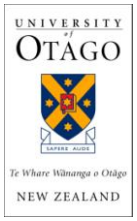
Preventing Home Based Injuries in Preschool Aged Children:

An Overview of the Evidence



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Introduction

Injuries are among the leading causes of morbidity and mortality in New Zealand children [1, 2] [3], with children under five years of age carrying a particularly heavy burden. This report focuses on home based injury prevention in preschool age children. It aims to provide DHBs / those working in the health sector, with a broad overview of the most common injuries experienced by New Zealand children (0-14 years), before reviewing preventative interventions for home based injuries in preschool age children in three high priority areas (poisoning, burns and scalds, drowning). The report is divided into four main sections:

1. **Brief Overview of Injury Related Hospital Admissions and Mortality in New Zealand Children**: Using information from the NZ Child and Youth Epidemiology Service's 2008 DHB Reports, this section provides an overview of the most common causes of injury related hospital admissions and mortality in New Zealand children.
2. **Poisoning**: This section considers a range of measures (e.g. child resistant packaging, parent education, safe storage of toxins) which may reduce the occurrence or severity of poisoning in this age group.
3. **Burns and Scalds**: This section considers a range of measures (e.g. changes to hot water cylinder temperatures, reduced flammability of nightwear) which may reduce the occurrence or severity of burns and scalds in this age group.
4. **Drowning**: This section considers measures to reduce the incidence of drowning in the home environment (e.g. swimming pool fencing legislation).

For each of the priority areas outlined above, the following information is reviewed:

1. Brief Overview of New Zealand Epidemiology:
2. Circumstances Surrounding Injury Event (using Haddon's Matrix [8]).
3. Relevant New Zealand Legislation and Standards
4. Overview of Available Evidence on Prevention and Implications for DHBs

When interpreting the information in each of these sections, a number of broad principles and cautions are important. While some childhood injuries may require very specific and targeted interventions, a range of broader approaches are also recognised as being effective in injury prevention. The World Health Organization World Report on Child Injury Prevention [9] lists a number of these:

1. Legislation and Enforcement
2. Product Modification
3. Environmental Modification
4. Safety Devices
5. Education, Skills and Behaviour Change

When assessing the literature for evidence of the effectiveness of these approaches however, a number of cautions are also warranted. Firstly, the field of child injury prevention is complex. While randomised controlled trials (RCTs) are considered the gold standard for assessing effectiveness, where causal pathways or interventions are complex (e.g. childhood injury prevention education), such trials are rare, as it is often difficult to control for all of the potentially confounding factors involved. Further, in many situations a formal RCT will never be undertaken, either because such a trial would be impractical or unethical, or because the intervention is already in established practice. Thus when assessing the evidence for the

effectiveness of particular interventions in the sections which follow, consideration must be given to the weight of evidence across all of the available studies. Further, the precautionary principle is applicable to injury prevention [10]. Thus if the body of evidence suggests an intervention may be effective, but no high quality RCTs are available, consideration must be given to the possible harm of not acting to protect the child despite the scientific uncertainty.

Injury Related Hospital Admissions and Mortality in New Zealand Children:
Injuries are a major cause of morbidity and mortality for New Zealand children and especially those under the age of five years. For preschool age children, falls, unintentional poisoning, burns and scalds and injuries arising from "inanimate forces" (e.g. being struck by objects or bumping into things) are all common causes of hospital admission, with children 1-3 years being particularly vulnerable to a number of these causes. For mortality, suffocation and drowning are of particular concern (among non-transport injuries). There appears also to be groups within the child population who are more vulnerable to non-transport injuries. For example, particular attention should be paid to Maori and Pacific children, boys and those living in more deprived, or rural areas, when planning injury prevention initiatives.

Poisoning
Potentially useful Interventions in the area of poisoning prevention include:

Child Resistant Packaging (CRP): CRP is a mechanism for making medicines and household chemicals less accessible to children. In New Zealand, a range of legislation provides guidance as to which medications and toxins require CRP. While no Cochrane reviews have considered the effectiveness of CRP in preventing childhood poisoning, a number of other reviews have summarised individual studies on their effectiveness [14], [7] and found them to be effective in childhood poisoning prevention. CRP have limitations however, with research suggesting that a significant proportion of childhood poisonings occur while the substance is in use. Further a significant minority of children are able to access some medications, even given a properly closed CRP.

Home Safety Education Regarding the Secure Storage of Poisons: Research [5] suggests that families receiving home safety education are more likely to store medicines and cleaning products safely, with the most effect being seen when locks are provided in addition to safety education. While there is still insufficient evidence to suggest that home safety education (with our without safety equipment) reduces poisoning rates, it is likely that home safety education regarding the safe storage of poisons may result in changes in parental behaviour.

Burns and Scalds
Potentially useful Interventions in the area of burns and scalds prevention include:

Lowering Hot-Water Tap Temperature: Research suggests that the exposure time required to produce a burn varies directly with water temperature and that between 44 and 51 degrees, the rate at which burning occurs is almost doubled with each degree rise in temperature [18]. Thus lowering tap hot-water temperatures is likely to result in significant reductions in burns, with two approaches to intervention being possible: 1) *Legislation*: In many countries (including New Zealand), law requires hot water to be delivered at a temperature which minimizes the risk of thermal injury. Such legislation may specify that all new hot water cylinders are preset at a certain temperature (e.g. 49 degrees) [20], or if higher storage temperatures are required (e.g. to prevent legionella), that a tempering valve (which mixes hot and cold water to achieve lower delivery temperatures) is used; 2) *Safety Education and the Provision of Safety Devices*: While legislation may address hot water temperatures in new homes, safety education and the provision of safety devices (e.g. thermometers, thermostatic

mixing valves) may also be required for those living in older homes, existing non compliant hot water systems, or where temperatures may have been increased after cylinder instillation.

Fire Retardant Clothing: Since the 1970s, a number of countries have enforced flammability standards to protect children from death and serious burns resulting from the ignition of their sleepwear by small open-flame sources. The safety requirements include performance tests requiring that sleepwear self-extinguish after being exposed for specified periods to a small open-flame ignition source.

Child-Resistant Lighters: There is evidence that child resistant lighters may reduce cigarette lighter fires started by young children.

Smoke Detectors: Research [25] suggests that counselling and educational interventions (with or without free or discounted smoke alarms), modestly increase alarm ownership, or having an installed, functional alarm. Smoke alarm installation programmes may also increase the likelihood of having a working smoke alarm, although research concerning the impact of such alarms on fire related injuries is inconclusive.

Drowning

Potentially useful Interventions in the area of drowning prevention include:

Pool Fencing: Pool fencing is a passive environmental intervention designed to reduce children's unintended access to swimming pools, and thus prevent drowning in the preschool age group. Research [28] suggests that pool fencing significantly reduces the risk of drowning or near drowning, with isolation fencing (enclosing pool only) being superior to perimeter fencing (enclosing property and pool).

In New Zealand the Fencing of Swimming Pools Act 1987 provides a means to prevent children from drowning, but evidence [26] suggests that a low level of compliance by the swimming pool owners may be compromising its effectiveness. Thus legislation alone is not sufficient to ensure the safety of children. Legislation must thus be enforced to be effective or compliance will be incomplete.

In Conclusion

Injuries are a significant cause of morbidity and mortality in preschool age children, with the majority of these injuries occurring in the home environment. This report on home based injury prevention in preschool age children aims to provide DHBs / those working in the health sector, with a broad overview of the most common injury types in children aged 0-14 years, as well as the available preventative interventions for a small number of high priority injuries (poisoning, burns and scalds, drowning). While the volume of literature relating to each of these injuries is considerable, and the issues surrounding the evidence are often complex, this should not preclude DHBs from ensuring that, to the best of their ability, effective interventions are implemented within their regions.

Introduction

Introduction

Injuries are among the leading causes of morbidity and mortality in New Zealand children [1, 2] [3], with children under five years of age carrying a particularly heavy burden. In 2001, 23% of New Zealand's 0-14s were less than 5 years of age, yet 52% of deaths and 35% of hospitalisation from injury occurred in this age group [4]. The circumstances surrounding such injuries vary however, with the age and developmental stage of the child. New Zealand data from the 1990s indicates that 53% of injury deaths and 54% of injury hospitalisations among those under five years occurred at home [4]. In contrast, for older children, most fatal injuries are road traffic related (as in other developed countries [5]). Further, a number of additional factors are thought to affect the likelihood of childhood injury, with Kendrick et al (2007) in one recent review noting that the risk of injury was higher (in a number of studies) for those from more disadvantaged socioeconomic backgrounds, those with younger mothers, those from large families, and amongst boys [5]. Similarly, a New Zealand study found a social gradient for child injury [6].

The high burden of injury related morbidity and mortality in preschool age children has led to a search for effective interventions to reduce injuries in the home environment. A number of interventions have been identified for specific mechanisms of injury, most of which are environmental in nature. Examples include swimming pool fencing, child proof packaging of medication and toxic chemicals, and temperature reduction for hot tap water [7]. These interventions do not address all injury types however and other strategies are also needed, with a review by Kendrick et al finding that home safety education and the provision of safety equipment can also be effective in changing some, but not all safety practices [5].

Structure of this Report

This report focuses on home based injury prevention in preschool age children. It aims to provide DHBs / those working in the health sector, with a broad overview of the most common injuries experienced by New Zealand children (0-14 years), before reviewing preventative interventions in the high priority areas. These priority areas (poisoning, burns and scalds, drowning) have been selected, not only because of their significant contribution to hospital admissions and mortality in preschool age children, but also because of the existence of preventative measures which fall within the scope of DHBs. While land transport injuries are also a major cause of morbidity and mortality in children, they are not reviewed in detail, as they are more common in older children and adolescents, and because the Ministries of Transport and Police are mandated to play the leading role in reducing these types of injuries.

The report which follows is thus divided into four main sections:

1. **Brief Overview of Injury Related Hospital Admissions and Mortality in New Zealand Children**: Using information from the NZ Child and Youth Epidemiology Service's 2008 DHB Reports, this section provides an overview of the most common causes of injury related hospital admissions and mortality in New Zealand children.
2. **Poisoning**: While not a leading cause of mortality in preschool children, unintentional poisoning is an important cause of hospital admission. This section considers a range of measures (e.g. child resistant packaging, parental education regarding safe storage of chemicals) which may reduce the occurrence or severity of poisoning in this age group.
3. **Burns and Scalds**: Burns and scalds are a common cause of severe morbidity in children. This section considers a range of measures (e.g. changes to hot water cylinder

temperatures, reduced flammability of nightwear) which may reduce the occurrence or severity of burns and scalds in this age group.

4. **Drowning**: While drowning is not a leading cause of hospital admission in children, it is an important cause of mortality. This section considers measures to reduce the incidence of drowning in the home environment (e.g. swimming pool fencing legislation).

In order to provide a framework for considering the priority areas outlined above (poisoning, burns and scalds, drowning), each of these sections is further sub-divided into four main parts:

1. **Brief Overview of New Zealand Epidemiology**: Each section begins with a brief overview of the injury's distribution in the New Zealand context.
2. **Circumstances Surrounding Injury Event**: In considering the contributory factors leading to home based injury events in preschool aged children Haddon's Matrix [8] provides a useful framework. Developed by William Haddon in 1970 [8], this matrix assists the reader to consider the personal attributes of the child, the properties of the agent itself, and the physical and social / policy environment which may have contributed to the injury event. It also assists the reader to consider potential intervention points at different stages during the poisoning episode. Haddon's Matrix [8] is thus used to review the key pre-event, event and post-event characteristics of the child, the agent of injury, and the physical and socioeconomic environment which may contribute to each of these injuries in this age group, as well as the implications for intervention design.
3. **Relevant New Zealand Legislation and Standards**: When considering the most effective interventions to reduce home injury, it is important to understand the legislative framework which governs for example, the manufacture, supply, or design of materials, the packaging of poisons, or the fencing of swimming pools.
4. **Overview of Available Evidence on Prevention and Implications for DHBs**: An understanding of the current evidence base is also crucial, when considering injury prevention options. This section aims to provide a brief best practice synthesis, with interventions being designated as having general support, some support, insufficient evidence, or occasionally, being unsafe or no longer in use.

When considering the information above, it is also necessary to have an understanding of some of the broader approaches to injury prevention, as well as the limitations of the current literature, in terms of the strength of the evidence it can provide.

Broad Approaches to Childhood Injury Prevention and Issues with Interpreting the Literature

The pathways leading to childhood injuries are heterogeneous, reflecting the developmental stage of the child, and the physical and social environments in which they occur. While some childhood injuries may require very specific and targeted interventions, a range of broader approaches are also recognised as being effective in childhood injury prevention. The World Health Organization World Report on Child Injury Prevention [9] lists a number of these:

1. **Legislation and Enforcement**: Legislation is a useful tool in injury prevention, with successful initiatives including smoke alarms, hot water temperature legislation, child resistant packaging, and swimming pool fencing regulations. While a number of studies have demonstrated reductions in injury rates following the introduction of such legislation, issues such as how well the legislation is enforced need also to be taken into account.
2. **Product Modification**: Changes to the design and manufacture of products have also resulted in reductions in injury rates, with examples including the introduction of child resistant packaging on drugs and household chemicals, and changes to cigarette lighters.
3. **Environmental Modification**: Initiatives which modify the environment with a view to injury prevention (e.g. fire resistant building materials, swimming pool fences) have also shown promise in some studies.

4. **Safety Devices**: The use of safety devices such as bicycle and motorbike helmets have been shown to reduce injuries in a number of studies, with the use of smoke alarms also showing promise (legislation may be required as an adjunct in this context).
5. **Education, Skills and Behaviour Change**: While research suggests that safety education may significantly change behaviour (e.g. storage of chemicals), evaluating these processes is difficult and it remains unclear how well such initiatives lead to reductions in childhood injury rates. Further research is required in this area. However, the educative process is important for increasing community awareness and acceptance of the importance of implementing interventions.

When assessing the literature for evidence of the effectiveness of such approaches however, a number of cautions are also warranted. Firstly, the field of child injury prevention is complex. While randomised controlled trials (RCTs) are considered the gold standard for assessing intervention effectiveness, where causal pathways or interventions are complex (e.g. childhood injury prevention education), such trials are rare, as it is often difficult to control for all of the potentially confounding factors involved. Further, in many situations a formal RCT will never be undertaken, either because such a trial would be impractical or unethical, or because the intervention is already in established practice.

In addition, there are also difficulties in measuring the effect of interventions on child injury and therefore whether they do result in reductions in injury rates [5]. There are also difficulties with the diversity of injury causes. While falls are the most common reason for admission to hospital among the under five year olds, developing interventions that address this cause is complex. Changing the environment, for example, is unlikely to address the circumstances of most fall events that result in injury. As a consequence, measures to address, for example, childhood poisoning that peak at around 2 years of age, will be very different to falls that occur commonly among the four to five year olds.

