

Evidence-Based Health Promotion: **No. 4 Child Injury Prevention**

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Public Health

Acknowledgments

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Foreword—Evidence-Based Health Promotion

The Victorian Government is committed to supporting evidence-based practice in the planning and implementation of effective health promotion action. The practical use of evidence promises better health outcomes by informing practitioners, program planners and funding bodies as they develop and select health promotion strategies, methods and activities.

The Public Health division of the Department of Human Services, in collaboration with statewide health advancement organisations, is working towards the provision of quality advice on health promotion practice. This involves preparing and facilitating access to systematic reviews of the effectiveness of different kinds of interventions.

Evidence-based reviews identify the most effective and efficacious interventions and provide information to help ensure efficient use of resources. The findings of these reviews are targeted to those needing to make decisions about the type of programs that should be developed and implemented; they do not tell practitioners how to deliver programs.

The advice provided by such reviews should be seen as complementing rather than replacing the practical experience and critical judgement of planners and practitioners. The recommendations need to be carefully considered in the light of the particular context for implementation in order to ensure a balanced and realistic application of the principles.

Significant logistical and methodological challenges are associated with reviewing the evidence base for health promotion. The amount of available evidence is often very limited and the quality highly varied. For this reason, these reviews should be seen as a first step only, requiring ongoing enhancement and critical application.

This publication is part of a series initiated by Public Health. The following four documents initiate the series:

- *Evidence-Based Health Promotion: Resources for Planning. No.1—Oral Health*
- *Evidence-Based Health Promotion: Resources for Planning. No.2—Adolescent Health*
- *Evidence-Based Health Promotion: Resources for Planning. No.3—Falls Prevention*
- *Evidence-Based Health Promotion: Resources for Planning. No.4—Child Injury Prevention*

These publications use current evidence in each field and contain a critical appraisal of the findings. Recommendations for implementation are made to assist health promotion funders, planners and practitioners requiring an evidence base for their work.

Summary assessments of individual programs evaluated as part of these reviews will be made available through a series of Web-based databases.

Feedback on these publications and suggestions for further topics are welcomed and can be made to the Health Development Section, Public Health, on 9637 4023.

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Executive Summary

The focus of this review is to ascertain the efficacy of child injury prevention interventions as they relate to specific types of injuries and to generic safety promotion. Conventionally, child health outcomes have focused on deaths, hospitalisations and diagnoses of morbidity associated with injury. This project aims to seek evidence of outcomes more broadly and to include issues such as the impact of injury on the family and on overall health and wellbeing.

This project used systematic methods to collate, review and analyse evidence-based approaches for the prevention of injury to children aged 0–4 years. This will inform the planning, funding and decision making of practitioners as they develop and implement health promotion interventions and activities.

Using This Resource: National and State Policy Context for Child Injury Prevention

Since this evidence-based review was completed, there have been considerable policy developments in child injury prevention at the State and national levels. This resource needs to be considered within this policy context.

Since 1996, Injury Prevention and Control has been identified by Australian Health Ministers as one of six National Health Priority Areas (NHPAs). The National Public Health Partnership Group (NPHPG) also identified injury prevention as a priority, leading to the development of the *National Injury Prevention Plan: Priorities for 2001–2003* within which child falls, drowning and near drowning and poisoning have been identified as priorities.

The Strategic Injury Prevention Partnership (SIPP) is responsible for implementing the National Injury Prevention Plan, with the aim of translating the strategies into action at a national, jurisdictional and local level. Developing key partnerships at these levels will be an important component of the implementation phase. In Victoria, *Taking Injury Prevention Forward* (1994) provided the first integrated framework for progress in injury prevention. A more specific focus on children was signalled in the *Children's Injury Prevention Action Plan* (1997). This report will inform development of the next generation of injury prevention strategies at both statewide and local levels.

Key Findings from the Systematic Review

Summary of Evidence for Effectiveness for Major Injury Cause Areas

Poisoning

- The strongest evidence on poisoning prevention rests with child resistant closures (CRCs).
- There appears to be some promise in changing the palatability of a product, increasing the use of medical treatment for cases requiring treatment and decreasing use of medical resources for cases not requiring treatment.
- Education strategies may be more effective if targeting a select audience. Otherwise, in the absence of other strategies, little evidence exists for the effectiveness of educational campaigns.

Falls

- Few studies have examined the effectiveness of strategies to reduce falls in children. The emphasis has mainly been on older children and injuries in playgrounds. This prevents conclusions being made regarding successful strategies, particularly in the Australian setting. A better understanding of how young children fall, and what causes the injuries, is needed in order to target interventions effectively.
- The potential for regulatory approaches in settings where enforcement strategies are feasible has not been systematically assessed; there needs to be further research in the prevention of injuries caused by falls.

Respiratory

- There is minimal evidence of what works in preventing respiratory injuries (for example choking and suffocation) in young children. One study with strong findings suggests the value of a campaign, or mix of community-wide strategies, encompassing media and individual educational strategies, warning labels on products and complementary policies in child care centres.
- Safe feeding and sleeping practices appear to have potential.

Immersion

- The introduction of pool fencing significantly decreases the incidence of immersion injuries in children.
- More work is required to improve compliance rates both from a government and a parental perspective. This would include, for example, investigating leaving pool gates open and fences in disrepair, for the full effectiveness of this strategy to be realised.
- Swimming and water safety programs offer promise for increasing swimming ability and safe behaviour around water but evidence of links to reducing immersion injury by these approaches has not yet been provided, particularly for the age group at greatest risk, that is 1–3 year olds.
- Awareness-raising education programs or campaigns may work, if appropriate for the age group at risk, but no significant impact has been found. Examples from Brisbane suggest that educational and media campaigns underpin the success of other approaches.

Burns and Scalds

- Legislation requiring flame resistant material and sleepwear design has proven to be successful in decreasing the incidence of burn injury. Few studies on the effectiveness of smoke alarms have isolated children as a target group.
- Changes in legislation are effective in achieving lower hot tap water temperatures and decreasing injuries from scalds. Resource-intensive, large-scale campaigns that encompass a combination of strategies (education, product modification and regulations concerning hot water temperatures) are associated with significant reductions in scald injuries among young children, particularly the more severe injuries. Cost-benefit ratios of this approach are still needed, although preliminary estimates suggest that such campaigns at least may return many times their cost in health care savings.
- Educational efforts, on their own, have not been linked to significant changes in burn injuries. There are greater signs of outcome effect if such campaigns are combined with product promotion (such as anti-scald devices) either by way of assistance in purchasing or installation.

Consultation with Key Stakeholders and Child Injury Prevention Experts

The program of consultation showed a commitment to injury prevention in early childhood. Injury prevention initiatives are viewed as complementing other preventive health care strategies and fitting well with the mode of health care service delivery used. Difficulties are perceived to be directly related to the inability to measure the effectiveness of programs in the short term. Opportunities for change are more likely to be amenable to assessment of longer term outcomes. Short term funding has been found to detract from program sustainability and adequate evaluation.

Sustainability of injury prevention programs is more likely to be achieved with a combination of strategies and involvement of a variety of groups using existing community networks and information sharing, legislative changes and leadership in policy direction.

Child Injury Prevention Interventions

There are relatively few child injury prevention interventions that are the subject of well-designed and well-reported studies. Burns, scalds and poisoning are the most widely researched areas. A significant number of studies present a range of evidence that provides a basis for intervention development and coinciding effectiveness measurement. Conclusions about what is effective are hampered by inadequate description of the interventions employed or by the process of selection of the study subjects, small sample sizes, the absence of comparison groups or statistical significance testing.

Only a small number of interventions are clearly recommended. Many interventions have been demonstrated but on a very limited basis. The majority of trialed interventions carry no recommendation, simply because the studies reported on their implementation and are not sufficiently strong to be conclusive about the direction and extent of effectiveness. Many injury prevention interventions have not been assessed for their impact on injuries. Evaluation is commonly confined to interim outcomes such as changes in knowledge or behaviour. In some instances, there are strong findings from individual studies; however, as these are not confirmed by other studies, their findings cannot be generalised.

The availability of cost data within studies is poor and, as a result, only limited analysis of the cost-effectiveness of programs has been possible. Few studies have considered the cost-benefit ratios of injury prevention initiatives, leaving this aspect of the intervention decision making process still uninformed.

The most definitive successes in childhood injury prevention relate to engineering or design changes to hazards or hazardous products that are uniformly applied through the use of legislation or enforcement. This would include, for example, child resistant containers for medications. A combination of approaches or large-scale campaigns which encompass educational, environmental and legislative strategies, have been found to be effective in reducing specific injuries (such as scalds, or respiratory injuries) or child injuries generally.

The careful targeting of programs, such as targeting those at greatest risk, as well as attending to public areas, because of the capacity to enforce or monitor safety compliance, have been found to be effective. Education (whether media-based, individual or group counselling) on its own, with or without print material, has not been found to impact injury outcomes measured in conventional ways. Education is more likely to be associated with a reduction in injuries if:

- It is coupled with enhancing access to safety devices (such as discounts or give-aways) particularly for low socioeconomic groups
- It is coupled with regulation or enforcement
- It is delivered over several occasions or extended counselling (30 minutes or more).

