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VISU
VICTORIAN INJURY SURVEILLANCE UNIT

Preventing injury in Victorian seniors aged 65 years and older

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This issue of Hazard provides an overview of the burden of injury among seniors with special attention given to the epidemiology and prevention of the three leading causes of death and serious injury (all unintentional): falls, transport and asphyxia (mainly caused by choking).

Summary

Analysis of the latest available 3 years of data from the three VISU-held injury surveillance datasets covering deaths (2003-5), hospital admissions (2004-6) and emergency department presentations (2004-6) found that:

- Over the 3-year study period, there were 1,942 deaths, 81,846 hospital admissions and at least 56,764 ED presentations for injury among seniors aged 65 years and older.
- Most injury deaths (87%) and hospital-treated injury cases (95%) were unintentional (formerly called 'accidental').
- A significant upward trend was evident in the unintentional injury death and hospitalisation rates over the decade (1996-2005 for deaths and 1997-2006 for hospitalisations).
- The leading cause of unintentional injury deaths and hospital admissions was falls (n=1,192 deaths and 61,486 hospital admissions), followed by transport and asphyxia (mainly choking).
- Fractures accounted for close to three-quarters of fall deaths (72%), more than half of hospital admissions (54%) and one-quarter (25%) of ED presentations.
- Among falls admissions, the most common specific injury was hip fracture (19% of all falls admissions), followed by open wounds to the head (9%), forearm/elbow fractures (8%), fractures of the abdomen/lower back/lumbar spine/pelvis (6%), and shoulder/upper arm fractures (6%).
- Although the age-adjusted hospitalisation rate for all fall-related injuries showed a significant 19% increase over the decade 1997-2006, there was a significant 31% decrease in the hospitalisation rate for fall-related hip fractures.
- The reason/s for the downturn in the hip fracture rate are not obvious and require more study but, if confirmed, the trend is a welcome development as 40% of seniors who sustain fall-related hip fractures have permanent functional disability and 15% fail to be able to live in their own homes after the fracture event.

Overview

Over the 3-year study period (2003/5 for deaths and 2004/6 for hospital-treated cases), 1,942 seniors aged 65 years and older died from injury causes and 137,610 were treated in hospital for injuries [81,864 hospital admissions and 56,764 emergency department (ED) presentations (non-admissions)].

Distribution by intent

Most injury deaths (87%) and hospital-treated injury cases (96%) were unintentional (accidental), mostly related to falls (Table 1). Twelve per cent of injury deaths and 1% of hospital-treated injuries were intentional, consisting of 217 suicides (11% of deaths) and 818 self-harm cases (<1% of hospital-treated cases), and 15 homicides (<1% of deaths) and 603 assaultive injury cases (<1% of hospital-treated cases).

An additional 13 injury deaths (<1% of all injury deaths) and 5,253 hospital-treated cases (331 injury admissions and 5,022 injury ED presentations — 4% of all hospital-treated cases) were assigned to the 'undetermined' intent code.

Trends in injury deaths and hospitalisations by intent

(1996-2005 for deaths, 1997-2006 for hospitalisations)

Trend in the frequency of injury deaths and hospitalisations

Trends in the frequency of deaths and serious injury (hospital admissions) by intent (excluding other and undetermined intent) are shown in Figures 1 and 2, respectively. The frequency of injury deaths and hospitalisations increased over the study period, by 64% and 63% respectively, driven by the increase in the frequency of unintentional (accidental) injury deaths and admissions.

Trend in injury death and hospitalisation rates by intent

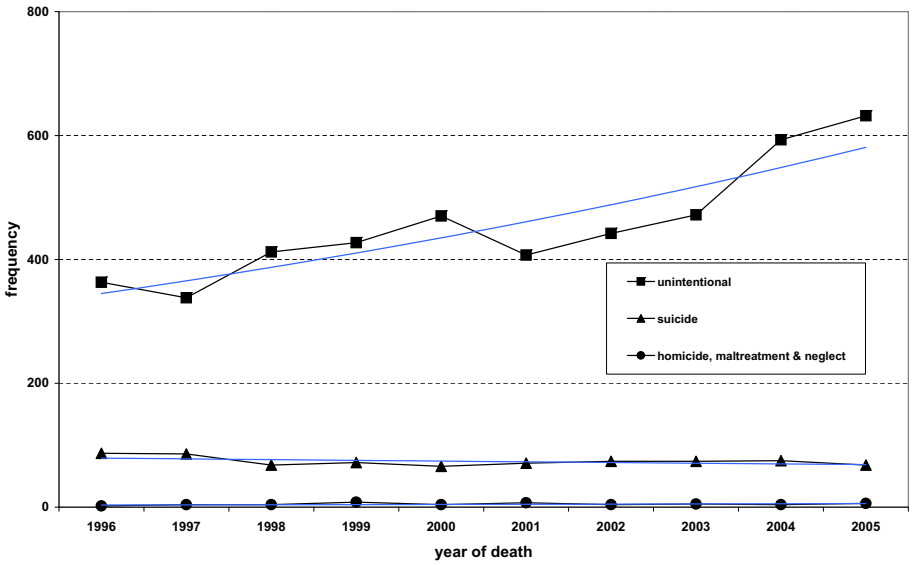
All rates are age-adjusted to take account of the ageing of Victoria's population over the decade.

Distribution of injury cases by intent, Victoria **Table 1**

	Deaths (2003-2005)	Hospital admissions (2004-2006)	ED presentations (2004-2006)
Unintentional	1,697 (87.4%)	80,602 (98.5%)	51,234 (90.3%)
Intentional	232 (12.0%)	913 (1.1%)	508 (0.9%)
Other & undetermined	13 (0.7%)	331 (0.4%)	5,022 (8.8%)
All	1,942 (100%)	81,846(100%)	56,764 (100%)

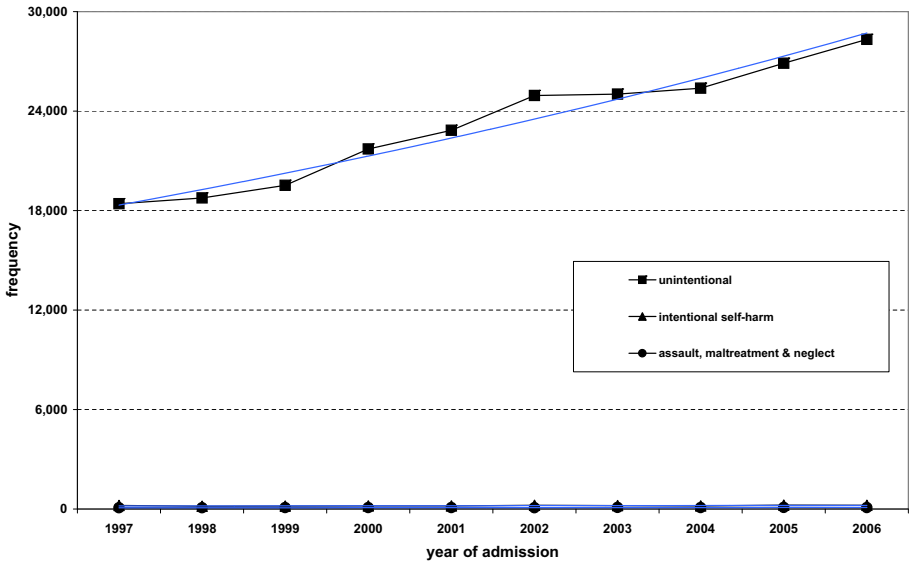
Source: Deaths (ABS-DURF); hospital admissions (VAED); ED presentations (VEMD)

Trend in the frequency of injury deaths of persons aged 65 years and older by intent, Victoria 1996 to 2005 **Figure 1**



Source: ABS-Death Unit Record File

Trend in the frequency of injury hospital admissions of persons aged 65 years and older by intent, Victoria 1997 to 2006 **Figure 2**



Source: Victorian Admitted Episodes Dataset (VAED)

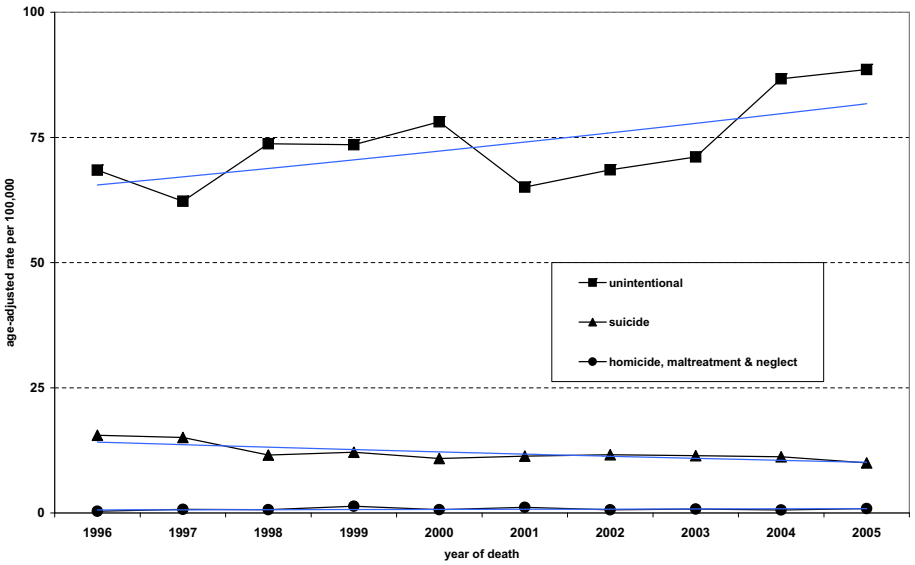
Trend in death rates by intent (1996-2005)

As shown in Figure 3, over the decade 1996 to 2005, there was a significant increase in the unintentional death rate (29%), a non-significant increase in the homicide rate (32%) and a significant decrease in the suicide rate (33%).

In detail:

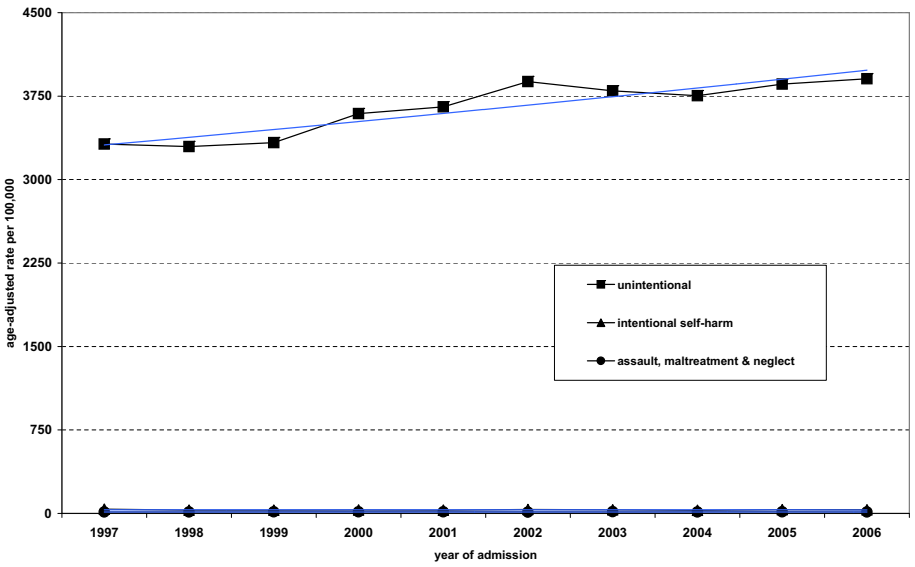
- The unintentional death rate *increased* significantly from 68.5/100,000 in 1996 to 88.5/100,000 in 2005, representing an estimated annual change of 2.6% (0.2% to 4.9%) and an overall increase of 29% (2% to 62%) based on the trend line. This was largely driven by a significant increase (43%) in the unintentional fall-related death rate from 42.8/100,000 in 1996 to 65.6/100,000 in 2006. Some of this increase can be explained by better reporting of deaths of older people involving a fall to the coroner.
- The suicide rate *decreased* significantly from 15.5/100,000 in 1996 to 10.0/100,000 in 2005, representing an estimated annual change of 3.9% (-6.1% to -1.8%) and an overall reduction of 33% (-47% to -16%) based on the trend line.
- The homicide rate *increased* from 0.3/100,000 in 1996 to 0.9/100,000 in 2005, representing an estimated annual change of 2.8% (-6.8% to 12.4%) and an overall increase of 32% (-51% to 221%) based on the trend line. This increase was not statistically significant.

