Hazard
(Edition No. 28)
September 1996

Victorian Injury
Surveillance System
Monash University
Accident Research Centre

This edition of Hazard continues the investigation of poisoning in early childhood commenced in Hazard 27. The previous edition focused on the ingestion of drugs and medications, this issue is concerned with the ingestion of chemicals and plants. The issue of injuries from power saws is also addressed. Results from the recent client surveys are included.

Childhood domestic chemical and plant poisonings

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Summary

Chemical poisonings represented 26% of poisoning admissions (VIMD) and 29% of poisoning emergency department presentations (VISS) to children aged less than 5 years.

Eighty-seven percent of chemical and plant poisonings occurred in the home and the peak age range was 13 to 17 months. At this stage of their development, toddlers are typically walking or crawling confidently and pulling themselves into a standing position. Chemicals stored at low levels were therefore the most vulnerable. They were most commonly accessed from a cupboard eg. moth repellants, from the floor eg. rat bait, or from an appliance eg. automatic dishwasher detergent.

Admissions most often resulted from the ingestion of automatic dishwasher detergents, caustics, rat bait and moth repellants. Emergency department presentations most often resulted from the ingestion of rat bait, bleaches, automatic dishwasher detergents, moth repellants, turpentine and snail bait.

Barriers should be placed between the child and the chemicals. These could take the form of child resistant packaging, child resistant closures on cupboards or appliances, out of reach storage and protective coverings, eg. around moth-balls and rat bait.

Clear and informative labels on toxicity and first aid, including the phone number of the Poisons Information Centre should be displayed on all poisonous chemicals.

Also in this issue:

Power saw related injury (pages 8 to 13)

Approximately 363 Victorians are hospitalised each year as the result of a power saw related injury.

An investigation of 386 emergency department presentions for power saw injuries found that 56% of victims were do-it-yourself home handypersons and 38% were workers on-the-job. The admission rate was 35% and finger lacerations were the single most common injury sustained (42% of total injuries).

The types of saws often involved were portable circular saws (29%), bench/table saws (10%) and band saws (10%).

Loss of control of the saw, including kickback, was the most common cause of injury.

Childhood domestic chemical and plant poisonings

The previous edition of Hazard examined poisoning relating to the ingestion of drugs and medications in children aged less than 5 years. These cases represented 74% of all poisoning admissions and 71% of poisoning emergency department presentations recorded by VISS. The remaining cases related to the ingestion of chemicals and plants and these are considered in this article. Poisonings from chemicals could most often be attributed to pesticides, household cleaners, detergents and volatile solvents. This article excludes poisonings from food and alcoholic beverages, the latter was classified as drugs and considered in the previous edition of Hazard.

Many ingestions of household chemicals involve low risk substances. However a significant minority involve toxic substances which pose a serious threat to health. These include caustic cleaners, oven cleaners, automatic dishwasher detergents, other acid and alkali corrosives, pesticides and naphthalene, as found in moth balls.

As part of the 1992 Australian Bureau of Statistics 'Safety in the Home' survey, data on the types of medicines, household cleaners and home maintenance products kept in households where a child aged under 5 years resided were collected. The survey involved interviewing 4,000 households in the Melbourne Statistical Division and making estimates for all Melbourne households. Relevant results relating to children under 5 are summarised in table 1.

These figures provide important exposure information, which when combined with poisoning data would allow relative risks to be calculated. It also provides useful baseline data from which to monitor changes in exposure over time.

A National Health and Medical Research Council household survey and audit of domestic chemical storage, conducted in 1991, identified the following: there was a general lack of community understanding of chemical hazards; existing

Products identified in childhood poisonings kept by Melbourne households with children under 5 years of age — Table 1

Type of product	Estimate of no. of households which have product and a child under 5 years	% of total households with children under 5 years
Household cleaners		
Disinfectants/antiseptics	161 400	90
Bleach	133 800	75
Oven cleaner	98 500	55
Auto. dishwasher detergent	71 700	40
Drain cleaner (caustic soda)	38 500	22
Home handyman products		
Petrol/motor fuel	118 900	67
Methylated spirits	102 600	58
Turpentine	89 400	50
Snail bait/slug pellets	74 100	42
Ant killer	51 000	29
Kerosene	38 200	21
Moth balls (naphthalene)	28 100	16
Mouse/rat bait	24 800	14
Camphor (block)	10 800	6
Total households	**178,300**	**100**

Source: Australian Bureau of Statistics 'Safety in the Home' survey, Melbourne, Nov. 1992

Victorian hospital admissions from poisonings by agent in the <5 age group excluding medications — Table 2

Poisoning agent excl. food & alcohol	N	% of total
Insecticides including moth balls and ant bait	218	18
Corrosives and caustics	170	14
Rodenticides	103	9
Other specified solvents include. turpentine	101	8
Petroleum fuels and cleaners include. kerosene	75	6
Plants including fungi	65	5
Household disinfectants	43	4
Synthetic detergents and shampoos	40	3
Other cleansing and polishing agents	36	3
Alcohol excluding beverages	27	2
Soap products	18	2
Other	321	26
Total	**1217**	**100**

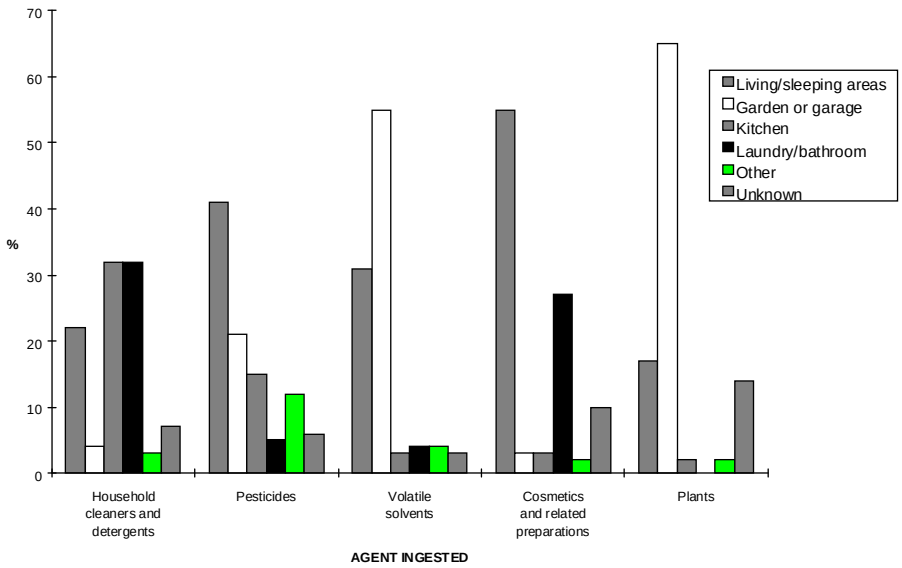
Source: VIMD July 1987 to June 1994

Chemical and plant ingestions by age of victim — Table 3

AGE	Cleaners /detergents n = 264 %	Pesticides n = 250 %	Volatile solvents n = 73 %	Cosmetics n = 60 %	Plants n = 43 %	Total n = 802 %
0	12.5	16	1	8	12	12
1	54.5	44	64	53	28	47
2	23	30	24	25	28	28
3	7	8	6	12	16	9
4	3	2	5	2	16	4
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**

Source: VISS - RCH,WH,PANCH 1989 to 1993, LRH July 1991 to June 1995

Chemical and plant ingestions by location — Figure 1



Source: VISS - RCH,WH,PANCH 1989 to 1993, LRH July 1991 to June 1995

labelling, packaging and warning statements were not understood and were not being acted upon; unsafe storage practices were widespread.