The most promising approach to address all injuries in children is the community-wide safe communities approach. Three studies of comprehensive, community-wide, multiple strategies (including one Australian study) showed considerable success when comparing pre- and post-intervention injury rates in children. Evidence also shows that a number of childhood injuries occur in the home and this is the principal setting for several child injury prevention strategies. In order to obtain consistency across the approaches for child injury prevention in the home, it would be worthwhile to develop a pilot generic education and environmental change strategy that is targeted at injuries in the homes of children under the age of five. Furthermore, with regard to educational strategies, evidence suggests three possible factors to increase the effectiveness:

- Timing—the timing of the education is significant because people may be more responsive at different times.
- Integrated campaigns—educational efforts need to be integrated with other strategies in a community such as regulation, enforcement and product modification or enhancing access to products, such as discounts or give-aways.
- Infrastructure—if developing a community-based program, program planners need to obtain commitment, agreement on a project's objectives, and keep an open line of communication with the existing community infrastructure.

1. Introduction

Injury is the leading cause of preventable morbidity and mortality for children aged 0–4 years in Australia (Moon et al., 1998). Opportunities to reduce this burden are extensive and have incorporated community awareness campaigns, legislative changes that target a range of environmental factors, and activities associated with injury causation (Nolan & Penny, 1992). Injury prevention and control is one of the National Health Priority Areas, which highlights the commitment to preventing childhood injury. The understanding of effective interventions, both in terms of the impact on length and quality of life, the impact on children and their families, and costs involved is essential for public health planning.

Over the last decade, there have been increasing financial and political imperatives to base health care decision making on all the available research evidence. Efforts to rigorously collate and review research from both published and unpublished literature have intended to minimise the bias that may be associated with decisions based on individual opinion, commonly adopted practice, or influential stakeholders. This systematic review of evidence has concentrated on collating studies on a single topic using comparable study designs, commonly randomised or controlled trials. There has been a longer history of statistical research in childhood injury on minimising the impact of bias in studies of effectiveness (using randomised controlled trials) than in other areas or study designs for health research. Rychetnik and Frommer (2000, p.3) describe three key principles of evidence-based practice in a paper prepared for the National Public Health Partnership:

- It is important to know whether public health interventions are effective and do more good than harm.
- The benefits and costs of public health interventions should be described and evaluated so they can be weighed against other options for the use of resources.
- People who make (or are affected by) evidence-based decisions about public health interventions should be aware of the strengths, weaknesses and limitations of the available evidence.

Public health decisions need to be based on the best possible evidence. This necessitates a more comprehensive approach in the collation of 'evidence' and the inclusion of a wider variety of studies and other forms of evidence, such as community consultations and cost data. For public health practice to change, it is vital to consider the experience of the practitioners and to involve the community practitioner in the change process.

The aim of this project was to develop recommendations to inform planning and investment into evidence-based practice in the field of injury prevention for young children. The reviewers combined systematic review processes with community consultation and cost effectiveness data to develop a set of recommendations that are likely to be effective and can be implemented to assist planning, decision making and investment into injury prevention programs.

1.1 Using This Resource: National and State Policy Context for Child Injury Prevention

Since the completion of this evidence-based review, there have been considerable developments in State and national policy in the area of child injury prevention. This planning resource needs to be considered in line with child injury prevention policy, activities and recommendations at the State and national level.

Since 1996, Injury Prevention and Control has been identified by Australian Health Ministers as one of six National Health Priority Areas. The National Public Health Partnership Group identified injury prevention as a priority, leading to the development of two significant documents: a national Plan (currently in draft form) with an accompanying Implementation Plan.

A National Injury Prevention Advisory Council (1997–1999) drafted a *National Injury Prevention Plan: Priorities for 2001–2003*. The draft Plan focuses on research and prevention efforts by health portfolios nationally, using a broad framework for activity in areas of high priority. The areas for immediate action relevant to the 0–4 age group are falls in children, poisoning and drowning and near drowning. The Plan recommends a focus on coordination across jurisdictions and identifying partnership opportunities across sectors.

The Strategic Injury Prevention Partnership (SIPP) has responsibility for implementing the Plan, in consultation with key stakeholders and jurisdictions, and will report to the National Public Health Partnership Group. SIPP has developed the *Implementation Plan for the National Injury Prevention Plan 2001–2003* to translate the strategies of the Plan into action at a national, jurisdictional and local level. The target audience includes injury prevention planners, funders and procurers of health services, service providers, and managers with budget allocation discretion. The National Public Health Partnership Group has also recommended that a separate plan be developed for injury prevention for Aboriginal and Torres Strait Islander people.

In Victoria, *Taking Injury Prevention Forward* (1994) provided the first integrated framework to promote injury prevention. A more specific focus on children was signalled in the *Children's Injury Prevention Action Plan* (1997). This report will inform development of the next generation of injury prevention strategies at both statewide and local levels.

2. Rationale for Conducting the Review

2.1 Injury Morbidity and Mortality in Children 0–4 Years in Victoria

Injury in childhood is a major public health problem because it is the leading cause of death in children aged 1–14 years in Australia (Moon et al., 1998) and is the second most common reason for childhood admission to hospital.

Infant mortality due to injury increases with the degree of remoteness, with marginally higher rates in rural areas compared to metropolitan areas, and a twofold increase in remote areas of Australia (Australian Institute of Health and Welfare Mortality Database, cited by Moon et al., 1998). Childhood injuries vary a great deal according to the age of children. Burns, scalds, poisonings and immersion (drowning or near-drowning) occur more frequently in children under five years of age, while fall injuries become more common with increasing age, as children are developing and becoming more physically mobile (Moon et al., 1998). Poisoning (pharmaceutical or other) is one of the leading causes of presentations to emergency departments in Australia, requiring hospitalisation for the 0–4 age group in particular (Department of Human Services, 1998).

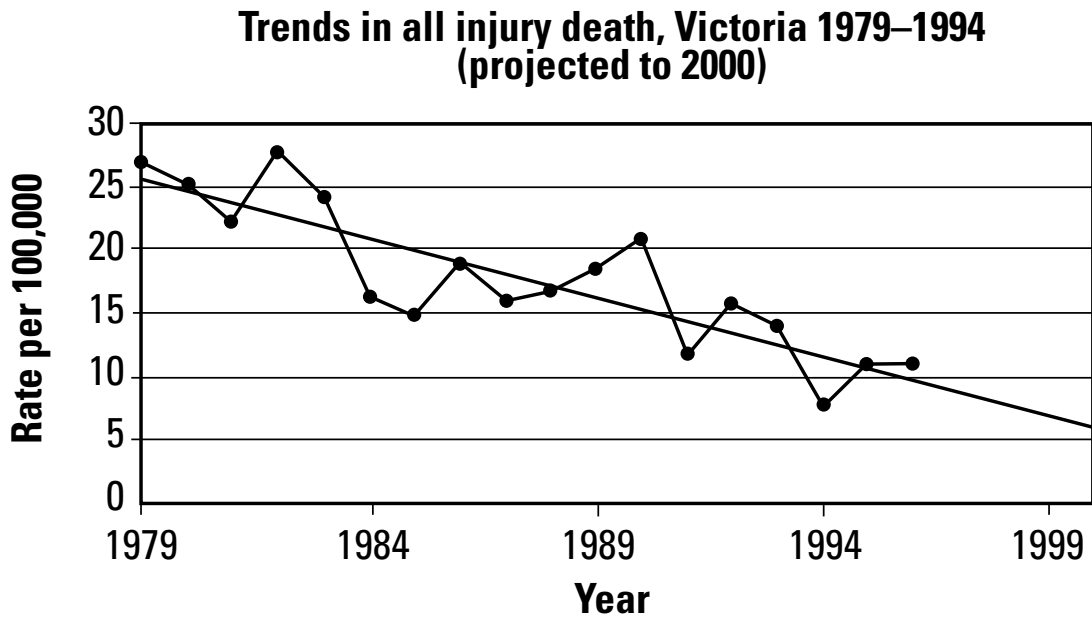
2.2 Cost of Child Injury

Information on the cost-effectiveness of potential interventions is essential for public health planning. Cost effectiveness data can contribute to the development of injury prevention planning and purchasing frameworks. The reviewers particularly wanted to investigate which types of intervention are cost-effective in preventing injury; while being aware that the inclusion of cost data into studies is still an emerging science, with relatively few studies considering the benefit-cost ratios of injury prevention initiatives.

2.3 Injury Prevention as an Investment

Preventing injury reduces costs to the health sector by decreasing absolute demand for treatment and reducing the severity of injury and therefore, the complexity of treatment required. Nationally, injury-related child mortality has decreased by 50 per cent since 1979 with major successes in road traffic safety, poisoning, scalds and nightwear related burns (Figure 1). At this stage, investment has not yet been made in measuring the benefit-cost of these changes.

Figure 1: Decreasing Trend in all Injury Death, Victoria 1979–1994



Hospitalisation trend data has only recently become available. Changes in admission practices, due to casemix management, makes it more difficult to accurately measure trends in the incidence of injury. Nevertheless, a distinct downward trend in many causes of injury among children can be identified (Watt, 1995). A method of identifying the costs and returns of injury prevention programs could be introduced, even at a broad level, to highlight the rationale for intervention funding and to determine how the benefits of interventions are distributed.

2.3.1 Investment and Return: The Costs

Injury to children under five years of age costs approximately \$80 million in Victoria each year, while the direct health care costs are \$46 million (Watson & Ozanne-Smith, 1997). A summary of these costs by broad injury categories is provided in Table 1 and Table 2 and shows the leading causes of injury cost and disability [ranked by disability life years (YLD)] for children aged 0–4 years.