Thus when assessing the evidence for the effectiveness of particular interventions in the sections which follow, consideration must be given to the weight of evidence across all of the available studies. Further, the precautionary principle is applicable to injury prevention [10]. Thus if the body of evidence suggests an intervention may be effective, but no high quality RCTs are available, consideration must be given to the possible harm of not acting to protect the child despite the scientific uncertainty.

Further, the limitations of the methodology used to undertake this review need to be taken into account. The textbox below outlines some of the issues inherent with this.

Methodology Used in Preparing Evidence Based Review Tables

The methodology used to undertake this review borrows heavily from the principles of the Evidence Based Medicine (EBM) movement, which has emerged in recent years as a means of providing busy clinicians with up to date overviews of the evidence in particular areas [202]. Such overviews generally rely on reviewers collating all of the available evidence (e.g. published and unpublished trials and observational studies), evaluating this in a rigorous manner, and then publishing the resulting synthesis in a format which allows clinicians to quickly evaluate the effectiveness of the intervention(s) reviewed. While the evidence base for population level injury prevention interventions is much less developed than for individual patient therapies (as such interventions often have longer follow up times, more diffuse outcomes, and less readily identifiable "control" groups [203]), there is nevertheless a reasonable body of evidence emerging as to the effectiveness of population level interventions in injury prevention.

The brief overviews presented in this report, thus aim to provide busy DHB staff with a logical starting point for considering the types of intervention available to address particular types of childhood injury. In preparing these overview tables however, the methodology used was not exhaustive, but rather involved searching a restricted number of EBM journals and databases (e.g. the Cochrane Library) for systematic reviews of population level interventions to prevent childhood injuries.

For most searches the *Evidence Based Medicine Reviews-Full Text** database was used to find reviews which considered the effectiveness of population level interventions to prevent each of the injuries in question. The search strategy concentrated on publications which attempted to synthesise all of the available evidence, thereby providing as broad as possible coverage of the relevant literature. In general, only literature from 2000 onwards was searched, although earlier publications were included if there was a paucity of more recent information. While

individual trials and protocols were not specifically sought, if there was no other relevant information available, an attempt was made to locate individual research reports or recommendations. While not being exhaustive, it is nevertheless hoped that these brief overviews will provide a useful starting point for DHBs wishing to explore strategies to address particular child injuries in their areas. (*This database allows three databases to be searched simultaneously: 1) The ACP Journal Club comprising two journals; ACP Journal Club and Evidence-Based Medicine 2) The Cochrane Database of Systematic Reviews; and 3) The Database of Reviews of Effects (DARE) produced by National Health Services' Centre for Reviews and Dissemination at the University of York, UK).

The Standards NZ http://standards.co.nz/default.htm, New Zealand Legislation http://www.legislation.govt.nz/ and Ministry of Consumer Affairs http://www.consumeraffairs.govt.nz/legislation-policy/acts-regulation/product-safety-standards websites were also searched in order to identify relevant New Zealand legislation.

In many cases, there was a paucity of high quality evidence based reviews on population level interventions to address childhood injuries (although the absence of such reviews does not rule out the existence of individual studies in particular areas). In this context, while the search strategy utilised did not primarily aim to identify individual studies, or reviews of individual programs, in cases where such studies were identified, and where no other systematic reviews were available, they were included under the heading of Other Relevant Publications. In such cases, the reader needs to be reminded that these studies were identified in a non-systematic manner and that their findings should thus not be given the same weight as systematic reviews (e.g. Cochrane reviews) where all the available evidence has been evaluated using a rigorous methodology. Further, it must be remembered that Evidence Based Medicine has three parts. In addition to the evidence, the clinical judgment made by the specialist, in this case, the public health specialist, and the realistic appraisal of what will be possible with the patient, or the population also contribute to decisions about what is the best practice to achieve the outcome sought.

In Conclusion

Injuries are a significant cause of morbidity and mortality in preschool age children, with the majority of these injuries occurring in the home environment. This report on home based injury prevention in preschool age children thus aims to provide DHBs / those working in the health sector, with a broad overview of the most common injury types in children aged 0-14 years, as well as the available preventative interventions for a small number of high priority injuries (poisoning, burns and scalds, drowning). Further, where New Zealand research on impediments to the implementation of safety interventions is available, this has been highlighted in the text, in order to ensure that DHBs are aware of potential barriers to the implementation of interventions which have been shown to be efficacious elsewhere.

While the volume of literature relating to each of these injuries is considerable, and the issues surrounding the evidence are often complex, this should not preclude DHBs from ensuring that, to the best of their ability, effective interventions are implemented within their regions. This document has been developed therefore to provide the key evidence on known interventions to prevent home based injuries in preschool age children, with a view to providing DHBs with a basis upon which to build effective prevention programs.

Injury Related Hospital Admissions and Mortality in New Zealand Children

Introduction

Injuries are the leading causes of hospital admissions and mortality for New Zealand children. The following section is derived from the NZCYES 2008 DHB Report Template, and provides an overview of injury related hospital admissions and mortality in New Zealand children aged 0-14 years (Note: in a small number of analyses, data for those aged 15-24 years has also been included, either for comparative purposes, or where numbers are small, in order to ensure sufficient numerical stability. In such cases this is clearly indicated in the relevant captions and text).

Data Source and Methods

Definition

Hospital Admissions and Deaths from Injury in Children 0-14 Years

Data Source

Admissions Numerator: National Minimum Dataset: Hospital admissions for children 0-14 years with a primary diagnosis of injury (ICD-9 800-995: ICD-10 S00-T79). Causes of injury were assigned using the external cause code (E code). The following were excluded: 1) Those with an E code ICD-9 E870-879: ICD-10 Y40-Y84 (complications of medical/surgical care), ICD-9 E930-949 (adverse effects of drugs in therapeutic use) and ICD-9 E929, E969, E959 (late effects (>1 year) of injury); 2) Inpatient admissions with Emergency Medicine Specialty code (M05-M08) on discharge (see Appendix 4);

Deaths Numerator: National Mortality Collection: Deaths of children 0-14 years with a clinical code (cause of death) attributed to injury (ICD-9 E800-995: ICD-10 V01-Y36). Excluded were deaths with an E code ICD-9 E870-879: ICD-10 Y40-Y84 (complications of medical/surgical care), ICD-9 E930-949 (adverse effects of drugs in therapeutic use) and ICD-9 E929, E969, E959 (late effects (>1 year) of injury).

Causes of Injury Numerator: Causes of injury were assigned using the first E code in ICD10 as follows: Transport Crashes, Pedestrian (V01-V09), Cyclist (V10-V19), Motorbike (V20-29), 3-Wheeler (V30-39), Vehicle Occupant (V40-79), Other Land Transport (V80-89, V98-99); Falls (W00-W19), Mechanical Forces: Inanimate (W20-W49), Mechanical Forces: Animate (W50-64), Drowning/Submersion (W65-74), Unintentional Threat to Breathing (W75-W84), Electricity/Fire/Burns (W85-X19), Unintentional Poisoning (X40-X49), Intentional Self Harm (X60-84), Assault (X85-Y09), Undetermined Intent (Y10-Y34).

Broader Categories included Transport Crashes (V01-V89, V98-V99) and Unintentional Non-Transport Injuries (W00-W74, W85-X49). Transport crashes were assigned to traffic or non-traffic related categories based on the fourth digit of the External Cause code as outlined in the ICD-10 Tabular List of Diseases. For time series analyses broader diagnostic categories (as well as those relating to unintentional threats to breathing, assault and self inflicted injuries) were also back mapped to ICD-9 (with coding for each of these categories available on request).

Denominator: NZ Census

Notes on Interpretation

Note 1: The limitations of the National Minimum Dataset are discussed at length in Appendix 1. The reader is urged to review this Appendix before interpreting any trends based on hospital admission data.

Note 2: 95% confidence intervals have been provided for the rate ratios in this section and where appropriate, the terms *significant* or *not significant* have been used to communicate the significance of the observed associations. Tests of statistical significance have not been applied to other data in this section, and thus (unless the terms *significant* or *non-significant* are specifically used) the associations described do not imply statistical significance or non-significance (see Appendix 2 for further discussion of this issue).

Most Frequent Causes of Injury Admissions and Mortality

Hospital Admissions:

In New Zealand during 2003-2007, falls followed by inanimate mechanical forces (injuries where children are struck by something or struck against) were the leading causes of injury related hospital admissions for children (0-14 years). Transport related injuries as a group however also made a significant contribution (**Table 1**).

Mortality

In New Zealand during 2001-2005, unintentional threats to breathing were the leading cause of injury related mortality in children (0-14 years), with the majority of these cases occurring during infancy and being attributed to unintentional suffocation or strangulation in bed. Vehicle occupant and pedestrian injuries and drowning also made a significant contribution (**Table 2**).

Table 1. Most Frequent Causes of Injury Related Hospital Admission for Children 0-14 Years, New Zealand 2003-2007

Mode of Injury	Number: Total 2001-2005	Number: Annual Average	Rate per 100,000	% of Total
Falls	26,122	5,224.4	604.95	43.4
Mechanical Forces: Inanimate	13,208	2,641.6	305.88	21.9
Mechanical Forces: Animate	2,520	504.0	58.36	4.2
Transport: Cyclist	3,442	688.4	79.71	5.7
Transport: Vehicle Occupant	1,373	274.6	31.80	2.3
Transport: Motorbike	1,214	242.8	28.12	2.0
Transport: Pedestrian	1,178	235.6	27.28	2.0
Transport: Other Land Transport	1,534	306.8	35.53	2.5
Unintentional Poisoning	2,707	541.4	62.69	4.5
Electricity / Fire / Burns	2,093	418.6	48.47	3.5
Assault	832	166.4	19.27	1.4
Intentional Self Harm	491	98.2	11.37	0.8
Unintentional Threat to Breathing	387	77.4	8.96	0.6
Drowning / Submersion	196	39.2	4.54	0.3
Undetermined Intent	141	28.2	3.27	0.2
No External Cause Listed	17	3.4	0.39	0.0
Transport: 3 Wheeler	6	1.2	0.14	0.0
Other Causes	2,781	556.2	64.40	4.6
Total	60,242	12,048.4	1,395.12	100.0

Source: Numerator-National Minimum Dataset; Denominator-Census; *Note: Mechanical Forces: Inanimate includes being unintentionally struck/crushed/injured by an object/implement. Emergency Department Admissions excluded (see Appendix 1 for rationale)

Table 2. Most Frequent Causes of Injury Related Mortality in Children 0-14 Years, New Zealand 2001-2005

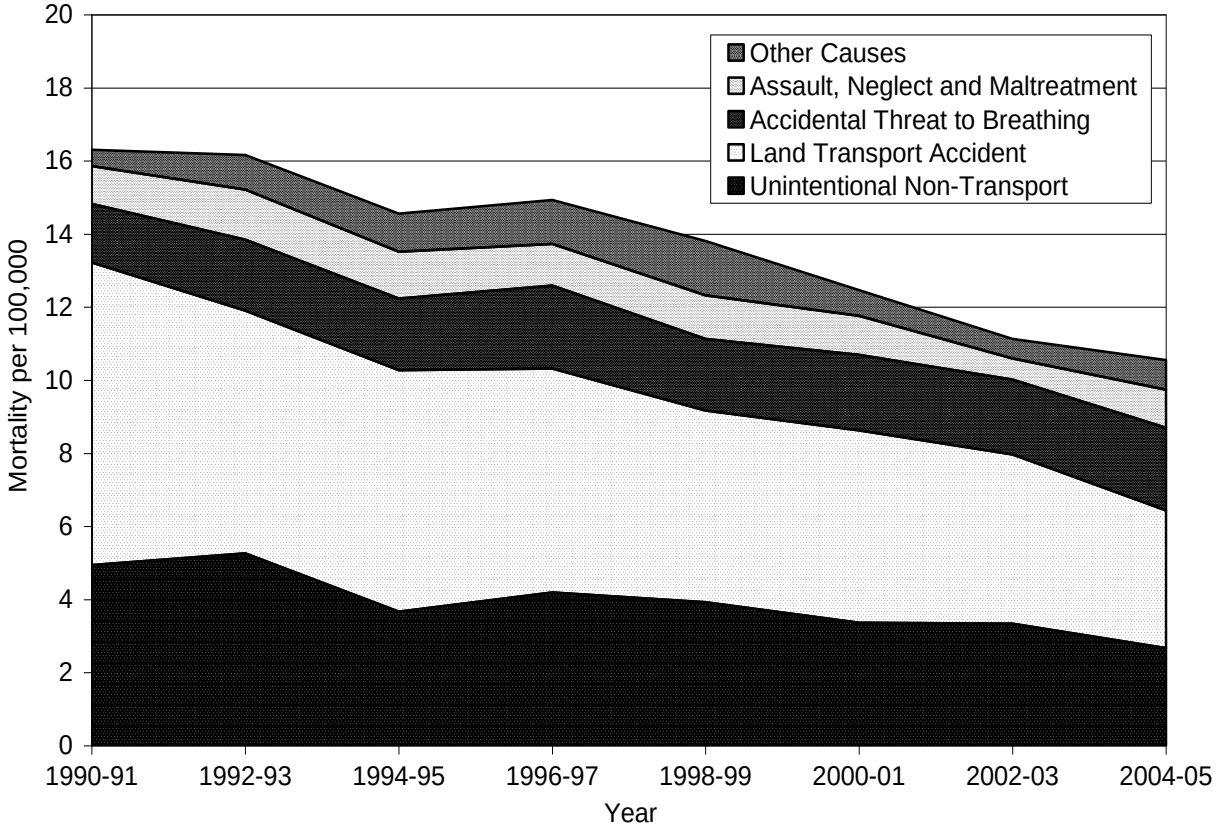
Cause of Death	Number: Total 2001-2005	Number: Annual Average	Rate per 100,000	% of Deaths
Unintentional Threat to Breathing	91	18.2	2.13	19.2
Transport: Vehicle Occupant	80	16.0	1.87	16.8
Transport: Pedestrian	71	14.2	1.66	14.9
Transport: Cyclist	13	2.6	0.30	2.7
Transport: Motorbike	8	1.6	0.19	1.7
Transport: Other Land Transport	13	2.6	0.30	2.7
Drowning / Submersion	68	13.6	1.59	14.3
Assault	36	7.2	0.84	7.6
Electricity / Fire / Burns	34	6.8	0.79	7.2
Intentional Self Harm	16	3.2	0.37	3.4
Falls	14	2.8	0.33	2.9
Mechanical Forces	11	2.2	0.26	2.3
Other Causes	20	4.0	0.47	4.2
Total	475	95.0	11.10	100.0

Source: Numerator-National Mortality Collection; Denominator-Census

New Zealand Trends in Injury Mortality

During 1990-2005, injury related mortality rates in New Zealand children (0-14 years) gradually declined, and while the largest absolute declines were in the land transport crash category (where rates fell from 8.3 per 100,000 in 1990-91 to 3.8 per 100,000 in 2004-05), the unintentional (non transport) mortality rate also reduced (**Figure 1**).

