FLINDERS UNIVERSITY
ADELAIDE AUSTRALIA

Australian Government
Australian Institute of Health and Welfare
Department of Health and Ageing

Number 5, October 2006

NISU Briefing

AIHW National Injury Surveillance Unit • Research Centre for Injury Studies • Flinders University • South Australia

Childhood poisoning in Australia

Raymond Cripps
Danielle Steel

October 2006

Key findings

- An estimated number of 14,339 young children were hospitalised as a result of poisoning during the period 1999–00 to 2003–04.
- Rates of hospitalised poisoning injury were highest at the age of two years (males 366 and females 338 poisoning admissions per 100,000 population).
- The risk of poisoning from pharmaceutical substances was higher at all ages when compared to the risk of poisoning from non-pharmaceutical substances.
- Maximum rates of hospitalisation occurred at the age of two years for pharmaceutical substances and one year for non-pharmaceutical substances.
- Paracetamol was the most common pharmaceutical poisoning diagnosed in one and two year old children.
- Twenty-five per cent of non-pharmaceutical poisoning admissions in children aged two years and older were due to poisoning from noxious bites from arthropods such as spiders, bees and wasps.
- Over half of the children poisoned by solvents, pesticides and plants were one-year old or younger.
- The most common place for poisoning to occur in young children was in the home or in adjacent grounds.

Introduction

A reduction in the morbidity and mortality associated with poisoning in children from medications, drugs and other substances was listed in the 2001–2003 plan as 'an immediate priority' (Commonwealth Department of Health and Aged Care 2001) and is mentioned in the 2004–2014 plan, but in less specific terms (National Public Health Partnership (NPHP) 2004). Each year in Australia since 1999–00 about 4,700 cases of poisoning in children under the age of 15 years resulted in hospitalisation. Of these, 63% were due to poisoning by pharmaceutical substances and 37% to poisoning by non-pharmaceutical substances. The age distribution of poisoning incident admissions indicated that children under the age of five years were most at risk of poisoning resulting in admission to a hospital (Figure 1).

The incidence of hospitalisation due to poisoning declined in children after the age of two years and remained low after age 6 until it began to rise at about the age of 12 years. Poisoning in older children is beyond the scope of this brief which has as its focus poisoning in children under the age of 5 years.

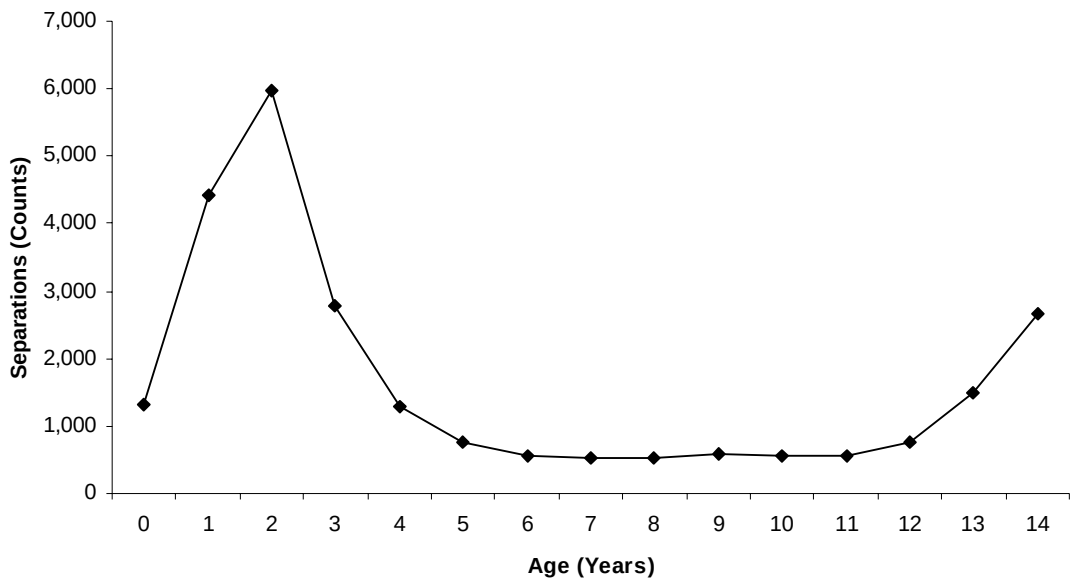

Figure 1: Hospital separations due to poisoning, by age, Australia 1999–00 to 2003–04

