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This edition of Hazard provides an overview of fall injuries among Victorians aged 65 years and over. This is an update of Hazard Edition 19 and is based on the latest available data on fall-related deaths, hospital admissions and emergency department presentations. A number of interventions have been shown to be effective in community trials and these are outlined. This information will be of particular interest to injury prevention practitioners and health professionals.

Prevention of falls injuries among older community-dwelling Victorians

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Summary

Falls are the leading cause of injury-related deaths, hospital admissions and emergency department (ED) presentations in older Victorians (aged 65 years and over). Australia's population is ageing, and the proportion of persons aged 65 years and over is projected to increase from its current level of 12% to 23% in 2051. Fractures, particularly hip fractures, become increasingly common with advancing age. It is projected that the number of fractures in the older age group will increase by at least 10% every 5 years to 2051 and by almost 20% every five years among people aged 85 years and over.

In Victoria, falls account for half the injury-related deaths and two-thirds of injury-related hospital admissions and ED presentations among people aged 65 years and older. Eighty per cent of fall-

related deaths, one-half of hospital admissions and two-thirds of ED presentations are due to fractures. The most frequently occurring fracture site is the neck of femur (hip). Injurious falls are more likely to occur in the home than in any other location.

Fall-related injuries at all levels of severity become increasingly common with advancing age. People in age group 75 years and over account for 92.9% of fall-related deaths in older persons, 75.1% of admissions and 59.9% of ED presentations. Females account for more than two-thirds of fall-related deaths, hospital admissions and ED presentations. As age increases so does the preponderance of injured females.

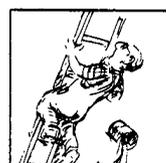
The latest evidence from randomised controlled trials, indicates that falls prevention interventions targeting

community-dwelling older people should concentrate on:

- the provision and promotion of group exercise programs that focus on improving balance and strength (specifically modified Tai Chi);
- the provision of individually tailored home exercise programs conducted by a physiotherapist targeting high risk women aged 80 years and older;
- multifaceted risk identification and abatement programs targeting higher-risk older people that prioritise the prevention of postural hypotension, rationalisation of drugs where possible, and interventions to improve balance, transfers and gait; and
- home environment assessment and modification (implemented by occupational therapists) for older people who have experienced one or more falls in the previous year.

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Introduction

Australia's population is ageing. The Australian Bureau of Statistics (ABS) 1996 census showed that 12% of Australians are aged 65 years and over. This proportion is projected to increase to 23% by 2051. Over the same period the proportion of Australians aged 85 years and over will increase from 2% to 8% (Sanders et al., 1999).

Bone fractures, particularly hip fractures, become increasingly common with advancing age. It is projected that the number of fractures in the older age group will increase by at least 10% every 5 years to 2051 and by almost 20% every five years among the very old, people aged 85 years and over (Sanders et al., 1999). In Victoria, falls account for half the injury-related deaths and two-thirds of injury-related hospital admissions and ED presentations among people aged 65 years and older. Eighty per cent of fall-related deaths, one-half of hospital admissions and two-thirds of ED presentations are for fractures.

The cost of these fall-related injuries is substantial in terms of health care use and dollars. The lifetime cost of fall injuries for Victorians aged 65 years and older who were injured in 1993/4 was \$199.3 million including direct medical treatment costs (\$127.1 million) and indirect morbidity and mortality costs (\$72.1 million). The direct medical care cost per fall-injured person in 1993/4 was \$4,504 for persons aged 65-74 years, increasing to \$6,206 for persons aged 75 years and older (Watson & Ozanne-Smith, 1997). Health expenditure per person aged 65 years and over is nearly four times higher than for younger individuals (Sanders et al., 1999).

A major challenge is to decrease the rate of falls and fall-related injuries in the older population, particularly in women. There are two major incentives for co-ordinated, well-funded and sustained prevention efforts. First, the burden of falls on the injured individuals (and their families) including treatment costs, loss of function and disability, possible loss of

independence, increased fear of falling and consequent reduced quality of life. Second, the projected blow-out in future health care costs associated with the treatment, rehabilitation and care of patients as the population of older Victorians increases.

This profile of fall injury among older Victorians has been produced from ABS data for deaths (on-line data available through the National Injury Surveillance Unit in Adelaide) and from two Victorian injury databases that cover all hospital admissions to public hospitals (Victorian Admitted Episodes Dataset - VAED) and approximately 80% of ED presentations (Victorian Emergency Minimum Dataset - VEMD).

Fall deaths

Limited data are available on fall-related deaths in older Victorians. Until 1995, the Victorian Coroners' Facilitation System (CFS) database (now superseded by the National Coroners' Information System) provided the most detailed data on injury deaths. However, fall-related deaths in older people are under-represented on the Coroners' system.

The Victorian Coroner instructs that the accidental death of an elderly person that occurs at home is not reportable to the Coroner if it is due to complications from a fractured neck of femur (hip) and the certifying doctor is of the opinion that osteoporosis or the general frailty of the patient contributed to the death. Consequently, the CFS database recorded an average of only 29 fall-related deaths per year of Victorians aged 65 years and older in the 5-year period 1989-90 to 1993-94 (the latest data available on the Victorian Coroners' database pending the establishment of a national system). By contrast, ABS data show an average of 221 fall-related deaths of older Victorians per year in the equivalent five-year period (www.nisu.flinders.edu.au/data).

Frequency of fall-related deaths

The latest ABS figures reveal that in 1998 falls were the leading cause of injury deaths in Victorians aged 65 years and over. In that year there were 252 fall-related deaths, representing 54.3% of all injury deaths in older persons. Other major causes of injury deaths in this age group were suicide (15.1%) and transportation (14.7%).

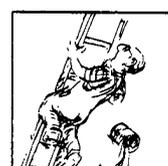
Gender and age patterns

Overall, females accounted for nearly two-thirds (64.7%) of the 252 fall-related deaths. The fall-related death rate for males per 100,000 population was higher than the female rate in age group 65-74 years (M8.8 vs. F2.3; rate ratio 3.8:1) but lower than the female rate in age group 75 years and over, the age group in which most deaths occurred (F101.2 vs. M77.7; rate ratio 1.3:1).

The overwhelming majority of fall deaths in older people occurred in persons aged 75 years and older (92.9%). The fall fatality rate for this group was 92.3 per 100,000 population. This is much higher than the all-age fall fatality rate and the rate for 65-74 year olds (5.4 per 100,000). There was no clear trend in the age standardised falls-related mortality rate during the mid- to late- 1990s, although a downward trend was evident in the early 1990s.