Figure 1. Trends in Injury Mortality Rates for Children 0-14 Years, New Zealand 1990-2005



Source: Numerator-National Mortality Collection; Denominator-Census

Unintentional Injuries in Children (Non-Transport)

Trends in Mortality

In New Zealand during 1990-2005, unintentional non-transport injury deaths (e.g. due to falls, mechanical forces (e.g. being struck by an object), drowning, burns, poisoning) in children gradually declined, although the pattern was more variable for young people after 2000-01 (**Figure 2**).

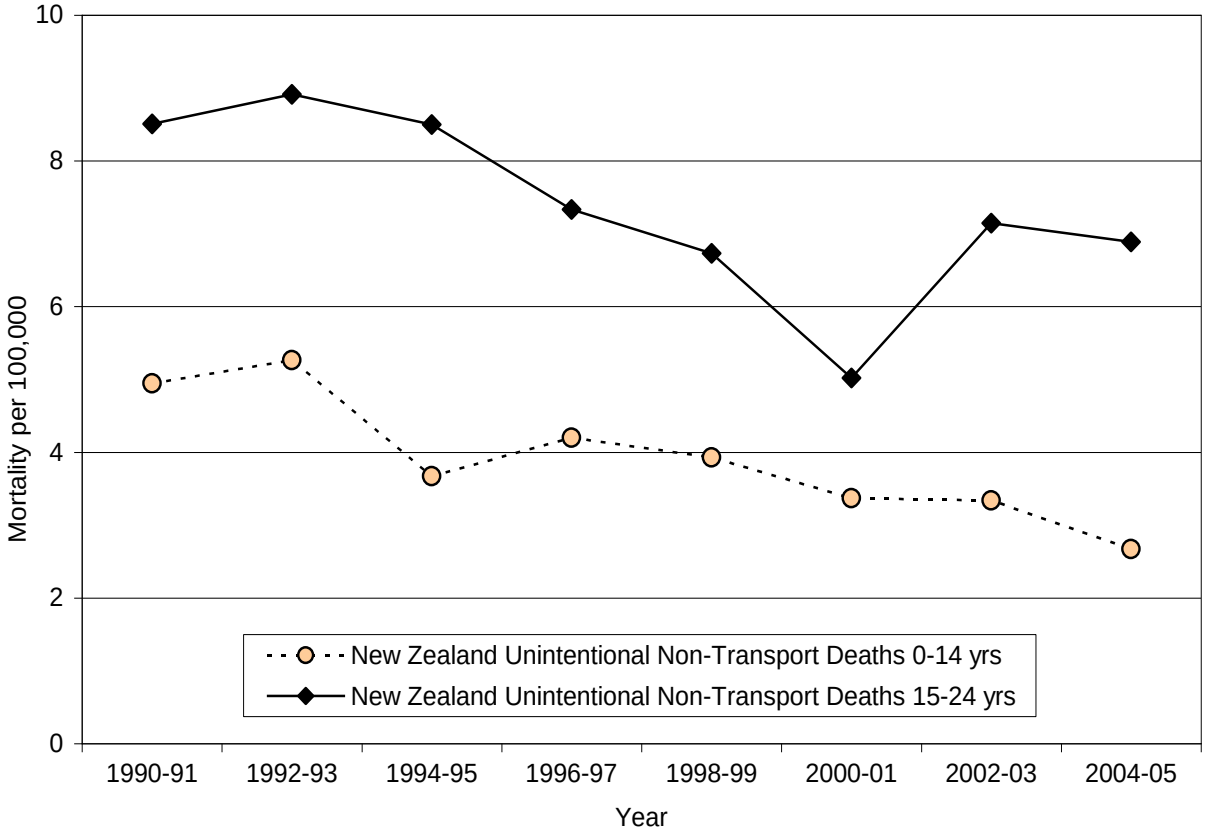
Gender and Age Differences

When broken down by age, unintentional non-transport injury admissions were lowest for those <1 year, but then rose rapidly to peak between one and two years of age. While for females, rates declined throughout childhood, for males this decline was much less marked. A similar gender imbalance was seen for mortality during the teenage years (**Figure 3**). When broken down by cause, admissions for falls peaked at 5 years, while unintentional poisoning, inanimate mechanical forces and exposure to electricity / fire / burns were highest for those aged 1-2 years (**Figure 4**).

Distribution by Prioritised Ethnicity, NZDep, Gender and Rural / Urban Location

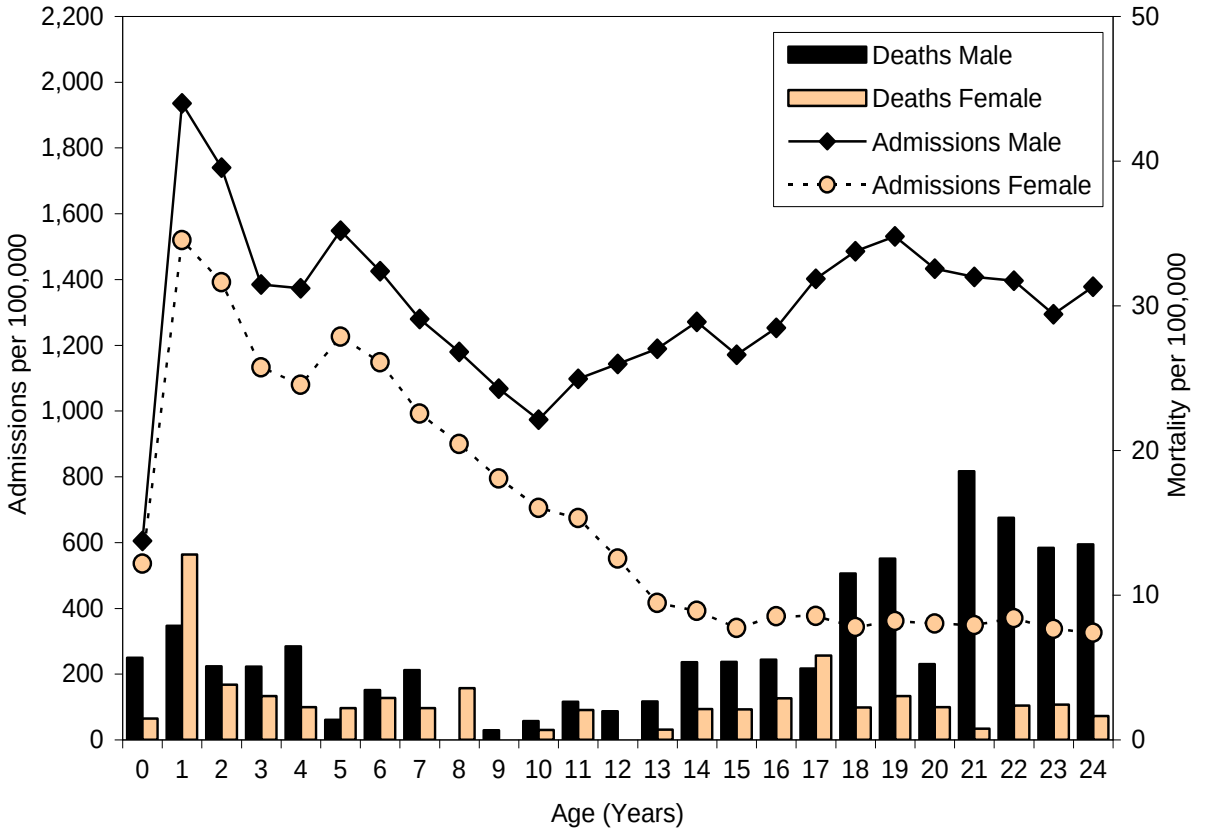
In New Zealand during 2003-2007, hospital admissions for unintentional non-transport injuries were *significantly higher* for Pacific than for Māori, than for European, than for Asian children. They were also *significantly higher* for males and those in more deprived or urban areas (**Table 3**). In contrast, during 1996-2005 mortality from unintentional non-transport injury was higher for Māori children and young people (**Figure 5**).

Figure 2. Mortality Rates from Unintentional Non-Transport Injuries in Children 0-14 Years and Young People 15-24 Years, New Zealand 1990-2005



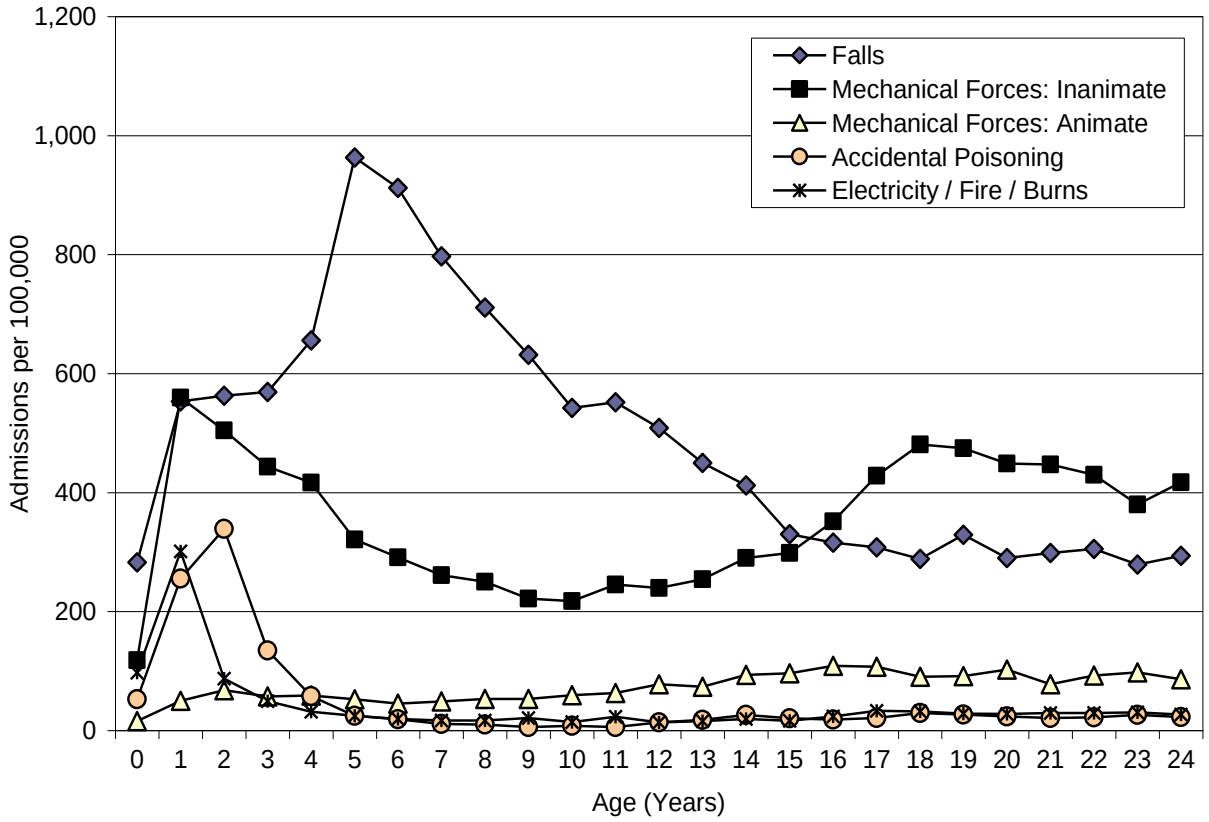
Source: Numerator-National Mortality Collection; Denominator-Census

Figure 3. Hospital Admission (2003-07) and Mortality (2001-05) Rates from Unintentional Non-Transport Injuries in New Zealand Children and Young People 0-24 Years by Age and Gender



Source: Numerators-National Minimum Dataset and Mortality Collection; Denominator-Census

Figure 4. Hospital Admission Rates for Selected Unintentional Non-Transport Injuries in Children and Young People 0-24 Years by Age and Cause, New Zealand 2003-2007



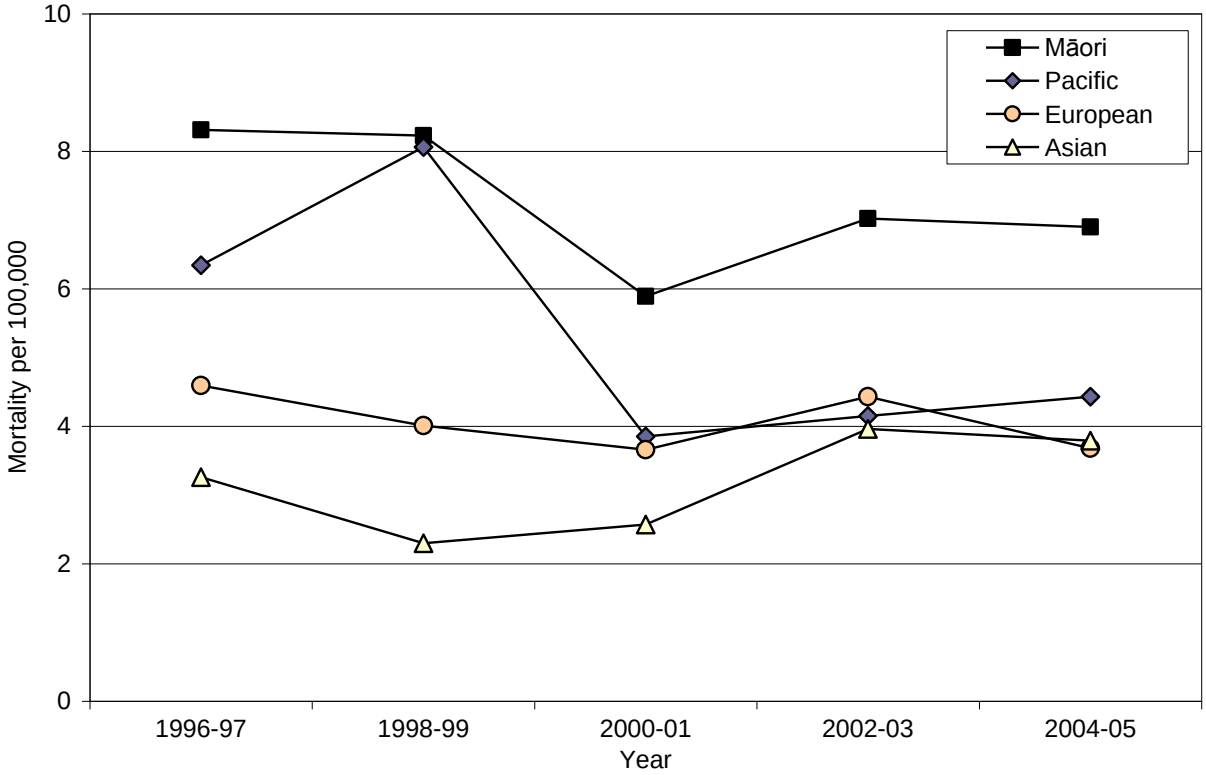
Source: Numerator-National Minimum Dataset; Denominator-Census