Trend in the injury death rate of persons aged 65 years and older by intent, Victoria 1996 to 2005 **Figure 3**



Source: ABS-Death Unit Record File

Trend in the injury hospital admissions rate of persons aged 65 years and older by intent, Victoria 1997 to 2006 **Figure 4**



Source: Victorian Admitted Episodes Dataset (VAED)

Trend in hospital admission rates by intent (1997-2006)

As shown in Figure 4, over the decade 1997-2006, there was a significant increase in the unintentional hospitalisation rate (23%) and very little change in both the self-harm hospitalisation rate (non-significant decrease of 3%) and assaultive injury rates (non-significant increase of 2.4%).

In detail:

- The unintentional injury hospital admission rate *increased* significantly from 3,320/100,000 in 1997 to 3,906/100,000 in 2006, representing an estimated annual change of 2% (1.3% to 2.8%) and an overall increase of 23% (14% to 31%) based on the trend line.
- The self-harm injury hospital admission rate *decreased* slightly over the decade from 38.3/100,000 in 1997 to 32.7/100,000 in 2006, representing an estimated annual change of -0.3% (-2.8% to 2.2%) and an overall decrease of 3% (-25% to 24%) based on the trend line. This decrease was not statistically significant.
- Although the assaultive injury hospital admission rate showed a small decrease over the decade, from 12.7/100,000 in 1997 and 12.4/100,000 in 2006. This was actually an overall estimated annual change of 0.2% (-1.6% to 2.1%) and an overall non-significant *increase* of 2.4% (-15% to 23%) based on the trend line.

Unintentional ('accidental') injuries

(Annual average: 566 deaths, 26,867 hospital admissions and 17,078 ED presentations)

Over the 3-year study period (2003/5 for deaths and 2004/6 for hospital-treated cases), there were 1,697 deaths, 80,602 hospital admissions and 51,234 ED presentations for unintentional injury among Victorian seniors, an annual average of 566 deaths, 26,867 hospital admissions and 17,078 ED presentations.

Gender and age

Females were over-represented, accounting for 56% of deaths, 66% of hospital admissions and 58% of ED presentations. The average annual unintentional injury death rate for females was 86/100,000 compared with 84/100,000 for males. The average annual unintentional female hospital admission rate was 4,666/100,000 population compared with the male rate of 3,065/100,000.

Unintentional injury deaths increased as age increased. There was an 18-fold increase in the rate of deaths and a sevenfold increase in rate of hospital admissions for seniors aged 65-69 years relative to those aged 85 years and older. The average age-specific unintentional injury death rate over the 3-year study period was 364/100,000 for persons aged 85 years and older compared with 21/100,000 for persons aged 65-69 years. The average age-specific annual hospitalisation rate for persons aged 65-69 years was 1,613/100,000 (1.6 in every 100) compared with 10,867/100000 for seniors aged 85 years and older (10.9 in every hundred).

The pattern was reversed for less serious injury (ED presentations) with 24% of unintentional injury cases occurring among 65-69 year-olds, reducing incrementally to 19% of cases among seniors aged 85 years and older.

Cause of injury

The major cause of unintentional injury deaths was falls (70%), followed by transport (13%), asphyxia: choking/suffocation (5%) and poisoning (2%).

Similarly, by far the most common cause of unintentional injury hospital admissions was falls (76%, mostly same level slips, trips and stumbles). The other major causes of admissions were: transport (5%, mostly car occupants and pedestrians); asphyxia: choking/suffocation (3%); and hit/stuck/crush (2%).

The major cause of unintentional injury ED presentations was falls (55%, mostly same level). Other common causes were struck by/collision with persons or objects (9%) and cutting/piercing (9%).

Nature and site of injury

Over half (53%) of the unintentional injury deaths were related to fractures, predominantly lower extremity (hip/thigh) fractures. Intracranial injuries accounted for 15% of deaths and foreign bodies causing threat to breathing a further 5%.

Among admissions, the lower extremity was the most frequently injured body site accounting for 35% of unintentional injury admissions, followed by the upper extremity (21%). Injuries to the trunk and head/face/neck were almost equally as common (each accounting for 17% of admissions). A different pattern was observed among ED presentations. The upper extremity was more commonly injured than the lower extremity (33% vs. 23%) and head/face/neck injuries were more common than trunk injuries (20% vs. 9%).

Forty-five percent of admissions were fracture cases, mostly affecting the hip and thigh (36% of fractures), the forearm/elbow (13%), the abdomen/lower back/lumbar spine/pelvis (12%) and the shoulder and upper arm (11%). Other frequently occurring injuries among admitted cases were open wounds (14%) and superficial injuries (9%). Open wounds (27%), fractures (17% mostly to the forearm/elbow) and dislocation/sprains/strains (17%) were the most common injuries among ED presentations.

Location (place of occurrence)

The place of occurrence (location) of injury was not recorded for 48% of unintentional injury deaths. Available records indicate that fatal injuries most commonly occurred in the home (17%) and residential institutions (15%).

Similarly, most hospital-treated unintentional injuries occurred in the home (38% of admitted cases and 59% of ED presentations), followed by residential institutions (17% of admitted cases and 5% of ED presentations).

The location of injury was unspecified for about one-quarter of the unintentional injury cases recorded on the VAED and the VEMD.

Length of stay

Thirty-seven per cent of unintentional injury admissions had a length of stay of less than two days. 30% had a LOS of 2-7 days and a further 30% had LOS of 8-30 days. 4% were in hospital for 31+ days. The average length of stay was just over one week (7.3 days).

Intentional injury

Suicide and self-harm

(Annual average: 72 deaths, 216 hospital admissions and 57 ED presentations)

Over the 3-year study period, there were 217 suicides, 647 self-harm hospital admissions and 171 self-harm ED presentations among persons aged 65 years and older, an annual average of 72 deaths, 216 hospital admissions and 57 ED presentations.

Gender and age

Males formed 77% of suicide cases whereas females were more likely to be treated in the hospital setting for self-harm than males. Females comprised 55% of self-harm admissions and 61% of ED presentations. Suicide and self-harm cases tended to be concentrated in the 'younger' age group of seniors; 57% of suicides, 52% of self-harm admissions and 65% of self-harm ED presentations involved persons aged 65-74 years.

Cause of injury

The major causes (mechanisms) of suicide were hanging (44%), poisoning by pharmaceuticals and other substances (28%) and firearms (13%).

Eighty-three percent of intentional self-harm injury hospitalisations and 56% of self-harm ED presentations were caused by deliberate self-poisoning with drugs, medicines and other biological substances. Other causes (mechanisms) were: cutting/piercing by sharp object (9% of admissions and 11% of ED presentations) and jumping/falling (1% of admissions and 12% of ED presentations).

Nature and site of injury

Because most self-harm injuries were poisonings their effect was systemic. The most common site-specific injuries were open wounds (14% of deaths, 6% of admissions and 13% of ED presentations) and fractures (0.3% of admissions and 7% of ED presentations).

Location (place of occurrence)

Most suicides and self-harm injuries occurred in the home (76% of suicides, 71% of self harm admissions and 59% of self harm ED presentations), followed by residential institutions (4%, 7% and 5% respectively).

Assault and neglect

(Annual average: 5 deaths, 89 hospital admissions and 112 ED presentations)

Over the 3-year study period there were 15 deaths, 266 hospital admissions and 337 ED presentations for assaultive injury, an average of 5 deaths, 89 hospital admissions and 112 ED presentations per year. There were no recorded neglect cases.

Gender and age

Males were more likely to be treated for assaultive injuries than females; 60% of deaths, 63% of admissions and 61% of ED presentations were male. The frequency of hospital-treated assaultive injury cases decreased as age increased. Sixty per cent of homicides, 55% of assaultive injury admissions and 60% of assaultive injury ED presentations occurred among seniors aged 65-74 years.

Cause of injury

The most common causes (mechanisms) of homicide were: bodily force (33%); sharp object (20%); strangulation/suffocation (20%); and blunt object (13%). The major causes of hospital-treated assaultive injury were: bodily force/struck by person (62% of admissions and 50% of ED presentations), followed by struck by blunt object (11% and 16%) and struck by sharp/cutting object (6% and 5%).

Nature and site of injury

The head, thorax (chest), and trunk were the most common sites of fatal injuries. Among admissions, the most frequently injured body sites were the head/face/neck (48%), the shoulder/upper arm (9%) and the thorax (chest) (8%) and the most frequently occurring injuries were fractures (30%), open wounds (22%) and superficial injuries (11%).

The head/face/neck (40%) and wrist/hand (11%) were the most frequently injured body sites for ED presentations. Open wounds (31%) were the most common injuries, followed by superficial injuries (17%) and fractures (12%).

Location (place of occurrence)

The major proportion of homicides and assaultive injuries occurred in the home (73% of deaths, 39% of admissions, 44% of ED presentations), followed by residential institutions (7%, 12% and 7% respectively) and the road, street and highway (7%, 6% and 11% respectively).

Major Causes of Injury in Seniors and Evidence-Based Preventive Measures

The ranking of causes of injury in seniors aged 65 years and older, based on frequency data, are shown in Table 2.

Falls are by far the major cause of injury in this age group and their prevention must continue to be the major focus of government (federal and state) and health sector health promotion/injury prevention initiatives.

1. Preventing fall injury

(Annual average: 397 deaths; 26,867 hospital admissions; and 9,398 ED presentations)

Our study showed that falls are by far the major cause of injury-related death and hospitalisation among seniors (aged 65 years and older). Over the three-year study period there were 1,192 fall related deaths, 61,486 fall-related hospital admissions and 28,195 fall-related ED presentations. In 2006, fall injury hospitalisations accounted for 157,303 hospital bed days, an average of 7.2 bed days per patient.

Trend in fall injury death and admission rates

All rates are age-adjusted to take account of the ageing of Victoria's population over the decade.

Trend in fall injury death rate (1996-2005)

The unintentional fall injury death rate showed a significant 43% increase over the decade, from 42.8 deaths/100,000 in 1996 to 65.6/100,000 in 2006. Some of this increase can be explained by improved reporting of fall-related deaths of older people to the coroner.

Trend in fall injury hospital admissions rate (1997-2006)

As highlighted on the front page of this *Hazard*, the all-fall age-specific injury hospital admissions rate showed a significant 19% increase over the decade based on the trend line, whereas the hip fracture rate showed a significant 31% decrease (Figure 5).