Table 1: Lifetime Cost of Injury (\$ Million) Per Annum for Children Aged 0–4 Years, Victoria 1993–94

Males					
Cause	Total	Direct Morbidity	Indirect Morbidity	Mortality	Rank
Falls	12.648	8.706	3.942	0	1
Poisoning	6.577	4.197	2.38	0	2
Other Unintentional	5.708	3.448	2.26	0	3
Fire Flames, Scalds	4.758	3.854	0.904	0	4
Hit, Struck, Crush	4.175	2.473	1.411	0.291	5
Motor Vehicle Traffic	3.273	1.09	0.357	1.827	6
Cutting, Piercing	2.515	1.41	1.105	0	7
Drowning	1.698	0.208	0.007	1.483	8
Other Transport	1.618	0.67	0.384	0.564	9
Interpersonal Violence	0.745	0.384	0.026	0.344	10
Asphyxia	0.678	0.337	0.028	0.313	11
Unknown Intent	0.044	0.041	0.003	0	12
Suicide Self-Harm	0.014	0.012	0.002	0	13
All Causes	44.451	26.83	12.809	4.822	
Females					
Cause	Total	Direct Morbidity	Indirect Morbidity	Mortality	Rank
Falls	9.778	6.231	3.547	0	1
Poisoning	5.057	3.114	1.943	0	2
Other Unintentional	4.574	2.693	1.882	0	3
Fire Flames, Scalds	3.243	2.316	0.604	0.323	4
Hit, Struck, Crush	2.689	1.582	1.107	0	5
Drowning	2.494	0.162	0.003	2.33	6
Cutting, Piercing	1.497	0.808	0.689	0	7
Other Transport	1.092	0.427	0.02	0.645	8
Motor Vehicle Traffic	1.07	0.741	0.027	0.301	9
Interpersonal Violence	0.422	0.396	0.026	0	10
Asphyxia	0.213	0.202	0.011	0	11
Unknown Intent	0.044	0.041	0.002	0	12
Suicide Self-Harm	0.012	0.011	0.026	0	13
All Causes	32.185	18.724	9.887	3.599	
TOTAL All Cause Costs	76.636	45.554	22.696	8.421	

Table 2: Leading Causes of Injury Cost and Disability Male and Female Aged 0–4 Years, Victoria

	Top Five Causes of Injury Ranked by Lifetime Cost	Top Five Causes of Injury Ranked by Lifetime Cost	Top Five Causes of Injury Ranked by YLD	Top Five Causes of Injury Ranked by YLD
	Males	Females	Males	Females
1	Falls	Falls	Striking or Crushing	Striking or Crushing
2	Poisoning	Poisoning	Fire and Scalds	Fire and Scalds
3	Other Unintentional	Other Unintentional	Falls	Falls
4	Fire Flames, Scalds	Fire Flames, Scalds	Cutting and Piercing	Cutting and Piercing
5	Hit, Struck, Crush	Hit, Struck, Crush	Road Traffic	Road Traffic

While males experience higher rates of injury, even at this age, the rank order of impact for both cost and disability for males and females is identical.

Table 2 reflects how the large volume of relatively low severity injuries, unlikely to result in disability, drives the total cost, while the more severe injuries drive the disability impact. Clear priorities for action emerge, however, when the two indicators are combined. These are:

- Falls
- Striking or crushing
- Fire and scalds
- Poisoning
- Cutting and piercing
- Road traffic
- Other unintentional injuries.

2.3.2 Possible Yields

Based on the reduction in fatalities achieved over the last 20 years, an annual average reduction in injury death rates of 2.5 per cent would seem achievable. However, trends in hospitalisation have not shown a similar reduction.

It is possible that the overall rate of injury reduction would be somewhat lower than reflected by the death rate changes and somewhat better than those reflected by the hospitalisation trends. With effective prevention, there would also be a downward shift in severity. Using a 6 per cent discount over five years, the Net Present Value of a cumulative 1 per cent per annum reduction is \$9.72 million. A conservative estimate for change would be 1.25 per cent (\$12.2) and an optimistic estimate 2.5 per cent (\$24.3).

2.4 Capacity To Implement Effective Interventions

Reports by the National Health Priority Advisory Committee, the Strategic Research Development Committee of the National Health and Medical Research Council have argued that there are weaknesses in the research and implementation workforce for injury prevention (National Health and Medical Research Council, 1999). This review has shown that there are few interventions where effectiveness has been demonstrated in a rigorous manner. However, there are a number of interventions that have varying degrees of evidence for effectiveness. This supports the ongoing development of interventions and coinciding measurement of effectiveness.

2.5 Scope of the Current Review

Researchers and governments around the world require information on the cost-effectiveness as well as the effectiveness of potential interventions. To date, there have been limitations in available analyses of cost-effectiveness, in addition to analyses of the costs incurred with injury interventions, morbidity and mortality.

The major aims of this review are:

- To collate, review, analyse and disseminate guidelines or recommendations on evidence-based approaches to the prevention of injury for children aged 0–4 years.
- To examine programs targeted to individuals and communities and investigate which types of intervention are efficacious and cost-effective in preventing injury.
- To examine the role of education, environment modification, behaviour change, legislation and policy, on child injury prevention.
- To seek evidence of broader outcomes such as the impact of injury on the family, overall health and wellbeing, and quality of life.
- To consult relevant key stakeholders and child injury prevention experts to collate their views on child injury prevention in practice and projects that have been conducted in their local communities.

3. Methods

An overall framework for the project was developed using the Victorian injury-related mortality and morbidity data to determine the priority injury areas. The project included three major stages:

1. A systematic review of the published and unpublished literature.
2. A structured program of consultation with key stakeholders and child injury prevention experts.
3. The employment of injury prevention experts to draw the evidence base and consultative outcomes together into a set of conclusions from the review.

3.1 Systematic Review of the Literature

The systematic review component of the project was based on the Centre for Reviews and Dissemination Guidelines (Deeks et al., 1995) and the Cochrane Handbook (Cochrane Collaboration, 1999).

The study team conducted systematic searches of computerised databases of published literature and report evaluations; reviewed the reference lists of other reviews and the articles themselves; scanned conference proceedings and communicated with key informants who provided recommendations for reports and evaluated projects. Copies of each relevant paper and evaluation report were obtained. A data extraction sheet was completed for each project. Two researchers independently reviewed each study and the evaluation reports were reviewed by one researcher.

The reviewers systematically extracted the data from the forms into a database and summarised selected information into tables. A narrative review is provided, as the studies were drawn from a heterogeneous range of injury types and study designs, each incorporating a range of statistical analyses. The availability of cost data within studies was poor and only limited analysis of the cost-effectiveness of programs was conducted, confirmed by the advice of health economists.

The reviewers conducted searches of titles, abstracts and key words. The articles were obtained and the bibliographies of studies relevant to the review were hand searched for additional articles. Bibliographies of relevant narrative and systematic reviews were also hand searched for additional articles. Only papers written in English were included. Databases and World Wide Web sites of relevant agencies and libraries were searched. The terms used for searching Web sites were: child, injur*, accident*, prevent*. Very few Web sites listed original articles.

3.1.1 Inclusion Criteria for Child Injury Prevention Studies

Studies were required to meet inclusion criteria relating to subjects, intervention, study type and outcomes:

- The intervention must have applied to children aged 0–4 years but could have been targeted, for example, at parents, community, industry and educators.
- The intervention must have related to the prevention of unintentional injury (includes the eight content areas from Table 3) but not intentional or transport injuries and must have been applicable to the Australian situation. The intervention could have included aspects such as environment modification.

- The study type must have included an evaluation of an injury prevention intervention. The study types, therefore, may have included: controlled clinical trial, randomised controlled trial, cluster randomised trial, controlled trial with historical controls, case-control or pre- and post-testing. Outcomes may be measured using qualitative or quantitative methods and may also be measured at more than two points in time (before and after), that is, time series.
- Outcomes must have included at least one of the following:
 - Morbidity data, such as hospital emergency attendance, hospital admission, self-reported injury, injury associated disability
 - Mortality data
 - Changes in knowledge, attitudes or behaviour
 - Changes made to make environments or products safer
 - Impact to functional health status or quality of life
 - Cost of injury or intervention
 - Changes to community networks, policies, procedures, organisational capacity.

3.2 Consultation with Key Stakeholders and Child Injury Prevention Experts

The program of consultation was undertaken simultaneously with the systematic review. This enabled the study team to conduct structured interviews with key Australian injury practitioners and identify any local projects that had an evaluation component that could be included in the review. Structured personal or telephone interviews were conducted with state government departmental representatives, injury prevention advisors and practitioners, industry and local government (see Appendix I). This element of the project was essential in obtaining comprehensive information from professionals working in the injury prevention field, in relation to effective injury prevention strategies and barriers to successful programs in the 0–4 age group.

Two experts in injury prevention and injury morbidity and mortality were provided with the results of the earlier stages and the objectives for the project. In collaboration with each other, and in the context of initiatives occurring at a national level, they synthesised the results and constructed the conclusions from the systematic review.

As a case study for this evidence-based review, maternal and child health nurses and health promotion officers were provided with questionnaires on their current practice in the field of child injury prevention. Focus groups were also conducted with maternal and child health nurses who are involved in the special interest group of their Victorian professional association. This group was selected specifically for a focus group discussion because they are the primary contact point and the principal providers of health promotion and injury prevention materials for mothers with children under five years of age. The special interest group is an active group of maternal and child health nurses who contribute regularly to government programs and policy and recognise the benefits of consultation with community providers in achieving changes to public health decision making. The findings from the questionnaires and focus groups are an interesting adjunct to the review and have been included here as Appendix II.