Table 3. Distribution of Hospital Admission Rates from Unintentional Non-Transport Injuries in Children 0-14 Years by Ethnicity, NZDep Decile and Gender, New Zealand 2003-2007

Variable	Rate	RR	95% CI	Variable	Rate	RR	95% CI
NZ Deprivation Index Decile				NZ Deprivation Index Quintile			
1	771.51	1.00		1-2	756.32	1.00	
2	740.45	0.96	0.91 - 1.01	3-4	854.11	1.13	1.09 - 1.17
3	792.63	1.03	0.98 - 1.08	5-6	1003.03	1.33	1.28 - 1.37
4	916.79	1.19	1.13 - 1.24	7-8	1230.58	1.63	1.58 - 1.68
5	927.76	1.20	1.15 - 1.26	9-10	1461.44	1.93	1.88 - 1.99
6	1078.43	1.40	1.34 - 1.46	Prioritised Ethnicity			
7	1145.71	1.49	1.42 - 1.55	European	1074.54	1.00	
8	1311.54	1.70	1.63 - 1.77	Māori	1231.98	1.15	1.12 - 1.17
9	1483.52	1.92	1.85 - 2.00	Pacific	1355.77	1.26	1.22 - 1.30
10	1443.16	1.87	1.80 - 1.95	Asian	635.94	0.59	0.57 - 0.62
Gender				Urban / Rural			
Female	885.43	1.00		Urban	1127.73	1.00	
Male	1274.89	1.44	1.41 - 1.47	Rural	836.28	0.74	0.72-0.76

Source: Numerator-National Minimum Dataset; Denominator-Census; Note: Rate per 100,000 per year; Ethnicity is Level 1 Prioritised; RR: Rate Ratios are unadjusted

Figure 5. Mortality Rates from Unintentional Non-Transport Injuries in Children and Young People 0-24 Years by Ethnicity, New Zealand 1996-2005



Source: Numerator-National Mortality Collection; Denominator-Census; Ethnicity is Level 1 Prioritised

Summary

Injuries are a major cause of morbidity and mortality for New Zealand children and especially for children under the age of five years. For preschool age children, falls, unintentional poisoning, burns and scalds, and injuries arising from “inanimate forces” (e.g. being struck by objects or bumping into things) are all common causes of hospital admission, with children 1-3 years being particularly vulnerable to a number of these causes. For mortality, suffocation and drowning are of particular concern (among non-transport injuries). There appears also to be groups within the child population who are more vulnerable to non-transport injuries. For example, various analyses indicate that particular attention should be paid to Maori and Pacific children, boys and those living in more deprived, or rural areas, when planning injury prevention initiatives.

Poisoning

Introduction

In New Zealand each year, on average 540 children aged 0-14 years are admitted to hospital as the result of an accidental poisoning, with the peak age of hospitalisation being 2 years (see previous section). Further, recent research in the Australian context suggests that the majority (94.1%) of children <5 years seeking medical attention (either poisons information centre, or the emergency department) as the result of a poisoning accessed the agent in their own home, and in 38% of cases, the parent or caregiver was in the immediate vicinity at the time of the incident. The span of unsupervised time reported was 5 minutes or less in 79.5% of cases, with the means of access generally being at the time of the use of the agent (75.3%) including just purchased, rather than when the agents were in their usual place of storage [11]. The authors of this study concluded that there may be little scope for improved supervision as a major intervention, but that improved labelling and packaging (including child resistant packaging) and agent specific interventions (e.g. child resistant bait stations for rat poison, covers for vaporisers), could potential play a much greater role in keeping children safe [11].

Circumstances Surrounding Poisoning in Preschool Children

In considering the contributory factors leading to home based injury events, Haddon's Matrix [8] provides a useful framework. **Table 4** provides an overview of these factors as they relate to poisoning in preschool age children.

Table 4. Haddon's Matrix Describing Circumstances Surrounding Home Based Poisoning Events in Preschool Aged Children

	Child	Agent	Physical environment	Social / Policy Environment
Pre-Event	Age and developmental stage (e.g. judgement, curiosity) Gender	Access: Ease of opening packaging Attractiveness of substance Inadequate labelling Large packaging dose	House has no lockable cupboards, Cupboards within easy reach Agent in use	Level of caregiver supervision Lack of awareness of toxicity and poisoning risks by caregivers Lack of standards / regulations for toxic products and packaging
Event	Child's secrecy about ingestion	Toxicity of chemical Ease of consumption (e.g. liquid vs. solid) Dose consumed	Places where child can ingest substances out of sight of caregiver	Caregiver not noticing unusual behaviour Caregiver distracted (e.g. other children sick, crisis, phone)
Post-Event	Child's inability to communicate post incident	Lack of suitable antidote Lack of instruction for post ingestion on packaging	Lack of access to Poison Information Centre Lack of adequate pre-hospital care, acute care and / or rehabilitation	Lack of awareness by caregivers of First Aid measures or how to contact Poison Info Centre Lack of timely decontamination by healthcare workers

Source of Information: [11] [9]

Relevant New Zealand Legislation and Standards

In New Zealand a range of Legislation and Standards are relevant to the prevention of unintentional poisoning in children. The textbox below outlines the key points for each.

Legislation and Standards Relevant to the Prevention of Poisoning in Children

Medicines Regulations 1984 (Section 37)

Section 37 of this regulation states that "*no person shall sell any tablet...or.. medicine.. belonging to a class of medicines to which this regulation applies, unless the tablet or item is enclosed in a safety container*". The following medicines are named specifically in this regulation: *aspirin, paracetamol, iron (high doses only), barbiturates, phenothiaszines (only those for mental illness), and antidepressants*. The definition of CRP under this legislation is not tied to any safety particular standard [12].

Hazardous Substances and New Organisms Act 1996

This Act restates and reforms the law relating to the management of hazardous substances and new organisms. The Environmental Risk Management Authority was established under this Act as an authority, with certain obligations and responsibilities. These include identifying a group of hazardous substances or products, and imposing conditions that they see fit. Group standards are an approval for a group of hazardous substances of a similar nature. Child Resistant Packaging clauses in some of the group standards outline what substances require CRP and which do not. For further detail see http://www.legislation.govt.nz/act/public/1996/0030/latest/DLM381222.html?search=ts_act_Hazardous+Substances+and+New+Organisms+Act+1996_resel&p=1&sr=1 .

Child-Resistant Packages (NZS 5825:1991)

Child resistant packaging (CRP) includes both non-recloseable and recloseable packaging. Non-recloseable packaging usually contains a single tablet enclosed in either aluminium foil or blister packaging, while recloseable packaging involves a container fitted with a child resistant cap [12]. CRP are designed to increase the amount of time that it takes for a young child to gain access to the medication or chemical (i.e. they are designed to be significantly difficult for most children under five years of age to open, or obtain a toxic amount of the substance within a reasonable time). CRP however are not child proof (see http://poisons.co.nz/fact.php?f=27&c=26) .

In New Zealand, child resistant packaging (CRP) is required to meet the current New Zealand Standard (NZS 5825:1991). This standard outlines the requirements for child resistant packaging and provides for panel testing of CRP, with typical test criteria requiring a container to undergo panel testing by e.g. 200 children aged from 42 months to 51 months, and 100 adults between the ages of 18 to 60 years (including people with disabilities). The Standard specifies that "*At least 85% of the children must be unable to open the container within 5 minutes of following a non-verbal demonstration of how to open the container. For adults, at least 90% must be able to open the container*".

1998 Code of Practice for Child Resistant Packaging and Toxic Substances

The *1998 Code of Practice for Child Resistant Packaging and Toxic Substance*s [13] produced by the Ministry of Health lists a range of chemicals requiring child resistant closures. These include:

Alkaline salts -dishwasher powders; Alkaline salts -dishwasher liquids; Cineole; Clove oil Eucalyptus oil preparations containing greater than 50%; Eugenol; Hydrocarbons when packaged as kerosene, lamp oil, mineral turps, thinner, reducers, white petroleum spirits or dry cleaning fluids; Hydrochloric acid; Melaleuca oil (tea tree oil); Methylated Spirits; Methyl salicylate preparations containing greater than 50%; Oil of turpentine; Potassium hydroxide; Sodium hydroxide.

If a substance is not included in the above list, the Code of Practice outlines a number of criteria against which an agent may be assessed in order to determine wither a CRP is required. These criteria fall into three main categories: toxicity, corrosivity and viscosity.

Pharmacy Contractors Section 51 Advice Notice

Pharmac funds child safety caps for oral liquid preparations of a number of medications [12]. Since 1 November 1997, it has been a requirement under the Pharmacy Contractors Section 51 Advice Notice, that child safety caps be placed on the subsidised, dispensed oral liquid formulations of the following:

Paracetamol; Salicylates/NSAIDs; Anticonvulsants; Thyroxine; Antidepressants; Narcotics; Beta-2-agonists; Benzodiazepines; Theophylline; Iron salts; Digoxin; Cardiac Drugs; and Phenothiazines, including sedating antihistamines (see http://poisons.co.nz/fact.php?f=27&c=26).

Current Evidence for Prevention and Implications for DHBs

Table 5 provides an overview of systematic and other reviews relevant to the prevention of poisoning in preschool age children. These reviews suggest that a range of measures may be effective in preventing poisoning events, but that each approach has its strengths and limitations. The following section considers these measures, under the subheadings *of General Support, Some Support and Insufficient Evidence*.

Table 5. Publications Relevant to the Prevention of Poisoning in Preschool Children

Systematic Reviews of Poisoning Prevention Studies in Children
Kendrick, D., et al., **Home safety education and provision of safety equipment for injury prevention**. Cochrane Database of Systematic Reviews, 2007(1). This review considered the effect of home safety education and provision of safety equipment on a variety of interventions to reduce childhood injuries. In total eighty studies were included, forty of which reported a range of outcomes related to poisoning prevention. Of these 40, there were 18 which were included in at least one of the meta-analyses of poisoning prevention outcomes. (14 RCTs, 3 non-RCTs and 1 controlled before-and after study.) Individual participant level data was obtained from 9 of these studies. The poisoning prevention interventions considered were: storage of medicines and cleaning products out of children's reach, possession of syrup of ipecac (*Note: now no longer recommended)* and having the poison control centre number accessible. The reviewers found that home safety education was effective in increasing all of these safety practices and that provision of equipment, as well as education (e.g. by providing childproof cupboard catches) was more effective than education alone. The reviewers found there was a lack of evidence that home safety education, with or without the provision of safety equipment was effective in reducing rates of thermal injuries, poisoning or a range of injuries, but note that the number of studies and the number of person years included in the meta-analyses for injury outcomes were relatively small. They explained that it was unlikely that this meant that safety education was not beneficial and reported on a number of observational studies supporting this point of view.
Nixon, J., Spinks, A. and Turner, C. **Community based programs to prevent poisoning in children 0-15 years**. Injury Prevention, 2004. **10**: p. 43-46. This authors of review found only four studies of community based poisoning prevention programs that included reporting on poisoning rates as an evaluative component (the 3 most recent of which are included in the Cochrane review above). Two studies were designed with a community control for comparison with the intervention community and a further two studies were designed using the intervention community as an historical control in a before-after design. Only one of the 4 studies provided convincing evidence for an effective community program for reducing child poisoning; this was a South African study which found that the introduction of child resistant containers for paraffin resulted in a 47% decrease in the incidence of paraffin ingestion in the intervention area compared to the control area. The authors note that further work is needed on two fronts: providing community implementation of interventions that have been shown to be efficacious in research settings and demonstrating the resulting population level improvements in outcomes through high quality evaluations.
Towner, E., et al., **What Works in Preventing Unintentional Injuries in Children and Young Adolescents**. 2001, Health Development Agency. www.nice.org.uk/niceMedia/documents/prevent_injuries.pdf Pages 71-75 of this document relate to poisoning. Five studies which examined the impact of educational approaches to poisoning prevention are reviewed. (3 of which are included in the Cochrane review above). These include 2 RCTs, a before-and-after study without a control group, a non-randomised controlled trial and one study having a post-test only control group design. The review found that interventions to increase the safe storage of non-medicinal poisons may be an effective means of preventing poisoning injury. It also found that educational interventions aimed at children and parents have been associated with increased knowledge of poisons and poison prevention but that it is not known whether such approaches result in reductions in poisoning injuries. In addition 2 studies examining the effect of legislation are reviewed. One was a U.K. before-and after study which reviewed hospital admission data following the voluntary introduction of child-resistant packaging or blister packs for all solid dose medications. This study did not demonstrate a reduction in poisoning admission rates and noted an increase in poisoning due to liquid medicines (which were not covered by the packaging agreement). The other was a U.S. time series study which examined poisoning deaths in the period 1964-1992 during which legislation on the packaging of prescription drugs was introduced (in 1974). This study found a reduction in children's deaths from poisoning over the study period.
Individual Randomised Trials of Poisoning Prevention in Children
Sznajder, M., et al., **Home delivery of an injury prevention kit for children in four French cities: a controlled randomized trial**. Injury Prevention, 2003. 9: p. 261-265. This study was a RCT involving 100 families in 4 French cities. Selection criteria for participation were primipara, medical problem, psychological and/or socio-economic difficulties. One group (50 families) received counselling and a kit including preventive devices and pamphlets about indoor injuries and ways to avoid them and the other group received only counselling. At follow up 6-8 weeks later, safety improvement in the group was significantly higher in the group with the kit ($p<0.01$ for improvements related to poisoning). The authors concluded that "Routine home visits by social services offer a good opportunity to tackle child injury prevention. Free delivery of prevention kits and counselling allow families to modify their behaviour and homes so as to reduce risks."