Causes of fall-related deaths

The detailed ABS data on cause of fall deaths is unsatisfactory in that 80.5% of deaths are classified under the code 'Fracture-cause unspecified' and a further 14.7% under 'Other/unspecified fall'. The remainder fell into more specific categories, but classifications with case counts of four or less are not reported in published data. No other information on fall-related deaths is available from the published ABS dataset.



Fall-related hospital admissions

Falls were by far the leading cause of injury-related hospital admissions for older people (aged 65 years and over) in Victoria. They accounted for 72.8% of injury admissions in the latest 4-year period of Victorian Admitted Episodes Dataset (VAED) data (July 1, 1995 to June 30, 1999). Other causes are motor vehicle traffic (6%), hit/struck/crush (2.0%), natural/environmental (1.9%) and cutting/piercing (1.6%).

The VAED recorded 46,955 fall-related injury admissions in older Victorians from 1995-99, an average of 11,739 admissions per year. In 1998-9 there were 11,845 fall-related admissions, 8,399 females and 3,446 males.

Trends over time

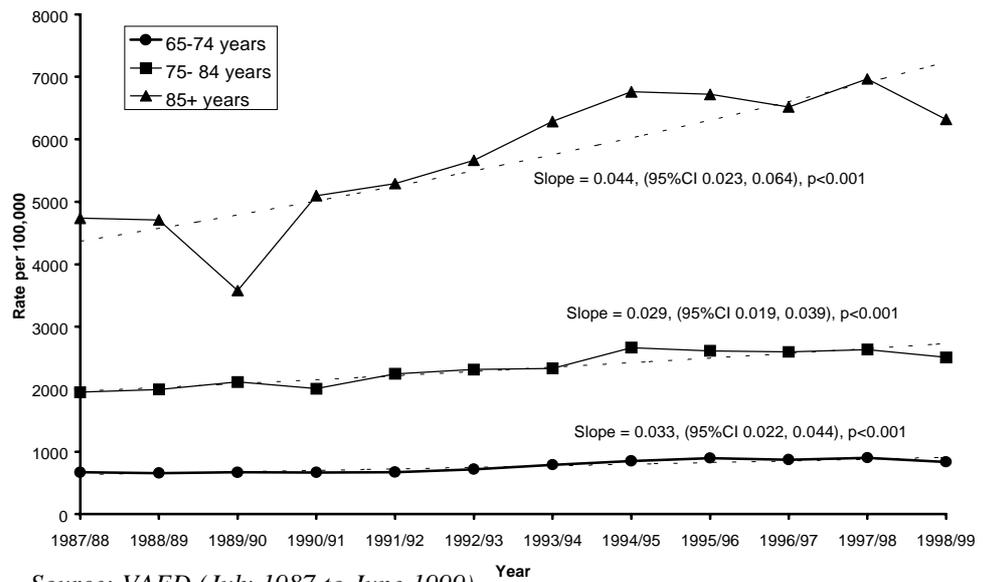
Figure 1 illustrates fall-related hospital admission rates and trends from July 1987 to June 1999 for the 10-year age groups from 65 years. Statistically significant increasing trends ($p < 0.0001$) for fall rates were observed for all three age groups over the 12-year period. The upward trend was most dramatic for those aged 85 years and older, representing an estimated annual percentage increase of 4.5%.

Gender and age patterns

Overall, most admissions for fall injuries were female (71.7%) and female admissions outnumbered males in each 5-year age group from ages 65 years. As age increased so did the preponderance of females. The female to male rate ratio for admissions increased from 1.6:1 for the age group 65-69 years to 3.4:1 in the age group 85 years and older.

Admissions for fall injuries became increasingly common with advancing age. The age group 65-69 years accounted for 10.2% of fall-related admissions, whereas the age group 85 years and over accounted for 33.0% of admissions. The fall-related admission rates per 100,000 population by gender and age for 1998-9 only are shown in Table 1.

Fall injuries, older persons 65+ years of age, rates per 100,000 by age group, public hospital admissions, Victoria **Figure 1**



Source: VAED (July 1987 to June 1999)

Location of fall

Falls most frequently occurred in the home (46.0%), followed by public buildings, residential institutions, hospitals and trade and service areas (26.0%), street and highway (4.0%) and other specified locations (2.5%). The location was unspecified in 21.5% of cases.

Causes of fall injury

Same-level falls (slips, trips and stumbles) accounted for 35.8% of fall-related admissions. The coding system allows no additional information on sub-categories of same-level falls. Different-level falls were relatively less frequent (16.9%) and comprise falls from chair or bed (8.2% of all falls cases), stairs and steps (4.0%), different level, other (2.7%),

ladders (1.6%) and building/structure (0.3%). Other and unspecified falls accounted for 47.3% of cases.

Nature and body site of injury

Fractures were by far the most common primary injury observed (66.0%), followed by open wounds (10.0%), traumatic complications (6.1%), bruises/haematomas (5.3%) and intracranial injuries, not skull fracture (3.0%). The lower extremity was the most frequently injured body site (47.4%), followed by the upper extremity (19.3%), trunk (15.9%) and head/face (13.0%). Fractures were most frequently to the lower extremity (58.1%, predominantly neck of femur and ankle) followed by the upper extremity (22.0%, mostly radius, ulna and

Fall-related hospital admission rates per 100,000 population by gender and age, Victoria, 1998-99 (n=11,845) **Table 1**

Gender	Age groups				Persons (65 and over)
	65-69	70-74	75-79	80+	
Male	513	787	1332	3 616	1 325
Female	766	1 267	2 205	5 595	2 481
Persons	643	1 044	1 834	4 991	1 979

Source: VAED (July 1998 to June 1999)



humerus) and trunk (18.0%, mostly involving the chest, abdomen/pelvis and spine/back).

Length of hospital stay

The average length of stay for older persons with fall injuries was 12 days. About one-quarter of patients (23.7%) required less than 2 days stay, 29.5% required 2-7 days, 38.6% required 8-30 days and 8.2% required 31 or more days. By contrast, only 12.2% of younger adults (aged 15-64 years) with fall-related injuries required stays of 8 days or more.

A higher proportion of patients with fractures (43.5%) required stays of 8-30 days and a lower proportion required short stays of less than two days (17.8%).