During the 5 years to 30 June 2004, 15,798 hospital separations for children under the age of 5 years were identified as being potentially in-scope for this report. Those records had an ICD-10-AM diagnostic code in the range T36–T65 present in any diagnosis field in the National Hospital Morbidity Database (NHMD). Hospitalisations primarily for complications of surgical or medical care, adverse effects of treatment and other non-poisoning diagnostic codes (n=814) were removed from the data set because the focus of this brief is on poisoning of children in a community setting. The remaining 14,984 poisoning separations (estimated to equate to 14,339 incident cases*) will be used as the main study set for this report.

* Incident admissions estimated by excluding cases transferred from acute hospitals.

Hospitalisations, Australia, 1999–00 to 2003–04

An estimated number of 14,339 young children were hospitalised as a result of poisoning during the period 1999–00 to 2003–04 (Table 1).

The population-based incidence rate was 225.1 cases per 100,000 population per year over the 5-year period.

Table 1: Number of cases and rates of poisoning in children aged 0–4 years, Australia, 1999-00 to 2003-04

Principal Diagnosis, ICD-10-AM Codes T36–T50;T51–65	Counts	Age-specific Rate	Age-adjusted Rate*
Males	7,884	241.1	241.4
Females	6,455	207.7	208.0
Persons	14,339	224.8	225.1

* Direct standardisation employed using the Australian population in 2001 as the standard (Australian Bureau of Statistics 2003).

Age and sex

The age-specific rate for males and females increased with age up to two years and then declined. Male rates were a little higher than female rates at all ages (Figure 2). For both males and females, rates of hospitalised poisoning injury were highest at the age of two years (males 366 and females 338 poisoning admissions per 100,000 population).

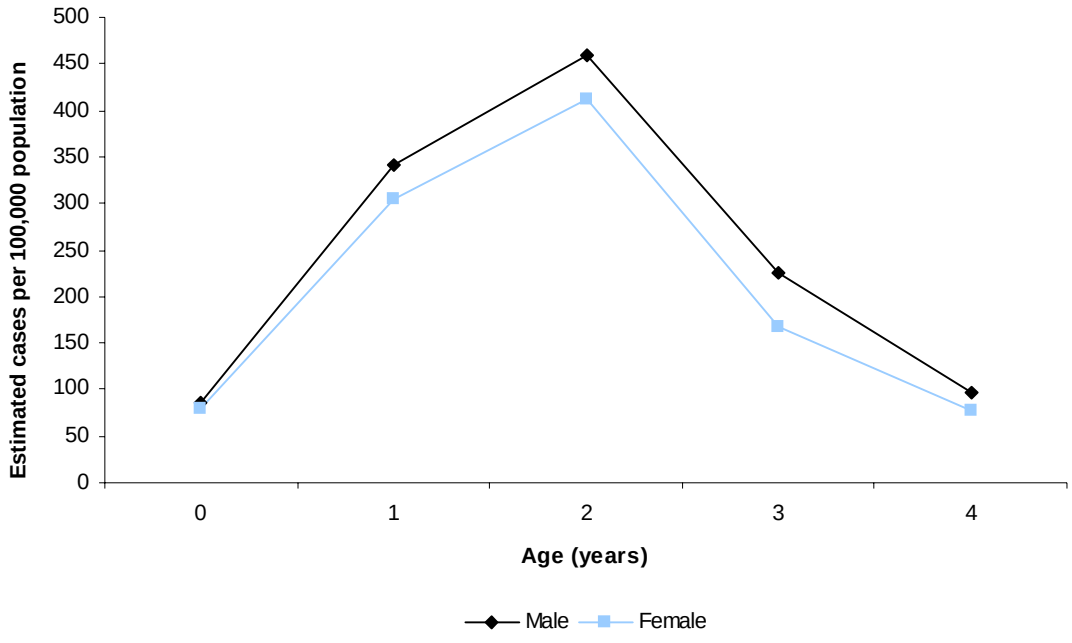

Figure 2: Age-specific rates of poisoning hospital admissions in young children by age and sex, Australia, 1999–00 to 2003–04

Children in a community setting are poisoned by two major groups of substances: 'drugs, medicaments and biological substances' and 'non-medicinal substances'. In this brief, these groups will be referred to as pharmaceutical and non-pharmaceutical substances, respectively.