In detail:

- The all-falls age-adjusted hospital admission rate *increased* significantly from 2,567/100,000 in 1997 to 2,992/100,000 in 2006, representing an estimated annual change of 1.8% (1.0% to 2.5%) and an overall increase of 19% (10% to 28%) based on the trend line. The increase was largely explained by significant increases in the rate of falls admissions for superficial injuries (52%) and open wounds (80%) over the decade.
- The fall-related all-fracture age-adjusted hospital admission rate showed a significant *decrease* from 1,810/100,000 in 1997 to 1,586/100,000 in 2006, representing an estimated annual change of -1.2 (-2.0 to -0.5) and an overall reduction of 12% (-18% to -4.6%) based on the trend line. This was driven by the decreasing hospitalisation rate for hip fractures. There was a non-significant increase in the hospital admission rate for all other fractures combined (3%) but this increase was much less than that seen for superficial injuries and open wounds.
- The downward trend in the all-fracture rate is driven by the decrease in the hip fracture hospital admission rate as there was no downward trend in the all-fracture rate excluding hip fractures. The fall-related age-adjusted hip fracture hospital

Ranking of injury causes among senior aged 65 years and older, Victoria (3-year period) **Table 2**

Rank	Deaths (n=1,942)	Hospital admissions (n=81,846)	ED presentations, non-admissions (n=57,922)
1	Falls – unintentional (1,192)	Falls – unintentional (61,486)	Falls – unintentional (28,195)
2	Transport – unintentional (221)	Transport – unintentional (3,668)	Hit/struck/crush – unintentional (4,667)
3	Suicide (217)	Choking/suffocation – unintentional (2,166)	Cutting/piercing – unintentional (4,407)
4	Choking/suffocation-unintentional (83)	Hit/struck/crush – unintentional (1,941)	Transport – unintentional (2,029)
5	Poisoning – unintentional (38)	Poisoning– unintentional (1,492)	Natural/environmental/ animals– unintentional (1,289)
6	Fires/burns/scalds – unintentional (27)	Natural/environmental/ animals – unintentional (1290)	Fires/burns/scalds – unintentional (569)
7	Natural/environmental/ animals – unintentional (21)	Cutting/piercing – unintentional (1024)	Poisoning– unintentional (394)
8	Assault (15)	Self-harm (647)	Machinery – unintentional (340)
9	Drowning – unintentional (13)	Fires/burns/scalds – unintentional (549)	Assault – unintentional (337)
10	Hit/struck/crush-unintentional (4)	Machinery – unintentional (447)	Choking/suffocation - unintentional (103)

Source: ABS-DURF: 2003-5; VAED: 2004-6; VEMD: 2004-6

admission rate *decreased* significantly from 789/100,000 in 1997 to 532/100,000 in 2006, representing an estimated annual change of -3.6% (-4.7% to -2.7%) and an overall reduction of 31% (-38% to -24%) based on the trend line.

A more detailed analysis of the downward trend in the fall-related hip fracture rate showed that the rate reduction was largely confined to hip fracture cases that occurred in the home (significant 40% reduction over the decade) and in cases where the location of injury was unspecified (significant 63% reduction over the decade). By contrast, the hip fracture rate for cases that occurred in residential institutions showed a non-significant upward trend over the decade (13%). The observed downturn in the hip fracture rate requires further investigation and confirmation.

Distribution and pattern of fall injury

The frequency, distribution and pattern of fall injury are shown in Table 3.

Gender and age

Females were over-represented accounting for 60% of deaths, 70% of admissions and 67% of ED presentations for fall injuries.

Fall injury deaths and hospital admissions increase as age increased, with seniors aged 85 years and older accounting for 60% of deaths and 37% of admissions. Over the 3-year study period, the average age-specific falls hospitalisation rate for seniors aged 85 years and older was 9,300/100,000 per year (1 in 11) compared with 3,565 /100,000 for seniors aged 75 –84 years (1 in 28) and 1,184/100,000 for seniors aged 65-74 years (1 in 84).

Cause of injury

A high proportion of falls cases for this age group on the deaths and admissions datasets were not allocated a specific cause code with 70% of fatalities and 53% of admissions coded to 'fall – unspecified' or 'fracture-unspecified'.

The major specified cause of fall injury at all levels of severity was same level falls including slips, trips and stumbles (17% of fall deaths, 47% of fall hospital admissions and 19% of ED presentations). Other common causes were: falls from beds, chairs (including wheelchairs) and other furniture (8% of deaths, 9% of admissions and 6% of ED presentations); and falls on or from stairs and steps (2% of deaths, 5% of admissions and 4% of ED presentations).

Nature and site of injury

Fractures accounted for close the three-quarters of fall deaths (72%, mainly hip fracture), more than half of hospital admissions (54%) and one-quarter (25%) of ED presentations. The other major injury related to deaths was intracranial (brain) injury (17%).

Among admissions, the most common specific injury was hip fracture (19% of all falls admissions) followed by open wounds to the head (9%), forearm/elbow fractures (8%), fractures of the abdomen/lower back/ lumbar spine/pelvis (6%), and shoulder/upper arm fractures (6%).

Location (place of occurrence)

In 52% of falls fatalities and 20% of admissions the location of injury was unspecified. The most common specified locations were the home (19% of deaths and 43% of admissions) and residential institutions (21% for both deaths and admissions).

ED presentations data were better reported for location with only 14% of cases coded to 'location, unspecified'. Analysis of these data confirmed that fall injuries mostly occurred in the home (including garage, garden and shed) (54%), followed by residential institutions (10%) and the road/street/ highway (10%).

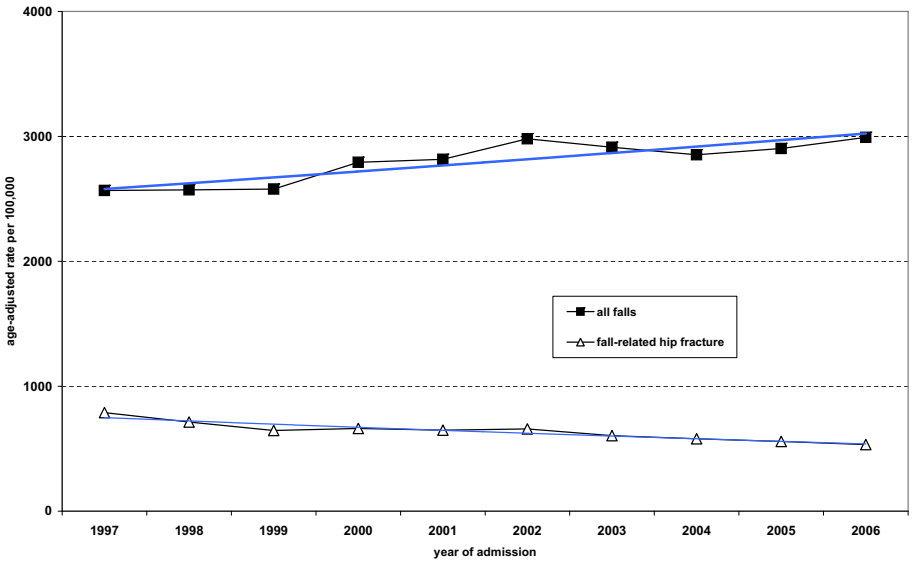
Length of stay

More than one third of fall injury admitted cases had a length of stay of less than two days (35%). The average length of stay was more than one week (7.6 days).

Evidenced-based falls prevention measures

Prevention of falls and fall injuries in older adults has been a major focus of health research stimulated by growing appreciation of the personal and societal costs of this health problem for older adults. There is extensive literature on interventions to prevent falls in older people and a number of

Comparison of trends in fall injury hospital admission rates and fall-related hip fracture hospital admission rates, Victoria 1997-2006. **Figure 5**



Source: Victorian Admitted Episodes Dataset (VAED)

good quality systematic reviews have been undertaken to evaluate the evidence from randomised controlled trials, the 'gold standard' for evaluation studies.

The Cochrane Collaboration* systematic reviews of randomised clinical trials are reliable sources of guidance on the effectiveness of health interventions. However, the Cochrane review of interventions for the prevention of elderly falls by Gillespie et al. (2003) which currently contains 62 trials, is due for a substantial update as the results of new trials, especially of interventions in the community setting, are being reported every few months. Results of other good quality published reviews are included in the discussion of effective interventions if they contained more trials than the Cochrane review and involve a meta-analysis of pooled data. Some results from recently published randomised controlled trials are included if relevant but a thorough search of the literature was not performed.

Interventions to prevent falls in community-dwelling older people

Risk factor screening/intervention programs

Three recent systematic reviews that included meta-analysis of pooled data have assessed the effectiveness of risk factor screening/ intervention programs and report conflicting results. The Cochrane review identified that risk factor screening/intervention programs were effective in reducing the risk of falls in unselected older people living independently in the community (4 trials, 1651 participants, pooled RR 0.73, 95%CI 0.63-0.85) and community dwelling older people with a history of falling or with known risk factors (5 trials, 1176 participants pooled RR 0.86, 95%CI 0.76 to 0.98) (Gillespie et al., 2003).

The systematic review by Chang et al. published in 2004, covered almost the same ground as the Cochrane review but included data from more original randomised clinical trials of falls interventions and used different statistical methods. These factors allowed the authors to explore the relative effectiveness of four individual interventions (multifactorial fall risk assessment, exercise, environmental modification and education). A multifactorial falls risk assessment and management program was shown to be the most effective intervention on risk of falling (10 studies adjusted risk ratio 0.82, 95%CI 0.72-0.94) and monthly rate of falling (7 studies adjusted rate ratio (0.63 95%CI 0.49-0.83), confirming the favourable findings of the Cochrane review. (Exercise had a significant beneficial effect on the risk of falls but not on the monthly rate of falling and environmental modification and education were not shown to be effective.)

In contrast to these favourable reports, the most recent review of the effectiveness of risk assessment and management for community dwelling older people concluded that current evidence indicates that this intervention may only have, at best, a modest effect (Gates et al., 2008). The review and meta-analysis, by Gates and colleagues from the Warwick Clinical Trials Unit in the UK, included all relevant studies in the Cochrane and Chang et al. reviews plus the results of six new trials of falls risk assessment and management published since 2003, five of which reported no effect and one a negative effect.

The review focussed solely on evaluating the evidence on the effectiveness of multifactorial falls risk assessment and intervention programs involving older people recruited from community and emergency care settings. Eighteen trials qualified for inclusion. Meta-analysis of pooled data showed no clear overall effect on the number of fallers during follow-up (18 studies; risk ratio 0.91, 95% CI 0.82-1.02) or fall-related injuries (8 studies; risk ratio 0.90, 95%CI 0.68-1.20).

The authors of all three reviews recommend more high quality controlled trials that are large enough to detect clinically important effects on the number of people sustaining falls and fall-related injuries and rates of falls. Lack of data on these important outcomes was found to be a major limitation of the existing evidence.

Exercise interventions

The Cochrane systematic review (Gillespie et al., 2003) remains the largest review of exercise interventions to date. The review

* *The Cochrane Collaboration, founded in 1993, is the name of a group of over 11,500 volunteer researchers in more than 90 countries who apply a rigorous, systematic process to review the effects of health interventions tested in randomised trials extended in a few more recent reviews to non-randomised, observational studies. All Australian residents with access to the internet can access the Cochrane Library (and thee review of falls interventions) free through the National Institute of Clinical Studies Australian Cochrane Centre. www.nicsl.com.au/cochrane/index.asp*

Frequency, distribution and pattern of unintentional fall injury among seniors aged 65 years and older, Victoria