Fall-related emergency department presentations

Falls are the leading cause of ED injury presentations for persons aged 65 years and over. They accounted for 66.4% of the 58,853 injuries to older persons recorded on the VEMD database in the latest four-year period, July 1996 to June 2000 ($n=39,088$; average 9,772 per year). By contrast, the next most-frequently reported causes were transport-related injury (6.5%), cutting and piercing injury (5.5%) and struck by/collision with person or object (4.4%). There were 11,669 fall-related presentations in 1999-2000, 8,364 females and 3,303 males. These data include cases admitted to hospital.

Gender and age patterns

Overall, females accounted for 72.2% of fall injury presentations in the 4-year period 1996-2000. They represented a higher proportion of presentations in all 5-year age groups from 65 years onwards but the difference was more pronounced as age advanced. The ratio of female-to-male presentations for 65-69 year olds was 1.8:1, which increased to 3.2:1 for the age group 80 years and older. Rate data are not available for ED cases.

The likelihood of presenting with fall injuries increased with age. The older-olds (people aged 80 years and older) comprised 47.9% of fall-related ED

Location of injury event and patterns of injury, hospital ED presentations, Victoria

Table 2

Pattern of injury	Home <i>n</i> = 24,704	Residential institution <i>n</i> = 4,315	Road/street/highway <i>n</i> = 3,379	Trade or service <i>n</i> = 670
Sex (female:male ratio)	2.6:1	3.4:1	2.4:1	3.0:1
Age	(%)	(%)	(%)	(%)
65-69	14.4	2.8	21.3	24.2
70-74	18.0	6.7	23.3	21.9
75-79	20.2	14.0	23.9	21.2
80+	47.4	76.5	31.5	32.7
Type of fall	(%)	(%)	(%)	(%)
From height up to 1 metre	95.6	97.1	97.8	94.2
From height over 1 metre	4.4	2.9	2.2	5.8
Nature of injury	(%)	(%)	(%)	(%)
Fracture	50.9	52.2	41.7	46.3
Open wound (excludes eye)	11.4	14.0	17.6	15.5
Sprain/strain	10.9	7.9	8.3	9.4
Superficial (excludes eye)	5.7	6.8	11.5	7.5
Site of injury	(%)	(%)	(%)	(%)
Lower limb	39.4	46.7	24.2	31.2
Upper limb	24.9	14.1	31.3	30.1
Trunk	10.8	8.4	4.8	5.4
Head/face	10.5	15.7	22.0	17.7
Other/unspecified/missing data	14.4	15.1	17.7	15.6
Departure status	(%)	(%)	(%)	(%)
Admitted or transferred to another hospital	52.2	60.0	34.6	38.0
Discharged to home/nursing home	47.1	39.6	64.5	61.0
Left of own accord/other/unspecified/missing data	0.7	0.4	0.9	1.0

Source: VEMD, July 1996 to June 2000

presentations, whereas the younger-olds (people aged 65-69) accounted for 14.5%

Location of fall

The home was the most common location of the fall (63.2%), followed by residential institution and hospital (12.4%), road, street and highway (8.6%), place for recreation (2.4%) and trade or service area (1.7%). There was some association between the location of injury event and advancing age. A much higher proportion of people aged 80 years and over compared with their younger counterparts (aged 65-74 years) sustained their fall injury in a residential institution (17.6% vs. 5.0%). Lower proportions of older-olds were injured on a road, street or highway (5.7% vs. 11.4%) and in places for recreation (1.4%

vs. 3.4%). There was little difference in the proportion of older people in each 5-year age group from 65-69 years to 80+ years that were injured at home (proportions ranged from 62.5% to 64.6%). Table 2 shows the comparative pattern of injury across the four major locations.

Causes of fall injury

The overwhelming majority (95.8%) of ED presentations of older people with fall-related injuries were caused by low-level falls (defined in the VEMD as a fall from a height up to one metre). High-level falls (from a height over one metre) accounted for only 4.2% of all fall-related injuries.



The one-line case narratives should provide detailed information on the cause and circumstances of the fall but they were of variable quality and yielded limited additional information. The data in this section may be biased but, nevertheless, reveals mechanisms of injury of sufficient frequency to be of concern.

Case narratives from a 50% random sample of high-level falls cases were extracted ($n=854$ cases). Only 39.8% of the sample ($n=340$ cases) gave any additional information on the mechanism/circumstances of the fall. Of these, falls from ladders accounted for 37.3%, followed by falls from stairs (8.5%), trees (7.1%), roofs (6.5%), 'trips' (5.0%), steps (4.1%), beds (3.8%), vehicles (3.2%), chairs (2.1%) and 'slips' (2.1%).

An even smaller proportion of the 5% random sample of case narratives for low-level falls provided information on the mechanism/circumstances of the fall (28.1%; $n=525$ cases). Of these cases, trips accounted for 24.5%, followed by slips (11.8%), beds (6.5%), steps (5.0%), stairs (3.6%) and chairs (3.4%).

Fifty-five percent of the sample of 'trip' narratives ($n=71$ cases) provided detail on the mechanism of the trip. The tripping hazards mentioned were: uneven or broken public footpaths, roads and gutters; mats, rugs and carpets in the home; power cords in the home; kerbs/borders in home gardens; household pets; and a wide variety of moveable/portable items in and around the house and garden.

Fifty-six percent of the sample of 'slip' narratives ($n= 35$ cases) provided detail on the circumstances of the slip. Wet or 'slippery' household floors, built outdoor surfaces (footpaths, deck, steps, brickwork) and 'natural' surfaces (grass, gravel) were the most frequently mentioned slip hazards.

Nature and site of injury

Fractures accounted for half the primary injuries recorded (49.7%). The most common sites of fractures were hip (36.8%

of all fractures), wrist/forearm (18.8%), upper arm (5.6%), ankle (4.7%), shoulder (4.5%) thorax (4.4%) and pelvis (4.4%).