Hospital Admissions (Victorian Inpatient Minimum Dataset)

Admissions to Victorian public hospitals were analysed for the period 1987/88 to 1993/94. In this 7 year period there was a total of 1,217 admissions (annual average of 174 compared with 508 for medication poisoning) as the result of unintentional poisonings from "solid and liquid substances, gases and vapours" i.e. non-medications, to children under 5 years of age (see table 2). Due to the nature of the ICD-9 coding system ingestions cannot be separated from other types of poisoning such as inhalation or absorption through the skin.

Emergency Department Presentations (VISS)

The Victorian Injury Surveillance System (VISS) collects detailed injury information from 7 campuses of 5 Victorian public hospitals. Child injury data is based upon 5 years of data, 1989 to 1993 at 3 Melbourne hospitals, Royal Children's Hospital, Western Hospital and Preston and Northcote Community Hospital and 4 years of data, July 1991 to June 1995 at Latrobe Regional Hospital - Traralgon and Moe campuses.

There were 802 cases of poisoning to children aged under 5 years due to the ingestion of household chemicals or plants, representing 29% of all poisoning ingestions recorded by VISS. Products such as household cleaners i.e. bleaches, oven cleaners and dishwasher detergents accounted for one third of all unintentional ingestions of household chemical to victims under 5 years; pesticides (31%), volatile solvents (9%), cosmetics (7%) and plants (5%) make up much of the remainder.

Unlike medication ingestions where victims are most often aged 2 years, 1 year olds are the most common victims of chemical poisonings, accounting for 47% of the total. Age breakdowns by household chemical categories show a dominance of 1 year olds for each substance, particularly volatile solvents, cleaners and detergents and cosmetics. (Table 3)

The peak age range was 13-17 months. At this stage toddlers are typically walking or crawling confidently and pulling themselves to a standing position. Also motor skills are sufficiently developed to open most cupboards, chemicals stored close to the ground being most vulnerable.

Eighty-seven percent of poisonings occurred in a home, mostly the living/ sleeping area (36% of total), garden or garage (21%), kitchen (16%) and laundry/ bathroom (14%). Breakdowns by location are shown in figure 1.

The agents with high rates of hospital admission include kerosene (90% admitted), caustic cleaning agents (76%), automatic dishwasher detergents (57%) and insecticides/ repellents (56%). Similar high risk agents were identified by Litovitz et al (1992) in the United States. The average admission rate for all under 5 years is 19%.

Pesticides (n = 250)

Two-thirds of pesticide poisoning cases related to the ingestion of rodenticides. Other products most often involved were

moth repellents, snail bait, ant bait and insecticides. Table 4 shows the most common types of pesticides involved.

Rodenticides (n=134)

Rodenticides or rat/mouse bait were a frequent and increasing cause of less severe childhood poisoning events (Parsons et al, 1996). There were an average of 11 hospital admissions in Victoria each year due to rodenticide poisoning and 2.3% of calls to the Victorian Poisons Information Centre (VPIC) related to rodenticide ingestions (Parsons et al, 1996). Seventeen percent of cases recorded by VISS required admission to hospital.

In Australia the most commonly available rodenticides are warfarin and related compounds. Traditional warfarins have low toxicity but due to increasing rodent resistance new more toxic "super-warfarins" have been developed. These "superwarfarins" produce more potent and long-lasting anticoagulant effects with even single or small doses and symptoms last from days to weeks depending on the agent and dose (Routt Reigart, 1995 & Smolinske et al, 1989). Fortunately Australian experience has shown that the amounts usually ingested by children are of an insufficient amount to cause symptomatic coagulopathy (Parsons et al, 1996).

There were 134 cases of poisoning from the ingestion of rodenticides. Over half of the victims were aged 1 year.

Over half (57%) of rodenticide ingestions occurred in the victim's own home, mostly in the living and sleeping areas (26% of total cases) and the kitchen (19%). A further 19% of cases occurred in a private home other than the victims, 7% in areas of commerce and 4% in day-care centres or schools.

A lesser proportion of cases occurred in a residential location in this category than non drug ingestions overall (76% rodenticides in the home vs 87% all non drug ingestions in the home).

The means of access to the rodenticide was noted in 43% of cases. Of these cases access was most commonly from the place where the agent had been laid (88%). Means of access was most frequently from behind an appliance or fixture (25%), particularly the fridge, cupboard and cabinets; from inside a cupboard (23%); under an appliance (12%), mostly fridge and washing machine; on the floor (12%), out of the packaging (11%); under the house (5%) or laid on a shelf (5%).

Parsons et al (1996), found that in a follow-up phone survey involving 115 cases of children under 5 years old identified through the Victorian Poisons Information Centre or VISS, most incidents occurred in the victim's own home (62%) and a quarter in another home, mostly that of a relative. The peak age was 1 year.

In this study, 90% of victims accessed the rodenticide at the site at which it had been laid, in most cases (92%) it had not been laid by a professional pest controller. The care giver was aware of the rodenticide being laid in over two-thirds of cases. Twenty percent of access sites were inside cupboards and wardrobes indicating that placing the rodenticide in seemingly out of the way places is not an effective means of preventing access. Eight percent of children accessed the rodenticide from the package. Most commonly the amount consumed was limited to only a few pellets or granules. In 61% of cases the child was not alone at the time of ingestion.

The type of agent was identified in 84% of cases. Fifty-three cases were warfarin based agents and 44 "superwarfarin". Fifty-five percent of those exposed to "superwarfarin" required medical attention compared to 25% of those exposed to warfarin.

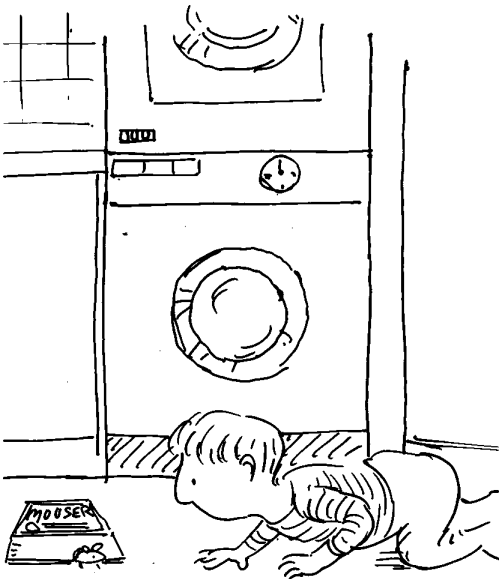
Most respondents (90%) said they were aware of some dangers associated with rodenticides prior to the poisoning, but over half of these knew no specific dangers.