Table 3

	DEATHS 2003-5 (n=1,192)		HOSPITAL ADMISSIONS 2004-6 (n=61,486)		EMERGENCY DEPARTMENT PRESENTATIONS 2004-6 (n=28,195)	
	N	%	N	%	N	%
Year						
Year 1	318	*26.7*	19,329	*31.4*	8,784	*31.2*
Year 2	403	*33.8*	20,317	*33.0*	9,268	*32.9*
Year 3	471	*39.5*	21,840	*35.5*	10,143	*36.0*
Gender						
Male	477	*40.0*	18,395	*29.9*	9,243	*32.8*
Female	715	*60.0*	43,091	*70.1*	18,810	*66.7*
Missing/unknown	-	-	-	-	142	*<1*
Age group						
65-74 years	87	*7.3*	12,509	*20.3*	10,106	*35.8*
75-84 years	392	*32.9*	26,248	*42.7*	11,224	*39.8*
85 years and older	713	*59.8*	22,729	*37.0*	6,865	*24.3*
Major causes of injury						
Falls on same level: slip, trip, stumble and other	203	*17.1*	28,705	*46.7*	5,483	*19.4*
Falls on same level: collision with/ pushing by other	1	*<1*	179	*<1*	32	*<1*
Fall involving ice and snow	1	*<1*	3	*<1*	2	*<1*
Fall involving iceskate/ski/rollerskate/skateboard	-	-	57	*<1*	3	*<1*
Fall on or from bed	53	*4.4*	3,217	*5.2*	874	*3.1*
Fall on or from chair	28	*2.3*	1,873	*3.0*	589	*2.1*
Fall on or from wheelchair	7	*<1*	333	*<1*	74	*<1*
Fall on or from other furniture	10	*<1*	202	*<1*	167	*<1*
Fall on or from stairs and steps	22	*1.8*	2,968	*4.8*	1,223	*4.3*
Fall on or from ladder	14	*1.2*	1,054	*1.7*	386	*1.4*
Out of or through building or structure	3	*<1*	231	*<1*	123	*<1*
Fall on or from scaffolding	1	*<1*	21	*<1*	3	*<1*
Fall from tree	-	-	42	*<1*	55	*<1*
Fall on or from playground equipment	-	-	11	*<1*	15	*<1*
Fall while being carried or supported by other	-	-	10	*<1*	5	*<1*
Diving or jumping into water	-	-	4	*<1*	-	-
Fall on or from cliff	-	-	29	*<1*	-	-
Other fall from one level to another	8	*<1*	606	*1.0*	N/A	N/A
Fracture, unspecified	411	*34.5*	2,307	*3.8*	N/A	N/A
Fall, unspecified	430	*36.1*	19,634	*31.9*	19,161	*68.0*
Broad body region injured						
Head/face/neck	318	*26.7*	12,325	*20.0*	7,334	*26.0*
Lower extremity	644	*54.0*	23,443	*38.1*	6,225	*22.0*
Upper extremity	53	*4.4*	13,367	*21.7*	9,595	*34.0*
Trunk	136	*11.4*	10,583	*17.2*	2,672	*9.5*
Multiple body regions	6	*<1*	47	*<1*	1,500	*5.3*
Body region not relevant	9	*<1*	259	*<1*	423	*1.5*
Other specified body region	-	-	-	-	90	*<1*
Unspecified body region	26	*2.2*	1,462	*2.4*	356	*1.3*
Nature of injury						
Fracture	859	*72.1*	33,207	*54.0*	7,046	*25.0*
Open wound	2	*<1*	8,483	*13.8*	6,674	*23.7*
Intracranial injury	206	*17.3*	1,709	*2.8*	355	*1.3*
Superficial injury	2	*<1*	5,721	*9.3*	3,875	*13.7*
Dislocation, sprain & strain	1	*<1*	1,855	*3.0*	5,572	*19.8*
Traumatic amputation	-	-	6	*<1*	4	*<1*
Injury to muscle & tendons	-	-	500	*<1*	1,337	*4.7*
Injury to internal organs	6	*<1*	207	*<1*	24	*<1*
Injury to nerves and spinal cord	3	*<1*	84	*<1*	14	*<1*
Injury to blood vessels	1	*<1*	24	*<1*	102	*<1*
Other and unspecified	112	*9.4*	9,690	*15.8*	3,192	*11.3*
Location						
Home	2 30	*19.3*	26,155	*42.5*	15,284	*54.2*
Residential institution	246	*20.6*	12,891	*21.0*	2,774	*9.8*
School, public buildings	71	*6.0*	4,566	*7.4*	384	*1.4*
Road, street, highway	11	*<1*	2,727	*4.4*	2,773	*9.8*
Trade or service area	7	*<1*	1,676	*2.7*	605	*2.1*
Place for recreation	3	*<1*	275	*<1*	1,009	*3.6*
Farm	2	*<1*	87	*<1*	107	*<1*
Industrial and construction area	3	*<1*	35	*<1*	32	*<1*
Other specified place	5	*<1*	797	*1.3*	1,419	*5.0*
Unspecified place	614	*51.5*	12,277	*20.0*	3,808	*13.5*
Length of stay						
<2 day			21,280	*34.6*		
2-7 days			18,040	*29.3*		
8-30 days			19,957	*32.5*		
31+ days			2,209	*3.6*		
Average length of stay (days)			7.6			

Source: Australian Bureau of Statistics (ABS-DURF) - deaths (2003-5); Victorian Admitted Episodes Dataset (VAED) - hospital admissions (2004-6); Victorian Emergency Minimum Dataset (VEMD) - ED presentations, non admissions only (2004-6).

included 23 trials of exercise and physical therapy interventions in the community and institutional care settings. The review split interventions by form of exercise (individually targeted and group) and setting (community and institutional care).

Group exercise delivered in the community setting

In the Cochrane review, data from nine of the 11 trials involving 1480 participants in group exercise programs conducted in the community setting were pooled to determine the overall effect on the number of fallers in the intervention group compared with controls. Although there was a trend in the right direction, no clear overall effect was found on the number of fallers during follow-up (9 studies, pooled RR 0.89, 95% CI 0.78-1.01).

Chang et al. reached a different conclusion but their meta-analysis included data from both individually targeted and group exercise trials. They found that exercise programs overall are effective in reducing the risk of falls (13 studies, adjusted risk ratio 0.86 95%CI 0.75 to 0.99) but this result could have been driven by the positive results from the included exercise programs targeting the individual.

Further support for the effectiveness of group strength and balance retraining is provided by a recently published controlled trial of group training by Freiberger et al. (2007). The study found a significant (23%) reduction in the number of fallers in a fitness group who participated in a 16-week exercise program focussed on strength, endurance and flexibility compared to the 'no intervention' (control) group (RR 0.77 95%CI 0.60-0.97).

Tai Chi

The Cochrane review included the one published trial of Tai Chi conducted by Wolf et al. (1997). Results could not be pooled. The study reported that those exposed to the intervention had a lower rate of falling than controls (risk ratio 0.51, 95% CI 0.36-0.75). Subjects, who were aged 70 years and older, participated in Tai Chi classes twice weekly for one hour over 15 weeks. The 10-form style of Tai Chi was specially designed to include movement components often restricted or absent with ageing, with a moderate focus on balance retraining.

A recently published controlled trial of a community based tai chi program conducted in Sydney by Voukelatos et al (2007) provides some additional evidence of the beneficial effect of Tai Chi. The study found that a 16-week Tai Chi program of classes of one-hour duration per week had no effect on the proportion of participants who had one fall over the 24-week follow-up period but substantially reduced the proportion of participants who had experienced two or more falls at 24 weeks follow-up (RR 0.54, 95% CI 0.28-0.96).

Individually tailored exercise programs delivered in the community setting

The Cochrane review assessed that individually tailored exercise programs that include muscle strengthening and balance retraining delivered by a trained health professional is of likely benefit, based on analysis of pooled data from three trials of the same home-based physical therapy program conducted by Campbell and colleagues in New Zealand. The meta-analysis demonstrated that the intervention significantly reduced the number of individuals sustaining a fall over a 12-month period (3 studies, pooled RR 0.67 95% confidence interval 0.51-0.98). Benefits were sustained for at least two years.

The intervention initially targeted women aged 80 years and older but subsequent trials targeted males and females aged 65 years and older. All participants were recruited through general practitioners. After a thorough assessment, participants were given a graduated tailored 30-minute exercise regime that included moderate intensity strengthening exercises with ankle cuff weights, balance and functional exercises. They were asked to walk outside the home at least three times a week. The health professional visited each of the exercise participants four times (for one hour) over the first eight weeks of the program. The program was equally effective when implemented by physiotherapists or nurses trained by physiotherapists.

Home hazard assessment and modification

The review by Chang et al. reported that available evidence did not support the effectiveness of environmental modification in reducing falls risk, the pooled estimates of effect did not reach statistical significance (5 studies, adjusted risk ratio 0.90 95%RR 0.77-1.05). The Cochrane review found a beneficial effect for people with a history of falls. It contained additional evidence and the meta-analysis of pooled data from four of the five trials of home hazard assessment and modification showed that among participants with a history of falls in the previous year there was a significant reduction in the number sustaining two or more falls during the study period (4 studies, RR 0.6, 95%CI 0.54-0.81).

Withdrawal of psychotropic medication

Several drugs have been associated with increased fall risk including neuroleptics, antidepressants, sedatives and cardiovascular drugs such as diuretics, type 1A antiarrhythmics and digoxin. Only one randomised controlled trial of the effectiveness of medication withdrawal has been conducted.

In a community-based study, Campbell and colleagues in New Zealand undertook a blinded withdrawal of psychotropic drugs (Campbell et al., 1999). The study found that the overall risk of falls was lower for the psychotropic medication (sedatives and antidepressants) withdrawal group compared with the original medication group (relative hazard 0.34, 95%CI 0.16-0.74). However, the sample size was small and nearly half of the patients that successfully reduced their use of psychotropic drugs in the trial returned to their former pattern of medication use within one month of the end of the trial.

A recently published prospective cohort study involving 139 elderly patients referred to one geriatric outpatient clinic and diagnostic day centre in the Netherlands found that the risk of a falls incident was halved in the group in which all fall-risk-increasing drugs (FRID) were discontinued or reduced compared with their cohorts who continued treatment without withdrawal of FRID (van der Velde et al., 2007).

The hazard ratio of a fall during follow-up was 0.48 (95% CI 0.23-0.99) for overall drug withdrawal, 0.35 (95% CI 0.15-0.82) for cardiovascular drug withdrawal and 0.56 (95% CI 0.23, 1.38) for psychotropic drug withdrawal, after adjustment for age, gender, use of fall-risk-increasing drugs, baseline falls frequency, co-morbidity, Mini-Mental State Examination score, and reason for referral. No information was given on whether the patients were living independently in the community or in supported accommodation and no follow-up occurred to determine

FRID drug-taking status beyond the two-month follow-up period after the set one-month period of drug withdrawal.

Hip protectors

Hip protectors are a secondary, rather than a primary, prevention measure because the aim of the intervention is to reduce harm after a fall event has occurred. There is a separate Cochrane review devoted to the evaluation of the effectiveness of hip protectors for preventing hip fractures in elderly people (Parker et al., 2006). The authors concluded from their meta-analysis of pooled data from three individually randomised studies that recruited elderly people living in the community that hip protectors had no effect on the incidence of hip fractures (3 trials, relative risk 1.16, 95%CI 0.85-1.59). Investigators who conducted a separate systematic review and meta-analysis, published in 2005, also found that hip protectors were ineffective in the community setting (Sawka et al., 2005).

Laboratory evidence indicates that hip protectors can reduce impact force on the hip to below the fracture threshold but trials of protectors are adversely affected by recruitment difficulties and compliance among the intervention (hip protector wearing) group. There are a number of community trials in progress that are attempting to address the issues of acceptability and wearing compliance.

Interventions to prevent falls in hospitals and aged care facilities

The most recently published systematic review of studies of the effectiveness of interventions to prevent falls and fractures in hospitals and care homes was published in the *BMJ* in January 2007 (Oliver et l., 2007). The review covers published studies to January 2005; 43 evaluation studies met the inclusion criteria.

Multifactorial interventions from risk factor assessment

Hospital patients

When results from the 12 eligible studies involving hospital patients were pooled, the authors found there is evidence for modest reductions in fall rates in patients from multifactorial interventions (meta-analysis showed a 20% reduction in fall rates). The interventions variously included risk and risk factor assessment, care planning, medical/diagnostic approaches, environmental changes, education programs, medication review, hip protectors, removal of physical restraints and exercise.

Care home residents

Although some individual evaluations of large multifaceted interventions in care homes reported significant reduction in falls, fallers and fractures, meta-analysis of pooled data from the 9 eligible studies showed no significant reduction in falls or fall injuries, so this type of intervention remains unproven in the aged care setting.

Single interventions

The authors also reviewed studies confined to single interventions: hip protectors in care homes (11 studies), calcium and vitamin D in care homes (2 studies), removal of physical restraints in either setting (5 studies), fall alarm devices in either setting (1 study), exercise in either setting (2 studies), changes in physical environment in either setting (1 study comparing carpeting with vinyl flooring), and medication review in either setting (1 study).

Hip protectors

Oliver et al. conclude that the only single intervention of proven effectiveness was hip protectors on hip fractures in care home residents. However, the update of the Cochrane review by Parker et al. (2006) on the effectiveness of hip protectors for preventing hip fractures in elderly people in nursing or residential care settings, found evidence of only a marginally significant reduction in the incidence of hip fracture (11 trials, relative risk 0.77 95%CI 0.62-0.97).