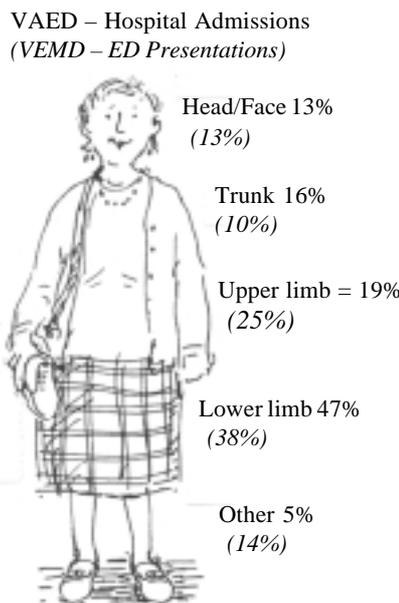
Other relatively common injuries were open wounds (12.6%, two-thirds of which were to the head and face), sprain or strain (10.3%, mostly to the ankle, hip and knee) and superficial injuries (6.5%, predominantly to the head and face). Intracranial injuries accounted for only a small proportion of injuries (1.3%). Overall, the most frequently injured body regions were the lower extremity (38.2%), upper extremity (24.6%), head and face (12.7%) and trunk (9.5%).

Figure 2 shows the body sites injured for both VAED admissions & VEMD presentations.

Admission rates

One-half of fall-related injury ED presentations of older persons were admitted to hospital. By contrast, only 13.9% of fall injury presentations in the age group 15-64 years are admitted. The proportion of injury cases admitted increased with advancing age, rising from 34.3% in 65-69 year olds, through 36.6% in 70-74 year olds and 48.3% in 74-79 year olds, to 58.9% in people aged 80 years and over.

Older persons fall injuries by body region, Victoria Figure 2



Over two-thirds (69.5%) of fall-related presentations with fractures were admitted to hospital. Admission rates for other kinds of fall-related injuries were lower: intracranial injuries (55.6%), dislocation (49.5%), injuries to muscles and tendons (25.9%), sprains and strains (23.5%), open wounds (21.1%) and superficial injuries (18.3%). Fall-related fracture cases accounted for 69.1% of all injury admissions for persons aged 65 years and older.

Prevention of falls in community-dwelling older people

The prevention of falls and fall injury in older people is one of the four initial priorities in the draft National Injury Prevention Action Plan: Priorities for 2000-2002 (Department of Health and Aged Care, 1999). The strategies in the plan include the development of partnerships at the local community level to implement fall injury prevention initiatives for community-dwelling older people. There has been an active program of trials on the effectiveness of community falls prevention interventions in Australia and elsewhere and findings from these rigorous evaluations should guide the planning of future prevention programs. Two recent reviews provide up-to-date information on the evidence-base for the effectiveness of most interventions.

The first review, *Guidelines for the prevention of falls in people over 65* was funded by the U.K. Department of Health and is published in the October edition of the British Medical Journal (Feder et al., 2000). The guidelines are based on a systematic review of evidence from randomised controlled trials (RCTs) of interventions designed to minimise or prevent exposure to the risk factors for falling (or fracture) with outcomes that included either the number of people who had fallen or the number of falls or fractures. (Trials with falls as an outcome generally rely on self-reported falls data and therefore have the potential for reporting bias. Future trials should



validate the injurious falls component of falls data using medical records.)

The second review, *An analysis of research on preventing falls and fall injury in older people: community setting*, funded by the Commonwealth Department of Health and Aged Care, was conducted by the National Ageing Research Institute (NARI). The review had less rigorous inclusion criteria and aimed to identify proven and promising interventions. The report is published on the Department's website (<http://www.health.gov.au>). Recommendations in this section have been guided by these reviews and some recently completed unpublished Australian research.

Falls in older people usually result from the interaction of a number of intrinsic (personal characteristics of the faller) and environmental factors, rather than any single factor. The intrinsic risk factors that have been shown to be significantly associated with falls among community-dwelling older people are:

- increased age; female gender;
- past history of falls;
- chronic medical conditions such as the effects of stroke and Parkinson's Disease;
- decreased bone mineral density and other risk factors for osteoporosis;
- multiple medications and specific medication types such as long-acting benzodiazepines and psychotropic medication; impaired balance and mobility;
- sensory problems including visual acuity and depth perception and dizziness;
- impaired cognition; and
- low levels of physical activity (Hill et al., 2000; King & Tinetti, 1996).

Environmental factors (such as surface hardness, slip and trip hazards, lack of grab rails, poor lighting) may interact with these intrinsic factors to increase the risk of a fall or a fall injury.

Community interventions to prevent falls and fall injury, therefore, often include several strategies aimed at reducing two or more potentially interacting intrinsic and extrinsic (environmental) risk factors for falls. Popular strategies include:

- community education on risk and protective factors for falls and fall injuries;
- group exercise classes;
- home falls hazard assessment with or without assistance to make safety changes;
- vision, footwear and podiatry checks;
- medication review and public fall hazard assessment and management.

Programs conducted through health services sometimes include individual falls risk assessments conducted by an allied health professional and tailored individual risk reduction programs.

The evidence-base on the effectiveness of each of these strategies will be briefly summarised here but readers are referred to the full discussions in the two recent reviews referred to above. The terms '*selected*' and '*unselected*' populations of older people are used in the discussion of RCTs. '*Selected*' means that only particular sub-populations of older people are recruited into the trial, for example only those that have experienced a recent fall, or subjects are recruited from a particular source such as general practice or EDs. '*Unselected*' means that subjects are recruited into the trial from the general population of older people, but individuals with serious health problems or cognitive deficits may be excluded.

Community education/health promotion

Group community education sessions usually aim to raise awareness in older people of the potential deleterious effect of fall injuries on their health and independence, the risk factors for falls and to provide participants with some practical advice on ways to reduce their personal falls risk profile. The NARI review concluded that there is some evidence that education increases

knowledge of falls risk factors but no evidence that community education, as a stand-alone strategy, has any effect on fall rates (Hill et al., 2000).

The reviewers suggest that education programs that use cognitive-behavioural approaches (group discussion, problem solving and individual homework programs e.g. home exercise regimes) may be more effective than didactic sessions in engendering desired preventive behaviours in older people (Hill et al., 2000). Community education sessions should provide information on local opportunities for participants to engage in activities that have been shown to be effective in preventing falls and actively link interested participants to these programs.

Summary

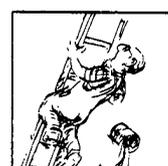
There is no evidence that community education alone reduces the risk of falls in older people. Education should be implemented in tandem with other effective strategies.

Exercise interventions

Both reviews conclude that exercise incorporating balance training is effective in reducing falls risk in older people (Feder et al., 2000; Hill et al., 2000). To date, modified *Tai Chi* training is the only stand-alone group exercise program to show a significant reduction in falls in trials involving *unselected* community-dwelling older people (Feder et al., 2000; Hill et al., 2000). Other types of stand-alone exercise programs have been shown to significantly reduce falls in RCTs conducted in *selected* community-dwelling older people.

