best approach to primary and secondary prevention among older persons with dementia, further research is needed regarding the health service needs, care arrangements and recovery expectations after hip fracture in this group.

Comorbidity has been associated with adverse trauma outcomes in terms of increased mortality (Morris et al 1990, Milzman et al 1992, Sacco et al 1993, Wardle 1999, Skaga et al 2007). The impact of comorbidity on mortality after trauma was confirmed in a cohort of older persons aged 65 year or more with hospital-treated injury in the Lazio Region in Italy (Camilloni et al 2008). The prevalence of comorbidities (as listed in the Charlson Index) was 18%; myocardial infarction, congestive heart failure, dementia, renal disease liver disease and malignancy and metastatic tumour were associated with increased mortality. This is similar to the

findings of the current study, although our analysis was limited to older patients admitted with hip fractures and the study by Camilloni et al (2008) included all persons aged ≥ 65 years who were admitted to the emergency department with injury that occurred in the home. The association between comorbidity and length of stay has also been examined by MacKenzie et al (1989), and it was found that trauma patients with pre-existing disease had 69% longer length of stay compared with those without pre-existing disease. This effect was more pronounced among younger patients (aged 15-54 years).

The findings in this edition of Hazard that diabetes, with or without chronic complications, had only little impact on length of stay, and was not associated with in-hospital mortality, was unexpected and merits further discussion. A United States study of the influence of diabetes on rehabilitation outcomes after hip fracture reported an association between diabetes and length of stay in rehabilitation facilities (Reistetter et al 2011). This effect decreased with increasing patient age; study inclusion was not restricted to age 65 or more. Our analysis only included persons aged 65 years and over: the diabetes prevalence per age group figures (Figure 5) suggest a possible healthy survivor effect. That is, persons with diabetes and poor overall health may have high mortality rates and may therefore be underrepresented among the older falls injury group. Furthermore, in the current analysis, patient data were not internally linked, and episodes of care could not be grouped together if the person was transferred to another hospital. It is therefore possible that the effect of diabetes on length of stay would have been more pronounced if transfers to rehabilitation in another facility were included. Given the limitations of the data, the current results should be interpreted with caution: these do not fully capture the rehabilitation trajectory, particularly if this takes place in a facility other than the hospital of the initial admission.

Ageing population and falls prevention

Australia's population is ageing, with proportions of those aged 65 years and over projected to double, from 3.2 million people (14% of the population) in 2012 to 6.8 million (20%) by 2040 (ABS 2013). In addition, the number of people aged 85 years and over is expected to increase three-fold by 2040 to approximately 1.2 million, comprising 4% of the population compared to only 2% in 2012 (ABS 2013). These significant changes in the age structure of the population are a result of decades of sustained low fertility rates,

decreasing mortality rates and increasing life expectancy levels (ABS 2013). These changes will place considerable demand on the provision of adequate health and aged care services to older Australians for many decades to come (Department of Treasury 2015).

The Productivity Commission estimates that Australian governments will need to add the equivalent of 6% of national GDP to their budgets by 2060 in order to meet increasing levels of expenditure on health, aged care and the Age Pension (Productivity Commission 2013). They identified two related factors regarding health care costs: the first being that health care costs rise with age as people utilise more services at older ages; and that costs are affected by factors such as advances in the quality of services and new technologies. For example, a new drug (\$2100 per script) used to treat macular degeneration among older people has seen prescription numbers increase dramatically (557%) from an annual cost to the government of \$45 million (2007/08) to almost \$310 million in 2011/12 (Productivity Commission 2013).

The Intergenerational Report prepared by the federal government acknowledged the valuable contributions older persons make to the economy and living standards through volunteering or carer activities (Department of Treasury 2010). Improving several factors including health outcomes was seen as an important feature in encouraging and maintaining workforce participation for mature aged people who want to work.