Their earlier review, published in 1999 and based on the evidence from 5 trials, concluded that hip protectors were effective for this population (Parker et al., 1999). The Cochrane authors report that results of trials in progress may help resolve the current uncertainty on the effectiveness of hip protectors. Ways to improve acceptance and adherence are being investigated in these trials.

Oral calcium and Vitamin D

Oral calcium and Vitamin D at appropriate doses was found to be effective in reducing rates of falls and fractures in older people in care homes in the two small studies included in the Oliver et al. review (2006) and in a third reasonably large Australian study (Flicker et al., 2005) published too late to be included. A broader systematic review and meta-analysis conducted by Biscoff-Ferrari et al. (2005) included only double-blind RCTs of oral vitamin D supplementation with or without calcium supplementation that examined hip or nonvertebral fractures not necessarily related to falls (8 trials).

When data from low- and high-dose Vitamin D trials were pooled separately, it was found that trials using 700-800 IU/d oral vitamin D with or without calcium supplementation significantly reduced the risk of sustaining a hip fracture (3RCTs, pooled RR 0.74; 95%CI 0.61-0.88) and any nonvertebral fracture (5RCTs, pooled RR 0.77; 95%CI 0.68-0.87) vs. calcium or placebo. In contrast, low dose Vitamin D supplementation (400 IU/d) was not sufficient for hip or non-vertebral fracture prevention. The target population consisted of older community dwelling or institutionalised persons.

These results were consistent with those from their previous review and meta-analysis of data from trials examining the role of vitamin D in preventing falls. They previously found that high dose Vitamin D (800 IU/d) reduced falls risk but low dose Vitamin D (400 IU/d) was not effective (Biscoff-Ferrari et al., 2004).

Tang and colleagues examined whether calcium supplementation can reduce osteoporotic fractures in persons aged 50 years and older (Tang et al. 2007). They performed a meta-analysis that included pooled data from all the randomised trials in which calcium, or calcium in combination with vitamin D, was used to prevent fracture and osteoporotic bone loss.

In trials that reported fracture as an outcome (17 trials, n=52 625), treatment was associated with a 12% risk reduction in fractures of all types (risk ratio 0.88, 95% CI 0.83-0.95; p=0.0004). In a subpopulation with a compliance rate of at least 80%, the level of fracture risk reduction was doubled (24%) compared with those with poor compliance (p<0.0001). The treatment effect was better with calcium doses of 1200 mg or more than with doses less than 1200 mg (0.80 vs. 0.94; p=0.006), and, as found by Biscoff-Ferrari et al., with vitamin D doses of 800 IU or more than with doses less than 800 IU (0.84 vs. 0.87; p=0.03). The authors suggest that additional calcium supplementation may not be critical for non-

vertebral fracture prevention once 700-800 IU of Vitamin D are provided.

Authors of a just-published review sound a word of warning on the efficacy of calcium monotherapy for older women (Reid et al., 2008). Their own trial (the Women's Health Initiative) suggested that calcium supplementation is associated with downward trends in vertebral, forearm and total osteoporotic fractures but a significant increase in hip fractures. They then repeated the Tang meta-analysis from a cohort of 55,000 considering only hip fractures and reported a similar reduction in fracture risk to that for all fractures found by Tang et al. However, when the studies were grouped according to whether calcium was given alone or in combination with Vitamin D treatment effects were very different.

Meta-analysis of pooled data from the 3 studies where calcium was given alone demonstrated an increase in the relative risk of hip fracture of 1.5 (95% CI 1.06-2.12). The studies all involved elderly community dwelling participants (mean ages 74-78 years) and had treatment durations of 4-5 years. By contrast, the meta-analysis of the 6 studies where calcium and Vitamin D were given in combination show a reduction in the relative risk of hip fracture (RR 0.84 CI 0,73-0.97). The authors conclude that current research indicates it is inappropriate to rely on high calcium intakes to reduce the risk of hip fractures and that, for high-risk older people, other agents with proven capacity to prevent hip fractures should be first in line for consideration (Reid et al., 2008).

Removal of physical restraints

Oliver et el. (2007) report that the 5 reviewed studies on the removal of physical restraints showed no significant positive or negative effect on falls or fractures.

Other single interventions

They also concluded that there was insufficient evidence for any other of the other single interventions —exercise, alarm devices, changes in the physical environment or medication review— in care settings and hospitals. However, the results in a missed report of a trial of clinical medication review of elderly residents (mean age 85) in care homes by a pharmacist (Zermansky et al., 2006) add weight to the existing evidence for the effectiveness of medication review. The UK study showed a very significant reduction (38%, pd"0.0001) in the number of falls in the reviewed population of residents compared with residents receiving usual care.

Recommendations

Current evidence indicates that interventions likely to be beneficial include:

- Health/environmental risk factor screening and multifactorial interventions for older people with a history of falling or selected because of known risk factors and for hospital patients
- Individually prescribed muscle strengthening and balance retraining prescribed at home by a trained health professional
- Home hazard assessment and modification that is professionally prescribed for older people with a history of falling.

Evidence is currently promising but inconclusive for Tai Chi in the community setting, and inconclusive for multifactorial interventions based on risk factor assessment, hip protectors in care settings and oral Vitamin D supplementation between 700 to 800 IU/d in high-risk community dwelling or institutionalised older women.

In an editorial in the *British Medical Journal*, Lesley Gillespie (an author of the Cochrane review) comments that the falls trials to date have only produced modest reductions, usually less than 35% in the number of people falling and in the number of falls. Because falls prevention interventions are labour intensive and expensive, she, Tinetti (1988) and Oliver et al.(2007) all suggest the need to target effective interventions to those at higher risk.

Campbell & Robertson (2007) advise that in the community setting, contrary to currently accepted guidelines, carefully targeted single interventions are as effective as multifactorial interventions, are likely to more acceptable to older people and cost less. Their meta-analysis of falls trials data showed that the seven multifactorial falls trials included in their review reduced falls by 22% (pooled rate ratio 0.78, 95%CI 0.68-0.89) and the 20 single interventions reduced falls by 23% (pooled rate ratio 0.77, 95%CI 0.67-0.89). They also recommend that intensive risk assessments and multifactorial interventions should be confined to individual patients who have fallen and are at increased risk of further falls. Their findings and recommendations have generated some debate in the literature (Day & Lord, 2008).

In an environment in which there are great demands on the health budget, available resources should be directed to the most effective and cost effective falls prevention measures. To this end, the Commonwealth Department of Health and Ageing has funded MUARC to model the impact, cost and benefits of falls prevention measures to support resource decision making by policy makers and program planners (personal communication, Lesley Day, MUARC). The report and recommendations will be submitted to DHA in June 2008.

The observed decrease in the hip fracture hospitalisation rate among senior Victorians over the decade 1997-2006 is a welcome development, but caution should be exercised when interpreting/using this finding as it requires further investigation and confirmation. There is some confirmatory evidence from New South Wales, New Zealand and elsewhere where reports indicate that hip fracture hospitalisation rates for persons aged 65 years and over stabilised, or decreased slightly in some age/gender groups, through the 1990s (Boufous et al., 2004; Fielden et al., 2001).

Conclusion

The increase in the number and rate of fall-related deaths and hospital admissions among senior Victorians indicate that insufficient resources are being allocated to elderly fall/fall injury prevention by federal and state governments. The proportion of older persons aged 65 years or more in Australia is currently about 2.6 million or 13% of the total population and is projected to double over time to 26% in 2051 (ABS, 2006). The pressure on ED Departments, hospital beds and aged care facilities will be tremendous if the current upward trend in the frequency and rate of fall injury-related deaths and hospital admissions is not arrested.

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2. Preventing transport-related injury

(Annual average: 74 deaths, 1223 hospital admissions and 676 ED presentations)

Transport-related injury ranked second to falls when the comparison is confined to fatalities and serious injury (defined as injuries requiring hospital admission). Over the 3-year study period there were 221 deaths, 3,668 hospital admissions and at least 2,029 ED presentations (non-admissions) for transport-related injuries.

Fatalities and admissions were mostly car occupants (53% of transport deaths and 57% of admissions) and pedestrians (31% of deaths and 18% of admissions). Other fatal and serious injury cases include pedal cyclists, motorcycle riders and bus occupants (for admissions only). Car occupants formed the major proportion of ED presentations for transport injuries (67%), followed by pedestrians (15%).

Trend in transport related hospital admissions (1997-2006)

The overall hospital admission rate for transport-related injuries showed a significant decrease (14%) over the decade 1997-2006, driven by the decreasing trend in the admission rate for injured car occupants (23%). There was a non-significant downward trend in the hospital admissions rate for pedestrians (19%) but an upward trend was observed in hospitalisation rates for motorcycle riders (150%) and bicyclists (3%) and 'other transport' (13%). Only the rate increase for motorcyclists reached statistical significance.

In detail:

- The all transport injury hospital admission rate decreased significantly from 212/100,000 in 1997 to 170/100,000 in 2006, representing an estimated annual reduction of -1.5% (-2.7% to -0.3%) and an overall decrease of 14% (-24% to -3%) based on the trend line.
- The car occupant injury hospital admission rate decreased significantly from 136/100,000 in 1997 to 98/100,000 in 2006, representing an estimated annual reduction of -2.6% (-4.1% to -1.2%) and an overall decrease of 23% (-34% to -11%) based on the trend line.
- The pedestrian injury hospital admission rate decreased from 35/100,000 in 1997 to 30/100,000 in 2006, representing an estimated annual reduction of -2.0% (-4.5% to 0.3%) and an overall decrease of 19% (-36.6% to 3.4%) based on the trend line. This reduction was not statistically significant.
- The motorcyclists injury hospital admission rate increased significantly over the decade from 3.8/100,000 in 1997 to 5.8/100,000 in 2006, representing an estimated annual change of 9.6% (3.2% to 15.2%) and an overall increase of 150% (37% to 312%) based on the trend line
- The pedal cyclist injury hospital admission rate showed a small increase from 11.8/100,000 in 1997 to 12.4/100,000 in 2006, representing an estimated annual change of 0.3% (-3.0% to 3.7%) and an overall increase of 3.4% (-27% to 44%) based on the trend line. This increase was not statistically significant.
- The 'other transport' injury hospital admission rate was fairly stable when rates at the beginning and end of the decade are compared (25.2/100,000 in 1997 and 24.7/100,000 in 2006), but over the decade there was an estimated annual increase of 1.2% (-1.3% to 3.7%) and an overall increase of 13% (-12% to 44%) based on the trend line. This increase was not statistically significant.

Distribution and pattern of injury

The pattern of transport-related hospital-treated injury among car occupants, pedestrians and 'other transport' groups is shown in Table 4. The 'other transport' group includes injured motorcycle riders, bicyclists and all forms of 'other' transport.

Gender

Females were over-represented in car occupant and pedestrian admissions and ED presentations but not in 'other transport' admissions and ED presentations

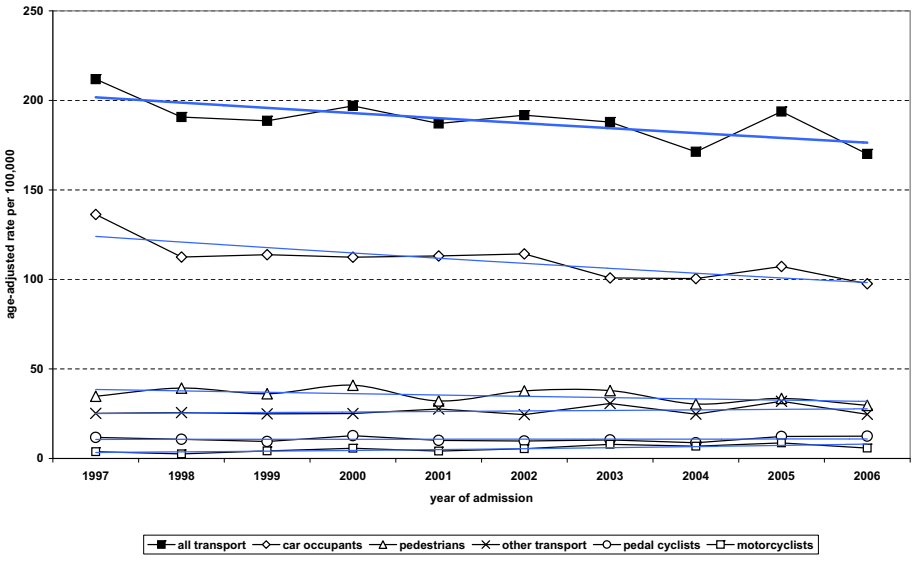
Body region injured

Among car occupant injury admissions and ED presentations, the most commonly injured body site was the trunk (44% of admissions; 30% of ED presentations), followed by the head/face/neck (27%; 26%).