3.3 Definitions

Injury was defined as a condition ‘directly resulting from a physical or chemical object or substance external to the body of the person concerned’ (Australian Institute of Health and Welfare and the Commonwealth Department of Health and Family Services, 1997 cited by Moon et al., 1998). This definition also classifies poisoning as an injury.

The range of injuries was reduced to exclude traffic-related injuries, as they are the focal point and responsibility of organisations such as VicRoads in Victoria. Injuries were, therefore, included where prevention efforts could be addressed through public health strategies involving the Victorian Department of Human Services in collaboration with other sectors. The scope of the injuries included is detailed in Table 3.

Table 3: Scope of Injuries Included in the Review

Type of Injury	Injury Subsets	Settings/Aetiology
Immersion Injuries	Drowning Near drowning	Swimming pools, bathtubs/buckets, waterways (dams, irrigation channels)
Thermal Injuries	Scalds Flame burns	Hot beverages, tap water House fires, wood stoves, BBQs, fire lighting fluid Flammable nightwear and other clothing
Respiratory Injuries	Choking Suffocation Asphyxiation	Food, small parts including toys
Chemical Injuries	Over-Medication Poisoning	Medications, household chemicals
Fall Injuries		Residential, playground
Animal Bites		Dog bites
Transport (non-road)		Driveways
Entrapment		Nursery furniture, doorway (finger jams), exercise bikes, playground equipment etc.

The following definition of a systematic review was employed:

a **systematic** review, as it differs from a review, is a valuable method of synthesising existing evidence from previous studies to serve as a basis for rational decision making. A systematic review explicitly states its objectives, materials and methods and is conducted according to reproducible methods that improve precision surrounding the effect of a practice or intervention, particularly in instances where there is a large amount of research information (Cochrane Collaboration, 1999).

In short, systematic reviews are an effort to make available information on effective strategies relating to health topics, in this case, injury prevention.

The definition of young children used by the reviewers was children under five years of age. As with other injury reviews of children (Towner et al., 1996), this age is grouped together as they are a relatively homogenous group: the type of accidents children have and where they occur reflects their age and stage of development. Their exposure to risk (of different hazards in different environments) at different ages remains relatively homogenous in this pre-school, mostly home-based age group.

4. Results and Discussion

4.1 The Systematic Review

A total of 112 studies were included in the systematic review. Of the published studies, 58 per cent pre-dated 1990 and 42 per cent were from 1990 or later. The majority of published studies were conducted in the United States of America. All of the unpublished studies date from 1990 and all were from Australia.

The majority of published and unpublished studies covered general injury, followed by thermal or chemical injuries. Far fewer studies focused on falls, respiratory and immersion injuries. The vast majority of studies were before and after study designs (51/104; 49 per cent); though 44/104 (42 per cent) were controlled trials with or without randomisation. The quality of the studies was generally rated 'good/reasonable' or 'reasonable'. More studies were rated 'reasonable/weak' than 'good'.

Table 4: Study Type by Study Quality: Published Papers

Study Type	Number of Studies	Good Reasonable	Study Quality			
			Good/ Reasonable	Reasonable/ Weak	Weak	
Cost-Benefit Study	1				1	
Cross-Sectional Survey	1			1		
Randomised Controlled Trial	17	1	8	4	4	
Cluster Randomised Controlled Trial	2		1		1	
Controlled Trial with Pseudo-Randomisation	7	3	1	2	1	
Controlled Trial with No Randomisation	16	1	8	4	3	
Historical Controls	2			1	1	
Case-Control Study	5		2	1	2	
Before and After Study	51	1	17	19	12	2
Cohort Study	3		1		2	

Unpublished Reports

Study Type	Number of Reports	Good/ Reasonable	Report Quality	
			Reasonable	Reasonable/ Weak
Before and After Study	11	3	6	2

4.2 An Overview of the Evidence for Major Injury Cause Areas

The current review of the literature indicates that there are few child injury prevention interventions that are the subject of well-designed and well-reported studies. A few injury cause areas have studies with impressive findings or sound evaluation methodologies, with burns, scalds and poisoning being the research areas of the highest quality. While there is a larger number of studies reporting on injury prevention approaches that target all or some different causes of injuries, the quality of these studies is quite variable.

Conclusions about what works are hampered by many reports having inadequately described the interventions employed or the process of selection of study subjects; having small sample sizes; or not using comparison groups or statistical significance testing. Furthermore, many interventions have not been assessed for their impact on injuries; evaluation is currently confined to interim outcomes such as changes in knowledge or behaviour. In some instances, there are strong findings from single studies, but they may lack confirmation from other studies, increasing the difficulty with generalising the report findings. Very few studies have considered the cost-benefit ratios of injury prevention initiatives, generally leaving this aspect of the intervention decision making process still uninformed.

On the basis of the current review, there are interventions that are ‘recommended’. Many others fall into the ‘promising’ category—where their success has been demonstrated on a very limited basis. The majority of trialed interventions carry no recommendation, promising or otherwise, simply because the studies reported on their implementation and are not sufficiently strong to enable conclusions to be drawn. In a few areas, a number of studies indicate that certain strategies do not impact on the problem and resources should not be devoted to these approaches.

Table 5 presents an overview of the amount of literature and its relative strength in defining the problems and possible child injury prevention interventions.

Table 5: The Volume and Strength of Literature in the Identified Priority Areas

Cause	Literature Volume	Literature Strength
Fire and Scalds	Moderate	Moderate
Poisoning	High	High
Falls	Moderate	Limited
Other Unintentional Injuries	Low	Low
Road Traffic	High	High

The following sections and tables provide a summary of the evidence for each of the major injury cause areas.

4.2.1 Poisoning

A synopsis of the studies addressing poisoning, according to the level of evidence available and the recommendations for their implementation, are tabled below.

Table 6: Poisoning

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Child Resistant Closures (CRCs)	5	45–60% reduction in death rate. 60–90% reduction in ED presentations 70% reduction in poisons centre enquiries relative to number of packages sold. 25–35% reduction in reported ingestions.	Good	Yes—current limitations in application exist with the limited number of substances covered and children’s access to substance once lid has been removed (i.e. container left open).
Accessibility/ Palatability: (fewer in pack, bitter tasting/ too large to swallow)	2	100% reduction in admissions. (25 pre intervention to 0 post), 25–66% reduction in proportion children tasting it more than once and 64–83% reduction in amount swallowed.	Reasonable	Promising—particularly for younger group (under 2 years) but also significant effect for 2–4 years—strong evidence but on very limited scale (one study group for outcomes and one study on behaviour)
Educational Campaigns	4	Indication of increased knowledge but translation to practice only established in one study. No study assessed impact on injuries. Some approaches included advocacy for CRCs and regulation for safe storage in public housing—impact of these not separately measured.	Reasonable/ Weak	Inconclusive—evidence on outcomes such as ED attendance or hospitalisation has not been tested or not significant. May serve as appropriate adjunct strategy to legislative measures.
Medi-Dump Campaign and Educational Messages	1	Adequate process evaluation to link campaign to outcome—of reduction of annual number of admissions from 38 to 28.	Reasonable	Inconclusive—one study only and no rates or significance testing provided.
Labelling Targeting Children (e.g. Mr YUK stickers)	2	Increased handling of containers with warning stickers, no significant impact on incidents of poisonings (either treated at home or medically).	Good	No—evidence suggests that while limited to a testing situation—stickers targeting children may increase interest in harmful substance.
Counselling/ Information Handouts	4	Some evidence of significant improvements in knowledge, having poisons information number by telephone, reduced time to contact Poisons Centre after event, and having childproof medicine cabinet (though use of cabinet not measured). No links with injury outcomes.	Reasonable	Inconclusive—evidence on outcomes such as ED attendance or hospitalisation not tested. May serve as appropriate adjunct strategy.
Use of Poison Control Centre	1	24% reduction in number of medically treated cases of poisoning admitted and not admitted. No change in control area. Estimated savings \$350 million (US) or each call saved \$175 in other medical spending.	Good/ Reasonable	Promising—very encouraging results but limited to one study. Model has been widely duplicated but no other studies reported.
Distribution of Syrup, e.g. Ipecac	3	Nett improved knowledge score among 32% of target group	Reasonable	Inconclusive—significance testing not done, links to outcome (including severity of poisoning) not reported.

While poisoning death has been dramatically reduced in this age group since the 1970s and disability impact is low, a significant problem remains in the load placed on emergency departments and through hospitalisations. Non-critical poisoning is still occurring and there are some suggestions that its rate is increasing. Many poisoning incidents occur when medications or poisonous household products are not supplied in child resistant packaging or when an adult has removed the products from their original packaging.

Child resistant closures are clearly identified as the most effective intervention in controlling poisoning. It is likely that poisoning could be further reduced by selectively increasing the coverage of child resistant closures and the development and use of closures that do not restrict access to medications by the elderly. A better public understanding of the poisoning problem among young children needs to be developed so that they do not bypass the protective strategies.

The scope for further advancing child resistant closures, currently in place to a large degree, would seem to lie in extending the list of poisons or chemicals to which the current Poisons Act applies. Additional strategies to address situations where the child restraint closure has been left off, or the child is gaining access at other points in the pattern of use, need to be considered. There appears to be some promise in:

1. Changing the palatability of a product—including a distasteful chemical (for example, denatonium benzoate) may minimise the ingestion of the substance (such as detergents).
2. Infrastructure (poison control centres)—decrease use of medical resources for cases not requiring medical treatment; increase speed of medical treatment for cases requiring further treatment rather than waiting for symptoms to appear.