Other Reviews, Programs and Campaigns - Overseas Publications
Peden, M., et al., (Editors) **World report on child injury prevention**. World Health Organization, 2008 http://www.who.int/violence_injury_prevention/child/injury/world_report/en/ This publication provides a global perspective on child injury. Chapter 6 relates to poisoning. It covers epidemiology and mortality, types of poison, risk factors and preventive measures. The preventive strategies of proven effectiveness are listed as: removing the toxic agent, legislating for (and enforcing) child-resistant packaging of medicines and poisons, packaging drugs in non-lethal quantities and establishing poison control centres.
MacKay, M. et al., **Child Safety Good Practice Guide: Good investments in unintentional child injury prevention and safety promotion**. Amsterdam: European Child Safety Alliance, EuroSafe, 2006. http://www.eurosafe.eu.com/csi/eurosafe2006.nsf/wwwVwContent/l3publicationsresources.htm This European Child Safety Alliance publication (a programme of the European Association for Injury Prevention and Safety Promotion (EuroSafe)) is a "Good practice guide" which aims to "combine the best available research evidence with the practical expertise of professionals in the 'real world'". Page 18 summarises good practice for poisoning prevention in children, while page 68 reviews a study on Child Resistant Packaging for Chemicals in the Netherlands.
Other Relevant Links – New Zealand Websites
New Zealand National Poisons Centre www.poisons.co.nz Provided by the Ministry of Health and ACC, the NPC maintains an accurate and up-to-date database of almost all poisonous substances in NZ and Australia, and provides professional and timely advice during poisoning incidents.
TOXINZ database www.toxinz.com TOXINZ is an Internet database containing information regarding toxic compounds and the management of poisoned patients. It is designed to meet Australasian requirements and contains over 190,000 listed chemical products, pharmaceuticals, plants and hazardous creatures. It is fully referenced and reviewed by an international editorial board.
SafeKids New Zealand http://www.safekids.org.nz/ Safekids New Zealand is a national child injury prevention service, and a service of Starship Children's Health. It aims to reduce the incidence and severity of unintentional injuries to children in New Zealand aged 0 - 14 years. Its website contains a range of information on child injury prevention relevant to the New Zealand context

Current Evidence for Prevention and Implications for DHBs

General Support

Child Resistant Packaging

Child Resistant Packaging is one mechanism for making medicines and household chemicals less accessible to children. In New Zealand, a range of legislation provides guidance as to which medications and toxins require CRP.

While no Cochrane reviews have considered the effectiveness of CRP in preventing childhood poisoning, a number of other reviews have summarised individual studies on the effectiveness of CRP [14], [7]. In one such review [14] of 3 RCTs and 2 observational studies, the authors found general support for the use of CRP. They cited one UK before and after study where the authors noted a significant fall in salicylate poisoning after the introduction of CRP for children's aspirin and paracetamol preparations in 1976. Similarly they note that in the USA, the Poison Prevention Packaging Act (PPPA) was introduced in 1970 to reduce unintentional childhood poisoning. Since 1970 there has been an extension in the number of substances with safety packaging (including prescription medicines, non-prescription and household products). This has resulted in a significant mortality rate reduction of 45% from levels before child-resistant packaging.

CRP have limitations however. Australian [11], research suggests that a significant proportion of childhood poisonings occur while the substance is in use, therefore necessitating ongoing parental vigilance, even in the presence of CRP. Problems identified include: adults failing to close the CRC properly; an older child opening the container and giving the contents to a younger child; closures that do not continue to function as designed over the period of use;

broken or faulty containers; parents having a false sense of safety, so that they are less vigilant. Further, the current ANZ Standard states that *at least 85% of children will be unable to open the container within 5 minutes*. This means that a significant minority of children will be able to access some medications, even given a properly closed CRP.

Some Support

Home Safety Education Regarding the Secure Storage of Poisons

Kendrick et al's systematic review [5] found that families receiving home safety education were significantly more likely to store medicines and cleaning products safely. The most effect appeared to be where locks were provided in addition to safety education. While there is still insufficient evidence that home safety education (with our without safety equipment) reduces poisoning rates, it is likely that home safety education regarding the safe storage of poisons may result in changes in parental behaviour. Further research may help clarify the actual processes that will ensure more effective reductions in poisoning rates. In addition, as previously noted, a significant proportion of poisonings actually take place while the agent is in use [11] and this also needs to be taken into account in any educational program.

No Longer Supported

While Syrup of Ipecac is mentioned in a number of reviews, it has been determined to be harmful in some cases, so it is no longer recommended (see National Poisons Centre fact sheet: www.poisons.co.nz/fact.php?f=19).

Additional Points for DHBs

In considering childhood poisoning prevention in their areas, DHBs might also like to consider the following:

1. Supporting the ongoing work of the National Poisons Centre www.poisons.co.nz, so that it can continue to provide immediate information that is critical to prompt and appropriate treatment for childhood poisoning.
2. Increasing community knowledge of the frequency, and effects, of poisoning from common medications such as paracetamol in young children, so that both prevention and rapid response to an ingestion are known to be important.
3. Continuing to actively support programmes that promote the use of CRP and/or actively monitor HSNO regulations, whether these are through pharmacies, community programmes, general information processes or home visiting.
4. Ensuring that syrup of ipecac is not longer included in any material on poisoning treatment at home.

Burns and Scalds

Introduction

Burns and scalds are a common cause of injury related hospital admission in preschool age children, with admission rates being highest for those between 1 and 2 years of age [4]. Research suggests that burns and scalds in this age group typically occur in the home environment and are usually caused by common household items, such as kettles, saucepans, taps, hot drinks, irons and heaters [15]. The most common cause in New Zealand is scalds from hot beverages. Common scenarios include adults with hot drinks who are interacting with young children, and when a child pulls containers with hot liquids onto themselves from the bench, table or stove. Children who play in the kitchen during food or drink preparation are also at risk, with the child's small stature and relative mobility making them vulnerable to an adult tripping / the spilling of hot drinks or food. Children's thinner skin also burns at a lower temperature, making them more vulnerable to deeper burns from contact with hot liquids [16]. Burns are also one of the top four causes of mortality for 0-4 year olds in New Zealand [4], with house fires being the major reason for these events.

Circumstances Surrounding Burns and Scalds in Preschool Children

Table 6 uses Haddon's Matrix to consider the attributes of the child, thermal agent, physical and social / policy environment which may contribute to burns or scalds in preschool children.

Relevant New Zealand Legislation and Standards

In New Zealand there is a range of Legislation and Standards relevant to the prevention of burns and scalds in children. The following textbox outlines the key points for each.

Flammability of Clothing

Children's Nightwear and Limited Daywear Having Reduced Fire Hazard (AS/NZS 1249:2003)

This Product Safety Standard aims to ensure that all children's nightwear is either designed to reduce fire danger or is made of fabric that is less likely to burn. All children's nightwear (including some types of daywear) must carry a fire hazard label. The label provides to caregivers information aimed at helping to reduce the risk of death and injury from fire hazards [17].

Product Safety Standards (Children's Nightwear and Limited Daywear Having Reduced Fire Hazard) Regulations 2008 (SR 2008/199)

This regulation, made under Section 29 of Fair Trading Act 1986 stipulates that children's' sleepwear and limited daywear must conform to standard AS/NZS 1249:2003.

Flammability of Upholstery

Furniture – Assessment of the Ignitability of Upholstered Furniture (AS/NZS3744:1998)

Ignitability characteristics of furniture can affect the ignition and spread of fires, especially when the furniture provides initial fuel for the fire (e.g. cigarette butt on couch, chair too close to a heater). This standard specifies the testing and performance requirements for the ignitability of upholstered furniture based on different ignition sources.

Upholstery Materials for Domestic Furniture – Smouldering Ignitability (AS/NZS 4088.1:1996)

This standard specifies testing and performance requirements for upholstery materials for domestic furniture use. While generally indicative of the likely ignitability characteristics of furniture items made from tested materials, variable outcomes may arise from different production methods and designs.

Smoke Alarms

Fire Detection and Alarm Systems in Buildings (NZS 4512:2003)

This Standard specifies the requirements for fire detection and alarm systems in specified buildings. It covers their design, installation, extension, modification, commissioning, testing and maintenance.

Interconnected Smoke Alarms for Single Household Units (NZS 4514:2002)
This standard sets out the requirements for installation and commissioning of externally powered interconnected smoke alarms. It also provides information on the selection, installation and maintenance of smoke alarms.

Cigarette Lighters

The Product Safety Standards (Cigarette Lighters) Regulations
This regulation, made under Section 29 of Fair Trading Act 1986, stipulates that cheap or disposable lighters must conform to various standards.

Cigarette Lighters – Child Resistance Requirements (AS/NZS 4867.2:2002)
This specifies the testing and performance requirements to ensure that cigarette lighters are not useable by children. It stipulates that such lighters must not be ignitable by 85% of children in a test panel, and that the child resistant mechanism resets after every ignition.

NZ Building Act (2004) and Associated Compliance Documents and Standards

Electricity Act (1992) and Gas Act (1992)
This Act makes provision for the regulation, supply, and use of gas and the gas industry in New Zealand and repeals the Gas Act 1982. It regulates the provision of electricity and gas, details the certification of electricians and gasfitters, and enables regulation of standards for associated appliances. http://www.energysafety.govt.nz/ acts as a portal for specific information.

Hot Water Temperatures

Building Regulations 1992 (SR 1992/150) (as at 01 February 2009)
"**G12.3.6** states "If hot water is provided to *sanitary fixtures* and *sanitary appliances* used for personal hygiene, it must be delivered at a temperature that avoids the likelihood of scalding."

The code requires all new and modified existing hot water systems to have hot water delivered to personal hygiene fixtures and appliances at a maximum temperature of 45 in early childhood centres, schools and old people's homes and 55 in all other building. It also requires that domestic hot water is stored at a minimum temperature of 60 to prevent the growth of legionella bacteria, recommending that a tempering valve be used to control delivery temperatures. Tempering valves mix hot and cold water to achieve a lower delivery temperature than the storage temperature. For further detail see http://www.dbh.govt.nz/UserFiles/File/Publications/Building/Compliance-documents/G12-Water-Supplies-30-sept-2010.pdf

Education (Early Childhood Centres) Regulations 1998 (SR 1998/85) (as at 01 December 2008)
Schedule 2 (Sanitary facilities required) Clause 3 (Hand-washing facilities):
(4) The centre must have a means, with an adjustable thermostat, of providing an adequate supply of hot water to the hand basins.
(5) The temperature of the water at hand basins accessible to the children must be effectively controlled so as not to be higher than 40° Celsius at the outlet.
(6) Notwithstanding sub clause (5), where a hot water cylinder is used as a means of providing hot water, the water in it must at all times when the centre is open be kept at a temperature of at least 60° Celsius. See http://legislation.govt.nz/regulation/public/1998/0085/latest/DLM248108.html

Current Evidence for Prevention and Implications for DHBs

Table 7 provides an overview of systematic and other reviews relevant to the prevention of burns and scalds in preschool age children. These reviews suggest that a range of measures may be effective in preventing burns and scalds, but that each approach has its strengths and limitations. The following section considers these measures, under the subheadings *of General Support, Some Support and Insufficient Evidence*.

Table 6. Haddon's Matrix Describing Circumstances Surrounding Burns and Scalds in Preschool Aged Children (Source information [9][15])

	Child	Agent	Physical Environment	Social Environment
Pre-event	Age and developmental stage (e.g. judgement, curiosity, comprehension of hazards and dangers of hot water and heat not developed) Being a boy Thin skin Large body surface area to mass ratio Motor control and balance may be unstable Child can play with matches and lighters	Hot water cylinder temperature set above 50^0c Hot drinks or foods in reach of children Containers that are easy to tip over. Storage of flammable substances in house Combustibles, Matches or lighters accessible to children Unsafe stoves or lamps	Hot drinks/food on tables/floor within reach of child or being held by adult with baby Bench with hot drinks or food in reach of child Pot handles on stove within grasp of child Electrical cords for jugs/kettles in reach of child Renovations occurring so normal safety precautions not in place No separation between cooking / child's play area Household materials (curtains/furnishings) not flame-retardant No power in house so using candles Matches /cigarette lighters accessible Adults leave cigarettes burning unattended near furnishings Lack of compliance with Smoke Alarms, Sprinkler Standards Lack of accessible escape routes	Lack of knowledge about children's vulnerability to heat Adult inattention to placement of hot beverages and other thermal hazards in kitchen / living areas Type of smoke alarm not suitable for situation (e.g. responds to steam but is near kitchen) Adult not attending to cooking on stove (eg. fat in frying pan) Adult alcohol misuse while attempting to cook (house fires)
Event	Wearing/not wearing flame-retardant clothing Overcome by smoke so unable to move	Hot substances accessible to child Toxicity of smoke and burning materials	Hot substances in close proximity to children Lack of fire extinguishers or sprinkler systems	Slow response to child's distress
Post-event	Delay in cooling due to parent panic Child upset by rapid cooling so not maintained long enough Child not able to get out of house	Clothing, or its residue, adheres to skin increasing effects of heat Toxicity of smoke and burning household materials	Lack of access to water Lack of first-aid kits	Inadequate first aid knowledge Inability to transport to medical care Inadequate access to burn centres and rehabilitation Insufficient community support for burns victims

Table 7. Systematic and Other Reviews Relevant to the Prevention of Burns and Scalds in Preschool Age Children

Systematic Reviews of Burns and Scalds Prevention Studies in Children
Kendrick,, et al., **Home safety education and provision of safety equipment for injury prevention**. Cochrane Database of Systematic Reviews, 2007(1): CD005014. This review considered the effect of home safety education and provision of safety equipment on a variety of interventions to reduce childhood injuries. In total 80 studies were included, 48 of which reported on outcomes related to thermal injury prevention. Of the 27 studies which were included in at least one meta-analysis 20 were RCTs, 3 were non-RCTs, and 4 were controlled before-and-after studies. Individual participant data were obtained from 11 studies. There was evidence that home education was effective in increasing the numbers of families reporting that they: 1. Had a safe hot water temperature. (11 studies, OR 1.34, 95% CI 1.00 to 1.80) 2. Had a functioning smoke alarm (13 studies, OR 1.85, 95% CI 1.24 to 2.75). 3. Had a smoke alarm (12 studies, OR 1.26, 95% CI 0.99 to 1.60) 4. Used a fire guard (4 studies, OR 1.40, 95% CI 1.00 to 1.95). There was a lack of evidence that home education was effective in increasing the numbers of families reporting they: 1. Kept hot drinks out of the reach of children (4 studies, OR 0.88 95% CI 0.66 to 1.18) 2. Stored matches out of reach (5 studies, OR 1.23, 95% CI 0.56 to 2.68). 3. Possessed a fire extinguisher (4 studies, OR 0.95, 95% CI 0.40 to 2.23). There was a lack of evidence that home safety education with or without the provision of safety equipment reduced thermal injuries (3 studies, IRR 1.12, 95% CI 0.81 to 1.56).
Turner, C., et al., **Community-based interventions for the prevention of burns and scalds in children**. Cochrane Database of Systematic Reviews, 2004(3): CD004335. The authors of this review considered 4 studies (controlled community trials). They found that “Two of the included studies reported a significant decrease in paediatric burn and scald injury in the intervention compared with the control communities. The failure of the other two studies to show a positive result may have been due to limited time-frame for the intervention and/or failure to adequately implement the counter-measures in the communities.” They reported that the 2 studies that did not show that the community based intervention was effective were the 2 which had “sound methodology with contemporary comparison communities” whereas the 2 studies which did report a reduction in burns in young children “need to be considered in the context of the specific methods used.” They consider that future research needs to be directed towards producing high quality evidence to guide the provision of community interventions for child injury prevention and that any future intervention programs should be based on interventions that have been shown to be effective in research settings and be subject to careful evaluation.
Towner, E., et al., **What Works in Preventing Unintentional Injuries in Children and Young Adolescents**. 2001, Health Development Agency. www.nice.org.uk/niceMedia/documents/prevent_injuries.pdf Pages 64-70 of this publication cover the prevention of burns and scalds. Sixteen studies are reviewed including seven in which there was random allocation to intervention and control groups (although randomisation was sometimes at the group, rather than at the individual level). Three of the studies included non-random comparison groups and the remaining six studies used a before and after design. The characteristics of the studies are presented in table form. The authors provide the following summary of the evidence: • Educational campaigns have been partially effective in increasing knowledge of burn and scald prevention. • There is little evidence that educational approaches alone have achieved reductions in burn and scald injuries. • There is some evidence that smoke alarm giveaway programmes can achieve reductions in fire injuries. • There is little evidence that campaigns involving the distribution of devices to control hot water temperatures are an effective means of reducing water temperatures. Pages 71-72 cover legislation and regulation relating to burn prevention. Three studies which examined the effects of legislation or regulations relating to product design on burns and scalds are reviewed, all three of which were focused on the general population. The authors concluded that: “Improved product design has been associated with reductions in specific burn and scald injuries” and that “More evidence is needed of legislation relating to smoke alarms and hot water heaters on burn and scald injuries.”
Warda, L., Tenenbein M, and Moffatt, M. **House fire injury prevention update. Part II. A review of the effectiveness of preventive interventions**. Injury Prevention, 1999. **5**(3): p. 217-25. This review considered 43 publications including seven randomized controlled trials, nine quasiexperiments, two natural experiments, 21 prospective cohort studies, two cross sectional surveys, one case report, and one program evaluation. Most related to various educational programs but 3 related to home inspection programs, 5 to smoke detector give- away programs and 1 to smoke detector legislation. Information on the main features of the studies (grouped in 4 broad outcome categories) is presented in table form. Within the tables studies are grouped by type of intervention and within each group they are ranked according to the level of evidence (RCTs first, ordered by degree of validity, case reports last). Regarding the publications on educational programs the authors reported that “Short term outcome evaluation and lack of rigorous evaluation limit the majority of these studies.” Only 4 studies reported on fire related morbidity and mortality and none of these were RCTs. The authors concluded “There is a need for more rigorous evaluation of educational programs, particularly those targeted at schools. An evidence based, coordinated approach to house fire injury prevention is critical, given financial constraints and potential for program overload for communities and schools.”