Among pedestrian injury admissions and ED presentations, the lower extremity (36%-37%) was the most commonly injured body region. The head/face/neck (24%) was the second-most frequent injury region for hospital admissions, whereas the upper extremity (25%) ranked second for ED presentations.

Lower extremity injury (35%) was most common among 'other transport' hospitalisations, followed by trunk injuries (23%),

Trend in transport injury hospital admission rates by specific transport types, Victoria 1997-2006 **Figure 6**



Source: Victorian Admitted Episodes Dataset (VAED)

whereas for ED presentations the upper extremity (32%) was the most commonly injured body region, followed by the lower extremity (21%).

Nature of injury

Fracture was the most common injury for all transport related injury admissions (car occupants, pedestrians and 'other transport') followed by superficial injury for car occupants and open wounds for both pedestrians and the 'other transport' group.

Length of hospital stay

Of the three groups, pedestrians had the highest average length of stay in hospital (7.2 days) followed by 'other transport' (5.6 days) and car occupants (4.7 days).

Evidence-based prevention measures

A. Preventing injuries to car occupants

(Annual average incidence: 39 deaths, 696 admissions and 453 ED presentations)

Research undertaken in Australia and elsewhere indicates that older drivers have a comparatively high risk of crash involvement, especially when the measurement of crash risk is based on per distance travelled and even when adjustment is made for frailty/ vulnerability (Figure 7). Their passengers, usually in the same age group, are also at increased risk.

The explanation of the apparent over-involvement of older drivers in crashes compared with middle-aged drivers is complex. Research indicates that contributory factors include the following:

- (For many) Frailty: Age-related physical decline makes older people more likely to be injured on crash impact and therefore more likely to be included in crash statistics
- (For some) Shorter travel distances: Older people undertake more short trips compared with their younger counterparts which, paradoxically, raises their risk of involvement in crashes as their travel is often concentrated on local roads and streets that are less safe than freeways and multi-lane divided roadways; and
- (For a few) Reduced fitness to drive: Functional decline in sensory (eg. vision and hearing) and perceptual capacities are features of 'normal' ageing, exacerbated

by the onset of medical conditions such as arthritis, heart disease, arterial hypertension, diabetes and various forms of dementia.

(Langford & Oxley 2006)

Research also indicates that many, but not all, older drivers 'self-regulate' to compensate for any perceived deterioration in their functional capacity to drive safely by reducing their exposure, cutting back on longer distance travel and confining their driving to their local area, consolidating trips and not driving at night or in bad weather.

Recommendations

In response to the plateau in the annual national road toll from the mid-1990s, Australia and all constituent states and territories adopted a 'Safe System' approach to road safety in 2003, emulating the road safety philosophies adopted by Sweden and The Netherlands. This new approach aims to provide a safe, crashworthy system that is forgiving of human error and accommodates vulnerability to serious injury. It recognises that all aspects of the transport system should be integrated and that the key tasks are to manage the road infrastructure, speeds, vehicles and road users and the interactions between these components to achieve safe mobility. In essence, it shifts the focus from behavioural interventions, the major component of past strategies, to a more holistic four-pronged approach that includes strategies and measures aimed to produce safer roads, safer vehicles, safer speeds and safer road users.

Langley and Oxley (2006) applied the Safe System framework to the so-called 'older driver problem' and highlighted the strategies that have the most potential to reduce the elevated crash/injury risk evident in this age group of drivers.

- ***Safer roads:*** Implement measures to reduce crash risk at intersections, particularly in urban areas, by greater use of roundabouts, fully controlled right turn phases at intersections controlled by traffic lights and a range of other road design features, such as provision of adequate sight distances and increased conspicuity of the intersection, that offer sufficient time for older drivers to assess the traffic, make a decision and carry out the driving task.
- ***Safer vehicles*:** Continue to improve vehicle occupant protection, generally, and promote the safety concept of vehicle crashworthiness to older drivers encouraging them to upgrade their vehicles and to use crashworthiness ratings when choosing vehicle make and model. ITS application that are assessed as having the most potential benefit for older driver safety are front, rear and side impact warning systems, night vision enhancement systems and automated lane changing systems.
- ***Safer speeds:*** Reduce overall speeds to lessen the severity of crash outcomes for older drivers and their passengers, recognising that the greatest gain will come from reducing the speed of all drivers because older drivers generally drive at or below posted speed limits. This can be achieved by lowering speed limits with supporting traffic calming measures, particularly when applied at or near intersections.
- ***Safer road users:*** Educate and train older drivers to understand and ameliorate their crash risk and to adopt safe driving practices, and implement an appropriate licensing system to identify potentially at-risk older drivers through establishing a notification and referral network (GPs, police, family, friends and self-referral) and an effective formal fitness-to-drive assessment process by the licensing authority (currently under trial in Australia).

(Langford & Oxley 2006)

Conclusion

The key underlying consideration of the authors when framing this approach was to maintain the safe mobility of older people for as long as possible, based on research that indicates that travelling in a car is the safest transport mode for older people and that the 'older driver problem' may be confined to certain sub-groups such as those who have reduced fitness-to-drive and those who have poor risk perception or poor recognition of their changing abilities.

B. Preventing injuries to pedestrians

(Annual average: 23 deaths, 215 hospital admissions and 103 ED presentations)

Pedestrians comprise around 15% of Australia and Victoria's road fatalities and older pedestrians (aged 60 years and older) comprise close to 40% of pedestrian deaths (Austroads, 2007; TAC crash database, accessed 16/1/2008). Compared with younger adult pedestrians, older pedestrians are over-involved in serious injury crashes and under-involved in crashes of minor severity.

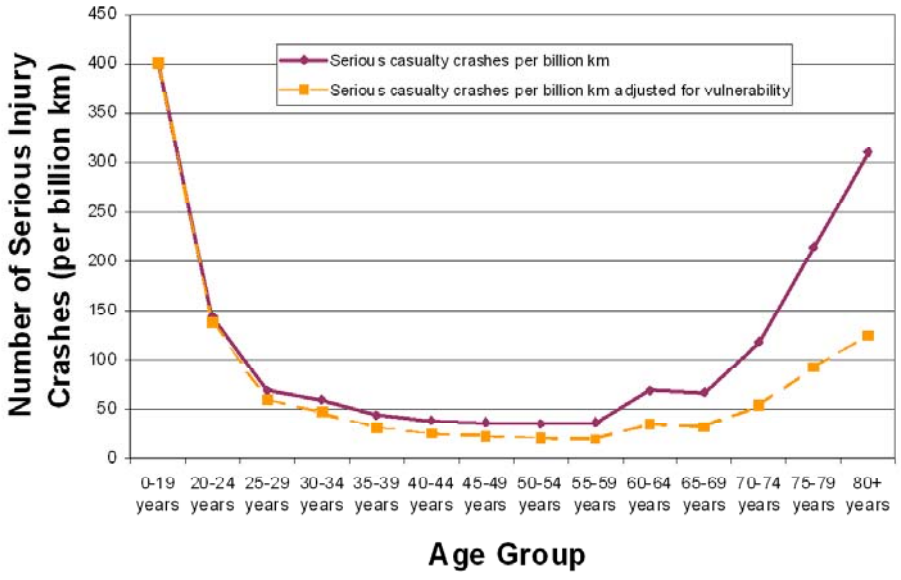
A comprehensive literature review conducted by MUARC researchers for the Swedish National Road Administration in 2004 (www.monash.edu.au/muarc/reports/muarc218.html) identified that complex traffic situations play a major role in the crash frequency of older pedestrians and they are over-represented in pedestrian-vehicle crashes at intersections (particularly those without traffic signals), mid-block crashes (particularly on wide multi-lane roads in busy bi-directional traffic), crashes with reversing vehicles and when accessing and exiting public transport (Oxley et al., 2004, review).

As for driving, there are consequences of ageing on sensory, perceptual, cognitive and physical abilities that contribute to the difficulties some older pedestrians have coping with complex traffic environments. For example, observation studies conducted in Victoria have shown that older pedestrians appear to have difficulty selecting appropriate gaps between traffic to accommodate their slower walking speed, especially evident when they make uncontrolled mid-block road crossings in complex two-way traffic (Oxley et al., 1997; Oxley, 2000). Research also shows that the average walking speed of older pedestrians is somewhere between 50-80% of that of younger pedestrians (Oxley et al., 2004).

Studies indicated that around 60% of pedestrian fatalities occur when the pedestrian is struck side-on by the front of a vehicle, is scooped over the bonnet and windscreen, slides over the roof and lands on the road. Multiple injuries are the usual result with the pedestrian sustaining lower leg injury on initial impact, then fracture of the femur/pelvis on impact with the leading edge of the bonnet and, subsequently, head, shoulder and chest injuries from impacts with the vehicle bonnet, windscreen frame or A-pillar and roof. The speed of the vehicle and the area of the vehicle struck by the head appear to be the main determinants of injury severity.

Based on available research evidence, the major causes of injury in older pedestrians are: the behaviour of drivers, the design of the frontal structure of vehicles especially large four-wheeled drive, vans and sports utility vehicles particularly if fitted with rigid bull bars, the design, construction and condition of the road environment and complex traffic conditions. Research on the role of functional decline in the causation of pedestrian-vehicle crashes is equivocal (Oxley et al., 2005), but increased frailty explains much of the over-representation of older pedestrians in crashes that result in death and high severity injuries.

Serious casualty crashes per billion km. By age group adjusted for vulnerability **Figure 7**



Recommendations

After a close analysis of a vast range of literature, Oxley and colleagues (2004) identified a number of innovative educational, behavioural and engineering measures that show promising benefits for the safety and mobility of older pedestrians. The authors recommend the following preventive strategies and measures:

- ***Awareness and education initiatives*** that raise safety awareness among older adults in relation to adopting safer behaviours when crossing roads, increasing their visibility to drivers and understanding signals, signs and road rules.

  Unfortunately, to date there have been no controlled evaluations of elderly pedestrian safety education/training programs and therefore it is difficult to gauge their effectiveness in reducing pedestrian trauma. However, the results reported from trials involving child pedestrians show that education and training can result in improvements in road safety knowledge and observed road crossing behaviour but whether these positive outcomes reduce the risk of pedestrian crashes and injury occurrence is unknown (Duperrex et al., 2002 - Cochrane review, accessed 2007; Congiu et al., in press).
- ***Vehicle design initiatives*** giving priority to international efforts to modify the design of frontal structures of vehicles to make them more 'forgiving' in the event of a collision with a pedestrian (or bicyclist). Examples of design improvements include the lowering of bumper position, use of impact absorbing material on parts of the bumper, redesign of the bonnet to cushion impact, provision of airbags and modifications to windscreens and windscreen.