Adding to government pressures with respect to older persons, carers and people with disabilities, will be the next generation of older persons: the baby boomers. The baby boomer generation, unlike previous generations, "have different expectations and aspirations and likely to demand higher quality and a greater range of services", (Department of Treasury 2010). In the report it is estimated that from 2009/10 to 2049/50, actual health expenditure on persons aged 65 years and over will increase seven-fold while real health spending on 85+ year olds will increase up to twelve-fold. A report by Moller (2003) specifically analysed projected costs of fall-related injury to older persons and found that for Victoria, overall health costs due to fall-related injury among 65+ year olds would increase to \$195.8 million in 2021 and \$256.7 million in 2031 representing a two-fold increase on the base amount of \$128.9 million in 2001. Hospital costs alone would increase by 52% to \$124.7 million in 2021, and will double by 2031 to \$163.8 million (Moller 2003). Hospital bed days for fall-related injury admissions among



older persons would increase by 47% to approximately 195,800 in 2021 and double in 2031 to 261,300 days. Moller (2003) estimated that to meet health cost expenditure at the current rate, a 66% reduction in the incidence of falls is required by 2051. These cost estimates, however, were conducted more than a decade ago and may underestimate the true cost of falls to the community. A recent study commissioned by NSW Health found that for the financial year 2006/07, the total cost of health care due to fall-related injuries in older residents of NSW was approximately \$558.5 million (Watson et al 2010). This NSW figure is almost double that of the estimate Moller (2003) projected for NSW in 2021 (\$265.5 million) and greater than the figure estimated for 2051 (\$443.1 million). Costs were broken down by health service utilisation type with hospital admitted cases comprising 84.5% of total costs, emergency department presentations accounting for 9% and other non-hospital attendances accounting for the remaining 6.5% (Watson et al 2010). The authors deduce that this equates to an average treatment cost of \$3,906 per fall-related injury treated, with the highest average costs associated with hospital admissions, at \$18,454.

Ageing populations affect labour supply, economic output and infrastructure requirements and government spending and can trigger the momentum for new reform and policies such as the current transition of age of retirement from 65 years and 6 months to 67 years in 2023 (Productivity Commission 2013). Older persons who continue to participate in the workforce are generally healthier (Kachan et al 2015); they may have a lower risk of falls and fall-related injury as they are more likely to be physically active and socially engaged in the community (NPHP 2005).

Falls prevention presents an opportunity to make a difference through a reduction of health service utilisation and cost. This report has demonstrated the significant number of older Victorians who continue to sustain serious injuries from their falls and the burden this places on the health care system.

Limitations and data issues

Almost a third (32%) of fall-related injury admissions and 43% of fall-related injury deaths were coded to the non-specific category of “fall, other specified (W19)”. This code provides very limited information regarding the circumstances of the fall event. Reasons for using this code may include: patients not being conscious when they are admitted to the hospital or present at the emergency

department; the mechanism of injury is simply not being reported by the patient or on their behalf; or the information is not included in the patient’s medical record despite being reported (AIHW 2008). Proportions within the range of 26-27% were reported for Australian fall-related injury admissions coded to the W19 – unspecified fall code, illustrating that while the Victorian figure was slightly higher at 32% it was still relatively consistent (AIHW 2013a, 2013b). Improvements in reporting the mechanisms of injury would see a reduction in the utilisation of this particular code.

VEMD narrative data for fall-related injury among Victorians aged 65 years and over failed to provide adequate information regarding the mechanism of the injury event. The VEMD cause category for falls is divided into two sub-categories: falls (low), defined as a fall on the same level or from less than a metre or unknown while the second category, falls (high) includes falls from heights greater than 1 metre. As low-level falls accounted for 96% of ED presentations, a 5% random sample of case narratives was selected and analysed to further investigate the mechanisms of the fall-related injury. Less than a third of the sample contained sufficient additional information in the narrative component regarding the mechanism of fall-related injury. Similarly, less than half of all high-level fall case narratives provided any additional information regarding the mechanism of the fall-related injury. These figures are unlikely to improve without the introduction of data quality and completeness benchmarks, ideally set by the Department of Health and Human Services (DHHS). Good quality hospital injury data are essential to support the development of sound public policy and prevention and appropriate control measures to reduce injury rates and to evaluate the effectiveness of any new falls, and more generally, injury prevention interventions. Narrative data in particular can provide a wealth of information regarding the injury event and can also help identify newly emerging clusters of injury issues not detectable through established coding systems, such as ICD-10-AM and other equivalent classifications.