Age and sex-specific rates of pharmaceutical and non-pharmaceutical poisoning hospitalisations indicated that for both males and females, the risk of poisoning from pharmaceutical substances was higher at all ages when compared to the risk of poisoning from non-pharmaceutical substances (Figure 3). In addition, the age at highest risk of poisoning was different between the two groups of poisoning substances, with maximum rates of hospitalisation occurring at the age of two years for pharmaceutical substances and one year for non-pharmaceutical substances.

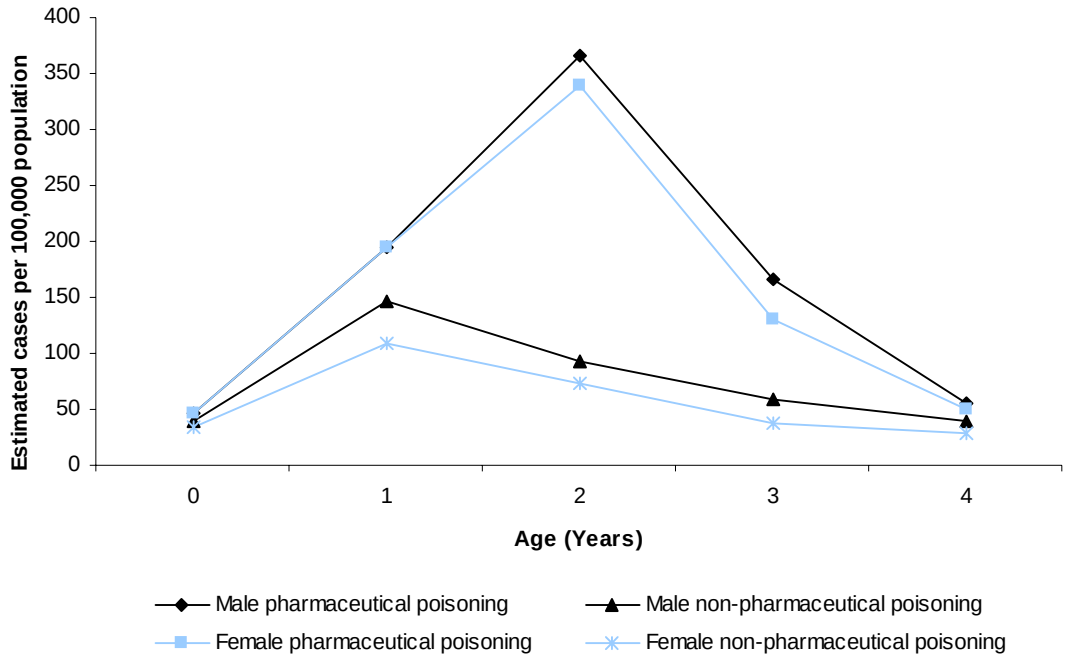

Figure 3: Age-specific rates of pharmaceutical and non-pharmaceutical poisoning hospital admissions in young children by age and sex, Australia, 1999–00 to 2003–04

Principal diagnosis

Seventy-one percent (n=10,133) of poisoning admissions diagnosed in young children were due to poisoning from pharmaceutical substances. Nineteen per cent of the pharmaceutical poisonings had a principal diagnosis of T39 (Poisoning by non-opioid analgesics, antipyretics and antirheumatics), four in five of these children having been poisoned by ingestion of 4-aminophenol derivatives (e.g. paracetamol) (Table 2). Other common poisoning diagnoses were poisoning by tranquilisers, antidepression medications and vitamins including iron compounds. These poisonings were most commonly reported in one and two year old children.

Non-pharmaceutical poisoning admissions accounted for 29% (4,206) of young children hospitalised (Table 3). In one-quarter of those cases, the source of the toxic substance was a bite or sting by an arthropod such as a spider, bee or wasp, particularly in children aged two years and older. Petroleum based solvents, pesticides, and noxious plant substances eaten as food accounted for an additional 41% of admissions due to non-pharmaceutical substances. Over half of the children poisoned by solvents, pesticides and plants were one-year old or younger.