  Also recommended is the banning of aggressive bull bars or the introduction of design rules that specify low profile, contour-hugging bull bars made of impact absorbing materials. ITS technologies that

Distribution and pattern of transport-related hospital-treated injury

Table 4

	CAR OCCUPANTS				PEDESTRIANS				OTHER TRANSPORT			
	Admissions (n=2,087)		ED Presentations (n=1,358)		Admissions (n=646)		ED Presentations (n=308)		Admissions (n=935)		ED Presentations (n=363)	
	n	%	n	%	n	%	n	%	n	%	n	%
Year												
2004	671	*32.2*	459	*33.8*	205	*31.7*	72	*23.4*	272	*29.1*	111	*30.6*
2005	730	*35.0*	443	*32.6*	229	*35.4*	104	*33.8*	362	*38.7*	101	*27.8*
2006	686	*32.9*	456	*33.6*	212	*32.8*	132	*42.9*	301	*32.2*	151	*41.6*
Gender												
Male	918	*44.0*	582	*42.9*	267	*41.3*	127	*41.2*	579	*61.9*	244	*67.2*
Female	1,169	*56.0*	765	*56.3*	379	*58.7*	181	*58.8*	356	*38.1*	119	*32.8*
Missing/unknown	-	-	11	*0.8*	-	-	-	-	-	-	-	-
Age group												
65-74 years	929	*44.5*	751	*55.3*	242	*37.5*	150	*48.7*	457	*48.9*	232	*63.9*
75-84 years	900	*43.1*	492	*36.2*	304	*47.1*	112	*36.4*	346	*37.0*	109	*30.0*
85 years and older	258	*12.4*	115	*8.5*	100	*15.5*	46	*14.9*	132	*14.1*	22	*6.1*
Broad body region injured												
Head/face/neck	565	*27.1*	352	*25.9*	157	*24.3*	45	*14.6*	179	*19.1*	50	*13.8*
Trunk	926	*44.4*	407	*30.0*	109	*16.9*	18	*5.8*	214	*22.9*	57	*15.7*
Upper extremity	211	*10.1*	132	*9.7*	136	*21.1*	78	*25.3*	196	*21.0*	117	*32.2*
Lower extremity	273	*13.1*	117	*8.6*	231	*35.8*	115	*37.3*	327	*35.0*	75	*20.7*
Multiple body regions	2	*0.1*	232	*17.1*	-	-	40	*13.0*	-	-	46	*12.7*
Body region not relevant	2	*0.1*	21	*1.5*	2	*0.3*	6	*1.9*	3	*0.3*	5	*1.4*
Other and unspecified	108	*5.2*	97	*7.1*	11	*1.7*	6	*1.9*	16	*1.7*	13	*3.6*
Nature of injury												
Fracture	813	*39.0*	110	*8.1*	353	*54.6*	55	*17.9*	493	*52.7*	62	*17.1*
Open wound	149	*7.1*	118	*8.7*	73	*11.3*	62	*20.1*	125	*13.4*	67	*18.5*
Intracranial injury	116	*5.6*	17	*1.3*	56	*8.7*	1	*0.3*	50	*5.3*	2	*0.6*
Superficial injury	257	*12.3*	295	*21.7*	56	*8.7*	52	*16.9*	68	*7.3*	62	*17.1*
Dislocation, sprain & strain	61	*2.9*	342	*25.2*	13	*2.0*	59	*19.2*	41	*4.4*	66	*18.2*
Injury to muscle & tendons	18	*0.9*	128	*9.4*	1	*0.2*	22	*7.1*	11	*1.2*	28	*7.7*
Injury to internal organs	75	*3.6*	4	*0.3*	13	*2.0*	2	*0.6*	22	*2.4*	1	*0.3*
Injury to nerves and spinal cord	14	*0.7*	2	*0.1*	2	*0.3*	-	-	8	*0.9*	1	*0.3*
Crushing injury	-	-	18	*1.3*	2	*0.3*	2	*0.6*	-	-	8	*2.2*
Injury to blood vessels	3	*0.1*	8	*0.6*	1	*0.2*	2	*0.6*	1	*0.1*	2	*0.6*
Other and unspecified	581	*27.8*	316	*23.3*	76	*11.8*	51	*16.6*	116	*12.4*	64	*17.6*
Location												
Road street highway	1,829	*87.6*	1,249	*92.0*	450	*69.7*	173	*56.2*	479	*51.2*	226	*62.3*
Home	61	*2.9*	39	*2.9*	66	*10.2*	84	*27.3*	46	*4.9*	39	*10.7*
Other specified place	62	*3.0*	42	*3.1*	61	*9.4*	30	*9.7*	148	*15.8*	81	*22.3*
Unspecified place	135	*6.5*	28	*2.1*	69	*10.7*	21	*6.8*	262	*28.0*	17	*4.7*
Length of stay												
<2 days	1,064	*51.0*			225	*34.8*			365	*39.0*		
2-7 days	637	*30.5*			215	*33.3*			330	*35.3*		
8-30 days	345	*16.5*			191	*29.6*			218	*23.3*		
31+ days	41	*2.0*			15	*2.3*			22	*2.4*		
Average length of stay (days)	4.7				7.2				5.6			

Source: VAED (Hospital admissions; VEMD (emergency department presentations, non-admissions)

would particularly enhance the safety older pedestrians are speed alerting and limiting devices, impact warning systems, in-vehicle speed alerting devices and systems that increase the visibility of vehicles to other road users. Canada, the Scandinavian countries and other Northern Hemisphere countries mandate the use of daytime running lights (DRL) and it is estimated that requiring DRL use in Australia could reduce fatal pedestrian-vehicle crashes by 4-12% (Paine, 2003).

- ***Infrastructure and road design initiatives*** giving priority to speed reduction measures including reducing speed limits to 30-40 km/h along with supportive traffic calming measures such as pavement narrowing, alteration to the road surface, installations of roundabouts in areas frequented by older pedestrians. Other recommended design improvements include separation of travel modes (eg. vehicle free areas, footpaths, barrier fencing, overpasses and underpasses), the simplification of traffic systems with priority given to intersection improvements and the provision of median islands on multi-laned and bi-directional roads and improved street lighting.

Retting et al. (2003) included only studies with adequate methodological designs in their recent review of traffic engineering measures to reduce pedestrian-motor vehicle crashes. The authors assessed that the most effective of the evaluated measures were single lane roundabouts, sidewalks, exclusive pedestrian signal phasing, pedestrian refuge islands and increased intensity of road lighting. Measures assessed as promising were advance stop lines, in-pavement flashing lights and automatic detection of pedestrians at walk signals.

Conclusion

There are obviously a number of actions that can be taken by government, road safety authorities, the health sector, the community and older people themselves that have good potential to reduce the toll of unintentional transport-related deaths and injuries among older Victorians. The Victorian Government has obviously paid close attention to the research evidence base and recommendations from experts in the field when developing the newly-released Road Safety Strategy for Victoria: Arrive-Alive 2008-17. The older driver and pedestrian sections of the safer road user element of the strategy includes many of the measures canvassed in the discussion above (http://www.arrivealive.vic.gov.au/). The further development, implementation and evaluation of these measures should increase our knowledge on how to reduce injury in this vulnerable, and growing, population of road users.

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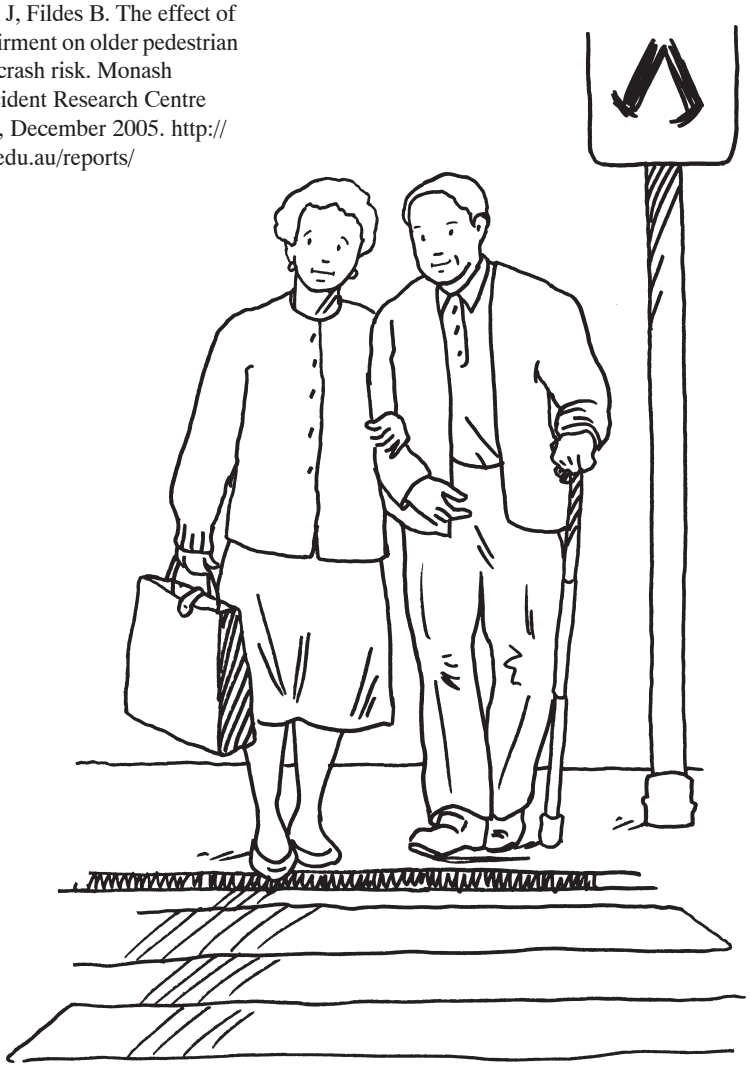

3. Preventing unintentional asphyxia (by choking)

(Annual average incidence: 28 deaths, 722 hospital admissions, 34 ED presentations)

Choking is defined as unintentional ingestion or inhalation of food or other objects resulting in the obstruction of respiration resulting in asphyxia (a threat to breathing). Among Victorian seniors it is the fourth most common cause of injury mortality and the third most common cause of injury hospital admissions. Over the three-year study period there were 83 unintentional asphyxia deaths, 2,166 hospital admissions and 103 ED presentations for asphyxia.

Frequency and pattern of unintentional asphyxia

The frequency, distribution and pattern of unintentional asphyxia are shown in Table 5. There were two accidental deaths caused by hanging and strangulation. All other injuries were caused by choking.

Gender and age

Males were over-represented in hospital admissions for asphyxia (60%), but not deaths (49%) or ED presentations (49%).

Persons aged 85 years and older accounted for almost half of all deaths (47%) but only 30% of hospital admissions and 20% of ED presentations.

Cause of injury

Almost 90% of deaths were the result of inhalation and ingestion of 'objects' causing obstruction of the respiratory tract (n=71), in one-third of these cases (n=23) the object was food.

Two thirds of asphyxia cases (n=1,421) on the VAED were not allocated a specific cause code but were coded to 'unspecified threat to breathing'. Injury codes were checked to see whether they provided any additional information but there is no code on ICD-10AM for dysphagia (difficulty with swallowing), a common condition among older people who have neurological/psychological disorders. Commonly reported co-morbidities for asphyxia (choking) cases were: metabolic disorders (57%); diabetes mellitus (37%); hypertensive diseases (36%); organic, including symptomatic, mental disorders (includes dementia) (27%); cerebrovascular diseases (includes stroke) (25%); and diseases of the oesophagus, stomach and duodenum (11%).

Examination of VEMD narrative data (for both admissions and presentations) indicated that choking incidents were most often the result of obstructions caused by food (commonly chicken bones, meats and other foods such as biscuits and lollies). Objects other than food that were mentioned in narratives included screws, thumbtacks, tablets and dentures.

Location (place of occurrence)

In 88% of asphyxia fatalities and 30% of admissions the location (place of occurrence) of injury was unspecified. The most common specified locations for deaths were the home (5%) and public buildings (4%). In more than one-third of hospital admissions (36%) the specified location was a public building (99% of which occurred in health service areas).

ED presentations data were better reported for location with only 15% of cases coded to 'location, unspecified'. Asphyxia mostly occurred in the home (69%), followed by residential institutions (10%).

Length of stay

More than half of all admitted cases had a length of stay of more than 8 days (53%). The overall average length of stay was 12.7 days.