As discussed in the previous issue of Hazard (edition no. 79), which reported similar data quality issues regarding the VEMD, the core VISU grant from DHHS does not cover the provision of regular ED staff training on VEMD data collection to improve data quality. VISU provides the ED directors of all VEMD hospitals with a tailored annual report on the quality of their hospital’s coded VEMD data benchmarked against similar hospitals. Past interactions between hospital ED and VISU

staff over data quality issues indicate that the attitudes of senior ED and hospital managers are key influences on the quality of VEMD injury surveillance data collected in the ED.

The VAED data used in this study were not internally linked: patient episodes can be linked only if the patient returned to the same hospital. As a consequence, the summed length of stay and occurrence of in-hospital death, as they were determined from the current dataset, are underestimated; furthermore, these data cannot be used to determine readmission and transfer rates. In other words, the data cannot be used well to establish injury outcomes. Injury incidence and comorbidity could also be determined with more accuracy using internally linked data, as shown by Vu et al (2012) for hip fracture admissions in Victoria 2005-2008. A final limitation to be acknowledged is that comorbidities are generally only recorded in the Victorian hospital separations data if they are considered relevant to the admission: the comorbidities presented in this report are therefore likely to be an underestimate of the overall prevalence in this patient population.

Conclusion

Current levels of fall-related injury deaths, hospital admissions and ED presentations among older Victorians aged 65 years and over need to be reduced further to ease the burden on ED departments, hospital beds and aged care facilities. The number of fall-related injuries is expected to continue to increase, with the ageing of the population. Primary and secondary fall-related injury prevention efforts can be targeted at the oldest age groups and persons with comorbidity, in particular those with cardiovascular disease or chronic pulmonary disease. Persons with dementia should not be omitted from preventive programs: the observed lower number of hospital days after fall-related hip fracture among those with dementia vs those without merits further research to determine whether this is driven by exclusion from rehabilitation programs and service underutilisation in general, or better home care arrangements facilitation early discharge.





Recommendations

Falls are preventable. To minimise the likelihood of an individual experiencing a potentially life-changing fall, fall and injury preventive measures need to be implemented. The findings of this edition of Hazard 80 demonstrate that fall-related injury rates are not declining but increasing (through to 2011/12), particularly among the oldest age groups, and particularly in terms of fall-related mortality. The ageing of the population and the increase in fall-related injury rates with increasing age will have a multiplicative effect.

The following section provides a summary of currently recommended interventions and assessments. The rates, however, have not declined (at least not through to 2011/12) and development of further preventive strategies may be warranted. Measurement of fall

incidence, repeat fall rates, complications and outcomes can support the development of primary and secondary preventive measures. In light of the need for more research into falls, recommendations with regard to hospital and emergency department data quality, availability and suggested further analyses are therefore also provided.

Interventions (Moyer 2012, ASCQHC 2009, American Geriatrics Society 2015):

- Single interventions:
 - Older people should engage in regular exercise to prevent falls (particularly balance training)
 - Persons who have previously fallen should have their medication reviewed (in particular those taking four or more medications)
 - Home or environmental assessment

and modification (if hazards are present) should occur for those at risk of falling

- Vision impairment should be assessed and treated as soon as practicable
- For those living in the community, vitamin D and calcium supplementation can benefit
- Assistive devices can be used where appropriate
- Multiple or multifactorial interventions:
 - The combination of balance and strength exercises, education on the use of assistive devices, home assessment and modification, and review and possible adjustment of medication





- <https://www2.health.vic.gov.au/hospitals-and-health-services/patient-care/older-people/falls-mobility/falls/falls-preventing>

Hazard edition no. 67, pages 7-12 also provides comprehensive recommendations and supporting literature for falls prevention among persons aged 65 years and over.