The literature suggests caution when considering educational strategies. There is little evidence that they are effective on their own, though there are indications that educational strategies may be more effective if targeting a select audience, those at high risk or at a more 'teachable moment' (such as prenatally).

4.2.2 Falls

A synopsis of the studies addressing falls, according to the level of evidence available and the recommendations for their implementation, is tabled below.

Table 7: Falls

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Falls in the Home—counselling and print material	1	Falls presenting to doctor's office (where counselling done) were significantly lower (about half) for intervention group than control group but hospitalised falls were higher.	Reasonable	Inconclusive—potential study biases may complicate interpretation of findings.
Falls from Windows—legislation—guards on apartment windows, counselling, media campaign	2	Reduction of hospitalised falls by 96%—expected admission number of 16 (based on pre-law data) but only 1 fall in post-legislation period. Reduction of deaths from falls out windows by 35% over two years of the multi-strategy intervention.	Good/ Reasonable	Promising—dramatically positive results in one study and another indicated a reduction in deaths over several years—but no pre-intervention baseline provided and contribution of different elements of the program not identified.
Falls—Day Care Centres—presence of regulatory and enforcement procedures	1	No difference reported on fall injury rates between centres with and without regulatory and enforcement procedures.	Reasonable/ Weak	Inconclusive—study biases make interpretation difficult.
Falls—Council Play Equipment—training package	1	Minor changes to equipment measured after training program and materials implemented. Compliance with recommendations remained very low.	Good/ Reasonable	Inconclusive—one study only. No injury outcomes measured.

As there are relatively few studies that have examined the effectiveness of strategies to reduce falls in children, it is not possible to form firm conclusions about what works in this area. The strongest evidence is in the area of reducing falls from high-rise apartment windows, based on legislation and educational efforts in New York City. The returns for this approach would clearly not be as great in Australia. The potential for regulatory approaches in settings where enforcement strategies are feasible (such as day care centres, schools and public playgrounds) has not been systematically assessed, with only two studies reported. Both of these studies had methodological limitations in terms of study biases or not measuring the impact of the intervention on injury outcomes.

Climbing and falling in a range of settings are a constant part of the lives of young children. A better understanding of how they fall and what causes the injuries is needed to target interventions effectively.

No studies addressed the effectiveness of harnesses in preventing falls from equipment such as high chairs, strollers, change tables or supermarket trolleys. This approach may be insightful.

There is clear evidence that many products sold for the use of young children are not designed or sized to meet their developmental needs and thus result in falls, striking and crushing injuries. The recent mandatory cot standard in Australia is expected to produce a reduction in injuries associated with these items. Current activities to develop a code of practice for nursery furniture aim at achieving similar gains but no evaluation of these activities is available. Such strategies contribute to safety through environmental changes and through raising awareness of the possibility of reducing injury risk through simple modifications at home. They offer promise and need to be properly documented and evaluated.

4.2.3 Respiratory

A synopsis of the studies addressing respiratory injuries, such as choking and suffocation, and the recommendations for their implementation, is tabled below.

Table 8: Respiratory

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Educational Campaign—mix of media and individual strategies, increased warning labels, policies in child care settings.	2	One study indicated 36% reduction nationwide in cases of foreign body asphyxiation ($p < 0.01$) after 30 months. The other study only measured knowledge among parents.	Reasonable	Promising—significant nationwide change, but no control group/area and limited to one study. Other study only addressed knowledge.
Product Design—changes and labelling requirements.	2	Reduction in in-humation death rates (result of cave-ins) but not crib related strangulations. One study looked only at intent to purchase based on labelling—some evidence of reduced intent with specific instructions on warning label.	Reasonable/ Weak	Insufficient evidence—some directional indication of the effects of the interventions but limited number and quality of studies. Scope for further studies.

There is scant evidence of what works in preventing respiratory injuries in young children. The one study (Sadan et al., 1995) with strong findings in this area, while lacking a control group, suggests the value of a campaign, or mix of community-wide strategies encompassing media and individual educational strategies, warning labels on products and complementary policies in child care centres.

4.2.4 Immersion

A synopsis of the studies addressing immersion, according to the level of evidence available and the recommendations for their implementation, is tabled below.

It has been shown that the introduction of pool fencing (whether it is three or four-sided fencing) significantly decreases the incidence of immersion injuries in children. What comprises ‘fencing’ was generally poorly defined in many articles, making it difficult to compare results. More work needs to be done to improve compliance rates both from a government perspective (Quan & Gomez, 1990) and a parental perspective, for example investigating leaving pool gates open and fences in disrepair (Pitt & Balanda, 1991), for the full effectiveness of this strategy to be realised.

Swimming and water safety programs offer promise for increasing swimming ability and safe behaviour around water but evidence of links to reducing immersion injury by these approaches has not yet been provided. Awareness-raising education programs or campaigns may work, if appropriate for the age group at risk, but no significant impact has been found. This may be due to the studies having too short a follow-up period and too few numbers to give power when mortality is used as the outcome measure.

Table 9: Immersion

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Swim Safe Education—training and adjunct strategies	2	Change in swimming ability and safety behaviour around water, including wearing safety devices while boating.	Good/ Reasonable	Promising. Evidence of increased safety skills and behaviour and wearing safety devices (only among younger children). Most initiatives multi-strategy without measuring contribution of individual strategies. Links to drowning not established.
Media Campaigns	1	Mortality—young children (non significant reduction from 10 cases to 4 cases)	Reasonable/ Weak	Inconclusive. Evidence limited by small numbers of events. One study only.
Environmental—pool fencing	5	Mortality—young children: attributable risk of not having adequate fencing identified as 19–67% (i.e. % of cases that would be expected to be avoided if all pools had adequate fencing). Odds ratio (OR) of an unfenced pool ranged from 2.06 to 4.83 for drowning and 3.76 for near drownings and drownings (ED attended). One study was a cost-benefit analysis and reported \$4.9million cost (95%CI \$2.4–7.9m); per life saved, or \$252,200 per life year saved.	Good/ Reasonable	Yes. Weight of evidence in direction of fencing a significant protective effect against children drowning in domestic pools. Variable quality of studies – low response rates, small numbers of events and inadequate definition of pool fencing in three of the studies. Cost consideration of this strategy given the low number of cases in any one area.
Multi-strategy—legislation, environmental modification and education	1	Signs of decreasing rate of deaths (from 0.21 to 0.02/100,000) and immersions (from .86 to .06/100,000) over 10 years—but significance testing not done. Observed decrease was limited to public areas, not private pools (under less control).	Good/ Reasonable	Promising—particularly for public swimming areas where compliance can more easily be enforced. Note that these results are limited to one study only.

4.2.5 Burns

A synopsis of the studies addressing burns, according to the level of evidence available and the recommendations for their implementation, is tabled below.

Table 10: Burns

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Legislation—nightwear or clothing standards	4	A significant decline post legislation in hospital admissions & proportion of burns associated with sleepwear from 12% to 3% (P<0.02) & proportion of flame burns associated with sleepwear (from ~ 30% to ~ 5% several data years—but no trend analysis done).	Reasonable	Yes—recommended. While some studies lacked rigour or sufficient number of cases, all were in a positive direction and of a significant magnitude.
Legislation—home hot water temperatures	2	Hospital admission rates suggest 50% reduction over five years—no significance testing. Home hot water temperatures non-significant reduction in intervention and control groups, significant decrease in temperature over time from 61°C to 50°C following introduction of legislation.	Reasonable/ Weak	Promising. Studies not strong but some indications of risk reduction (lower hot water temperatures) and signs of decrease in burns injury.
Legislation—smoke alarms	1	Five year follow-up of alarm installation and working rates. No significant difference in positioning and working order of smoke alarms between intervention (required of all homes) and control (required of only new homes).	Reasonable	Inconclusive—effect of differential enforcement and education or ‘word of mouth’ effects in the two communities may have diminished the difference between the two legislative approaches.
Product Modification—burns associated with vacuum cleaners.	1	Reduction in number of mouth burns due to vacuum cleaner plug—no rates or significance testing.	Reasonable	Insufficient evidence—one study and not strong. Promise lies in ‘logic’ of removing hazardous element from product that causes harm.
Education—group and mixed media strategies	6	Variety of outcomes measured including some significant knowledge gains (among children in school-based programs). Increased temperature testing (with distribution of testing cards). No program resulted in a significant reduction in the incidence or severity of burns.	Weak/ Reasonable	Insufficient evidence—no links with burns reduction established and fairly weak evidence of interim indicators.
Education—scalds prevention One to one counselling/home visits	3	Significant increase in proportion of homes with safe temperatures (from 9% to 42%) after 30 minute counselling. Results with 1-minute counselling, pamphlet +/- thermometer card, suggested the only significant difference between the groups was the proportion that tested hot water temperature.	Weak/ Good	Inconclusive—links to injury reduction not established. May be that longer counselling required to result in improved proportion of homes with safety features.

Table 10: Burns (continued)

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Large-Scale Campaigns—educational, environmental and legislative strategies, and in some cases improved burn treatment	3	Significant reduction in mortality and hospitalisation due to burns—especially among children.	Good/Reasonable	Yes. Several studies, even though of variable quality, have indicated a significant impact on actual cases of scald injuries resulting in death and/or hospitalisation. No clear set of strategies identified – but an indication of a large-scale concerted effort encompassing multiple interventions will significantly reduce the rate of serious burn injuries.
Education (or campaign)—and home modification/product promotion/installation	4	Mixed findings from slight reduction in burns admissions (in study with small numbers) to significant reduction in intervention group only. Other studies reported interim outcomes: an increase in proportion of homes with smoke alarms and proportion correctly installed. Some devices appeared to be removed after time.	Weak/Good	Promising—one strong study and several weaker ones. Findings generally in a positive direction with indications that installing and giving away safety devices, though cost-intensive, leads to greater proportion of homes with safety devices.