DiGuiseppi, C., C. Goss, and J. Higgins, **Interventions for promoting smoke alarm ownership and function**. Cochrane Database of Systematic Reviews, 2001(2); CD002246.

Based on a review of 26 trials, 13 of which were RCTs the authors of this review concluded that "Counselling as part of child health surveillance may increase smoke alarm ownership (OR=1.96; 1.03 to 3.72) and function (OR=1.72; 0.78 to 3.80), but its effects on injuries are unevaluated. Community smoke alarm give-away programmes apparently reduce fire-related injuries, but these trials were not randomised and results must be interpreted cautiously. Further efforts to promote smoke alarms in primary care or through give-away programmes should be evaluated by adequately designed randomised controlled trials measuring injury outcomes."

Individual Randomised Trials of Burns and Scalds Prevention in Children

Thomas, A., Hassanien, R., Christophersen, E., **Evaluation of Group Well-Child Care for Improving Burn Prevention Practices in the Home**, Pediatrics, 1984. 74;879-882

In this study, 58 couples were randomly assigned to a control group and an experimental group. Both groups received a single 90 minute well child group class which provided information and discussion on nutrition, dental care, safety in the car and home, child development, child rearing, illness management, and immunizations. In addition, the experimental group also received specific burn prevention information regarding hot water heater settings and smoke detectors. On a follow-up home visit, 65% of the couples in the experimental group had their hot water temperature measured at 54.4 degrees C (130 degrees F) or less, whereas all of the couples in the control group had hot water temperatures of more than 54.4 degrees C (130 degrees F) (a significant difference). Only one couple in the experimental group did not have an operational smoke detector but enough of the couples in the control group had operational smoke detectors that difference between the groups was not significant.

Other Reviews, Programs and Campaigns

Peden, M., et al., Editors **World report on child injury prevention**. World Health Organization, 2008
http://www.who.int/violence_injury_prevention/child/injury/world_report/en/

This publication provides a global perspective on child injury. Chapter 4 relates to burns. It covers the classification and epidemiology of burns in children and the risk factors. It discusses interventions for prevention and treatment and it provides recommendations for interventions and further research. The strategies listed as being of proven effectiveness in burn prevention are listed as:

- Setting (and enforcing) laws on smoke alarms
- Developing a standard for child-resistant lighters
- Setting (and enforcing) laws on hot-water tap temperature and educating the public
- Treating patients at dedicated burns centres

The strategies listed as being promising are:

- Separating cooking areas from living areas
- Developing standards and codes for fire-retardant garments
- Banning the manufacture and sale of fireworks
- Promoting the use of safe lamps and stoves
- Providing first-aid for scalds – "cool the burn"

MacKay, M. et al., **Child Safety Good Practice Guide: Good investments in unintentional child injury prevention and safety promotion**. Amsterdam: European Child Safety Alliance, EuroSafe, 2006.

http://www.eurosafe.eu.com/csi/eurosafe2006.nsf/wwwVwContent/l3publicationsresources.htm

This publication from The European Child Safety Alliance (a programme of the European Association for Injury Prevention and Safety Promotion – EuroSafe) is a "Good practice guide" which aims to "combine the best available research evidence with the practical expertise of professionals in the 'real world'". Page 16 contains a summary table setting out Good practice for burn and scald prevention in children.

Han, R., Ungar, W., Macarthur, C. **Cost-effectiveness analysis of a proposed public health legislative/educational strategy to reduce tap water scald injuries in children**. Injury Prevention, 2007. 13: p. 248-253.

This Canadian analysis was conducted from a government perspective over a 10 year time horizon. It aimed to determine the cost effectiveness of proposed legislation to set thermostat settings on new domestic water heaters to lower temperatures (maximum 49°C) plus annual educational notices to utility customers versus the status quo. The analysis estimated the cost of the intervention to be $C51 000 (the cost of The cost of printing and distributing annual notices to utility customers in Ontario as the legislation itself was considered to have zero cost), with a projected 56% reduction in tap water scald injuries. Over 10 years, the intervention group was expected to show total costs of $C1.17 million and 704 scalds, compared with $C1.65 million and 1599 scalds in the status quo group. The authors concluded that the intervention would be cost saving and reduce morbidity from tap water scalds with an incremental ratio of $C531 saved per scald averted.

Smith, L., Greene, M., and Singh, H. **Study of the effectiveness of the US safety standard for child resistant cigarette lighters**. Injury Prevention, 2002. 8: p. 192-196.

This study compared fire data on children playing with lighters which was solicited from solicited from selected US fire departments for incidents occurring from 1997–99, compared with similar data from 1985–87 in order to evaluate the effectiveness of the US Consumer Product Safety Commission's (CPSC) Safety Standard for Cigarette Lighters, which applies to products manufactured or imported after 12 July 1994 and requires that disposable cigarette lighters be resistant to operation by children younger than age 5.

In the post-standard study period, 48% of the cigarette lighter fires were started by children aged younger than 5 years, compared with 71% in the period before the introduction of the standard. The odds ratio of 0.42 was statistically significant ($p<0.01$). The authors sate that "This represented a 58% reduction in fires caused by the younger age group compared to the older age group. When applied to national fire loss data, an estimated 3300 fires, 100 deaths, 660 injuries, and $52.5 million in property loss were prevented by the standard in 1998, totalling $566.8 million in 1998 societal savings." The authors concluded that "The CPSC standard requiring child resistant cigarette lighters has reduced fire deaths, injuries, and property loss caused by children playing with cigarette lighters and can be expected to prevent additional fire losses in subsequent years".

Other Publications and Websites New Zealand

Duncanson M, Woodward A, Reid P. **Social and economic deprivation and fatal unintentional domestic fire incidents in New Zealand 1988 – 1998**. 2000. New Zealand Fire Service Commission Research Report Number 5.

This report reviewed the international literature on the relationship between socioeconomic circumstances and risk of death or injury in fire events. Analysis was also undertaken of New Zealand fire fatality data from July 1988 to June 1998. The review found that the international literature suggested that more socioeconomically deprived households generally experienced higher rates of fatal fire incidents. In New Zealand rates of fatal fires in the most deprived areas were 4.5 times the rates in the least deprived areas. The authors concluded that strategies to address this differential risk for fire related mortality need to identify and take into account barriers to household fire safety in these vulnerable population groups. In the longer term, addressing the underlying socio-economic determinants through strategic policy development was also seen as being important.

Duncanson M, Ormsby C, Reid P, Langley J, Woodward A. **Fire Incidents Resulting in Deaths of New Zealand Children aged Under 15 Years 1991-1997**. New Zealand Fire Service Commission Research Report Number 30.

This study collated fire fatality data from the Fire Incident Recording System and the NZ Health Information Service and linked with coroners files to provide an overview of fire related deaths in children <15 years in New Zealand. The study found higher risk for males, particularly Maori, with the most common heat sources in fatalities among children being lighters and matches. A significant risk factor identified was children visiting an unfamiliar house or where there were visitors to the family home. Operating smoke detectors were not present in nearly every incident involving fatalities.

SafeKids New Zealand http://www.safekids.org.nz/

Safekids New Zealand is a national child injury prevention service, and a service of Starship Children's Health. It aims to reduce the incidence and severity of unintentional injuries to children in New Zealand aged 0 - 14 years. Its website contains a range of information on child injury prevention relevant to the New Zealand context

Current Evidence for Prevention and Implications for DHBs

General Support

Lowering Hot-Water Tap Temperature

Research suggests that the exposure time required to produce a deep second-degree burn varies directly with water temperature. At 44 degrees, an exposure time of 6 hours is required for a significant thermal injury, whereas at 70 degrees, less than one second is required. Between 44 and 51 degrees, the rate at which burning occurs is almost doubled with each degree rise in temperature [18], and thus lowering tap hot-water temperatures to 49 degrees is likely to result in significant reductions in burns, as burn time at this temperature is 5-10 minutes [19].

In reducing hot-water temperatures two approaches are possible:

Legislation: In many countries, law requires hot water to be delivered at a temperature which minimizes the risk of thermal injury. Such legislation may specify that all new hot water cylinders are preset at a certain temperature (e.g. 49 degrees) [20], or if higher storage temperatures are required (e.g. to prevent legionella), that a tempering valve (which mixes hot and cold water to achieve lower delivery temperatures) is used.

Support for legislative approaches comes from a small number of studies. In the USA, a 1983 Washington State law required all new water heaters to be preset to 49 degrees. Prior to this law, 80% of homes had tap water temperatures above 54 degrees, whereas 5 years after this law was enacted, 77% of homes had tap water below this temperature, with few people increasing temperatures after cylinder instillation. Further, hospitalizations for burns decreased from 5.5 per year in the 1970s, to 2.4 per year after the law came into place, with the total body surface area burned, morality, requirement for grafting, scarring and length of hospital stay all being reduced [20].

Barriers to compliance with legislation may occur however, with one New Zealand study finding that issues such as hot water systems heated by solid fuel, and public ignorance of hot tap water safety may have reduced the effectiveness of legislation. Other factors included a lack of knowledge by plumbers of the hazards of hot tap water, as well as a lack of importance given to hot tap water safety in their plumbing practice. Shower performance and the threat to health posed by legionella were prioritized over the prevention of hot tap water scalds [21].

Safety Education and the Provision of Safety Devices: While legislation may address hot water temperatures in new homes, safety education and the provision of safety devices (e.g. thermometers, thermostatic mixing valves) may also be required for those living in older homes, existing hot water systems which do not comply with building codes, or where hot water temperatures may have been increased after instillation of the cylinder.

In a review (4 eligible studies) of home safety education and the provision of safety devices (thermometers, mixing valves), Kendrick et al [5] found that families who received home safety education were somewhat more likely (OR 1.35 95% CI 1.01-1.80) to have safe hot tap water temperatures, but that there was insufficient evidence (i.e. a lack of high quality studies) to determine whether such education actually decreased the risk of burns.

In general, because of the variable success of educational interventions to encourage households to test and reduce their hot water temperatures, it is felt that a combination of education and legislation is the most effective mix [19].

Fire Retardant Clothing

Since the 1970s, a number of countries have enforced flammability standards to protect children from death and serious burns resulting from the ignition of their sleepwear by small open-flame sources. The safety requirements include performance tests requiring that sleepwear self-extinguish after being exposed for specified periods to a small open-flame ignition source. Such standards are intended to address the risk of burn injury from a relatively brief contact between sleepwear and an ignition source (e.g. children playing with matches or lighters). They were not intended to address injuries from large fires, such as whole house or bedding fires [22]. In the United States, children's bedclothes are regulated by the United States Product Safety Commission [23]. Certain types and sizes of clothes need to pass a flammability test or else be tight-fitting, so as to reduce the risk of burns. In addition, many countries require that bedding, mattresses and upholstered furniture be fire retardant [9]. Similar legislation in the New Zealand context is outlined in the text box above.

Some Support

Child-Resistant Lighters

There is evidence that child resistant lighters may reduce cigarette lighter fires started by young children. In one US study which evaluated the US Consumer Product Commissions Safety Standard for Cigarette Lighters, which required that disposable cigarette lighters be resistant to operation by children <5 years, a 58% reduction in fires caused by children <5 years was found compared to fires caused by older children (prior to the standard, 71% of cigarette lighter fires were started by children <5 years, whereas after the standard was in place, only 48% of cigarette lighter fires were started by this age group [24]).

Smoke Detectors

In a systematic review of interventions to promote smoke detector ownership DiGuiseppi et al [25] reviewed 26 trials, of which 17 were randomised. Overall, counselling and educational interventions (with or without free or discounted smoke alarms), modestly increased alarm ownership (OR = 1.36; 95% CI 0.92 to 2.00) or having an installed, functional alarm (OR = 1.29; 95% CI 1.04 to 1.58). Whether or not the intervention programme provided free or discounted smoke alarms (in addition to education) did not influence these results. Injury outcomes were reported in only one randomised trial, which found no effect of an alarm give-away programme on injuries or on hospitalizations and deaths, in contrast to a substantial reduction in serious injuries reported in a non-randomised trial that evaluated a similar programme. Neither trial showed a beneficial effect on fires. Mass media and community education showed little benefit in multiple non-randomised trials. Two trials showed that smoke alarm installation programmes increase the likelihood of having a working smoke alarm, and the non-randomised trial reported reductions in fire-related injuries. The authors concluded that programmes to promote smoke alarms have at most a modest beneficial effect on smoke alarm ownership and function, and no demonstrated beneficial effect on fires or fire-related injuries, and that further research was required to determine the effectiveness of community smoke alarm instillation programs.