Data quality and further studies to support the development of preventive strategies

- Continue to improve the specificity and quality of data regarding fall-related injury deaths, hospital admissions and ED presentations in Victoria
- Provide internally linked, or patient-based, hospital admission data. This will provide the opportunity to analyse the injury burden in terms of bed days and cost. This will also enable the analysis of complication rates and repeat rates of fall-related injury. And finally, this will provide more comprehensive data on comorbidities. These further analyses can be used to develop measures aimed at preventing complications after a fall and repeat falls; furthermore, these analysis will help to identify high risk groups that may benefit most from targeted interventions.
- Consider data linkage studies of hospital admission, emergency department presentations and cause of death data, to establish the true mortality rate, as deaths may occur after hospital discharge. This will also help identify risk factors for mortality after a fall, which can support development of preventive measures (that is, measures aimed at preventing complications, delayed recovery and death after a fall).
- Consider linkage studies with alternative sources of injury death data such as the NCIS which would provide greater detail relating to the mechanism of the injury event
- Consider more in-depth population based studies of falls risks and burden. This can be achieved by combining ED/ admissions/death data (numerator) with residential population data (denominator), to calculate falls admissions/bed days/deaths per population group. For this, both numerator and denominator need to be stratified by the variable(s) of interest, such as sex, age, residential aged care, health status, marital status.
- The development and enforcement of data quality benchmarks for coded and case narrative data within the VEMD (emergency presentation dataset) by DHHS

Assessment (American Geriatrics Society 2015):

- Health care professionals should be asking older adults at least once a year about falls
- Balance testing should occur, with any individuals displaying unsteadiness undergoing further assessment

Comprehensive falls prevention best practice guidelines in the community setting can be found in document “Preventing Falls and Harm from Falls in Older People: Best Practice Guidelines for Australian Community Care”, published by the Australian Commission on

Safety and Quality in Healthcare at: <http://www.safetyandquality.gov.au/wp-content/uploads/2012/01/Guidelines-COMM.pdf>. Guidelines for aged care and hospital settings can also be found on the website.

The Victorian Department of Health and Human Services provides several resources relating to falls prevention in various settings (community, hospitals, aged care):

- <https://www2.health.vic.gov.au/ageing-and-aged-care/wellbeing-and-participation/healthy-ageing/falls-prevention>



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BOX 1: DATA SOURCES, CASE SELECTION AND ANALYSIS METHODS

Deaths

Death data have been extracted from the VISU-held Cause of Death (COD) dataset supplied by the Australian Coordinating Registry (ACR) and based on the Australian Bureau of Statistics (ABS) cause of death data.

Fall-related injury death cases were restricted to older Victorians aged 65 years or more at their time of death with a reference year within the range of 2006 – 2012 for trend figures and 2010 – 2012 for the main analysis. Fall-related injury death cases were defined by their underlying cause of death code (ICD-10) ranging in value between W00 – W19. Reference year rather than year of death was chosen to be consistent with ABS publications of COD data.

To improve the quality of ICD coding, the ABS introduced a revisions process for all coroner certified deaths registered after 1 January 2006. The process means data are preliminary when published for the first time, revised when published the following year and final when published two years after initial publication. For more detailed information regarding the ABS Causes of Death coding and revision processes, readers are directed to the ABS website and in particular: <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/3303.0Technical+Note12012>. As a result of the revisions process, the current release of data from the ACR contains final data for the period 2006-2010, revised data for 2011, and preliminary data for 2012.

Note: Frequencies less than 5 and rates based on frequencies less than 10 are suppressed and appear with an “” in the tables provided.*



Hospital admissions

Hospital admission data were extracted from the Victorian Admitted Episodes Dataset (VAED). The VAED records all hospital admissions in public and private hospitals in the State of Victoria.

Fall injury incident cases were selected for older Victorians aged 65 years or more at the time of admission, with a principal diagnosis in the ICD-10-AM coding range of S00-T75 or T79 and a first recorded external cause code in the range of W00 – W19 (Fall) (NCCH 2008). In addition, readmissions to the same hospital within 30 days, deaths in hospital and transfers within and between hospitals were excluded to avoid over-counting. All falls sub-categories were defined using external cause codes.