A summary of the most frequently diagnosed poisoning hospitalisations in very young children (under the age of one year) is presented in Table 4.

Table 2: Principal diagnosis of pharmaceutical poisoning hospitalisations in children aged 0–4 years, Australia, 1999–00 to 2003–04

	Age of the child at the time of admission (Years)					
	0	1	2	3	4	All ages
Principal diagnosis	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
Poisoning by systemic anti-infectives—T36, T37	22	54	83	51	14	224
Poisoning by hormones—T38	6	86	172	79	25	368
Poisoning by non-opioid analgesics, antipyretics and antirheumatics—T39	112	471	889	389	97	1,958
Poisoning by narcotics and psychodysleptics (hallucinogens)—T40	27	69	136	67	14	313
Poisoning by anaesthetics and therapeutic gases—T41	15	11	11	2	0	39
Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs—T42	30	335	669	240	102	1,376
Poisoning by psychotropic drugs, not elsewhere classified—T43	31	238	548	262	107	1,186
Poisoning by drugs primarily affecting the autonomic nervous system—T44	56	140	296	133	37	662
Poisoning by primarily systemic and haematological agents, not elsewhere classified—T45	41	192	502	207	63	1,005
Poisoning by agents primarily affecting the cardiovascular, gastrointestinal, muscular and respiratory systems—T46, T47 and T48	81	334	653	325	164	1,557
Poisoning by topical agents—T49	122	357	301	72	35	887
Poisoning by diuretics and other and unspecified drugs, medicaments and biological substances—T50	40	161	231	91	35	558
All pharmaceutical poisoning principal diagnoses	**583**	**2,448**	**4,491**	**1,918**	**693**	**10,133**

Table 3: Principal diagnosis of non-pharmaceutical poisoning hospitalisations in children aged 0–4 years, Australia, 1999–00 to 2003–04

	Age of the child at the time of admission (Years)					
	0	1	2	3	4	All ages
Principal diagnosis	Count	Count	Count	Count	Count	Count
Toxic effect of alcohol—T51	17	58	50	12	11	148
Toxic effect of organic solvents—T52	34	399	178	74	23	708
Toxic effect of halogen derivatives of aliphatic and aromatic hydrocarbons—T53	3	28	6	4	2	43
Toxic effect of corrosive substances—T54	30	184	78	28	14	334
Toxic effects of soaps and detergents—T55	31	99	27	3	4	164
Toxic effects of metals and other inorganic substances—T56, T57	9	23	24	13	10	79
Toxic effect of carbon monoxide, other gases, fumes and vapours—T58, T59	35	47	36	22	20	160
Toxic effect of pesticides—T60	65	260	169	52	34	580
Toxic effect of noxious substances eaten as seafood—T61	1	1	1	1	5	9
Toxic effect of other noxious substances eaten as food—T62	61	131	97	72	50	411
Toxic effect of contact with venomous animals—T63	56	170	261	291	253	1,031
Toxic effect of aflatoxin and other mycotoxin food contaminates—T64	0	0	0	0	0	0
Toxic effect of other and unspecified substances—T65	115	220	137	48	19	539
All non-pharmaceutical poisoning principal diagnoses	**457**	**1,620**	**1,064**	**620**	**445**	**4,206**

Table 4: Principal diagnosis of poisoning hospitalisations in children aged less than one year, Australia, 1999–00 to 2003–04

Principal diagnosis	0–2 Months	3–5 Months	6–8 Months	9–11 Months	Less than 12 Months
Poisoning by Paracetamol—T39.1	21	18	10	29	78
Poisoning by drugs primarily affecting the autonomic nervous system—T44 (e.g. anticolic drugs)	32	10	3	6	51
Poisoning by topical agents—T49 (e.g. topical dental drugs)	16	20	14	46	96
Toxic effect of pesticides—T60	1	1	3	36	41
Toxic effect of other noxious substances eaten as food—T62	0	2	11	28	41
Toxic effect of contact with venomous animals—T63 (e.g. spiders)	9	5	15	21	50
Other diagnoses	60	78	75	233	446
All principal diagnoses	**139**	**134**	**131**	**399**	**803**