Agents involved in chemical and plant ingestions in the <5 age group - Emergency Department Presentations **Table 4**

AGENT INGESTED	NO. OF CASES	% OF TOTAL	NO. ADMITTED	% ADMITTED
Pesticides	250	31	72	29
- rat bait	134	17	23	17
- moth repellents	46	6	21	46
- snail bait	37	5	15	41
- ant bait	13	2	3	23
- insecticides or insect repellents	9	1	5	56
- other pesticides	11	1	5	45
Household cleaning agents	165	21	55	33
- bleaches (non-cosmetic)	61	8	13	21
- caustics (excl. lye)	34	4	26	76
- general purpose cleaners	27	3	4	15
- pine oil and disinfectant preparations	15	2	3	20
- toilet bowl products	15	2	4	27
Soaps and detergents	99	12	40	40
- dishwasher detergents	53	7	30	57
- laundry soaps or detergents	29	4	8	28
Volatile solvents	73	9	33	45
- turpentine	38	5	14	37
- petrol	16	2	7	44
- kerosene	10	1	9	90
- methylated spirits	5	1	0	0
Cosmetics	60	8	12	20
- fragrance preparations (excl powders)	23	3	1	4
- nail preparations	10	1	5	50
Plants	43	5	14	33
Chemicals and compounds excl. cleaning	35	4	11	31
- chemical or chemical compounds NEC	17	1	9	53
- metallic compounds NEC	11	1	1	9
Automotive supplies	24	3	9	38
- anti-freeze	6	1	6	100
Adhesives (excl tapes)	19	3	3	10
Other	34	4	0	0
TOTAL	**802**	**100**	**248**	**31**

Source: VISS - Royal Children's Hospital, Western Hospital and Preston and Northcote Community Hospital 1989 to 1993 and Latrobe Regional Hospital July 1991 to June 1995.

Figure 2



Recommendations

- Encourage or legislate for rodenticides to be enclosed in a child resistant container which still allows the rodent access to the agent. (Figure 2).
- Encourage manufacturers to retail rodenticides in smaller quantities just enough for the average domestic dwelling.
- Include in the packaging multi-lingual recommendations and diagrams showing the safe positioning of baits.
- Research the comparative poisoning risks for wax block and pellet formulations.

Moth repellents (n = 46)

Eighty-three percent of moth repellent ingestions related to mothballs, a further 2 cases ingested naphthalene crystals. Forty-six percent of victims required hospital admission. Moth repellents were most often accessed via cupboards (7 cases), drawers (5), wardrobes (3), off the floor (3) or from a table (1). The amount ingested was recorded in only 10% of cases and on average was 2 mothballs although one victim ingested 6 mothballs. Children suffering from a relatively common genetic enzyme deficiency (G6PD deficiency) among Mediterranean and Chinese families are susceptible to severe consequences of naphthalene ingestion.

Recommendations

- Package moth balls individually in small, ventilated, plastic boxes, which prevent ingestion. There are examples currently on the market where 3 moth balls are packaged in a cylindrical plastic container which is suitable to hang in a wardrobe.

Snail bait (n = 37)

Forty-one percent of victims ingesting snail bait required admission to hospital. At mostly 2 years these victims were slightly older than other chemical ingestion cases. Sixty-five percent of victims were playing in the garden or yard at the time of ingestion e.g. *"Playing, got into vegetable patch, ate snail bait"*.

Other pesticides (n = 31)

Poisonings from other pesticides included ant bait (13 cases), insecticides or insect repellents (7), other pest control products (3) and weed killer (3).

Household cleaners (n = 165)

One third of victims ingesting household cleaning agents required admission. Victims were aged mostly 1 (51%) or 2 (29%) years and 60% were male. Seventy-seven percent of ingestions occurred in the victim's own home, mostly in the bathroom, laundry or toilet (33% of all household cleaners), living or sleeping areas (21%) or the kitchen (18%).

Bleaches (n=61)

Household bleaches were the most commonly ingested household cleaning agent recorded by VISS accounting for 37% of cleaning agents ingested and 8% of all chemical and plant ingestions. The admission rate was 21% for bleach ingestions and 36% for the 14 victims who ingested nappy solutions. Bleaches were usually accessed straight from the bottle (11 cases); a bucket, commonly a nappy bucket (8); a cupboard or cabinet (5); and from discarded bottles in a rubbish bin (4). Two children ingested bleach which had been stored in an alternative container. Most bleaches and nappy solutions are without child resistant packaging.

Caustic cleaners (n=34)

Kynaston et al, 1989, define a caustic substance as one which is capable of burning, corroding or destroying live tissue. These substances have the potential to cause full thickness burns and ulceration of the face, mouth and oesophagus after even minimal exposure (Hazard 4, Rider and Tarar, 1995). Rider and Tarar report that strong alkalis, like those found in oven cleaners, rapidly penetrate the skin and cause liquidation of fat, allowing further penetration and ongoing tissue damage over a period of hours if inadequately treated. Sodium hydroxide (caustic soda) is a strong alkali used in many oven cleaners. Most contain approximately 4%. However products containing less than 5% sodium hydroxide are not required to have child resistant closures (Choice, 1994).

Caustic cleaners accounted for 34 cases of ingestion and had an admission rate of 76%. They mostly involved oven cleaners (12 cases), straight caustic soda (10), drain cleaners (6) and caustic wall cleaners (4). Six victims found the agent in a cupboard or cabinet, a further 6 simply stated ingestion from the container. Other sources were from the rack of an oven (2); from a cup or glass (2); or from the ground after it had been used to clean an outdoor surface (2).

Other cleaners (n=70)

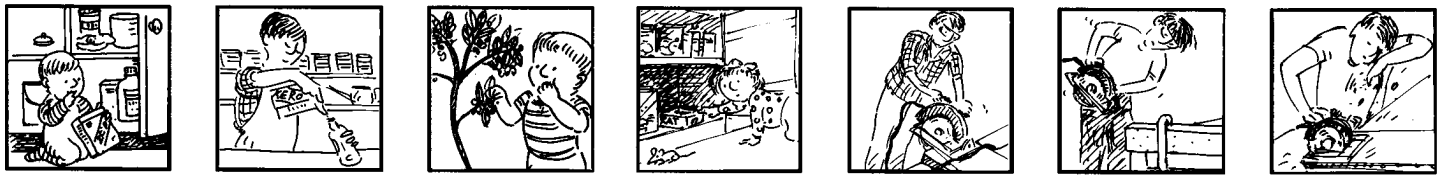
Other ingestions of household cleaning agents included general purpose cleaning agents (27 cases), pine oil cleaning and disinfectant preparations (15) and toilet bowl products (15).