All types of fall-related injury admissions were included when providing estimates of direct hospital costs and number of hospital bed days as their inclusion provides a more accurate estimate of the burden of injury.

Emergency department (ED) presentations

ED presentations data were extracted from the Victorian Emergency Minimum Dataset (VEMD). The VEMD records all presentations to Victorian public hospitals with 24-hour emergency departments (currently 39 hospitals – 100% state-wide coverage of these hospitals applies from 2004). ED presentations were selected if the cause was coded as a fall, had a principal diagnosis in the range of S00-T75 or T79 and the person was a Victorian resident aged 65 years or older. Deaths, cases subsequently admitted to hospital and return visits for follow-up care were excluded to avoid over counting. Only fall-related initial ED presentations were analysed.

Analysis Methods

Rates

Crude and age-specific rates (per 100,000) were calculated using ABS Estimated Resident Population (ERP) figures for older Victorians in the corresponding years of injury. Age-standardised rates were calculated using the direct method and applying the 2001 ABS Victorian Census population figures as the standard.

Trend Analysis

Population based trends in the rates of Victorian hospital admissions (same day admissions excluded) and deaths due to falls were modelled using Poisson models, as trends in the annual number of events, with the log of the annual Victorian residential population as offset. Trends in hospital admissions due to falls were only modelled for the years 2004/05 to 2011/12 (the years 2012/13 and 2013/14 were omitted), because of the admission policy change which introduced a discontinuity in the data series. The results are shown in figures as the observed rates over time as well as the fitted rates with 95% confidence intervals. The analyses were conducted using the PROC GENMOD procedure in SAS V9.4.

Comorbidity Analysis

Charlson's seventeen comorbidities (Charlson, 1987) were determined from the ICD-10 diagnosis codes as described by Quan et al. (2005). Comorbidities that were recorded as a complication rather than a primary or associated condition, as indicated by the prefix variables, were not included.

Among hospital admissions for hip fracture in 2011/12-2012/13, the associations between comorbidities and hospital stay outcomes were examined. The outcomes considered were hospital days and the occurrence of death while in hospital. Incident admissions as well as readmissions and transfers to the same hospital were included. Admission records were internally linked by URNO: unique hospital-generated patient identifiers. Admissions were considered to be related to the incident hip fracture admission if they had the same URNO patient identifier, if they occurred within 12 months of the incident admission and if they contained a diagnostic code for hip fracture (not necessarily the first diagnostic code listed). To verify the likelihood that these were indeed hip fracture follow-up admissions, the first listed diagnostic code of the final admission was determined: in over 95% of cases, this code referred to rehabilitation, orthopaedic follow-up care, or femur fracture.

Length of stay was summed for the linked admissions and categorised as 10+ days or less than 10 days. Death while in hospital was determined from the final hospital admission related to the hip fracture. Comorbidities were determined from the incident admission.