The nature of poisoning admissions

In 98% of poisoning cases the separation record of the child's stay in hospital mentions no medical procedure, and the average length of stay was only 1.2 days. In 94% of cases, the child was discharged home. Transfer to another hospital occurred in 5% of cases, and in 5 cases the child died in hospital. This profile (i.e. predominantly short stays in hospital, generally without recorded procedures, and followed by discharge home) suggests that admission is frequently precautionary, to observe a child who has, or may have, ingested or come into contact with a potentially toxic substance. A small proportion of the cases have characteristics suggesting that toxic effects were observed (i.e. longer stay, procedures, and transfer to another hospital). For the 2% that required procedures, the average length of stay was 2 days and the most common procedure documented was from under the umbrella *generalised allied health interventions* (e.g. contact with a pharmacist or other allied health practitioner). Another common procedure was *panendoscopy,* a largely exploratory technique associated primarily, in this context, with poisoning resulting from corrosive substances, as well as *non-incisional irrigation, cleaning and local instillation*, focussing upon the digestive system, and resulting from the ingestion of 4-aminophenol derivatives (e.g. paracetamol). Finally, for cases where the poisoning resulted from contact with a venomous animal, the procedure administered was the *injection or infusion of a therapeutic or prophylactic substance* in 65% of cases.

Length of stay in hospital

Overall, the mean length of stay (LOS) for treatment of poisoning in young children was brief, about 1.1 days (Table 5). In terms of health burden, poisoning accounted for about 17,000 bed-days in hospital to treat 14,339 young children. Ninety-three per cent of children poisoned stayed up to one day in hospital, and nearly all the rest were discharged within a week. Thirty-five children remained in hospital longer than one week and these are likely to include serious poisoning cases. An examination of their poisoning diagnosis indicated that they had been poisoned by analgesic and anti-inflammatory drugs, antidepressants, barbiturates, caustic alkalis (most common, 5 children), pesticides, solvents and venoms such as stings or venom from amphibians.

Table 5: Length of stay for poisoning hospitalisations in children aged 0–4 years: separations, percentage of total patient days for care and mean length of stay; Australia, 1999–00 to 2003–04.

Principal diagnosis	Separations (counts)	LOS (days)	Per cent patient days	MLOS
Pharmaceutical poisonings (T36–T50)	10,579	11,730	69	1.1
Non-Pharmaceutical poisoning (T51–T65)	4,405	5,215	31	1.2
All poisonings	**14,984**	**16,945**	**100**	**1.1**

Table 6: Length of stay for poisoning hospitalisations in children aged 0–4 years, Australia, 1999–00 to 2003–04

Length of stay (days)	Pharmaceutical poisoning separations (counts)	Per cent	Non-Pharmaceutical poisoning separations (counts)	Per cent	All poisoning separations (counts)	Per cent
Up to 1	9,969	94.2	4,107	93.2	14,076	93.2
2	414	3.9	170	3.9	584	3.9
3–4	145	1.4	80	1.8	225	1.8
5–7	38	0.4	26	0.6	64	0.6
8–14	8	0.1	15	0.3	23	0.3
15–21	3	0.0	3	0.1	6	0.1
More than 21 days	2	0.0	4	0.1	6	0.1
Total	**10,579**	**100.0**	**4,405**	**100.0**	**14,984**	**100.0**

Place of occurrence and activity

A place of occurrence was recorded for 58% of cases. The most common place for poisoning to occur in young children was in the home (Table 6). Young children spend most of their time at home or in adjacent grounds where they are cared for, develop and play. As a consequence, the potential for exposure to any poisons that may be present in their surroundings is high. Other places where poisoning occurred were residential institutions, schools, health service areas and trade and service areas.

Information pertaining to the activity undertaken when poisoning occurred was present in only 7% of cases. Of the 5 identified activities, 94% were leisure or other vital activities such as sleeping or eating.