Tai Chi in unselected populations

The Atlanta FICSIT (Frailty and Injuries: Cooperative Studies of Intervention Techniques) trial of Tai Chi found that, after a 15-week group exercise program with individual instruction, the number of falls in the participants randomly assigned to the intervention was reduced by 47.5% compared with controls (Wolf et al., 1996).



The Tai Chi study was conducted in a group of community-dwelling older people aged 70 years and over. The 108 forms of Tai Chi Tuan were reduced to 10 composite forms that emphasised the movement components often restricted or absent with ageing and were easy to learn by older individuals within a reasonable time frame (Wolf et al., 1997). Tai Chi classes involved 15 participants and were held twice weekly for one hour to enable participants to receive individual attention so that they mastered the 10 'forms' taught in the class. No other modified Tai Chi programs for older people, for example the Tai Chi for Arthritis program, have been subject to a RCT with falls as an outcome.

Other group exercise programs in unselected populations

Feder et al. (2000) conclude from their review of current evidence that, with the exception of Tai Chi, most exercise programs without other interventions do not appear to reduce the incidence of falls. When data from the four U.S. FICSIT trials that were focused solely on exercise were pooled (including the Tai Chi trial above), the meta-analysis showed that exercise alone did not significantly reduce the rate of falls

(Province et al., 1995). However, when the three remaining FICSIT multifactorial interventions that included an exercise component were factored into the analysis, there was a significant decrease in falls in subjects that received an exercise intervention, compared with controls. Interventions that included balance training appeared to be particularly effective (Province et al., 1995).

Since the publication of the two recent reviews, the MUARC multi-component falls prevention RCT in an unselected group of 1,107 older persons aged over 70 years residing in the Victorian municipality of Whitehorse (Box Hill) has been completed. The intervention included balance and strength assessment and improvement, vision assessment and improvement and home hazard assessment and reduction. All components were trialed alone and in combination.

Preliminary results suggest a favourable effect for the stand-alone exercise component (Day, personal communication). The exercise was devised by a physiotherapist and was designed to improve balance, flexibility and leg strength, with about one-third of session time content given to balance

improvement. Exercise instructors were trained and experienced VicFit leaders. They received additional training from the physiotherapist who devised the program. Exercise sessions were conducted once a week for 15 weeks. It is anticipated that a resource package for exercise leaders based on this program will be published in 2001. Study results have been submitted to an international peer reviewed journal.

Stand-alone exercise programs in selected populations

Two other trials of stand-alone exercise programs targeted to selected community-dwelling older people have reported positive results. Campbell et al. (1997 & 1999) studied the effect of individual home-based training programs of physical therapy for women aged 80 years and older, recruited through general practitioners. The authors found a significant reduction in the rate of falls and fall injuries at the one-year follow up, and at two years for women who continued with the program.

The physiotherapist visited each of the subjects randomised to the exercise group four times (for one hour) over the first two months of the program. Subjects were given a graduated, tailored exercise regime that included moderate intensity strengthening exercises with ankle cuff weights and balance and functional exercises.

The exercises took 30 minutes to complete and the women were told to complete the regime three times a week and to walk outside the home at least three times a week. They recorded exercise compliance and falls on a daily calendar that was returned monthly, and received regular telephone contact from the research nurse. The program was designed for general practice. Campbell and colleagues are currently engaged in a similar RCT in which trained nurses are being used to deliver the exercise program rather than physiotherapists. The trial is complete but results have not been published as yet.

Participants in a pilot study of Tai Chi at NARI

Figure 3



Source: National Ageing Research Institute (NARI)



The second RCT in a *selected* population that showed a significant reduction in the risk of falls involved older adults aged 68-85 years with at least mild deficits in strength and balance randomly chosen from enrollees in a health maintenance organisation (Buchner et al., 1997). The intervention was supervised one-hour sessions, three times a week for 24-26 weeks followed by self-supervised exercise. Subjects were randomly assigned to one of three different exercise groups: strength training using weight machines; endurance training using bicycles; and combined strength and endurance training. The individual exercise interventions showed no effect but when the results of all three groups were combined the risk of falls was reduced by 47% in the intervention group compared to the control group (who maintained usual activities).

Summary

For *unselected* community-dwelling older people, modified Tai Chi classes with individual tuition can reduce the number of falls (Feder et al., 2000; Hill et al., 2000). Exercise programs with a strong balance component delivered by trained exercise leaders may also be effective, if the preliminary results from the Whitehorse 'No Falls' RCT are taken into consideration. If only published results from RCTs are considered then other kinds of exercise programs without additional interventions do not reduce the incidence of falls (Feder et al., 2000). For *selected* groups, individually home-based tailored exercise programs administered and supported by a physiotherapist are effective for high-risk women (aged 80 years and older) as are strength and endurance training programs for older people with at least mild deficits in strength and balance (Feder et al., 2000; Hill et al., 2000).

Multifaceted programs that include an exercise component

Several RCTs have shown that multifaceted programs that combine a number of interventions targeting

proven risk factors effectively reduce falls, particularly in *selected* high-risk groups (Feder et al., 2000; Hill et al., 2000). The effective programs, that mostly include exercise, are as follows:

- an intervention that combined exercise sessions, daily walks, home environmental audit and group education involving community-dwelling older people aged over 65 years drawn from a health maintenance (insurance) organisation (Hornbrook et al., 1994);
- an intervention targeted to people aged 70 years and older drawn from health maintenance organisations that included comprehensive falls risk assessments by nurse practitioners and physiotherapists and tailored risk abatement programs (Tinetti et al., 1994);
- a program comprised of an assessment visit by a trained nurse-educator that aimed to increase physical and social activity and provide home safety advice and referrals for medication review and vision and audiological testing (Wagner et al., 1994);
- interventions that included medication review and advice about environmental hazards [pooled results included in the Cochrane Collaboration systematic review (Gillespie et al., 1997)]; and
- a program targeting older people who presented to a hospital ED after a fall, that included a medical examination conducted in a day hospital covering a detailed assessment of postural hypotension, visual acuity, balance, cognition, affect and medications, and an occupational therapy assessment conducted at home with appropriate advice and direct intervention to ameliorate identified falls risk factors (Close et al., 1999).