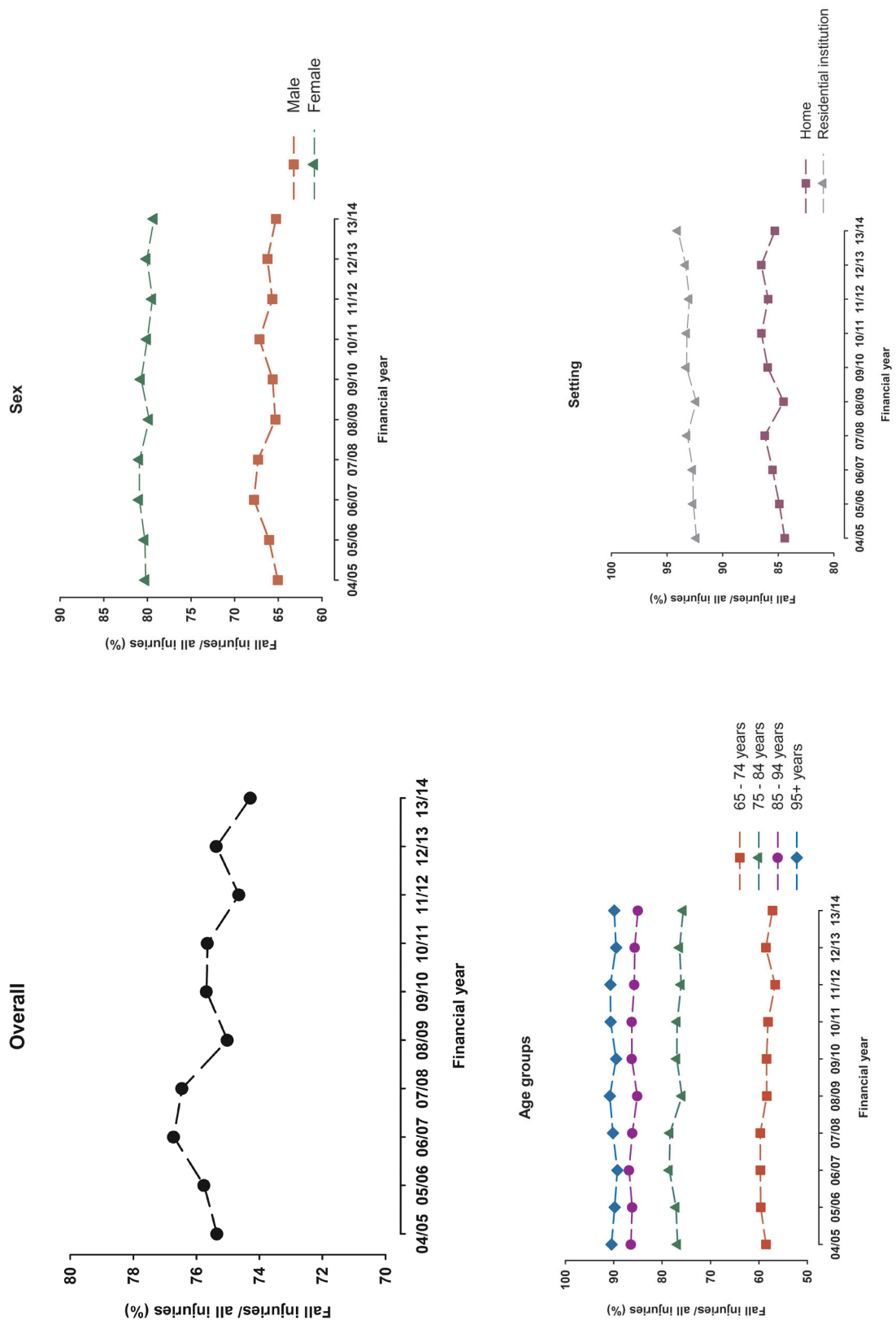
Crude associations between comorbidities and summed hospital days were statistically tested using signed rank tests; crude associations between comorbidities and death while in hospital were tested using chi-square tests. The associations between comorbidities and outcomes were then modelled using logistic regression models, adjusted for age group, sex, and all listed (Charlson) comorbidities.





Appendix

Figure A1 The percentage of all incident injury admissions that were fall-related, among Victorians aged 65 years and over. Results are shown overall (top left), per sex (top right), per age groups (bottom left) and per two settings: home and residential institution (bottom right).



Source: VAED (2004/05-2013/14)