Table 6: Place of occurrence of hospitalised poisoning cases in children aged 0–4 years, Australia, 1999–00 to 2003–04

Place of occurrence of poisoning	Count	Per cent
Home	7,967	55.6
Residential institution	28	0.2
School	29	0.2
Health Service area	60	0.4
Other specified institution and public administrative area	11	0.1
Sports and athletics area	6	0.0
Street and highway	18	0.1
Trade and service area	35	0.2
Industrial and construction area	16	0.1
Farm	18	0.1
Other specified place of occurrence	191	1.3
Unspecified place of occurrence/place not reported/not applicable	5,960	41.6
Total	**14,339**	**100.0**

Discussion

The introduction of child-resistant closures (CRC) in the late 1970s and early 1980s caused a dramatic decrease in deaths in young children (Rodgers 1996). However, poisoning hospitalisations in Australia in young children remain high, accounting for more admissions from community injury causes except falls. As a consequence, reduction in poisoning was identified in the National Injury Prevention Plan as a priority for 2001–03 (Commonwealth Department of Health and Aged Care 2001).

In 1999–00 to 2003–04 the age-adjusted rate of poisoning in Australia was 225 poisoning admissions per 100,000 population, with male rates higher than female rates. In general, the number of children admitted was age-related, with maximum admissions occurring in one and two year old children for pharmaceutical and non-pharmaceutical poisoning. The great majority of episodes in hospital are brief, involve no procedures and end with discharge home.

In young children, exposure to poisoning substances appeared to be associated with their stage of development. In the first nine months of age, most poisonings occurred as a result of medication incorrectly administered by parents or caregivers (e.g. paracetamol, anticolic drugs, or topical dental compounds). To reduce poisonings in the very young, improvements in packaging and/or labelling as well as clearer directions in administration of medications may be warranted (Ozanne-Smith, Day et al. 2001).

As infants develop they become more mobile (able to crawl and pull themselves to a standing position), and their opportunities for exposure to poisonous substances increase. This is reflected in a three-fold increase in the number of poisoning hospital admissions from 131 at ages 6–8 months to 399 at 9–11 months (Table 4). Children at this age learn about objects and their surrounding through oral and tactile activities, thus further increasing their risk of poisoning.

Hospitalisations for this group of children were primarily due to poisoning by ingesting noxious substances eaten as food (e.g. plant material or mushrooms), ingesting organic solvents, corrosive alkalis, pesticides, such as rodenticides, and spider bites. From a crawling infants' perspective, these non-pharmaceutical poisonous substances and spiders would be quite common in their home environment or outside in the garden and were responsible for the highest incidence of non-pharmaceutical poisoning hospitalisations occurring in this group of children.

The rate of hospitalisations due to non-pharmaceutical substances peaked at one year of age, while that for pharmaceutical substances peaked at two years. By the age of two years, children are ambulatory and capable of climbing and manipulating objects as they explore their environment and develop physically and mentally. This increase in exposure to poisoning substances may account for the increased incidence of poisoning and the variety of poisoning substances reported. Poisons identified from principal diagnoses reported in hospital separation records were the type 4-aminophenol derivatives including Paracetamol (80% of cases coded to T39), benzodiazepines (70% of cases coded to T42), vitamins and iron compounds (84% of cases coded to T45), petroleum products (40% of cases coded to T52), pesticides, and contact with venomous animals. After age two, the incidence of poisoning hospitalisations declines, presumably reflecting further development in behaviour and cognition. An adherence to the principles of safe and secure storage of medication, as well as vigilance in the supervision of children at the age of greatest risk, are necessary precautions.

The effectiveness of child-resistant packaging of medication

When considering accidental poisoning prevention, one issue that appears consistently in the literature is assessment of the effectiveness of child-resistant packaging. In Australia only reclosable containers are tested for their child-resistant status, whereas in the United States the effectiveness of both reclosable and non-reclosable packaging is tested (Hender & Balit 2005). Results of a study by Hender and Balit indicated that currently used blister or strip packaging is not preventing children from accessing the medication contained within. Furthermore, in 523 telephone interviews conducted with the parents of children who had visited various emergency departments in Melbourne, or had contacted the Poisons Information Centre between April and December 1993, Ozanne-Smith, Day et al. (2001) observed that in close to 80% of cases the child was unsupervised for 5 minutes or less when the accidental poisoning occurred. This timeframe becomes relevant when considering that child resistant closures are deemed 'effective' (in most countries) if at least 85% of children aged 3.5 to 4 are unable to gain access to the medication within 5 minutes (Durham 1998).