Soaps and detergents (n = 99)

Dishwasher detergents (53 cases), laundry soaps and detergents (29) and dishwashing liquids (9) account for the majority of cases in this category.

Automatic dishwasher detergents (n=53)

It is estimated that 1 in 5 Australian households possess a dishwasher (Cornish et al, 1996).



Highly alkaline dishwasher detergents present a corrosive risk when ingested by children. As with caustic cleaners the potential for burn injuries is extremely high. They usually contain a variety of alkaline salts (70% to 80%) and have a pH of more than 11.5 in a 1 per cent solution (Kynaston et al, 1989; Cornish et al, 1996). Cornish et al found that factors such as the proximity of the machine in one of the busiest rooms in the home, the ease with which the dispenser can be reached when the door of the dishwasher is open and the ease with which many dispensers open at the touch of a finger combine to make dishwashers very effective vehicles for delivering this highly caustic substance.

Of the 53 cases recorded by VISS, most victims (62%) accessed the dishwasher detergent from the dishwasher itself, with 17% specifically from the dispenser e.g. *"Dishwasher door left open, ate residue powder from dispenser in door"*. A further 13% of ingestions were directly from the packaging. Most detergents, (64%) were in the form of a powder or granules; a further 9% involved a liquid. Thirty percent of ingestions were of detergent residue remaining in the washer after the wash cycle, e.g. *"Standing at the dishwasher, ate some powder out of the dispenser after the end of cycle"*. A *Choice* report on dishwasher detergents found that residue or sludge is only found as the result of a malfunction such as the dispenser not opening properly or an incorrectly loaded machine which causes blockages of the rotors. Eighty-three percent of ingestions recorded by VISS occurred in the kitchen of the victim's own home and more than half (53%) were to victims aged 1 year.

The rate of admission for dishwasher detergent ingestions is higher than that of household chemicals in general (57% vs 31%), and the rate for victims under 2 is higher again at 64%. Burns to the mouth and oesophagus and respiratory difficulty were noted in 36% of victims of dishwasher detergent ingestions.

Cornish et al (1996), in an examination of 61 calls to the VPIC relating to ingestion of dishwasher detergents, found that most of the children gained access from the dispenser after the machine had been opened by an adult, suggesting that child resistant catches on the door of the dishwasher would make a limited contribution to reducing poisonings.

Recommendations

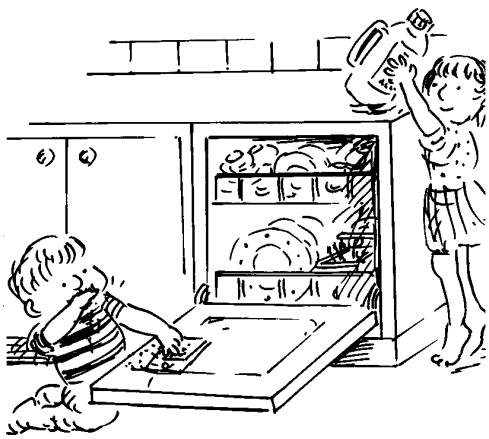
- Re-design or relocate the detergent dispenser to make it child resistant.
- Examine the role of obstruction of water flow to the dispenser which can result in detergent caking.
- All packaging of automatic dishwasher detergents should feature child-resistant closures.
- Make first aid warnings prominent on packaging.
- Develop less alkaline dishwasher machine detergents.
- Store in cupboard with a child resistant lock.
- Bulk loading and automatic feed of detergent during cycle.

Progress

Since 1991, generic brands of detergent have been progressively packaged in child resistant packaging.

Currently major suppliers provide information on the hazards of dishwashing detergents with most new machines. Several machine suppliers have arranged for warning labels to be attached to their machines.

Figure 3



A recent European innovation is the bulk dispenser which would only require filling every 2 to 4 weeks depending on frequency of use. Measured amounts of powder would be automatically released during each wash and machines could possibly feature an adjustment switch to account for heavy or light loads.

Limited research and development occurs in Australia since dispensers are obtained from one specialist manufacturer in Italy.

Volatile solvents (n = 73)

Forty-five percent of victims ingesting volatile solvents required admission to hospital. Most victims (68%), were aged 1 year. Turpentine was most common accounting for over half of these cases, others included petrol (22% of volatile solvents), kerosene (14%) and methylated spirits (7%).

There were 38 cases of turpentine ingestion with an admission rate of 37%. Five children accessed the turpentine from an open container or a source such as a bowl or a jar, another 4 ingested turpentine kept in an alternative container e.g. a soft drink bottle, and 4 placed a turpentine soaked paintbrush in their mouths. Child resistant packaging is required for quantities of 5 litres or less.

Three of the 16 children who ingested petrol syphoned it out of the car or lawn mower, another 2 drank petrol kept in drink bottles e.g. *"Drank from a coke bottle filled with petrol"*.

While not as commonly ingested as other solvents in this category, kerosene (10 cases) had an admission rate of 90%. Kerosene is a common source of poisoning in developing countries and was in the past in Australia when kerosene was more widely used.

Because the lungs are particularly vulnerable to damage from volatile solvents, causing pneumonitis, it is important not to induce vomiting (and potential inhalation) following ingestion.

Plants (n = 43)

There were 43 cases of ingestion of plants, seeds, berries and flowers to children aged less than five years, with an admission rate of one third. Forty-seven percent of cases occurred in the autumn

months (March to May). Commonly ingested items were berries (10 cases) mostly from the deadly nightshade (3), rhus and lantana trees; toadstools (8%) and a variety of leaves, seeds, petals and plant nutrients and fertilisers.

Recommendations

- Identification of a lead agency to co-ordinate and facilitate childhood poisoning prevention.
- Investigate call-back Poisons Information Centres as in the USA as a means of reducing hospital presentations and admissions.
- Caustic soda, oven cleaners or drain cleaners should not be stored in households with young children.
- Any caustic cleaner must be kept out of the reach of children.
- Household chemicals or volatile substances must not be stored in alternative containers e.g. drink bottles
- Special collections of household chemicals by local councils
- Child resistant packaging for a wide range of dangerous household products
- Assessment of substances involved in poisoning to examine the possibility of replacement products that perform the same function with a lower toxicity.
- Packaging of toxic products in smaller volumes may reduce the amount of product ingested and level of injury.
- Research to clarify the means of access to specific agents and potential design or other countermeasures.
- Clear labelling regarding contents, use, toxicity and first aid.
- Poisons Information Centre phone number on all labels. 131126
- Monitor progress on the implementation of countermeasures.