Legislation for the use of flame-resistant material and sleepwear design has been successful in decreasing the incidence of burn injury involving children’s sleepwear (as seen with decreased hospital admissions for such a burn injury).

Few of the studies in the literature on the effectiveness of smoke alarms have isolated children as a target group. Consequently, the current review does not reflect the evidence available on this approach to reduce house fire-related burns to children. Building codes that require smoke alarms to be installed in new houses appears to increase the use and compliance of such devices. Community-wide education campaigns, unaccompanied by free smoke alarms, have shown little effect on the incidence of burn injury (MacKay & Rothman, 1982; McLoughlin et al., 1982). Multi-faceted community-based education programs appear to have the most favourable effect in decreasing burn injuries, however, it is not possible to determine which strategy is the more powerful (Clark et al., 1992; Elberg et al., 1987; Ytterstad & Sogaard, 1995).

Overall, changes in legislation regarding acceptable temperatures for home hot tap water (reducing the temperature of hot water in ablution areas to 50 degrees Celsius) have been shown to be effective in decreasing injuries from scalds and achieving lower hot tap water temperatures. There is evidence that resource-intensive, large-scale campaigns that encompass a mix of strategies (education, product modification, regulations concerning hot water temperatures) are associated with significant reductions in scald injuries among young children, particularly the more severe injuries (Clark et al., 1992; Elberg et al., 1987; Elkington & Gaffney, 1998). Strategies utilising cost-benefit analysis of these approaches are still needed, although preliminary estimates suggest that such campaigns may return many times their cost in health care savings (Elkington & Gaffney, 1998).

Another major hazard identified is scalding by hot beverages. Hot drinks held by a parent or visitor are hot and voluminous enough to result in scalds over large body surface areas

including the face, resulting in disfigurement and expensive cosmetic surgery. No satisfactory intervention has yet been tested, although changing cup design or reducing the volumes of hot liquids has been suggested.

Consideration could be given to the potential for lobbying manufacturers to alter the designs of certain products, as evidenced by one study that found an association between a particular type of vacuum cleaner and children’s burns to the mouth (Sorensen, 1976).

Educational efforts on their own have not been linked with significant changes in burn injuries (Thomas et al., 1984; MacKay & Rothman, 1982; McLoughlin et al., 1982; Waller et al., 1993; Katcher, 1987; Slinger & Rowlands, 1995). There are greater signs of outcome effect if such campaigns are coupled with product promotion (such as anti-scald device) either by way of assistance in purchasing or installation (Ytterstad & Sogaard, 1995; Miller et al., 1982; Gorman et al., 1985; Fallat & Rengers et al., 1993).

4.2.6 General Injuries

A synopsis of the studies addressing general injuries, according to the level of evidence available and the recommendations for their implementation, is tabled below.

Table 11: General Injuries

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Education—group or individual session and print material	5	Some self-reported changes in behaviour in some studies. Studies that examined injury outcomes showed no evidence of positive impact on injury rates that could be linked to program.	Good/Reasonable	Not recommended. Available evidence, while limited, suggests as stand-alone strategies, group education and handouts are not effective.
Expos/Safety Fairs	1	Some signs of short-term attitude shift. Impact on behaviours and injuries not measured.	Reasonable	Inconclusive—insufficient evidence. One study only and injuries not measured.
Education—one-on-one (typically maternal/child health nurse, GP) with or without product promotion/	16	Increased parental knowledge. There were some or no signs of increased safety features in-home with counselling. Significant increase in safety device use/installation was noted if give away counselling was accompanied by increased product access. Greater improvement in outcomes was apparent with lower SES groups. Two studies showed statistically significant declines in ED attended injuries - both used intensive counselling. Two studies indicated evidence of positive benefit-cost ratios (medical care) or family expenses and quality of life.	Weak/Good	Inconclusive—mixed findings and generally methodological limitations and no, or unclear links with injury outcomes. Some signs that beginning education prenatally, or focusing on higher risk groups/areas is more likely to result in significant gains. Greater success may be linked with parental education over many occasions and longer counselling sessions. Enhancing access to products, particularly for low SES groups, appears to assist home modification.

Table 11: General Injuries (continued)

Strategy	No. of Qualifying Studies	Outcome Effect	Strength of Evidence	Recommended (Y/N) Comments
Education via media strategies plus individual counselling and home visits/home inspections	9	Some knowledge gains. Links to behaviour change were less strong, except one study which suggested that individual counselling and home hazard assessment followed by 10 minute broadcast TV safety series was more effective in prompting changes than a letter and followed by the TV series. No evidence of links to targeted injury rates except in one large program (SCIPP) where paediatrician counselling backed by media efforts appeared to be linked with 15% reduction in injuries over 2 years, than just media efforts alone.	Reasonable	Not sufficient evidence to recommend. Fairly resource intensive strategy without measurable gains. There were signs that if media efforts are not linked back to the community/ or individualised assessment of risk, then media/counselling approach will not effect change. Some indications that learning has to be participatory to result in significant behaviour change. Most studies did not provide evidence of impact on targeted injuries.
Education of Professionals (pre-school teachers, GPs)	4	Significant decrease in injuries (but some data limitations). None to some signs of promotion of minor environmental change. No sign of GPs increasing safety counselling.	Reasonable/ Weak	Insufficient evidence—but limitation of study methodologies prevents firm conclusions.
Community-Wide Strategies (safe communities)	5	Approximately 45% reduction in child injuries in the home, 17– 32% of all child injuries and 14% decline in hospital admissions. One study had much less success – but numbers of injuries were small and program may have filtered to control communities. One Australian report indicated increased parental knowledge and stocking of safety products by retail outlets, other reported significant reduction in ED attended injuries and estimated \$272 spent on the intervention per injury saved.	Good/ Reasonable	Promising—three studies (including one Australian study) showed considerable success but control groups not used in child injury analysis. One study with very marginal improvements and one Australian report did not discuss selection of study subjects or use a control group – and limited measures to knowledge and retail supplies.
All Strategies (education, enforcement, engineering and combination)	2	One study compared the impact of each strategy as delivered by a city Sanitary Code inspector (able to enforce as well as educate, provide required safety devices) on items on a checklist relating to the relevant strategy. Proportion of homes with identified hazards pre and post were: Education strategy = 28 vs 21%, regulation = 17 vs 0% Environmental modification = 63 vs 10%, combination = 27 vs 17%; $p < 0.005$ for all strategies. Other study indicated 6% reduction in injuries, no evidence of change in knowledge of hazards by parents.	Reasonable	Insufficient evidence—limited to two studies and difficult to compare strategies with each other since they related to different hazards in the home (i.e. not same motivation to change each one) or public place. Some promise in that significant change in environment was achieved with every approach (home based)—suggested value of the ‘vehicle’ of the city inspector—and signs of injury reductions in playground related injuries.

The most promising approach identified in the literature to address all injuries in children is the community-wide **safe communities** approach. Three studies of comprehensive, community-wide, multiple strategies (including one Australian study) showed considerable success when comparing pre- and post-intervention injury rates in children, although there were some limitations in study design, such as the non-use of a control group in the analysis of injury outcomes in children. The Australian study provided the estimates of \$272 spent on the intervention for each emergency department attended injury avoided.

While available evidence is limited, it suggests that stand-alone strategies, group or individual education with or without handouts are not effective (Minchom et al., 1984; Tellnes, 1985; Schlesinger et al., 1997; Parcel et al., 1984; Laughlin, 1997). Where people were visited in the home, it was found that the number of hazards in the home decreased (Olds et al., 1994; Petridou et al., 1998; Colver et al., 1982; Sullivan et al., 1990; Bablouzian et al., 1997) as did the number of children requiring inpatient care for major illnesses or accidents (Hardy & Streett, 1989; Jordan et al., 1993). In most instances, provision of safety devices (smoke alarms, poison centre telephone numbers, ipecac syrup, electric outlet covers) increased the use of those devices in the home (Colver et al., 1982; Sullivan et al., 1990; Clamp & Kendrick, 1998; Schwarz et al., 1993; Bablouzian et al., 1997).

The literature on evidence concerning programs addressing child injuries in general suggested three possible factors to increase the chances of desired effect via educational strategies:

- **Timing**—the timing of the education may be important with people being more responsive at different times. One study indicated that education commenced pre-natally versus post-natally was found to be more effective (Larson, 1980).
- **Integrated campaign**—an analysis of the most effective strategies suggested that educational efforts need to be integrated with other strategies in a community, such as regulation and enforcement (Gallagher et al., 1985), product modification or enhancing access to products, such as discounts or giveaways (Colver et al., 1982; Sullivan et al., 1990; Clamp & Kendrick, 1998; Schwarz et al., 1993; Bablouzian et al., 1997).
- **Infrastructure**—if developing a community-based program within an existing community infrastructure, one study indicated that program planners would need to obtain agreement on the project's objectives, commit to the project and maintain an open line of communication (Wortel et al., 1995).