Summary

The design of these trials does not allow conclusions to be drawn about the relative effectiveness of individual components. However, the UK guidelines recommend that multifaceted programs should prioritise correction of postural hypotension, rationalisation of

drugs where possible and interventions to improve balance, transfers and gait (Feder et al., 2000).

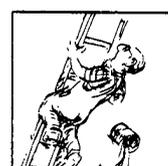
Environment assessment and modification programs

Home environment assessment and modification

Both Feder et al. (2000) and Hill et al. (2000) conclude that there is no published evidence from RCTs that stand-alone home hazard assessment and modification programs in *unselected* groups of community-dwelling older people reduce falls. A completed but unpublished West Australian trial of a program delivering home hazard assessments and subsidised safety modifications found that there was no significant difference in falls rates in the home modification intervention group compared with controls (Stevens, personal communication). Also, preliminary results from the MUARC Whitehorse 'No Falls' trial are not promising (Day, personal communication).

To date, only one RCT in a *selected* group of community-dwelling older people has found a significant reduction in falls in an intervention targeted at home environmental hazards (Cumming et al., 1999). The effect was confined to the highest risk group for falls. The study was conducted in Sydney and subjects were recruited primarily before discharge from hospital wards. An occupational therapist, experienced in aged care, made a home visit and assessed the home for environmental hazards and facilitated any necessary home modifications. About 50% of the identified home modifications were in place at the 12-month follow-up visit.

The study found that the intervention was effective only in the group of subjects who reported having one or more falls in the year before recruitment into the study. In this group the risk of having at least one fall during follow-up was reduced by 46%. The authors raise



the issue that the effect may not be due to the home modifications alone because the intervention group had fewer falls both at home and away from home. Subjects may have been influenced to change their behaviour by the implicit and explicit advice given by the occupational therapist during the home visit.

Public environment assessment and modification

There have been no formal evaluations of programs that aim to reduce falls in public places (Hill et al., 2000). Hill et al. (2000) comment on the considerable methodological challenges in designing evaluation trials in this area and refer to recommendations made by Gallagher & Scott (1997) on the management of fall hazards in public places.

Summary

There is little evidence that broadly targeted community home assessment and modification programs are effective in reducing falls. Any future investments in home environment assessment and subsidised modification programs should be focussed on schemes that target older people with a recent history of falls. The home assessments should be conducted by an occupational therapist who should take responsibility for facilitating the recommended safety modifications. There are no formal evaluations of public place environmental falls risk reduction programs.

Medication review and reduction

Hill et al. (2000) conclude, on the basis of two promising trial results, that medication review and reduction has good potential for delivering falls reductions. Medication reduction was one arm of the FICSIT multifactorial RCT by Tinetti et al (1994) that produced a significant reduction in falls in the intervention group compared to controls.

More recently, Campbell et al. (1999) reported a significant reduction in falls risk (66%) from a small randomised trial

of psychotropic medication withdrawal conducted in 93 patients recruited through 17 general practices in New Zealand. The intervention group was gradually withdrawn from psychotropic medication (by reducing the active component of their capsules) over a 14-week period and followed up for a further 30 weeks. The controls continued to take their usual psychotropics. Both groups were blinded to the experiment. However, 47% of the intervention group had resumed psychotropic use one month after the study ended, mainly because of sleep disturbances or stress. The authors commented that permanent withdrawal from psychotropic medication (especially long-term benzodiazepine use) is very difficult to achieve without the provision of ongoing support, for example sleep information and counselling.

Summary

Available evidence suggests that medication review that aims to reduce the number of prescription drugs used and the use of psychotropic drugs is a promising falls prevention measure, but older people experience problems maintaining psychotropic drug withdrawal.

Vision assessment and remediation

There are no published RCTs on the effectiveness of vision assessment and remediation as a falls prevention measure (Hill et al., 2000). The recently completed MUARC City of Whitehorse 'No Falls' trial had a vision assessment and improvement arm. Participants were tested in the home for vision acuity and stereopsos (stereoscopic vision). They were referred, where appropriate, for further assessment and treatment if they had not had a recent vision test by an optometrist or were under current treatment. Preliminary results for this intervention component are not promising (Day, personal communication).

Summary

There is currently no evidence that vision assessment and remediation programs reduce falls in older people.

Injury minimisation measures

Hip protectors

There is consistent evidence from RCTs that external hip protectors protect against hip fractures in residents of nursing homes (Lauritzen et al., 1993; Ekman et al., 1997; Chan 2000) but little evidence to date on the feasibility and effectiveness of this intervention in community-dwelling older people.

Kannus et al. (2000) recently reported positive results from an RCT conducted in Finland that involved a mixed population of independent living older people and residents in geriatric care facilities. The study found that the use of hip protectors reduced the risk for hip fracture by 60% in ambulatory but frail elderly adults recruited from 22 community geriatric health care centres that provided treatment services to elderly people at high risk of fall-related fractures. The health centre units that participated were either geriatric long stay facilities or outpatient care units for supported living at home. A higher proportion of the 1,801 subjects in the trial (approximately 60%) was drawn from the residential long-stay facilities. The amount and kind of supported care given to subjects living at home was not reported, nor were results separated for the two groups.

Hip Protector

Figure 4



Source: Hornsby Hip Protection Study, NSW



All trials of hip protectors report problems with acceptability and compliance indicating some resistance among older people to wearing hip protectors as a part of their daily clothing and problems with fit and comfort (Parker et al., 2000). For example, in the recent Finnish trial 31% of the eligible subjects allocated to the intervention group refused to participate, which limited the generalisability of study findings (Kannus et al., 2000). There are 11 known current trials of hip protectors internationally. Several of these are exclusively targeting populations of high-risk community-dwelling older people, including the Community Hip Protector Study underway in NSW (Parker et al., 2000).

Summary

Evidence is lacking on the efficacy of hip protector programs in community-dwelling older people who are at high risk of fall injury. Several trials are in progress and these should provide information to guide future programs, including strategies to increase acceptance and compliance.

Maintenance and improvement in bone strength

To carry out its functions bone is continuously destroyed and rebuilt. After age 40, bone destruction (resorption) begins to exceed bone formation, leading to bone loss called osteoporosis. This disease results in an increase in the fragility of bone and its susceptibility to fractures. It occurs most commonly in women as a result of estrogen deficiency but other causes exist and there is a high incidence of osteoporotic fractures in older men.