Non-Ingestions

Chemical splashes and sprays (n = 210)

While ingested chemicals were the dominant mechanism of injury there were a further 210 cases of injury where victims were splashed or sprayed by a chemical. Thirty-five percent of victims were aged 1 year and almost three quarters of injuries occurred in the victim's own home. Only 7% were admitted to hospital. Half of the victims were splashed in the eyes and 11% to the face. The most common products involved were oven cleaners (9% of total), general purpose household cleaners (8%), fragrance preparations (8%), laundry soaps or detergents (7%) and bleaches (5%).

Inhalations (n = 32)

Almost 60% of inhalations were to children aged 1 year and under with an admission rate of almost one third. Smoke inhalation was the most common cause of injury (31%), followed by carbon monoxide (19%), household cleaners (9%), insecticides (6%), chlorine (6%) and eucalyptus oil (6%).

Acknowledgements

VISS gratefully acknowledge the comments and contributions of: Barry Parsons and Elizabeth Hender, Director and Deputy Director respectively, Victorian Poisons Information Centre; Dr Anne Altmann and Julie Hoy, Monash University Accident Research Centre.

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Power saw related injury

Karen Ashby

The Victorian Injury Surveillance System (VISS) recorded 386 cases of injury relating to power saws with an admission rate of 35% compared to 48 cases of injury from unpowered saws with an admission rate of 10%.[1]

Power saws as defined for this article do not include chainsaws, which have been previously reported (Hazard, edition 22, March 1995). VISS data comprises 9 hospital years of self reported adult injury presentations to the Emergency Departments of five Victorian public hospital campuses[2].

Power saws (excl portable circular) and portable circular saws were found to rank 8th and 12th respectively behind grinders, lawn mowers and ladders as the most common factors involved in do-it-yourself (DIY) injuries. Their relative severity meant they ranked 3rd and 4th in the most common causes of hospital admissions (Routley and Ozanne-Smith, 1996).

Of the 386 power saw related injury cases, the overwhelming majority of victims were male (99%) with frequency of presentations peaking in the 20 - 39 years age range (68% of total cases); 35-39 years (15% of total); 20-24 years (14%) and 30-34 years (12%).

Fifty-six percent or 217 of the injuries occurred during do-it-yourself activities defined by Venema (1991) as 'activities which could have been done by a professional craftsman', 84% of which occurred at home. Another 38% of injury cases occurred while the victim was on duty at work or "on-the-job". Areas of production (57%) were the most frequent location for "on-the-job" injuries, areas of commerce (16%) and residential sites (13%) were also common. The injury location was unspecified in 16% of the total 386 cases.

Table 1 shows a comparison of the types of power saws implicated in relation to the operator's activity.

Do-it-yourself vs on-the-job injuries

Injuries which occurred whilst undertaking DIY or on-the-job activities were compared. This analysis included 94% of the injury cases recorded by VISS.

Victims sustaining on-the-job power saw injuries were younger than those injured undertaking DIY activities. Almost 40% of victims sustaining injuries on-the-job were aged less than 25 years compared with 6% of victims in the same age group undertaking DIY tasks. Most (66%) victims injured while undertaking DIY activities were aged 30-60 years, another 20% were over 60 years of age.

Nearly half of the DIY injuries occurred on the weekend, mostly Saturday and were most common in January. On-the-job injuries were at their lowest point in December and January, each accounting for only 5% of cases. They peaked in October (15%) and July (13%).

The majority of DIY injuries occurred in the victim's own yard (69%) or another's yard (8%). On-the-job injuries were most common at factories and warehouses (30% of on-the-job cases), industrial sites (16%), areas of private enterprise e.g. shops, pubs or cinemas (16%), residential locations (13%), construction sites (10%) or areas of education (4%).

The manufacturing (30%), construction (29%) and retail and wholesale industries (15%) were most commonly cited as those industries involved in on-the-job power saw injuries. One quarter of all victims of on-the-job injuries were employed as carpenters or joiners, other common occupations were meat tradespersons (14%), labourers (14%) and cabinet-makers (6%). Almost three quarters of the operators using band saws were meat tradespersons.

Power saw injuries by activity being undertaken, type of saw used and severity **Table 1**

Type of saw	Total no. of cases	DIY % of saw type	On-the-job % of saw type	Other % of saw type	Total % of saw type	% Admitted
Portable circular	112	68	23	9	100	46
Bench /table	40	52.5	42.5	5	100	43
Band	37	21	76	3	100	27
Jigsaw	16	75	19	6	100	0
Power hack	5	40	40	20	100	0
Radial arm	4	25	75	0	100	75*
Other /unspecified	172	56	41	3	100	32
TOTAL	**386**	**56**	**38**	**6**	**100**	**35**

Source: VISS - WH, LRH, RMH, PANCH (N = 386).
** note only 4 cases of injury.*

[1] There are a further 116 cases of injury to adults on the database where the power source of the saw was not specified.

[2] Collection periods at each of the VISS hospitals are as follows: Latrobe Regional Hospital - Traralgon and Moe campuses - July '91 to June '95, Western Hospital - Dec '91 to Dec '92, Royal Melbourne Hospital - Mar '92 to Feb 93 and Preston and Northcote Community Hospital Mar 92 to Feb 93.

The admission rate for on-the-job injuries was higher than DIY injuries, 39% vs 34%. VISS recorded 2 deaths relating to power saws, both occurred while undertaking DIY activities. The first death occurred when a saw blade disconnected and hit the victim in the chest, the second when the victim cut an electrical lead with a circular saw.

Table 2 shows the breakdown of power saw related injuries by severity.

Useful data on factors contributing to the injury event was provided in the narratives of almost 60% of DIY and half of the on-the-job cases. The operator losing control of the saw (17% of DIY and 12% of on-the-job cases) was the single most common cause of injury, most often when the saw kicked back e.g. *"Using circular saw, blade jammed and kicked back cutting leg"* or when the saw slipped e.g. *"Cutting wood with electric saw, saw slipped and lacerated victim's thumb"*. Other common injury scenarios included foreign bodies in the eye, mostly woodchips, sawdust or metal; the object being sawn slipping or jamming often flying up and hitting the victim e.g. *"Using electric round blade saw to cut wood, piece of wood jumped and thumb caught saw"* or the victim's clothing catching in the saw drawing them into the path of the saw blade, eg. *"Cutting wood with saw, jumper sleeve caught in saw and arm was pulled in"*.

Table 3 gives a breakdown of the most common injury scenarios.

VISS can record up to 3 separate injuries per case. Figure 1 shows the overall breakdown of injuries sustained by body part. Many similarities exist between the types of injuries sustained during DIY tasks and those on-the-job. Eighty-eight percent of on-the-job and three quarters of DIY injuries were to the upper limbs, particularly the fingers (approximately 63% of both groups). Finger lacerations were the single most common injury sustained in both groups (43% on-the-job and 39% of DIY injuries). Injuries to the eyes, mostly foreign bodies were also common accounting for 13% of DIY and 10% of on-the-job injuries. Other common injuries are shown in table 4.