Evidence-based prevention measures

There are few published studies on the epidemiology and prevention of asphyxia (by choking) in the elderly. Similar findings to those from our study are reported from retrospective autopsy based studies of predominantly adult cases of deaths associated with choking conducted in the San Diego and Florida in the U.S.; Vienna, Austria and South Australia (Dolkas et al., 2007; Mittleman et al., 1982; Berzianovich et al., 2005; Berzianovich et al., 1999; Wick et al., 2006) and studies in Sweden and the U.S. involving pre-hospital and hospital populations (Ekberg & Feinburg, 1992; Saroudi et al., 2007).

In general, research shows that older people at greatest risk have factors present that interfere with masticating and or swallowing. Predisposing factors to choking consistently reported in the literature include old age (mean age 62-73years), use of sedative/hypnotic drugs, underlying neurological/psychological disorders or anatomic difficulty with swallowing (dysphagia) and poor dentition (absent teeth, ill-fitting dentures or dental disease). Alcohol involvement was more characteristic of younger adult cases.

Around 95% of adult choking cases involved food, commonly a mixture of food, poorly masticated meat or meat products and semi-solid adherent foods e.g. peanut butter sandwiches and thick soups. The studies found that a wide range of foods were involved in choking episodes, influenced by cultural, regional and feeding habit differences. Ekberg et al. (1992) commented that the recommended diet of semisolids for people with dysphagia might actually contribute to their risk of choking.

Four studies reported place of occurrence/ location of choking episodes (Dolkas et al., 2007; Berzianovich et al., 1999; Wick et al., 2006; Ekberg & Feinburg, 1992). Common locations were private homes (range: 30%-73% of cases), care facilities (5%-60%), hospitals (0-19%) and restaurants (11%-14%).

The study of choking fatalities by Dolkas et al. (2007) found that first response interventions performed by paramedics, family members, staff at supervised homes and bystanders was generally appropriate except for incidents that happened in restaurants where, in all but one case, no attempt made by staff to respond/resuscitate. However, wrong diagnosis that adversely affected immediate, emergency and medical

response was raised as a major issue by the authors of three other study reports.

Berlanovich et al. (2005) reported that 63% of the 191 cases of fatal foreign body asphyxiation in their study were observed and paramedics called, but in 92% of these cases neither the observers nor the majority of the emergency response personnel and physicians recognised the definitive diagnosis, and only 10/120 cases were correctly identified during CPR. In an earlier report, Berlanovich and colleagues found that 49/73 patients who died in hospital due to foreign body asphyxia underwent autopsy because the caregiver team did not ascertain the cause of death (Berlanovich et al., 1999). Another retrospective study conducted in a hospital for chronic diseases found that eight of the 14 patients who died in the hospital from food asphyxiation were mistakenly diagnosed as having died from acute myocardial infarction until autopsy was performed (Irwin et al., 1997).

How common are swallowing difficulties in community-dwelling older people? Roy et al (2007) recently reported the first estimate of the prevalence of dysphagia in the general population of people aged 65 years and older. Using a prospective cross sectional survey design the researchers interviewed 117 seniors living independently in the community in Utah and Kentucky and found that the prevalence of swallowing disorders was 38%, with 33% of participants reporting current problems. Medical conditions associated with a history of dysphagia were stroke, oesoageal reflux, chronic obstructive pulmonary disease and chronic pain.

Previous studies report prevalence in older populations. Bloem et al. (1990) estimated that 16% of Dutch community dwelling seniors aged 85 years and older had swallowing difficulties and Lindgren & Janzon (1991) estimated the prevalence of dysphagia was 35% for 50-79 year old men

Frequency, distribution and pattern of unintentional asphyxia among seniors aged 65 years and older, Victoria

Table 5

	DEATHS 2003-5 (n=83)		HOSPITAL ADMISSIONS 2004-6 (n=2,166)		EMERGENCY DEPARTMENT PRESENTATIONS 2004-6 (n=103)	
	n	%	n	%	n	%
Year						
Year 1	18	*21.7*	721	*33.3*	32	*31.1*
Year 2	35	*42.2*	736	*34.0*	36	*35.0*
Year 3	30	*36.1*	709	*32.7*	35	*34.0*
Gender						
Male	42	*50.6*	1,290	*59.6*	50	*48.5*
Female	41	*49.4*	876	*40.4*	53	*51.5*
Age group						
65-74 years	21	*25.3*	548	*25.3*	39	*37.9*
75-84 years	23	*27.7*	979	*45.2*	42	*40.8*
85 years and older	39	*47.0*	639	*29.5*	22	*21.4*
Major causes of injury						
Other accidental hanging & strangulation	2	*2.4*	-	-	-	-
Inhalation of gastric contents	9	*10.8*	200	*9.2*	-	-
Inhalation and ingestion of food causing obstruction of respiratory tract	23	*27.7*	432	*19.9*	59	*57.3*
Inhalation and ingestion of other objects causing obstruction of respiratory tract	48	*57.8*	113	*5.2*	16	*15.5*
Unspecified threat to breathing	1	*1.2*	1,421	*65.6*	28	*27.2*
Location						
Home	4	*4.8*	288	*13.3*	71	*68.9*
Public buildings	3	*3.6*	768	*35.5*	1	*1.0*
Residential institution	2	*2.4*	438	*20.2*	10	*9.7*
Trade or service area	1	*1.2*	9	*<1*	3	*2.9*
Other specified place	-	-	4	*<1*	3	*2.9*
Unspecified place	73	*88.0*	659	*30.4*	15	*14.6*
Length of stay						
< 2 days	N/A		337	*15.6*	N/A	
2-7 days			674	*31.1*		
8-30 days			943	*43.5*		
31+ days			212	*9.8*		
Average length of stay (days)			12.7			

and women living in an urban area of Sweden. In the Dutch study, none of the subjects in whom dysphagia was particularly severe had reported their symptoms to a doctor (Bloem et al, 1990). Studies involving seniors in long term care facilities such as nursing homes, group homes or other assistive care facilities, estimate that approximately 40%-50% have current swallowing difficulties (ASGM, 2004).

The Australian Society of Geriatric Medicine (ASGM) has published a position statement and background paper on the diagnosis and management of dysphagia in older people for health professionals (http://www.asgm.org.au/documents/PositionStatementNo12-DysphagiaAspiration.pdf). Our literature search found reference to only one small observational study of the efficacy of self-management of dysphagia among non-learning disabled older adults (Leiter & Windsor 1996). The study only included eight subjects. Adherence to recommended safe swallowing instructions was low (36%). There were no reports in the literature on community interventions to raise awareness among community-dwelling older people (and their carers) of the prevalence of dysphagia in their age group, their concomitant increased risk of choking on food, and recommended preventive measures (for example adopting safe swallowing techniques, dietary modification, oral care, positioning and the use of specialised utensils implements).

There is a small body of literature on adherence to dysphagia management plans for direct staff and carers of high-risk groups that is outside the scope of this report. This literature should be accessed by health and care professionals planning and evaluating management guidelines and patient/client plans and providing education and training for high-risk older groups who are self feeding and for carers. A recent evaluation study, for example, found that carers of adults with learning difficulties were more likely to remember and implement concrete management strategies pertaining to alteration of the consistency of food and drink and use of specialised utensils than support-based strategies such as verbal prompting and pacing (Chadwick et al., 2002).

Recommendations

Researchers made the following recommendations for prevention (primary and secondary), none of which has been formally evaluated for effectiveness:

- Educate older community dwelling adults and their carers about the increased risk of choking with ageing especially among older people with dysphagia (swallowing difficulties).
- Evaluate the efficacy of guidelines for identifying older persons at risk of dysphagia and associated dysphagia management plans both for older persons with dysphagia who self-feed and those whose feeding is supervised.
- Hospitals and care settings should routinely screen older patients for dysphagia and institute appropriate management plans that include dietary and medication management.
- Educate potential first responders (carers, careworkers, paramedics, doctors, ED and hospital medical staff and restaurant staff) to alert them to the predisposing factors for food/foreign body asphyxia, to enable them to better identify a choking episode and take appropriate action including the removal the obstructing materials before applying CPR.
- Train the general public especially older people, care and medical staff and food service industry staff in the simple methods of manually removing inhaled food or other foreign material from the oropharynx as well as how to use the Heimlich manoeuvre.
- Make instruments to extract foreign objects readily available in nursing homes, restaurants and other public facilities.
- Conduct a study of fatal food asphyxia in Victoria utilising coroners' data extracted from the National Coroners Information System (NCIS).
- Conduct research to better understand the causes of asphyxia hospitalisations in Victoria.

Conclusion

Findings from our descriptive study and previous research indicate the need for community wide and targeted awareness raising, education and training to encourage older people (or their families and carers) to report and address swallowing difficulties, to recognise a choking episode and to make the appropriate first aid response. The causes and prevention of asphyxia and dysphagia in older adults are under-researched in Australia.

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BOX 1 Data extraction and statistical methods

DATA EXTRACTION

Overall

Deaths (ABS-DURF)

- Cases were selected if the person was aged over 65 years and the cause of death was in the range V00-Y36.

Hospital admissions (VAED)

- Cases were selected if the person was aged over 65 years, the case contained an external cause code in the range V00-Y36 and the injury did not result in death.

Hospital ED presentations (non-admissions)

- Cases were selected if the person was aged over 65 years, the VEMD cause of injury was in the range 1-30 and the injury did not result in hospital admission or death.

Fall injury

Deaths (ABS-DURF) and hospital admissions (VAED)

- Cases were selected for analysis utilising ICD-10 (deaths) and ICD-10-AM (admissions) external cause of injury codes W00-W19. Additionally, cases originally classified to X59 (exposure to unspecified factor) were selected if they had at least one multiple cause of injury coded to 'fracture'.

Hospital ED presentations (non-admissions)

- Cases were selected if the VEMD injury cause was 9 (fall low- same level or less than 1 metre or no information on height) or 10 (fall high- greater than 1 metre).

Transport injury

Deaths (ABS-DURF) and hospital admissions (VAED)

- Cases were selected for analysis utilising ICD-10 (deaths) and ICD-10-AM (admissions) external cause of injury codes V00-V99.

Hospital ED presentations (non-admissions)

- Cases were selected if the VEMD injury cause ranged from 1-8. These causes include motor vehicle and motorcycle drivers and passengers, pedal cyclists (riders or passengers), pedestrians, horse related incidents and 'other transport-related circumstances'.

Choking and suffocation

Deaths (ABS-DURF) and hospital admissions (VAED)

- Cases were selected for analysis utilising ICD-10 (deaths) and ICD-10-AM (admissions) external cause of injury codes W75-W84.

Hospital ED presentations (non-admissions)

- Cases were selected if the VEMD injury cause was 13 'Other threat to breathing (includes strangulation, asphyxiation)'.

STATISTICAL METHODS

Age-specific rates

Rates were calculated by dividing the number of injury deaths, admissions or ED presentations by the age group specific population, derived from the Australian Bureau of Statistics (ABS) estimated resident population figures for June 30 of the relevant year.

Age-adjusted rates

For all trends, rates have been age-adjusted (using the Victorian 2001 population as standard) to take account of the ageing of Victoria's population over the decade.

Trend analysis

Trends were determined using a log-linear regression model of the rate data assuming a Poisson distribution of cases. The statistics relating to the trend curves, slope and intercept, estimated annual percentage change, estimated overall change, 95% confidence intervals around these estimated changes and the p-value, were calculated using the regression model in SAS® 9.1.3. A trend was considered to be statistically significant if the p-value of the slope of the regression model was less than 0.05.

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General Acknowledgements

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
Maroondah 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 April 2005
Casey Hospital

National Injury Surveillance Unit

The advice and technical back-up provided by NISU is of fundamental importance to VISU.

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 should be directed to the VISU Co-ordinator or the Director by contacting them at the VISU office.

Contact VISU at:

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Monash University WEB SITE Accident Research Centre

All issues of *Hazard* and other information and publications of the Monash University Accident Research Centre can be found on our internet home page:
http://www.monash.edu.au/muarc/visu

Coronial Services

Access to coronial data and links with the development of the Coronial Services statistical database are valued by VISU.

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Victoria The Place To Be

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