4.2.6.1 Other Unintentional Injuries, Including Striking Crushing, Cutting and Piercing

Striking, crushing, cutting and piercing have not been well studied in the literature. Door jam injuries, access to knives and other sharp objects and cuts caused when striking against the edges of furniture have been identified as particular problems. Behavioural change programs have had varied success in obtaining environmental changes such as door jam guards, safety locks on cupboards and protection of furniture edges and corners. The most successful environmental changes have been included in home inspections and provision of safety items as part of the service.

Despite the importance and cost of the injury problem, support for research and the evaluation of interventions has been poor. The success of interventions is strongly affected by cultural attitudes that shape the home environment and the expectation of the developing child. The majority of injuries to young children occur in the home, which, in

Australia, is an important bastion of privacy and individual rights. Regulatory changes to the home environment have been resisted or have had only part implementation, thereby lowering their effectiveness.

4.2.6.2 Generic Injury Prevention Programs

Generic anticipatory guidance programs (for example, The Injury Prevention Program conducted by paediatricians in the United States) have produced some changes in knowledge, behaviours and environment. The Australian adaptation of this method, the Early Childhood Injury Prevention Program, has not been well evaluated. A limited evaluation using pre- and post-testing methods in South Australia concluded that there were no changes in injury rates associated with the program. The study found positive changes in the environment especially for poison storage, smoke alarms and earth leakage devices.

Guidance programs aimed at non English-speaking families and lower socio-economic families appeared in the literature. Generally, sample sizes are small and there has been no opportunity for a controlled research study. The programs have been developmental in nature and have frequently described good client acceptance. There are indications that environmental changes to lower risk have been made.

The lack of firm evidence concerning the generic education and voluntary environmental change programs appears to be related to the provision of resources for an adequate evaluation with a large enough sample size and adequate controls. The nature of the injury problems in this age group, and the need to determine effective strategies for reducing injury in the home setting, indicate that effective programs of this type are needed.

There is firm support for generic programs among child health practitioners. They are perceived as complementing other preventive health care strategies and modes of health service delivery.

4.3 Consultation with Key Stakeholders and Child Injury Prevention Experts

4.3.1 Synthesis of Structured Interviews

Eighteen people working in injury prevention in Victoria were interviewed using structured interview questions (see Appendix I). The majority of interviewees were injury prevention advisors, practitioners and officers from the Victorian Department of Human Services regions. Other interviewees represented industry and local government.

Interviews were recorded and transcribed in preparation for analysis and summaries of the main points were collated. To synthesise the information collected, responses were divided into those focusing on injury prevention program design, development, delivery and decision making. Implications for funding of injury prevention programs and for program implementation were drawn from the consultations. These classifications are described below.

4.3.1.1 Design of Injury Prevention Programs

The majority of respondents believed that a combination of techniques was necessary for effective injury prevention programs for the 0–4 year age group. Respondents believed legislative changes and engineering and environmental design changes were particularly effective strategies. Education and behaviour modification strategies were also mentioned by some as effective, particularly when combined with other techniques. Other injury

prevention techniques that were thought to be effective included practical exercises, developing safety as a design tool for marketing, policy change and facilitating socio-cultural attitude changes towards injury prevention.

Two main measures of effectiveness were suggested:

- The collection, analysis and reporting of various forms of injury data
- Qualitative measurement of awareness, attitude and behaviour change.

Interviewees highlighted the difficulties inherent in measuring effectiveness of programs in the short term with the widely-held belief that noticeable changes can often only be measured in the long term. Interviewees also questioned whether it is possible, or necessary, to consistently measure effectiveness of injury prevention strategies for the 0–4 year age group in terms of outcomes. Some respondents believed process information to be an appropriate measure of effectiveness.

Each person interviewed was familiar with examples of programs they considered to be successful. Some were also able to mention successful programs for hard-to-reach groups. Common suggestions of programs which were considered successful included the ‘Hot Water Burns Like Fire’ campaign, pool fencing legislation, child restraint programs and farm safety projects. ‘Safe Accident Free Environment’ and multilingual information brochures were mentioned as successful programs for hard-to-reach groups.

The most commonly mentioned measure of success was the incorporation of a coordinated and collaborative approach to the program, gaining support from a variety of groups, such as industry, manufacturers, health professionals, media and parents. Other measures included identifying the problem or need in collaboration with the target group, which enhanced acceptance of the program. It was also felt that long term programs should be sustainable.

4.3.1.2 Development of Injury Prevention Programs

Interviewees believed that gaining program support by identifying key players and actively involving a variety of groups were the key to building sustainability. Achieving legislative change and increasing workers’ skill levels in injury prevention were perceived to be effective strategies that help build sustainability.

Several interviewees identified that leadership in policy direction was also required to build sustainability. Long term direction, planning and funding was identified as necessary in the area of injury prevention for the 0–4 year age group.

The predominant opinion on establishing networks was to utilise existing groups and community systems. In addition, the majority of respondents reinforced the importance of working actively on building networks, by sharing information, involving a variety of players with vested interests and establishing inter-agency partnerships.

4.3.1.3 Delivery of Programs

The main factors that assisted in implementing injury prevention programs were those associated with cost: who is responsible, how much money is available and whether commitment exists between funders and service providers. Program design features were raised as factors that assist in the implementation of programs. Several respondents cited using available research and people with specific injury prevention knowledge as assisting implementation of programs. Commitment from both the funding body and the service provider were also important.

The most common response with regard to barriers working against the implementation of injury prevention programs was difficulties associated with competitiveness and short term funding allocations. The short term nature of many projects was reported to limit evaluation opportunities, detract from sustainability and fragment injury prevention efforts.

Further barriers noted by the respondents included a dominant community attitude that injuries are not preventable, a lack of injury prevention knowledge and training, the diversity of the target group and that injury prevention is not on the cultural or political agenda.

Policy change to establish injury prevention as a priority for action was considered a crucial factor in the delivery of injury prevention programs and could potentially be achieved from both top-down and bottom-up approaches. It was also felt that policy change could be driven by the needs of the community and achieved by constant advocacy using a collaborative approach.

4.3.1.4 Decision Making

With regard to the issue of funding for injury prevention, interviewees commented that insufficient funds have been allocated to injury prevention. Comments were made regarding the need for funding to develop an injury prevention infrastructure. However, the problem of short term funding detracting from sustainability and the ability to evaluate programs will need to be considered.

The following is a summary of what components may be required for a program to be allocated funding:

- Comprehensive, incorporating research and identifying key priority areas rather than buying projects ad hoc.
- Existing organisations with established networks.
- Well researched and based on evidence.
- Specifically targeted and able to demonstrate how target groups would be accessed.
- Demonstrate cost-effectiveness.
- Incorporate a collaborative effort and use a range of strategies.
- Potential to be sustainable.
- Adequate provision for quality evaluation.

4.4 Summary of General Findings across All Child Injury Areas

Some general findings have been noted about the weight of evidence for certain approaches across all child injury areas. These include:

1. The most definitive successes in child injury prevention relate to engineering or design changes to hazards or hazardous products. These are uniformly applied through the use of legislation or enforcement, for example:
 - Child resistant containers for medications or poisonous substances
 - Modifications to children's sleepwear
 - Swimming pool fencing
 - Bars on windows in high-rise apartments
 - Reduction of maximum hot water temperatures in the home.

2. A mix of strategies, community-wide approaches or large-scale campaigns which encompass educational, environmental, legislative strategies and, in some cases, improved treatment or medical response, has been found to be effective in reducing specific injuries (such as scalds, or respiratory injuries) or child injuries generally (as in the safe communities approach).
3. The careful targeting of programs, such as targeting those at greatest risk, as well as attending to public areas, because of the capacity to enforce or monitor safety compliance, have been found to be effective.
4. Education (whether media-based, individual or group counselling) with or without print material on its own has not been found to have an impact on injury outcomes.
5. Education is more likely to be associated with a reduction in injuries if:
 - It is coupled with enhancing access to safety devices (such as discounts or give-aways) particularly for low socioeconomic groups.
 - It is coupled with regulation or enforcement.
 - It is delivered over several occasions or is extended counselling (30 minutes or more).

4.5 Conclusions of Systematic Review

This document presented findings from a systematic review of the evidence for effectiveness of several child injury prevention interventions. There is clear evidence for particular health promotion strategies across the range of injury types including poisoning, burns and scalds, falls, immersion and road transport. However, there has been limited evaluation of several programs, some programs are currently being evaluated and further research is required in some areas.

While a substantial volume of research has been undertaken with regard to child injury cause areas and the effectiveness of specific interventions, there are gaps in the evidence base. For example, key stakeholders in injury prevention commented that injury surveillance has been shown to be an important tool in identifying the causes of injury and effective strategies for prevention. However, resource limitations have restricted the availability of detailed data through Emergency Department surveillance systems, in addition to the capacity to conduct follow-up studies to identify and develop intervention strategies.

While there will need to be further work undertaken to determine cost-effectiveness issues, it would be advantageous to continue to develop Emergency Department surveillance systems, including support for more detailed data collection and adequate follow-up research. The negotiation of support from key stakeholders for adequate research into the effectiveness and efficiency of child injury prevention strategies is a key component of this system, including support from stakeholders at the local level. This will be necessary to implement pilot strategies and research and may also include acting as a control area for interventions.

The review of the evidence showed that a number of childhood injuries occur in the home and this is the principal setting for several child injury prevention strategies. To obtain consistency across the approaches for child injury prevention in the home, it may be worthwhile to develop a pilot generic education and environmental change strategy that is targeted at injuries in the homes of children under the age of five. Development would need to include a pilot intervention with adequate controls and high quality evaluation of impact on knowledge, attitude, beliefs, environments and, possibly, injury rates.