Power saw injuries by severity — Table 2

Level of Severity	DIY (n = 217) % of cases	On-the-job (n = 146) % of cases	Other (n = 23) % of cases	Total (n=386) % of cases
No treatment	1	2	0	1
Minor treatment	11	11	13	11
Significant treatment				
- ED review	23	18	13	21
- referral general	16	14	13	15
practitioner	12	14	26	13
- referral outpatients	2	2	4	3
- other referral				
Admission	34	39	31	35
Death (DOA or died in ED Dept.)	1	0	0	1
TOTAL	**100**	**100**	**100**	**100**

Source: VISS - WH, LRH, RMH, PANCH (N = 386)

Power saw injuries by mechanism of injury — Table 3

Mechanism of Injury	DIY (n = 217) % of cases	On-the-job (n = 146) % of cases	Other (n = 23) % of cases
Loss of control of saw including kickback	17	12	30
Foreign body in operator's eye	14	12	0
Material being sawn slipped	11	5	4
Operator of saw slipped	7	10	13
Operator's clothing caught in saw	2	3	0
Failure or removal of saws guards	1	2	0
Disconnected saw blade	1	0	0
Electrical incident	1	0	0
Other incident	5	5	9
Non-specific incident	41	51	44
TOTAL	**100**	**100**	**100**

Source: VISS - WH, LRH, RMH, PANCH

Safety Equipment

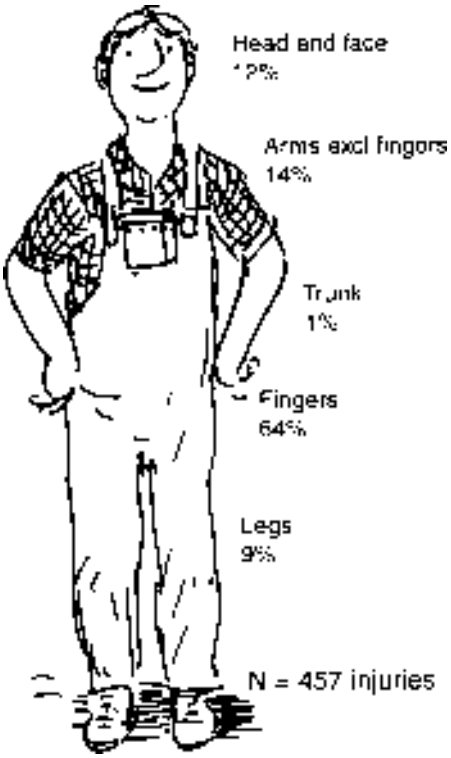
The use of safety devices was recorded in 30% of on-the-job and 29% of DIY injury cases. Devices most commonly noted included protective eyewear (15% of DIY and 10% of on-the-job victims), ear plugs/ protection (5% DIY and 3% on-the-job) and gloves (3% DIY and 2% on-the-job).

One quarter of the victims performing DIY tasks who sustained foreign bodies in the eyes claimed to be wearing protective eyewear at the time of injury. Doremus (1992), found that barriers to the wearing of eye protection included misting up and restricted field of view for the operator. She found that style and comfort of the eyewear was a major factor in the operator's decision to choose to wear it. Payne et al (1990), promoted the use of saws which have built in dust collectors to afford greater protection to the eyes and the respiratory system. Adequate eye protection however should still be worn as dust collectors do not protect against flying woodchips.

In a survey of professional carpenters with a number of years' experience, Moore and Rennell (1991), found that half had never read the manufacturer's instructions relating to portable circular power saws and many had little or no understanding of the operating conditions that cause kickback nor the precautions necessary to prevent it.

Electrocution can be guarded against by the use of an Earth Leakage Detection

Power saw injuries by body part **Figure 1**



Source: VISS - WH, LRH, RMH, PANCH
(NB: up to 3 injuries per case)

Unit (ELDU). An ELDU constantly monitors and compares current flows in both the Active and Neutral circuits of an electrical installation. Should the current flow become unbalanced the unit, upon detecting the imbalance, will automatically cut the electricity supply.

Victorian Hospital Admissions

The Victorian Inpatient Minimum Dataset records admissions to Victorian Public Hospitals where data is coded using the ICD-9 coding system. Power saw injuries were estimated to constitute 97% of 2539 woodworking power tool injuries (E919.4), recorded statewide, based on VISS hospital admissions (5 hospitals). The yearly average admitted cases for woodworking power tool injuries, July 1989 - June 1994 was 363. This is a high frequency compared with other cases of adult admissions: falls from building structures (yearly average 255), bicyclists (161), lawn mowers (108), dog bites (97) and electrical currents (27). Rates and trends over time are shown in Figure 2 and a statistically significant increase is indicated.

More than 70% of hospital admissions were for a period of 2 days or less, One day was the most common length of stay with 40% of victims requiring a stay of this length. Almost three quarters of the primary injuries sustained were open wounds and another 17% dislocations.

A further unknown number of cases is recorded under metal working machines (E919.3). Approximately 3% of VISS cases involved metal working.

Saw Types

1. Portable Circular Power Saws

The circular saw is fast and powerful and has precision and versatility. It can cut wood, metal, plastic, brick or tile with appropriate blades. Heavy duty models account for half of circular saws sold by retailers to both tradespersons and do-it-yourselfers, at a cost of $150 or more. The U.S. Consumer Product Safety Commission estimates that in 1991 alone some 11,700 people required emergency room treatment for injuries involving a circular saw in the USA (Consumer Reports, 1992)

VISS findings showed that portable circular saws were the most common type of saw, cited in 29% of cases. Forty-six percent of all injuries relating to portable circular saws required admission. Portable circular saws were implicated in both of the recorded fatalities.

More than two-thirds of the victims of portable circular saw injuries were undertaking home DIY activities. Of the 141 separate injuries sustained, there was a higher proportion of amputations attributable to portable circular power saws than the all power saw group (19% vs 9%). The same pattern emerged with finger fractures (10% vs 3%). Again finger lacerations were the most common type of injury (38%). Foreign bodies in the eyes were rare.

Safety Features

All portable circular saws are equipped with an upper stationary guard which covers the upper half of the blade and lower retractable guard that retracts as the blade cuts and then snaps back when sawing is complete. The lower guard should always be left to move freely never being clamped or wedged in an open position. (Figure 3).