Current drug therapies mainly concentrate on agents that inhibit bone resorption (Rodan & Martin, 2000). These include oestrogens and selective oestrogen receptor modulators (for example raloxifene) for early postmenopausal women with low bone density and bisphosphonates (for example alendronate) for men and older

postmenopausal women with osteoporosis. Alendronate has been shown to reduce fractures of the spine and hip in several large RCTs (Rodan & Martin, 2000; Sambrook & Eisman, 2000). Although oestrogen inhibits bone loss, the efficacy of oestrogen in the prevention of fractures has not yet been established in large long-term prospective RCTs (Rodan & Martin, 2000; Gillespie et al., 2000). The effects of 'natural' therapies (for menopausal symptoms) in preventing osteoporosis are unproven (Sambrook & Eisman, 2000). Older people, especially those that have sustained low trauma fracture, should be encouraged to raise the issue of their risk status for osteoporosis with their GPs.

Vitamin D and calcium deficiencies are also indirectly associated with femoral bone loss. An RCT conducted in 3,207 nursing home residents in France found that nutritional supplementation with Vitamin D and calcium reduced hip fractures by 43% in the treatment group compared to controls who received placebo (Chupay et al., 1992). Conflicting findings were reported from a later RCT conducted in The Netherlands that included community-dwelling elderly people (Lips et al., 1996). The Dutch investigation of the effects of Vitamin D supplementation was conducted in 2,578 elderly persons aged 70 years and older living in apartments for elderly persons or in residential care homes. There was no decrease in the incidence of hip fractures and other peripheral fractures in the intervention group compared to the placebo group.

Summary

Further research is required to establish the benefits of current and emerging drug therapies for osteoporosis in the prevention of hip fractures in high-risk community-dwelling older people, and of Vitamin D and calcium supplementation in the prevention of fractures in sunlight-deprived and Vitamin D-deficient older people living independently.

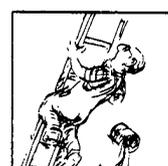
Conclusion

Based on current evidence the most effective falls prevention interventions for the general population of community-dwelling older people aged 65 years and older are Tai Chi and multifaceted interventions that include exercise with a strong balance training component. In groups of community-dwelling older people at higher risk of falls, research evidence supports the institution of tailored home exercise programs supervised by a physiotherapist, home assessments with referral and direct intervention conducted by an occupational therapist and assessment and modification of falls risk factors. Promising measures for community-dwelling older people at higher risk of falls and fall injury are Vitamin D and calcium supplementation for the housebound, stand-alone medication review and reduction programs with attention to the issue of long-term maintenance, hip protectors with attention to the issue of compliance and osteoporosis therapies that have been shown to reduce hip fractures.

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Recommendations

Prevention programs in community settings

On the basis of current evidence it is recommended that future falls and fall injury prevention programs for community-dwelling older people should concentrate on:

- modified Tai Chi using the 10 composite forms trialed, for *unselected* community-dwelling older persons;
- exercise programs for strength and balance conducted by trained exercise leaders for *unselected* community-dwelling older people (tentative recommendation pending publication of findings from Whitehorse No Falls RCT);
- individually tailored home exercise programs administered and supported by a physiotherapist for *selected* high-risk women (aged 80 years and older) and strength and endurance group training programs for *selected* older people with at least mild deficits in strength and balance;
- multifaceted programs that target higher-risk community-dwelling older people that prioritise correction of postural hypotension, rationalisation of drugs where possible, and interventions to improve balance, transfers and gait; and
- home environment assessment and modification programs only for older people who have experienced one or more falls in the previous year and if conducted by an occupational therapist who facilitates home safety modifications.

Promising measures for community-dwelling older people at higher risk of falls and fall injury are Vitamin D and calcium supplementation for the house-bound, stand-alone medication review and reduction programs with attention to the issue of long-term maintenance, hip protectors with attention to the issue of compliance and osteoporosis therapies that have been shown to reduce hip fractures.

Data issues

- improve the specificity and quality of data on fall-related deaths and injuries, especially in relation to information on the cause (mechanism) and circumstances of the fall:
 - the Victorian Registrar of Births, Deaths and Marriages should consider the adoption of the new and improved medical certificate cause of death form developed and adopted in Tasmania. This form aims to record more information on cause and circumstances of deaths from injury.
 - institute a research project to analyse a sample of fall-related injury death cases in older people to determine the cause of current problems (coding and other) with the provision of more detailed information on these deaths in ABS data.
 - introduce separate codes for slipping, tripping and stumbling on the same level in place of current combined code (W00 *Fall on the same level from slipping, tripping and stumbling*) in the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) - Australian Modifications.
 - introduce incentives and sanctions to encourage the full collection of data on injury presentations to ED's (VEMD data), with special attention to improving the quality of case narrative data.

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FALLS PREVENTION FOR OLDER PEOPLE: A QUICK RESOURCE GUIDE

Some useful web sites and resources:

http://www.health.gov.au:80/pubhlth/strateg/injury/falls/pdfs/falls_prog_dir.pdf -

a national directory of falls prevention programs compiled by the National Ageing Research Institute, May 2000. While not an exhaustive list of programs involved in falls prevention activity in Australia the directory does provide an overview of these programs.

http://www.health.gov.au:80/pubhlth/strateg/injury/falls/rsrch_aud.htm -

provides the results of a review conducted by the National Ageing Research Institute (NARI) in October 1999 of the scientific literature to identify best practice in falls and falls injury prevention and to pinpoint the gaps in the evidence base. The report "An analysis of research on preventing falls and falls injury in older people: community, residential aged care and acute care" is available on the Information page of this site.

<http://www.dhs.vic.gov.au/acmh/aged/maintaining/falls.htm> -

This web site of the Victorian Department of Human Services provides general information about the issue of falls and tips for their avoidance, falls prevention projects across the State and a useful link to other falls web sites.

www.preventinghomefalls.gov.uk -

web site set up by the UK Department of Trade & Industry (DTI). Contains downloadable information and resources including about falls on stairs and a useful document on evaluating health promotion programs for older people.

<http://infowest.maribyrnong.vic.gov.au/fallsprevention/> -

the web site of the Maribyrnong Falls Prevention Project. Contains a home safety checklist in the following community languages: Chinese, English, Greek, Italian, Spanish, Vietnamese, plus a form for reporting footpath hazards to local council.