Insufficient Evidence

Parental Education About Keeping Hot Drinks and Food out of Reach of Children

Kendrick et al [5], in a review of 4 studies which provided home safety education regarding keeping hot food and drinks away from children found that families with such safety education were not significantly more likely to keep hot food and drinks away from children (OR 0.88 95% CI 0.66-1.18) than control group families.

Additional Points for DHBs

In considering childhood burns and scalds prevention in their areas, DHBs might also like to consider the following:

1. Working with local authorities, fire service and other relevant organisations to address the specific issues associated with poor housing (particularly rental) that increase the risk of house fires, for example, lack of electrical power, construction materials, modifications, installation of good smoke detectors that facilitate use (e.g. do not go off when only steam is present)
2. Working with local authorities and local house owners of rental properties to reduce the temperature of hot water from the tap to increase safety, without resulting in systems incapable of providing adequate showers for families in low rental accommodation.
3. Working with plumbing manufacturers and importers to foster the development and use of systems able to provide adequate hot water systems in older housing without high cost, and without compromising safety or adequate showers.

Drowning

Introduction

While being a relatively infrequent cause of hospital admission, drowning is the fourth leading cause of injury related mortality in children aged 0-14 years, with an average of 14 New Zealand children per year dying as the result of a drowning (see previous section). During infancy, the most common site for drowning is the bath, with nine New Zealand infants aged 1-12 months drowning in a bathtub between 2002-2007 (the most common reason for leaving the infant unattended in the bath was to answer the phone [26]. For preschoolers (0-4 years), 34% of those drowning between 2003-2007 drowned in a private pool, 24% in the bath, and 9% in a bucket or other low volume water [26].

Circumstances Surrounding Home Based Drowning Events in Preschool Aged Children
Table 8 uses Haddon's Matrix to consider the attributes of the child, water body, physical and social / policy environment which may contribute to drowning in preschool age children.

Table 8. Haddon's Matrix Describing Circumstances Surrounding Home Based Drowning Events in Preschool Aged Children [9, 27]

	Child	Agent / Physical Environment	Social / Policy Environment
Pre-event	Age and developmental stage (e.g. judgement, curiosity, physical strength) Gender Underlying medical condition (e.g. epilepsy)	Unfenced swimming pool Presence of pool cover Fence in poor repair / Gate catches broken Objects next to fence permitting climbing / propping open gate Direct access to swimming pool from house without a self closing door Buckets used without secure lids Use of bath seats giving false assurance to parents	Lack of supervision Reliance on peer / older child supervision Failure to comply with fencing requirements or protect hazards Lack of water safety awareness in community Bodies of water kept around property, e.g. old tubs, tanks, buckets, or access to creeks not fenced off
Event	Parent's overestimation of swimming ability Lack of physical strength Lack of comprehension of situation	No constant adult supervision in bath No constant adult supervision by swimming popol Child has access to body of water (eg old tub, tank in garden) Poor visibility of hazards from house	No supervisor Distraction of caregiver
Post-event		Poor visibility delaying child being found (e.g. pool cover, trees, reduced visibility from house) No or inaccessible First-Aid Kits / resuscitation equipment	Inadequate rescue and treatment skills Inadequate transport to medical care Poor access to acute care and rehabilitation services

Source of Information: [26] [9]

Relevant New Zealand Legislation and Standards

In New Zealand a range of Legislation and Standards is relevant to the prevention of drowning in children. The following textbox outlines the key points for each.

Legislation and Standards Relevant to the Prevention of Poisoning in Children

Fencing of Swimming Pools Act 1987 (FSPA 1987)

The FSPA 1987 was enacted to promote the safety of young children by requiring certain swimming pools to be fenced. The Act requires that pools with a depth greater than 400mm, whether temporary or permanent, have a fence surrounding them. The fence must not be able to be climbed, and have self-closing, self-latching gates, and must be compliant with requirements of the building code in force under the Building Act 2004. The minimum height of a swimming or spa pool fence is 1.2m above ground level. Gates or hinged doors must comply with regulations and be fitted with a self-closing device capable of closing and operating the latching device from an opening distance as small as 150mm. Where the latch is on the pool side of the fence it must be accessible only from over the top of the fence or through a hole at least 1.2m above the ground. If outside the pool area, it must be at least 1.5m above the ground and the gate must always open away from the pool

Pool owners are required to advise their territorial authority of the existence of a pool, or of their intention to install a pool. Territorial authorities are then required to take all reasonable steps to ensure that the FSPA 1987 is complied with within its district.

Building Act 2004

The Building Act 2004 applies to the construction of new pools, any alterations made to existing pools, and the nature of the fencing that is required.

A territorial authority may not pass a bylaw that would have the effect of allowing a pool subject to the FSPA 1987 to provide less protection against young children gaining access to the pool than the performance standard set by the building code, under force in the Building Act, or to make pool fencing more restrictive those specified in this Act.

Current Evidence for Prevention and Implications for DHBs

Table 9 provides an overview of systematic and other reviews relevant to the prevention of drowning in preschool age children. These reviews suggest that a range of measures may be effective in preventing drowning events, but that each approach has its strengths and limitations. The following section considers these measures, under the subheadings *of General Support, Some Support and Insufficient Evidence*.

Table 9. Publications Relevant to the Prevention of Drowning in Preschool Age Children

Systematic Reviews of Drowning Studies in Children
Thompson, D. and Rivara, F. **Pool fencing for preventing drowning in children**. Cochrane Database of Systematic Reviews, 1998 (1): CD001047 Pool fencing is a passive environmental intervention in place to reduce unintended access to swimming pools, thus preventing drowning in preschool aged children. This review evaluated the effect of such pool fencing in children under the age of 14 years. Three case control studies were included in the review – two from Australia and one New Zealand study. The studies showed that the risk of drowning or near-drowning was significantly reduced with any pool fencing. Isolation fencing (enclosing the pool only), was superior to perimeter fencing (enclosing the property and pool). Isolation fencing was also associated with a lower risk of drowning compared to three sided fencing (three sides of a fence and a building wall with restricted access to the pool via a house door) with an OR of 0.17 (95% CI 0.07 to 0.44). The authors conclude that pool fences should have a dynamic and secure gate and ought to isolate the pool from the house.
Kendrick, D., et al. **Home safety education and provision of safety equipment for injury prevention**. Cochrane Database of Systematic Reviews, 2007(1): CD005014. In industrialised countries, injuries are the leading cause of childhood mortality, with steep social gradients in child injury mortality and morbidity. For pre-school children, the majority of injuries occur at home. Given that there is little meta-analytic evidence about child home safety interventions, this review evaluated the effectiveness of home safety education and discounted or free equipment in increasing home safety practices or reducing child injury rates. The authors also examined whether any effects varied by social group. Eighty studies were included in the review. Home safety education was found to be effective in increasing a number of injury prevention measures around the home. However, only three studies examined the practice of not leaving children alone in the bath. These studies did not show home safety education was effective in preventing children being left alone in the bath.

Individual Studies of Drowning in New Zealand Children
Morrison, L., et al. **Achieving compliance with pool fencing legislation in New Zealand: A survey of regulatory authorities**. Injury Prevention, 1999 (5): 114-8. New Zealand has legislation requiring pools over a certain depth to be fenced, through the Fencing of Swimming Pools Act 1987. Territorial authorities are responsible for enforcement of the Act. This study was undertaken to identify the status of compliance and enforcement of the Act 10 years after its introduction. A postal questionnaire was sent to all 74 territorial authorities in NZ, asking about their enforcement of the Act. Some telephone interviews were also undertaken. The authorities reported that only 44% of pools complied with the Act. Nineteen percent of pools were reported non-compliant, and compliance was unknown for 33%. Few (9%) of authorities had procedures for locating and inspecting pools, and only 28% had a programme of re-inspection to ensure ongoing compliance. The authors conclude that due to ambiguity in the legislation, enforcement of the Act is inconsistent, with incomplete compliance and that legislation needs to be enforced to be effective.
Gulliver P, Cousins K, and Chalmers, D. (2009). **Achieving compliance with pool fencing legislation in New Zealand: how much progress has been made in tens years?** International Journal of Injury Control & Safety Promotion, *16*(3), 127-132. This study assessed levels of enforcement and compliance with the Fencing of Swimming Pools Act 1987, to determine if enforcement and compliance had changed since 1997. A postal questionnaire was sent to all territorial authorities. The study found a 9% increase in domestic swimming pools in New Zealand (46 pools/1000 dwellings in 1997 to 50 pools/1000 dwellings in 2006) and a 65% increase in the proportion complying with the Act. The % of authorities reporting a programme of re-inspection for swimming pools increased from 28% in 1997 to 63% in 2006. There was also an increase in the proportion of swimming pools recorded as complying with the Act. Finally, a considerable improvement in the enforcement and monitoring activities of territorial authorities was found.
Other Reviews Programs and Campaigns
Peden, M., et al., Editors **World report on child injury prevention**. World Health Organization, 2008 http://www.who.int/violence_injury_prevention/child/injury/world_report/en/ This publication provides a global perspective on child injury. Chapter 3 relates to drowning. It covers the epidemiology of drowning in children and the risk factors. It discusses interventions for prevention and it provides recommendations for interventions and further research. Potential strategies in drowning prevention are listed as: • Eliminating Hazards • Pool Fencing and Enforcement • Personal Flotation Devices (e.g. life jackets in boats) • Parental and Lifeguard Supervision
MacKay, M. et al., **Child Safety Good Practice Guide: Good investments in unintentional child injury prevention and safety promotion**. Amsterdam: European Child Safety Alliance, EuroSafe, 2006. http://www.eurosafe.eu.com/csi/eurosafe2006.nsf/wwwVwContent/l3publicationsresources.htm This publication from The European Child Safety Alliance (a programme of the European Association for Injury Prevention and Safety Promotion – EuroSafe) is a “Good practice guide” which aims to “combine the best available research evidence with the practical expertise of professionals in the ‘real world’”. Pages 13-14 provide a summary table of Good practice for child water safety and there are summaries of 3 studies • Pool Safety, France (p58) • Drowning Prevention, Iceland (p60) • Drowning Prevention Campaign, Greece (p63)
SafeKids New Zealand http://www.safekids.org.nz/ Safekids New Zealand is a national child injury prevention service, and a service of Starship Children's Health. It aims to reduce the incidence and severity of unintentional injuries to children in New Zealand aged 0 - 14 years. Its website contains a range of information on child injury prevention relevant to the New Zealand context

Current Evidence for Prevention and Implications for DHBs

General Support

Pool Fencing

Pool fencing is a passive environmental intervention designed to reduce children’s unintended access to swimming pools, and thus prevent drowning in the preschool age group. A systematic review by Thompson and Rivara [28] considered three case controls studies which evaluated the effectiveness of pool fencing in preventing drowning or near drowning. The authors found that pool fencing significantly reduced the risk of drowning or near drowning, with risk of in a fenced pool vs. an unfenced pool being 0.27 (95% CI 0.16 to 0.47). Isolation fencing (enclosing pool only) was superior to perimeter fencing (enclosing property and pool);

the OR for the risk of drowning in a pool with isolation fencing compared to a pool with three-sided fencing was 0.17 (95% CI 0.07 to 0.44). The authors recommended that pool fences should have a dynamic and secure gate and should isolate the pool from the house (i.e. four-sided fencing). Further, that legislation should require isolation fencing with secure, self-latching gates for all pools, public, semi-public and private, and should require fencing of both newly constructed and existing pools and include enforcement provision.

In New Zealand the Fencing of Swimming Pools Act 1987 provides a means to prevent children from drowning, but evidence [26] suggests that a low level of compliance by the swimming pool owners may be compromising its effectiveness. In a review of 17 private swimming pool related drowning in New Zealand children during 2002-2008, the Child and Youth Mortality Review Committee noted that in 70% of cases the pool fence did not comply with the Act (a number of these fences had been compliant with the Act but had subsequently deteriorated or been modified). In 59% of cases, the child had accessed the pool via the gate, with the majority of gates being non compliant with the Act (e.g. gate spring and latch failure, mechanical blockage of gate, faulty catches). In 18% of cases, the child was able to climb over the fence (using chairs, toys or footholds in the fence) [26].

Thus legislation alone is not sufficient to ensure the safety of children. Legislation must be enforced to be effective or compliance is incomplete.

Potentially Harmful Interventions

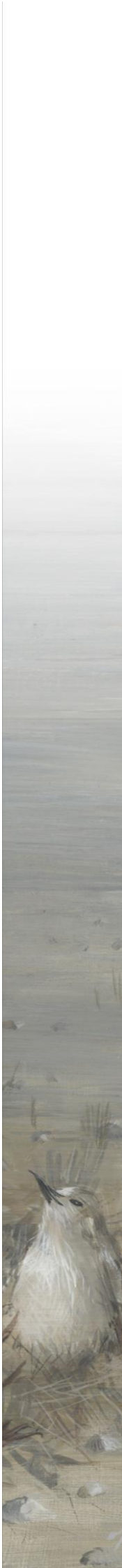
Baby Bath Seats

Bath seats have been investigated to determine if they are associated with an increased risk of drowning, While no studies have been able to prove that bath seats are a risk factor, they do appear to increase the likelihood of an infant being left alone in the tub ([29, 30]).

Additional Points for DHBs

In considering childhood drowning prevention in their areas, DHBs might also like to consider the following:

1. Actively supporting community initiatives to maintain or strengthen swimming pool fencing regulations, and where necessary direct attention if this intervention is at all under threat from individual citizens.
2. Supporting community programmes, parenting and community campaigns that reinforce messages about safety near water in the home environment, especially the constant, active, and focused supervision of young children by responsible adults. Also developing strategies that ensure this supervision is fostered in families and whānau especially when there are family gatherings or hui.



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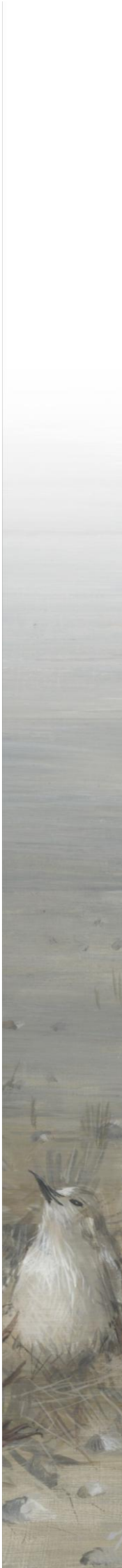

Appendix 1: The National Minimum Dataset

Mode of Data Collection

The National Minimum Dataset (NMDS) is New Zealand's national hospital discharge data collection and is maintained by the New Zealand Health Information Service (NZHIS). The information contained in the dataset has been submitted by public hospitals in a pre-agreed electronic format since 1993. Private hospital discharges for publicly funded events (e.g. births, geriatric care) have been submitted since 1997. The original NMDS was implemented in 1993, with public hospital information back loaded to 1988 [31]. Information contained in the NMDS includes principal and additional diagnoses, procedures, external causes of injury, length of stay and sub-specialty code and demographic information such as age, ethnicity and usual area of residence.