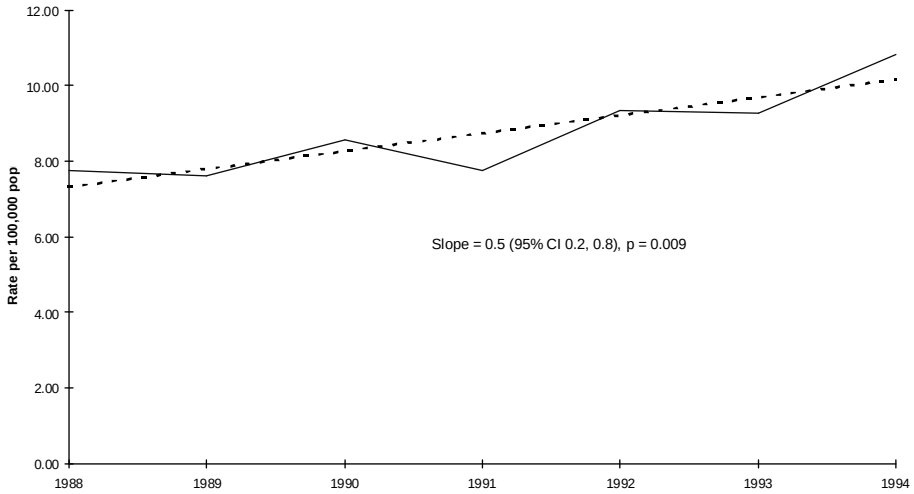
Power saw injuries by body part and nature of injury **Table 4**

	DIY (n = 262 injuries) %	On-the-job (n = 166 injuries) %	Other (n = 29 injuries) %	TOTAL (n = 457 injuries) %
Finger lacerations	39	43	59	42
Finger amputations	13	10	14	14
Finger fractures	7	4	10	6
Hand lacerations	8	10	7	9
Foreign bodies in the eye	9	6	0	7
Eye abrasions	3	2	0	2
Eye inflammation/swelling	1	2	0	2
Leg lacerations	5	5	3	5
Other	15	20	7	13
TOTAL	**100**	**100**	**100**	**100**

Source: VISS - WH, LRH, RMH, PANCH (N =457)
NB: VISS can record up to 3 separate injuries per case.

Woodworking injuries*, 15 years and over, rates and trend **Figure 2**

Public Hospital Admissions, Victoria, July 1987 to June 1994



Source: Victorian Inpatient Minimum Dataset, July 1987 to June 1994

* Comparisons with VISS admitted cases found that 97% of these cases relate to power saws

Many circular saws are fitted with a dead man switch which must be clicked into position before the on-off spring loaded trigger switch (which automatically cuts off the power when finger pressure is released) becomes operational. The dead man switch prevents the trigger switch being locked into place thus complying with the requirements of the standard AS/NZS 3160:1993 that "any switch or speed control device shall automatically return to the OFF position and shall not be capable of being locked in the ON position".

Other safety features include a variety of mechanisms to reduce kickback from the blade binding in the cut. These include slip or safety clutches and riving knives which, respectively, reduce the force transmitted to the saw and reduce cut closure. A second benefit of riving knives is that, in the event of kickback it is the riving knife and not the blade which will touch the victim.

Some models feature an electric brake which greatly reduces the blade stopping time to a fast stop (2 seconds or less after release of the trigger switch, compared to the typical 5 to 10 seconds). Non-slip handles to improve operator's grip, dust ejection shutes to keep sawdust away from the blade to improve visibility and anti-kickback blades which clear the cut more easily are available on some models.

2. Bench/table saws

Ten percent of cases recorded by VISS related to bench/table saws with an admission rate of 43%. Justis et al (1987), found that, of 100 surveyed workers in a demographic study, 61% of injuries occurred to amateur woodworkers, 42% of injuries were from a table saw and the most significant causal factor was failure to use properly installed guards, followed by the performance of intrinsically dangerous operations eg. hand pushing a small piece of wood through a saw.

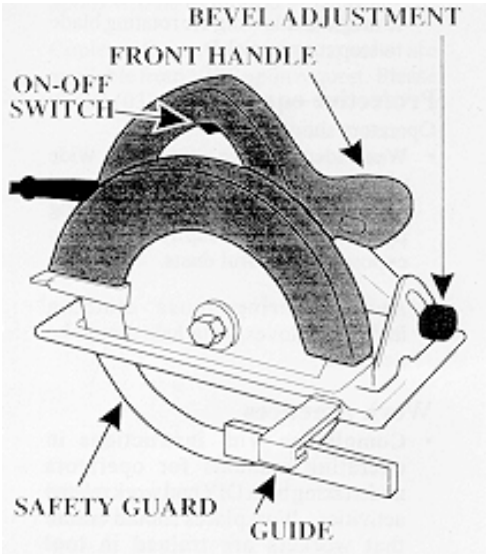
Legislative Requirements

Power tools are defined as items of plant under *The Code of Practice for Plant and Occupational Health and Safety (Plant) Regulations 1995* but the Regulations do not specifically include hand held tools. However the Victorian Department of Labour and Industry state that under the Regulations they are broadly defined as Plant (Rod Shannon, personal communication 1996). 'Codes of Practice' under the *Occupational Health and Safety Act 1985* are "for the purpose of providing practical guidance" to designers, manufacturers and employers in how to make judgements of risk assessment and hazard identification to meet the requirements of the Act. The objectives of the Act are to protect people at work against the risks to health and safety arising from plant and systems of work associated with plant. This essentially means that the onus now lies with the manufacturer to provide safe products and safe working conditions (Routley and Ozanne-Smith 1996). *The Equipment (Public Safety) Act 1994* and the *Equipment (Public Safety) (General) Regulations 1994* mirror the above Acts and Regulations for the home and for public places and are more relevant to persons undertaking home DIY activities.

Standards

Circular saws are covered by the Australian and New Zealand Standard *AS/NZS 3160:1993 Approval and test specification - Hand-held portable electric tools.* This standard specifies the essential safety requirements for approval and test purposes, in Australia to be read in conjunction with *AS 3100: 1994 Approval and test specification - General*

Common safety features of portable circular saws **Figure 3**



Source: Makita

requirements for electrical equipment, which applies to the construction of the tool and the insulation and safeguarding. AS3160:1993 applies to circular saws, reciprocating saws, sabre saws and jigsaws and covers such things as the requirements for mechanical guarding, switches and speed control devices, markings eg. voltage and intended operating positions and instructions for the use of eye protection. It also sets out requirements specifically for circular saws and knives relating to the marking of blades with the direction of rotation of the blade (Australian Standard AS/NZS 3160:1993).

Recommendations

Design

- Earth leakage detection units should be incorporated into the lead, on all models, to prevent electrocution. New tools should also have double insulation which assists in preventing electrocution, however these tools still require ELDU's for full protection.
- A number of design options could be included on saws to prevent kickback included riving knives and slip clutches. Other design changes should be investigated such as faster blade braking.
- Investigate electronic braking systems for all saws where, upon braking, the energy produced by the motor is fed to magnets allowing the rotating blade to stop more quickly.

Protective equipment

Operators should:

- Wear adequate eye protection, wide vision goggles are best to protect against serious eye injuries; hearing protection; and respirators when exposed to harmful dusts.
- Avoid wearing loose clothing including gloves, long hair should be tied back.