In correspondence used in the recent inquest into the death of a young South Australian boy, who died as a result of consuming his father's medication, Somers (2006) reiterates that there is not yet a standard for performance testing for non-reclosable medication packaging in Australia. This is despite a standard existing for reclosable containers, and standards for the testing of both types of packaging currently implemented in other countries. According to the British Standard (BS 8404:2001 Packaging-Child resistant packaging-Requirements and testing procedures for non-reclosable packages for pharmaceutical products) packaging is ineffective if greater than 8 units can be accessed by a child within one 10 minute session (which includes a non-verbal demonstration after the initial five minutes has elapsed). Somers cited results from studies from the United Kingdom which indicated that over 40% of the children aged 42–51 months gained access to all tablets contained in a conventional 15 tablet blister pack, and within the first 5 minutes. He also reported that in a 1998 study from the US, when children were given access to 'unlimited numbers of conventional blister packages', the average number of 'blisters opened was 23 (range 0–85) and the average time taken to open the first blister was 169 seconds' (p.2, 2006). He points out that in testing carried out in 2003 and 2004 in Australia, blister packaging that had been more robustly made was considerably more child-resistant than two conventional blister packs (used for comparison), despite not being entirely child-proof. Based on correspondence introduced by Somers in the inquest into the death of a young South Australian the Coroner recommended that '*the Minister for Health give consideration to the contents of Exhibit C30 with a view to considering the introduction of appropriate standards in South Australia for the child-proofing of blister packaging for hazardous pharmaceuticals'* (Courts Administration Authority South Australia 2006).

References

Australian Bureau of Statistics (2003). Population by age and sex, Australian states and territories, 2001 Census Edition—Final. Canberra: ABS (cat. no. 3201.0).

Commonwealth Department of Health and Aged Care (2001). National Injury Prevention Plan: Priorities for 2001–2003, Commonwealth Department of Health and Aged Care, Canberra.

Courts Administration Authority South Australia (2006). Findings in the matter of Ian Myles Smith. South Australia: Coroner's Court [cited 2006 July 6]. Available from: <http://www.courts.sa.gov.au/courts/coroner/findings/findings_2006/smith.finding.htm>.

Durham G. Code of Practice for Child-resistant Packaging of Toxic Substances. Ministry of Health, Wellington, 1998.

Hender EA. & Balit CR. (2005). 'Which medicines do young children access from blister packs?' MJA 182: 594.

National Public Health Partnership (NPHP) (2004). The National Injury Prevention and Safety Promotion Plan: 2004–2014. Canberra: NPHP.

Ozanne-Smith J, Day L, et al. (2001). 'Childhood poisoning: Access and prevention.' J. Paediatr. Child Health 37: 262–265.

Rodgers G. (1996). 'The safety effects of child-resistant packaging for oral prescription drugs. Two decades of experience.' JAMA 275: 1661–5.

Somers RL. (2006). Comments regarding the child resistance of blister packaging. Correspondence to the Counsel Assisting in relation to the Findings in the matter of Ian Myles Smith. South Australia: Coroner's Court [cited 2006 July 6]. Available from: <http://www.courts.sa.gov.au/courts/coroner/findings/findings_2006/smith.finding.htm>.

Data issues

Cases included

In this briefing poisoning cases are records in the National Hospital Morbidity Database with a Principal Diagnosis code in the range T36–T65. Inward transfers from other acute care hospitals (i.e. Source of Referral = 1) are excluded from case counts, but not from assessments of bed days. Except where stated otherwise, only records where age is less than 5 years are included.

Age adjustment

Some all-ages rates have been adjusted for age to overcome the effect of differences in the proportions of people of different ages (and different injury risks) in the populations that are compared. Direct standardisation was employed, taking the Australian population in 2001 as the standard.

Data quality

Hospitalisations

This report uses data collected from state and territory hospitals. After coding and collection from the states and territories, the data is further processed by the AIHW and NISU. The geographical spread of the data and the large number of people involved in its processing increases the risk of inconsistencies across time and place in the data. Variations in reporting and coding continue to exist across jurisdictions, although standard classifications and formal coding guidelines have been in place for some years.

Correspondence regarding this report can be addressed to the AIHW National Injury Surveillance Unit at Flinders University, GPO Box 2100, Bedford Park, South Australia 5042, Tel: 08 8201 7602, Fax: 08 8374 0702, e-mail: nisu@flinders.edu.au

ISSN 1833-024X

INJCAT 90