Falls prevention videos in community languages:

The video from the *Standing on your own two feet* resource kit produced by the Australian Pensioners & Superannuants Federation ((02) 281 4566) has been translated into the following community languages: Arabic, Cantonese, English, Greek, Italian, Polish, Turkish, Vietnamese. The set is available for approx. \$135 from Video Record, Richmond, Vic. – phone (03) 9429 5899 or singly \$15.50

Falls Prevention booklet for older people

Peninsula Health Care Network (Mt Eliza Aged Care & Rehabilitation Centre). Enjoy the best years of your life: A guide to preventing falls

These free booklets are designed to be distributed in education sessions. If ordering in bulk, they can be customised to provide local listings of services. Phone: (03) 9788 1260 or (03) 9788 1259

Training manual for health professionals to use in training sessions for staff and clients

Inner South Community Health Service/Caulfield Community Health Service. Foothold on Safety: A falls prevention training manual

Contact: Bernadette Byrne, Caulfield Community Health Service (03) 9523 6666.

Monash University Accident Research Centre is preparing an information and resource kit "Getting started: Falls prevention in community-dwelling older people", funded by Esso Australia. The Kit should be available in April 2001. To pre-order a copy, phone Carmen Lee (03) 9905 1907.



Hazard 44 Erratum

Table 2, "Child falls resulting in hospitalisation*, Victoria, annual average frequency and rates (per 100,000)" on page 3 of Hazard 44 (September 2000) incorrectly transposed 2 groups of data. Groups identified as 5-9 y.o contained data for 10-14 y.o. and vice versa. The table below presents the data correctly.

Child falls resulting in hospitalisation*, Victoria, annual average frequency and rates (per 100,000)

Table 2

Type of Fall	<1 y.o.		1-4 y.o.		5-9 y.o.		10-14 y.o.		Total	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Falls, different level	113 (78)	181	683 (65)	267	1,271 (66)	402	482 (36)	154	2,549 (57)	269
- Steps/stairs	8	13	43	17	28	9	21	7	100	10
- Ladders/scaffolds	0	0	9	4	8	2	4	1	21	2
- Building/structures	0	1	33	13	46	15	33	11	112	12
- Playground equip.	1	1	187	73	733	232	177	57	1,098	116
- Chair or bed	45	72	210	82	111	35	35	11	401	42
- Different level other	59	94	201	79	345	109	212	68	817	86
Falls, same level	17 (12)	28	186 (18)	72	366 (19)	115	602 (45)	193	1,171 (26)	124
- Same level, not sport	10	16	151	59	244	77	286	92	691	73
- Falls in sport	0	1	4	1	42	13	203	65	249	26
- Fracture unspecified	7	11	31	12	80	25	113	36	231	24
Other/unspecified falls	15 (10)	23	187 (18)	73	267 (14)	84	255 (19)	82	724 (16)	76
TOTAL	145	231	1,056	413	1,904	601	1,339	429	4,444	469

*Public hospitals only, July 1992 to June 1998

Source: Stathakis V. 1999. Hospitalised Injuries, Victoria: July 1992 – June 1998. Monash University Accident Research Centre Report No. 160.

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Acknowledgments

The authors gratefully acknowledge Voula Stathakis and Karen Ashby for assistance with data extraction.

DATABASE DESCRIPTIONS

Coroners' Facilitation System (CFS)

The Coroner's Facilitation System is a database containing all unnatural deaths and is collated from the findings of the Victorian State Coroner over the period 1989/90-1994/95. These include deaths that were unexpected, unnatural or violent, or which resulted from accident or injury (See Hazard 38 for a recent overview of this database). This system is in the process of being replaced with a high quality National Coroners' Information System.

Victorian Admitted Episodes Dataset (VAED)

The VAED contains information on admissions to Victorian hospitals over an 12 year period – July 1987 to June 1999. For most of the period covered, the data was collected by Health Computing Services Victoria under the direction of Human Services Victoria. Detailed information on hospital admissions, from admission to discharge, is collected. The information on the nature of injury is based on the diagnosis by physicians. MUARC has access to those records which involve injury and poisoning. In this and earlier editions of Hazard admission data based on the ICD 9 version of coding has been used. However, from July 1998 ICD version 10 has been applied in hospitals.

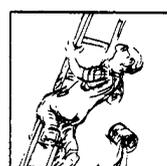
Victorian Emergency Minimum Dataset (VEMD)

The electronic VEMD database records details of injuries treated at the emergency departments of 26 major public hospitals, 23 of which cover a general adult community (see page 15). The total number of cases on the database to December 2000 was approximately 908,000. For most hospitals the period January 1996 to October 2000 is covered. The injury variables collected include injury cause, location, activity, nature of main injury, body region, human intent and a narrative describing the injury event. VEMD hospitals represent approximately 80% of statewide emergency department presentations. The data provided to MUARC does not include all ED presentations, only injury specific cases. Hence it is not possible to analyse any VEMD data which may have been re-categorised to a non-injury grouping. A MUARC study found that the VEMD captured only 82% of possible VEMD presentations.



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Participating Hospitals

<i>From October 1995</i>	<i>From November 1995</i>
Austin & Repatriation Medical Centre	Dandenong Hospital
Ballarat Base Hospital	<i>From December 1995</i>
The Bendigo Hospital Campus	Royal Victorian Eye & Ear Hospital
Box Hill Hospital	Frankston Hospital
Echuca Base Hospital	<i>From January 1996</i>
The Geelong Hospital	Latrobe Regional Hospital
Goulburn Valley Base Hospital	<i>From July 1996</i>
Maroondah Hospital	Alfred Hospital
Mildura Base Hospital	Monash Medical Centre
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Wangaratta Base Hospital	Royal Melbourne Hospital
Warrnambool & District Base Hospital	
Western Hospital - Footscray	
Western Hospital - Sunshine	
Williamstown Hospital	
Wimmera Base Hospital	

Coronial Services

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

National Injury Surveillance Unit

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

How to Access VISS Data:

VISS collects and tabulates information on injury problems in order to lead to the development of prevention strategies and their implementation. VISS analyses are publicly available for teaching, research and prevention purposes. Requests for information should be directed to the VISS Co-ordinator or the Director by contacting them at the VISS office.

Contact VISS at:

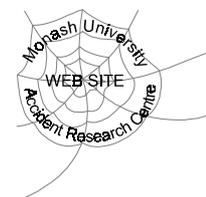
MUARC - Accident Research Centre
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Recent issues of *Hazard*, along with other information and publications of the Monash University Accident Research Centre, can be found on our internet home page:

<http://www.general.monash.edu.au/muarc>



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