Work practices

- Compliance with instructions in operating manuals for operators undertaking both DIY and work related activities. Workplaces should ensure that workers are trained in tool inspection, in use of the correct tool and blade for a job and recognition of operating imperfections.
- Operators should undertake routine inspection and cleaning, ensuring faults are dealt with promptly. All major work should be undertaken by trained repairers.
- Materials of all sizes, when possible, should be securely clamped to stable supports. Basic safe work practices should always be adhered to e.g. the saw should attain full power before commencing the cut, always hold the saw with 2 hands during operation and if it is necessary to stop the blade during the cut, hold the saw firmly and do not resume the cut until the blade has reached full speed.
- Small wedges of scrap wood will help prevent the cut closing up and the saw jamming. The lower retracting guard should be fully returned to place before laying down the saw. Guards should never be clamped or wedged into the open position.
- Operators should maintain proper footing and balance and avoid overreaching or forcing the saw.
- Power cords should be disconnected before any inspection or adjustment occurs and during operation should be positioned away from the cutting area.
- Ensure all wiring is installed and certified by an A grade electrician.
- ELDU's should be used with all power tools with the ELDU connected into the power source or power point.

Alternative practices

- Undertake a basic handyperson's course to obtain the skills necessary for the required DIY activities.
- Consideration should be given to employing a professional rather than undertaking potentially dangerous DIY activities.
- Institute public education and establish a "culture of safety" which encourages: the use of safety features, use of protective equipment, reading and following of instructions and checks of equipment safety.
- Explore the potential development and use of alternative information distribution mechanisms such as the provision of single issue DIY safety information cards or pamphlets at points of sale/hire of DIY equipment.
- Provide incentives to manufacturers, retailers and safety organisations to publicise the safety features of power tools.
- Alternative instruction media should be more widespread eg. loan of instructional videos at point of sale, encouragement to attend safety demonstrations at convenient locations.

The recommendations made in this article are largely based on recommendations made by Routley and Ozanne-Smith (1996), Spinks and Driver (1992) and National Safety Council of Illinios (1986) in the cited literature.

A good demonstration of an achievable safe working environment has been provided by the Kelaston Community Day Centre which runs a workshop designed for the visually impaired in rural Victoria. The workshop has maintained a perfect safety record in its five years of operation by using special safety devices including custom built wood and metal jigs which allow visually impaired operators to use machines including band saws, sanders, lathes and press drills.

Workcover's Corporate Director, Eileen McMahon stated that "If it is possible to turn a potentially hazardous situation into a safe working environment for the visually impaired, the task of creating injury-free workplaces geared towards prevention rather than cure in the wider community was not an unrealistic aim" (Ballarat Courier, 1996).

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Acknowledgements

VISS would like to thank Deborah Jordan, *Makita*; Scott Lucas, *Bosch*; Rob Beeches, *Ryobi*; Rod Shannon, Department of Labour and Industry; George Rechnitzer, Monash University Accident Research Centre; Chris Powell, Resources Manager and Staff, Civil Engineering Department, Monash University; Ian Adams, retired designer for construction industry; Phillip Shand, *Phillip Shand Fencing*; John Adams, *ABC Builders* and the staff at Hardwarehouse for background information.

Survey of client needs for progressing VISS recommendations for action

In 1995 VISS received a small grant from the Victorian Health Promotion Foundation to support the implementation of findings from VISS data analyses and research. This grant included funds for a survey of VISS clients and to collect information on their data and other needs for progressing the recommendations for action published in *Hazard* and to investigate client satisfaction with VISS services. The client survey was included with *Hazard* Nos 25 &26 which were mailed to 880 organisations and individuals. There were 74 surveys returned, a response rate of approximately 8%. Lack of funding precluded any follow-up to increase the response rate.

Results

- 85% of respondents had used the data/ information/ recommendations in *Hazard* editions.
- respondents used information on 36 different specific topics-the most used information (nominated by over 10% of respondents) was on child injuries/injuries in childcare settings, sports injury, burns/scalds/ spill resistant mug, home injuries, falls, product-related injuries/ appliance faults and tractor injuries
- information in *Hazard* was mostly used for publicising issues/ increasing awareness (32%), as a resource for research, submissions and talks (21%), to support injury prevention initiatives (14%), for teaching/training (14%) and for advocacy/lobbying (8%).
- 62% of respondents were satisfied with *Hazard*, 22% made suggestions for improvement which included: more information on references used in articles, closer liaison with/promotion of other injury prevention agencies and their events, broader/greater number/ more practical recommendations, more updates/tracking of issues, more information about products and improved formatting.
- 26% of respondents felt that the information dissemination service offered by VISS could be improved. Their suggestions included: publishing information on the Internet, increasing distribution, update data more regularly, improve communication and use E-mail.

Conclusion

Based on this small sample there appears to be a high level of satisfaction among VISS clients with the publication *Hazard* (in terms of quality and usefulness) and with the information service provided by VISS. This is further supported by the fact that several organisations frequently reproduce articles for wider circulation in their own publications (for example, the *Australian Combined Emergency Services Gazette*, *Parents* magazine, the *Australian Journal of Emergency Care* and *Kidsafe* magazine).

The suggestions for improvements to performance are receiving attention. The new electronic data collection, currently being implemented, will deliver more timely data and the offers to assist implementation of VISS recommendations will be mobilised as needed.

Copies of the full survey results are available from VISS upon request. Please phone (03) 9905 1805.

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* Special edition

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General Acknowledgements

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Latrobe Regional Hospital (Traralgon and Moe)

The contributions to the collection of VISS data by the director and staff of the Emergency Departments of these hospitals, other participating clinicians, Medical Records Departments, and ward staff are all gratefully acknowledged. The surveillance system could not exist without their help and co-operation.

Coronial Services

Access to coronial data and links with the development of the Coronial Service's 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.

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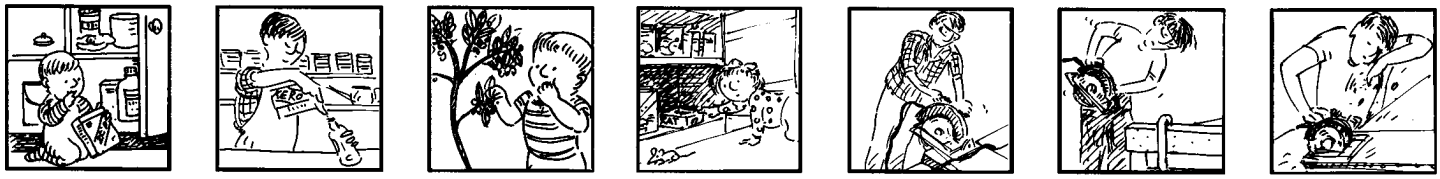

Project Funded by
Victorian Health Promotion Foundation

VISS is a project of the Monash University Accident Research Centre.

Hazard was produced by the Victorian Injury Surveillance System
with the layout assistance of Glenda Cairns, Monash University Accident Research Centre.
Illustrations by Jocelyn Bell, Education Resource Centre, Royal Children's Hospital.

ISSN-1320-0593

Printed by Sands and McDougall Printing Pty. Ltd., North Melbourne