Dataset Quality and Changes in Coding Over Time

There are a number of key issues which must be taken into account when interpreting information from the NMDS. Many of these issues arise as a result of regional differences in the way in which data is coded and uploaded to the NMDS. These include

1. Inconsistencies in the way in which different providers upload day cases to the NMDS, and how this has changed over time.
2. The changeover from the ICD-9 to ICD-10 coding system, and irregularities in the way in which diagnoses and procedures are allocated ICD codes.
3. Changes in the way in which ethnicity information has been collected over time and across regions.

The following sections discuss the first two if these issues.

1. Inconsistencies in the Uploading of Day-Cases to the NMDS

One of the key issues with time series analysis using hospital discharge data is the variability with which different providers upload day cases to the NMDS. Day cases are defined as cases that are admitted and discharged on the same day, with the "three hour rule" (treatment time >3 hours) traditionally being utilised to define an admission event. In contrast patients who spend at least one (mid)night in hospital are classified as inpatients irrespective of their length of stay [32].

In the past, there have been significant regional variations in the way in which different providers have uploaded their day cases to the NMDS, leading to problems with both time series analysis and regional comparisons. These inconsistencies have included

1. During the mid 1990's, a number of providers began to include A&E events as day cases if the total time in the Emergency Department (including waiting time) exceeded 3 hours, rather than uploading only those whose actual treatment time exceeded 3 hours [32]. NZHIS provided feedback which rectified this anomaly and since January 1995 the correct procedure has been used (these additional cases were coded using medical and surgical sub-specialty codes and are thus difficult to filter out using traditional Emergency sub-specialty filters).
2. Over time, a number of providers have become more efficient at recording the time of first treatment within the Emergency Department (rather than time of attendance) and thus during the late 1990s and early 2000s have become more efficient in identifying emergency department cases which meet the 3-hour treatment rule and are thus eligible to be uploaded to the NMDS. This has resulted in a large number of additional cases being uploaded to the NMDS, particularly in the upper North Island.
3. In addition, some providers admit cases to their short stay observation units while other providers do not, leading to regional variations in the appearance of day cases in the NMDS [33].

Previous Attempts to Address Inconsistent Uploading at the Analytical Stage

When producing their annual Hospital Throughput reports, the Ministry of Health has adopted the following filter to ensure regional and time series comparability with respect to day patient admissions [33]. In its analyses it excludes all cases where:

1. The admission and discharge date are the same (length of stay = 0)
2. AND the patient was discharged alive
3. AND the health specialty code on discharge is that of Emergency Medicine (M05, M06, M07, and M08).

While this coding filter succeeds in ensuring a degree of comparability between regions and across time (although it fails to correct the anomalies occurring during the mid 1990s when A&E cases were uploaded using medical sub-specialty codes), the exclusion of emergency day cases from time series analysis has a number of limitations including:

1. Exclusion of only those with a length of stay of 0 days means that those emergency cases who begin their treatment late at night and are discharged in the early hours of the following morning (up ¼ of emergency cases have a length of stay of 1 day in some DHBs) are included as genuine hospital admissions, whereas those who begin their treatment early in the morning and are discharged late in the afternoon or the evening of the same day are excluded.
2. With a move towards the development of specialist paediatric emergency departments in larger urban centres (e.g. Auckland), there remains the possibility that some larger DHBs are now seeing and treating a number of acute medical patients within the emergency setting, while in regional centres similar patients continue to be assessed on the paediatric medical ward / assessment unit and thus receive a paediatric medical specialty code. The exclusion of all emergency presentations from time series and sub-regional analysis may thus differentially exclude a large portion of the workload occurring in large urban centres where access to specialist advice and treatment is available within the Emergency Department setting.

The potential impact of inconsistent uploading of day cases to the NMDS is likely to be greatest for those conditions most commonly treated in the emergency department setting. Analysis of 2001-2003 hospital admission data suggests that >1/3 of NMDS emergency department discharges for those 0-24 years were due to injury, with another 1/3 were due to ambulatory sensitive conditions (e.g. asthma, gastroenteritis, respiratory infections). In contrast, only 2% of those presenting with bacterial meningitis and 4% of those with septic arthritis were discharged with an emergency sub-specialty code.

Further sub-analysis of these two admission categories however demonstrated that inclusion / exclusion of emergency department admissions had quite different effects depending on the category of admission under study (injury vs. ambulatory sensitive admissions) and whether the region had access to a specialist Paediatric Emergency Department. In this analysis the Wider Auckland Region, (comprising 1/3 of the NZ population and whose residents have access to specialist Paediatric Emergency Departments) was compared to the rest of NZ. For ambulatory sensitive admissions, exclusion of emergency department cases resulted in Auckland's admission rates being consistently lower than in the rest of New Zealand. It was only when emergency cases were included in this analysis that Auckland's admission rates began to approximate those of the rest of NZ. In contrast for injuries, inclusion of emergency department cases resulted in hospital admissions in the Auckland Region consistently exceeding the rest of New Zealand. It was only when emergency cases were excluded from the analysis that Auckland's injury admission rates began to approximate those of the rest of NZ. (These findings occurred despite Auckland having a similar proportion of children living in the most deprived NZDep small areas as the rest of NZ).

Loosely interpreted, the findings of this analysis suggest that the workload of large specialist paediatric emergency departments must not be discounted when examining trends in ambulatory sensitive or other medical admissions, as it is only when emergency cases are included in the analysis that the admission rates of the Wider Auckland Region (with its

access to Specialist Paediatric Emergency care) begin to approximate the rest of NZ. In contrast, it is possible that specialist paediatric emergency departments have much less of an influence on admission thresholds for injury, with these being handled in a similar manner by different emergency departments across the country. Thus for injury data, the greater tendency for some emergency departments to upload their cases to the NMDS must be taken into account in any analysis.

Implications for Interpreting Time Series Analyses

Throughout this report, analysis of time series and other information has been undertaken using unfiltered hospital admission data, with the exception of the injury and poisoning sections. Here emergency department discharges have been filtered out of the dataset, in an attempt to address some of the inconsistencies discussed above. Despite such an approach, there remains the potential for the inconsistent uploading of day cases to significantly influence the time series analyses presented in this report. In particular, such practices may lead to an over estimate of the number of medical admissions commonly treated in the emergency department setting (e.g. asthma, skin infections, respiratory tract infections), while at the same time the filtering out of injury/poisoning emergency cases may lead to undercounting for a number of more minor types of injury. Nevertheless, the filtering process utilised in this report are thought to provide the best balance when considering hospital admissions amongst those 0-24 years. Despite this, the reader must bear in mind that a potential for significant residual bias remains, when interpreting the time series analyses presented in this report.

2. Data Quality and Coding Changes over Time (ICD-9 and ICD-10)

Change Over from ICD-9 to ICD-10 Coding

From 1988 until June 1999, clinical information in the NMDS was coded using variants of the ICD-9 classification system (ICD-9 CM until June 1995, then ICD-9-CM-A until June 1999). From July 1999 onwards, the ICD-10 classification system has been used, although for time series analysis, back and forward mapping between the two classification systems is possible fusing pre-defined algorithms [31].

The introduction of ICD-10 represents the most significant change in the International Classification of Diseases (ICD) in over 50 years and uses an alphanumeric coding system for diseases in which the first character of the code is always a letter followed by several numbers. This has allowed for the expansion of the number of codes to provide for recently recognised conditions and to provide greater specificity about common diseases (there are about 8,000 categories in ICD-10 as compared to 5,000 in ICD-9). While for most conditions there is a reasonable 1:1 correspondence between ICD-9 and ICD-10 codes, for some this may lead to some irregularities in time series analysis [34]. Where possible such irregularities will be highlighted in the text, although care should still be taken when interpreting time series analysis across the 1999-2000 period as some conditions may not be directly comparable between the two coding systems.

Accuracy of ICD Coding

In recent years the NZHIS has undertaken a number of reviews of the quality of ICD coding in the NMDS. In the latest audit 2708 events were audited over 10 sites during a 3 month period during 2001/2002. Overall the audit found that 22% of events required a change in coding, although this also included changes at the fourth and fifth character level. The average ICD code change was 16%, with changes to the principal diagnosis being 11%, to additional diagnoses being 23% and to procedure coding being 11%. There were 1625 external causes of injury codes, of which 15% were re-coded differently [35]. These findings were similar to an audit undertaken a year previously.

While the potential for such coding errors must be taken into consideration when interpreting the findings of this report, it may be that the 16% error rate is an overestimate, as in the majority of the analyses undertaken in this report, only the principal diagnosis (with an error rate of 11%) is used to describe the reason for admission. In addition, for most admissions the diagnostic category (e.g. lower respiratory tract infections) is assigned using information at the

3 digit level (with the 16% error rate also including issues with coding at the 4th or 5th digit level).

Conclusion

In general the inconsistencies outlined above tend to make time series and (regional) comparative analyses based on the NMDS less reliable than those based on Mortality or Birth Registration data (where legislation dictates inclusion criteria and the type of information collected). While hospital discharge data still remains a valuable and reasonably reliable proxy for measuring the health outcomes of children and young people in this country, the reader is cautioned to take into consideration the biases discussed above, when interpreting the findings outlined in this report.

Appendix 2: Statistical Significance Testing and Its Use in This Report

Understanding Statistical Significance Testing

Inferential statistics are used when a researcher wishes to use a sample to draw conclusions about the population as a whole (e.g. weighing a class of 10 year old boys, in order to estimate the average weight of all 10 year old boys in New Zealand). Any measurements based on a sample however, even if drawn at random, will always differ from that of the population as a whole, simply because of chance. Similarly, when a researcher wishes to determine whether the risk of a particular condition (e.g. lung cancer) is truly different between two groups (smokers and non-smokers), they must also consider the possibility that the differences observed arose from chance variations in the populations sampled.

Over time, statisticians have developed a range of measures to quantify the uncertainty associated with random sampling error (i.e. to quantify the level of confidence we can have that the average weight of boys in our sample reflects the true weight of all 10 year old boys, or that the rates of lung cancer in smokers are really different to those in non-smokers). Of these measures, two of the most frequently used are:

1. **P values**: The p value from a statistical test tells us the probability that we would have seen a difference at least as large as the one observed, if there were no real differences between the groups studied (e.g. if statistical testing of the difference in lung cancer rates between smokers and non-smokers resulted in a p value of 0.01, this tells us that the probability of such a difference occurring if the two groups were identical is 0.01 or 1%. Traditionally, results are considered to be statistically significant (i.e. unlikely to be due to chance) if the probability is <0.05 (i.e. less than 5%) [36].
2. **Confidence Intervals:** A 95% Confidence Interval suggests that if you were to repeat the sampling process 100 times, 95 times out of 100 the confidence interval would include the true value. In general terms, if the 95% confidence intervals of two samples overlap, there is no significant difference between them (i.e. the p value would be ≥0.05), whereas if they do not overlap, they can be assumed to be statistically different at the 95% confidence level (i.e. the p value would be <0.05) [36].

The Use of Statistical Significance Testing in this Report

In the preparation of this report a large range of data sources were used. For the purposes of statistical significance testing however, these data sources can be considered as belonging of one of two groups: Population Surveys and Routine Administrative Datasets. The relevance of statistical testing to each of these data sources is described separately below:

1. **Population Surveys**: A number of indicators in this reporting series utilise data derived from national surveys (e.g. Action for Smoking and Health (ASH) Smoking Surveys, the NZ Children's Nutrition Survey), where information from a sample has been used to make inferences about the population as a whole. In this context statistical significance testing is appropriate, and where such information is available in published reports, it has been incorporated into the text accompanying each graph or table (i.e. the words *significant*, or *not significant* in italics are used to imply that a test of statistical significance has been applied to the data and that the significance of the associations are as indicated). In a small number of cases however (e.g. SPARC Physical Activity Surveys) information on

statistical significance was not available in published reports, and in such cases any associations described do not imply statistical significance.

2. **Numbers and Rates Derived from Routine Administrative Data**: A large number of the indicators in this report are based on data derived from New Zealand's administrative data sets (e.g. Birth Registration, Hospital Admission, Mortality), which capture information on all of the events occurring in a particular category. Such datasets can thus be viewed as providing information on the entire population, rather than a sample and as a consequence, 95% confidence intervals are not required to quantify the precision of the estimate (e.g. the number of leukaemia deaths in 2000-2004, although small is not an estimate, but rather reflects the total number of deaths during this period). As a consequence, 95% confidence intervals have not been provided for any of the descriptive data (numbers, proportions, rates) presented in this report, on the basis that the numbers presented are derived from the total population under study.

3. **Rate Ratios Derived from Routine Administrative Data**: In considering whether statistical significance testing is ever required when using total population data Rothman [37] notes that if one wishes only to consider descriptive information (e.g. rates) relating to the population in question (e.g. New Zealand), then statistical significance testing is probably not required (as per the argument above). If however, one wishes to use total population data to explore biological phenomena more generally, then the same population can also be considered to be a sample of a larger super-population, for which statistical significance testing may be required (e.g. the fact that SIDS in New Zealand is 10 times higher in the most deprived NZDep areas might be used to make inferences about the impact of the socioeconomic environment on SIDS mortality more generally (i.e. outside of New Zealand, or the 5 year period concerned)). Similarly, in the local context the strength of observed associations is likely to vary with the time period under study (e.g. in updating 5-year asthma admission data from 2002-2006 to 2003-2007, rate ratios for Pacific children are likely to change due to random fluctuations in annual rates, even though the data utilised includes all admissions recorded for that particular 5-year period). Thus in this report, whenever measures of association (i.e. rate ratios) are presented, 95% confidence intervals have been provided on the assumption that the reader may wish to use such measures to infer wider relationships between the variables under study [37].

The Signalling of Statistical Significance in this Report

In order to assist the reader to identify whether tests of statistical significance have been applied in a particular section, the *Data Sources and Methods* text box accompanying each indicator includes a small paragraph entitled *Statistical Significance Testing* (see examples below). It is suggested the reader briefly reviews this information before considering the analyses presented in the sections which follow.

Data Sources and Methods

Statistical Significance Testing Example 1

Note: Tests of statistical significance have not been applied to any of the data in this section, and thus any associations described do not imply statistical significance or non-significance.

Statistical Significance Testing Example 2

Note: Tests of statistical significance (in the form of 95% confidence intervals) have been applied to some of the data in this section. Where relevant, the significance of these associations has been signalled in the text (with the words *significant*, or *not significant* in italics being used to denote the statistical significance of the observed association). Where the words *significant* or *non-significant* do not appear in the text, then the associations described do not imply statistical significance or non-significance.