- HAZARD EDITION INDEX -

Subject.....	Edition	
Asphyxia.....	60	Ladders.....63
Assaults.....55,73,79		Lawn mowers.....22
Babywalkers, update.....16,20,25,34		Marine animals.....56
Baseball.....30		Martial arts.....11
Boating-related recreational injury.....56		Mobility scooters.....62
Bunkbeds.....11, 75		Motor vehicle related, non-traffic, vehicle jack injuired.....20,63
Button Batteries.....75		Motorcycles.....64,65
Bicycles - Bicycle related.....6,31,34,44,65		Needlestick injuries.....11,17,25
- Cyclist head injury study.....2,7,8,10		Nursery furniture.....37,44
Burns - Scalds, Burns prevention.....3,12,25		Older people.....19,67,80
- Unintentional burns and scalds in vulnerable populations.....57		Off-street parking areas.....20
Child care settings.....16,76		Pedestrians.....71,72
Client survey results.....28		Playground equipment.....3,10,14,16,25,29,44,61,65,77
Co-morbidity analysis.....80		Poisons - Domestic chemical and plant poisoning.....28
Cutting and piercing (unintentional).....52		- Drug safety and poisons control.....4
Data base use, interpretation & example of form.....2		- Dishwasher detergent, update.....10,6
Deaths from injury (Victoria).....11,38,76,80		- Early Childhood, Child Resistant Closures.....27,2,47
Dishwasher machine detergents - Update.....18		- Adult overview.....39
DIY maintenance injuries.....41		Power saws, Chainsaws.....22,28
Dog bites, dog related injuries.....3,12,25,26,34,69		Residential Institutions.....76
Domestic architectural glass.....7,22,25		Road injury.....36,65,76
Domestic Violence.....21,30,79		Roller Blades, Skateboards, Scooters.....2,5,25,31,44,78
Drowning/near drowning, including updates.....2,5,7,30,34,55		School.....10,76
Elastic luggage straps.....43		Settings for injury.....76
Escalator.....24		Shopping trolleys.....22,25,42
Exercise bicycles, update.....5,9		Smoking-related.....21,25,29,44
Falls - Child, Older Persons, Home, Bunk Beds..44,45,48,59,65,75,77,78,80		Socio-economic status and injury.....49, 70
Farm, Tractors.....30,33,24,47,68		Sports - child sports, adult sports, surf sports, snow sports.....8,9,44,15,51,56,66,74,76
Finger jam (hand entrapment).....10,14,16,25,59		Suicide - motor vehicle exhaust gas.....11,20,25,41
Fireworks.....47		Trade and service areas.....76
Geographic regions of injury.....46		Trail bikes.....31
Health Service Areas.....76		Trampolines.....13,42,61,75
Home.....14,32,59,65,76,80		Vapouriser units.....43
Horse related.....7,23		Venomous bites and stings.....35
Infants - injuries in the first year of life.....8		VISS: How it works, progress, A decade of Victorian injury surveillance.....1,26,40
Injury surveillance developments, inc. ICD10 coding.....30,43		VISAR: Celebration of VISAR's achievements, VISAR name change to VISU.....50,61
Intentional.....13		Work-related.....17,18,58,76
Latrobe Valley		
- First 3 months, Injury surveillance & prevention.....9, March 1992, Feb 1994		



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Participating hospitals

From October 1995

Austin & Repatriation Medical Centre
Ballarat Base Hospital
The Bendigo Hospital Campus
Box Hill Hospital
Echuca Base Hospital
The Geelong Hospital
Goulburn Valley Base Hospital
Maroonah Hospital
Mildura Base Hospital
The Northern Hospital
Royal Children's Hospital
St Vincents Public Hospital
Wangaratta Base Hospital
Warrnambool & District Base Hospital
Western Hospital - Footscray
Western Hospital - Sunshine
Williamstown Hospital
Wimmera Base Hospital

From November 1995

Dandenong Hospital

From December 1995

Royal Victorian Eye & Ear Hospital
Frankston Hospital

From January 1996

Latrobe Regional Hospital

From July 1996

Alfred Hospital
Monash Medical Centre

From September 1996

Angliss Hospital

From January 1997

Royal Melbourne Hospital

From January 1999

Werribee Mercy Hospital

From December 2000

Rosebud Hospital

From January 2004

Bairnsdale Hospital
Central Gippsland Health Service (Sale)
Hamilton Base Hospital
Royal Women's Hospital
Sandringham & District Hospital
Swan Hill Hospital
West Gippsland Hospital (Warragul)
Wodonga Regional Health Group

From January 2005

Mercy Hospital for Women

From April 2005

Casey Hospital

From July 2011

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How to access VISU data:

VISU collects and analyses information on injury problems to underpin the development of prevention strategies and their implementation. VISU analyses are publicly available for teaching, research and prevention purposes. Requests for information can be lodged via the data request form on the VISU website or by contacting the VISU office by phone.