With regard to the specific injury cause areas of poisoning and burns and scalds, there are

child injury prevention strategies that are proven to be effective. These include child resistant containers for medications or poisonous substances and the reduction of maximum hot water temperatures in the home. The ongoing enhancement and improvement of these existing approaches is a further key child injury prevention strategy. For example, in the area of poisoning, strategies include increasing coverage of child resistant closures and developing and testing of logic based child resistant closures that selectively increase child resistance while increasing ease of use by the elderly. With regard to burns and scalds, strategies include monitoring of smoke alarm use and impact of battery failure in non-mains alarms, in addition to wider implementation of household water temperature controls.

In conclusion, this resource presents a critical review and analysis of approaches for the prevention of injury for children aged 0–4 years. Programs targeted to individuals and communities have been reviewed and their efficacy described. The reviewers noted that there was a limited amount of information on the cost-effectiveness of interventions. The effectiveness of a range of strategies for the prevention of child injury has been examined including education, environment modification, behaviour change, legislation and policy. Evidence has also been sought on the broader outcomes of injury such as the impact on the family, overall health and wellbeing and quality of life. Relevant key stakeholders and child injury prevention experts were interviewed to collate their views on child injury prevention in practice and projects that have been conducted in their local communities.

There is evidence for effectiveness for some child injury prevention strategies and this review supports the establishment and implementation of interventions that have been demonstrated to be effective. There is, however, a need to actively seek to change knowledge and attitudes of the public and decision makers to make it possible to implement effective measures fully and properly. Effective injury prevention strategies, as well as cost-effective strategies, will need to be identified and piloted with sufficient resources and it will be necessary to undertake high quality evaluation of these strategies. This will ensure that they are widely disseminated to the field if they are found to be effective or, if they prove to be ineffective, they may be withdrawn.

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Appendix I

Structured Interview Questions: Program of Consultation with Key Stakeholders and Child Injury Prevention Experts

1. What do you see as the most effective injury prevention strategies for the 0–4 age group, for example, legislation, education/behaviour modification, design/engineering/environmental modification?
2. How would you measure effectiveness, that is, what outcome measures would you use?
3. Could you give some examples of successful programs?
4. What about programs for hard to reach groups?
5. Why do you think they were successful?
6. What are the main factors that assist in implementing injury prevention programs?
7. What are the barriers?
8. How do you build sustainability?
9. How do you establish networks?
10. How important is policy change? How do you achieve it?
11. What skills and training are needed for injury prevention practitioners?
12. Comment on funding for injury prevention.
13. What do you think are the best buys? If you worked in State government how would you use your injury prevention budget?
14. The final report for this project will be widely disseminated. What information and format would be most useful to you?

Appendix II

A Case Study of Current Child Injury Prevention Practice

As a case study for this evidence-based review, maternal and child health nurses (MCHNs) and health promotion officers were provided with questionnaires on their current practice in the field of child injury prevention. Focus groups were also conducted with MCHNs who are involved in the special interest group of their Victorian professional association. This active group of MCHNs contributes regularly to government programs and policy and recognises the benefits of consultation with community providers in achieving changes to public health decision making.

The case study was seen as an opportunity to observe the practice of two key groups who deliver child injury prevention strategies, rather than provide a critique of current activities. While some aspects of practice presented here challenge the findings of the evidence-based review, this is viewed as fertile ground for strategies to increase knowledge and change behaviour.

Maternal and Child Health Nurses and Health Promotion Officers

Questionnaires were disseminated to MCHNs and health promotion officers to elicit their injury prevention training needs and effective injury prevention strategies. MCHNs are the primary contact point and the principal providers of health promotion and injury prevention materials for mothers with children less than five years of age. MCHNs play key roles in population-based public health surveillance, the early identification and intervention for health concerns and the provision of maternal and family support. Health promotion officers play key roles in the development, implementation and evaluation of community and workplace education and health promotion strategies. Twenty-seven of the 250 members of the Australian Nursing Federation's (ANF) MCHN Special Interest Group and 26 health promotion officers (from 64 local government areas) returned completed questionnaires.

Design of Childhood Injury Prevention Strategies

All the MCHNs nominated that they provided written or verbal advice to parents about child safety. The sources of this written information were not clear but were likely to include information from the Victorian Child Health Record, the Royal Children's Hospital Safety Centre information booklets and Early Childhood Injury Prevention Program (ECIPP) sheets. More than 90 per cent of MCHNs conducted group sessions with new parents. Other activities included conducting home safety checks and recommending environmental changes.

Other injury prevention strategies employed by MCHNs included referral to services, displaying safety news items, videos and various brochures for parents, organising workshops with celebrities, and safety audits. The major thrust of MCHN activity was an individual approach.

Health promotion officers used more global approaches than MCHNs, with a wider spread of strategies across education, environmental models and advocacy. Other child injury prevention strategies utilised by health promotion officers included policy development, injury prevention planning and responding to children's services regulations.

Effective Child Injury Prevention Strategies

The majority of MCHNs nominated educational strategies as the most effective and noted that a combination of strategies was also very effective. There was a perception that allowing parents to discuss issues of child safety allowed them to explore relevant issues and reinforced learning.

Approximately half of the health promotion officers surveyed nominated educational injury prevention strategies to be most effective. Six per cent named environmental modification or engineering as the most effective, while the remaining 44 per cent believed a combination of strategies to be most effective. A combination of strategies was considered effective because different elements were required to support and complement the others.

Experience of Delivery of Childhood Injury Prevention Strategies

MCHNs were invited to rate their experience with program delivery on a Likert scale from 1 (no experience) to 5 (a lot of experience). All nurses had some degree of experience. Few health promotion officers had experience in program delivery, 27 per cent nominating some experience to a lot of experience. Seventy-three per cent had little or no experience in program delivery.

Factors Facilitating Implementation of Childhood Injury Prevention Strategies

The following factors facilitated implementation of childhood injury prevention strategies:

Maternal and Child Health Nurses

- Early Childhood Injury Prevention Program (ECIPP)
- Awareness weeks organised by other groups
- Safety video
- Visiting and using the Royal Children's Hospital Safety Centre
- Research and statistics on injuries
- Various safety information brochures.

Health Promotion Officers

- New mothers are keen to learn
- Quantitative and qualitative analysis
- Local government willing to fund
- Parent community involvement
- Statistics support injury as a priority.

Barriers Inhibiting Implementation of Childhood Injury Prevention Strategies

The following barriers inhibited implementation of childhood injury prevention strategies:

Maternal and Child Health Nurses

- Attitudes of parents that accidents are inevitable
- Difficult for parents in rental accommodation to implement safety design modifications; dependant on attitude of landlords
- Inadequate resources

- Difficult for families to attend group sessions
- Some groups difficult to access
- Cost of safety products and design modification.

Health Promotion Officers

- Time availability for parents to attend information sessions
- Lack of time and resources devoted to injury prevention, as injury prevention is not core business
- Lack of information on model programs
- Lack of awareness about the particular issues and approaches to child injury prevention
- Injury prevention is not part of the tender contract and funding is not available to work on programs.

Allocation of Funding

MCHNs perceived that opportunities for funding allocation included public education campaigns using television advertisements, more accessible static displays, speakers with other languages available if necessary, and easier access to products, product availability and price listings.

Health promotion officers perceived that opportunities for funding for longer term programs included the incorporation of injury in municipal public health plans by local government, better local area analysis of the risk and protective factors for communities, and the provision of packaged programs to support a statewide message.

Summary Results of Maternal and Child Health Nurse Focus Group

An informal discussion was held with representatives of the ANF Maternal and Child Health Special Interest Group and comprised 15 participants. The discussion was recorded and transcribed. For the purposes of this section, the main themes of the discussion are divided according to those relating to delivery of injury prevention programs and those relating to decision making with regard to injury prevention.

Delivery of Injury Prevention Programs

The focus group believed that MCHNs have a key role to play in the implementation of injury prevention strategies for the 0–4 year age group. MCHNs are actively involved in municipal health plans at local government level and feel they are the main group to address injury prevention with the 0–4 year age group. Although maternal and child health groups have performed roles in injury prevention and quality improvement projects, they feel that they are given little opportunity to identify issues and lobby for change.

The focus group expressed that their ability to be involved in community development is limited by a shortage of resources and that they are poorly resourced for ongoing programs. Participants believed that this, combined with the employment of MCHNs on short term contracts, may contribute to the lack of program sustainability. In addition, within the allocation of funding assigned to maternal and child health, injury prevention has not been recognised as a priority.

Decision Making

The MCHN focus group offered suggestions to improve their ability to implement injury prevention strategies for the 0–4 year age group. The group requested that injury prevention priorities be planned, rather than introduced as a response to an incident. The group also highlighted that a more collaborative, coordinated and committed approach to child safety was necessary—from those funding injury prevention, those providing services and the manufacturers and retailers of furniture and other products—to ensure that information and products are continually updated and programs are sustained.

Conclusions from Case Study

In conclusion, this case study has examined the current child injury prevention practice of MCHNs and health promotion officers. As previously mentioned, rather than provide a critique of current practice, the case study was an opportunity to observe two key groups that deliver child injury prevention strategies. Some aspects of practice challenge the findings of the evidence-based review. However, through the provision of leadership and the development of partnerships and linkages, there will be opportunities to share successful strategies in child injury prevention and thereby advance the evidence-based practice of these practitioners.