Preventing Unintentional Injury in Children Review 4:

Strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury in children and young people in the home environment

18 August 2009

COMMISSIONED BY: NICE Centre for Public Health Excellence

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About the Peninsula Technology Assessment Group (PenTAG)

The Peninsula Technology Assessment Group is part of the Institute of Health Service Research at the Peninsula Medical School. PenTAG was established in 2000 and carries out independent Health Technology Assessments for the UK HTA Programme, systematic reviews and economic analyses for NICE (Technology Appraisal and Centre for Public Health Excellence) and systematic reviews as part of the Cochrane Collaboration Heart Group, as well as for other local and national decision-makers. The group is multi-disciplinary and draws on individuals' backgrounds in public health, health services research, computing and decision analysis, systematic reviewing, statistics and health economics. The Peninsula Medical School is a school within the Universities of Plymouth and Exeter. The Institute of Health Research is made up of discrete but methodologically related research groups, among which Health Technology Assessment and Evidence Synthesis are strong and recurring themes. Projects to date include:

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- Preventing unintentional injury in children on the road; a review of effectiveness and cost effetciveness (2009)
- Barriers to, and facilitators of, preventing unintentional injury in children on the road (2009)
- A Systematic Review of the Effectiveness and Cost-Effectiveness of Weight Management Schemes for the Under Fives (2009)
- The Effectiveness and Cost-Effectiveness of Cochlear Implants for Severe to Profound Deafness in Children and Adults: A Systematic Review and Economic Model (2008)
- The Effectiveness and Cost-Effectiveness of Methods of Storing Donated Kidneys from deceased donors: A Systematic Review and Economic Model (2008)
- Bevacizumab, sorafenib tosylate, sunitinib and temsirolimus for renal cell carcinoma: A systematic review and economic model (2008)
- The Effectiveness and Cost-Effectiveness of Cinacalcet for Secondary Hyperparathyroidism in end stage renal disease patients on dialysis. Systematic Review And Economic Evaluation (2007)
- The effectiveness and cost-effectiveness of Carmustine Implants and Temozolomide for the treatment of newly-diagnosed High Grade Glioma**.** Systematic Review And Economic Evaluation (2007)
- The Effectiveness and Cost-Effectiveness of Cardiac Resynchronisation Therapy for Heart Failure. Systematic Review And Economic Evaluation (2007)
- Inhaled Corticosteroids and Long-Acting Beta2-Agonists for The Treatment of Chronic Asthma in Adults and Children Aged 12 Years and Over: a Systematic Review and Economic Analysis (2007)

- Inhaled Corticosteroids and Long-Acting Beta2-Agonists for The Treatment of Chronic Asthma an Children Under the Age of 12 Years: a Systematic Review and Economic Analysis (2007)
- The Cost-Effectiveness of testing for hepatitis C (HCV) in former injecting drug users. Systematic Review And Economic Evaluation. (2006)
- Do The Findings Of Case Series Studies Vary Significantly According To Methodological Characteristics?(2005)
- The Effectiveness And Cost-Effectiveness Of Pimecrolimus And Tacrolimus For Atopic Eczema - A Systematic Review And Economic Modelling (2005)
- The Effectiveness And Cost-effectiveness Of Dual Chamber Pacemakers Compared To Single Chamber Pacemakers For Bradycardia Due To Atrioventricular Block Or Sick Sinus Syndrome - Systematic Review And Economic Evaluation (2005)
- The Effectiveness and Cost-Effectiveness Of Surveillance Of Barrett's Oesophagus: Exploring The Uncertainty (2005)
- The Effectiveness And Cost-Effectiveness Of Microwave And Thermal Balloon Endometrial Ablation For Heavy Menstrual Bleeding - A Systematic Review And Economic Modelling (2004)
- Systematic Review Of Endoscopic Sinus Surgery For Nasal Polyps (2003)
- The Effectiveness And Cost-Effectiveness Of Imatinib For First Line Treatment Of Chronic Myeloid Leukaemia In Chronic Phase (2003)
- The Effectiveness And Cost-Effectiveness Of Imatinib (STI 571) In Chronic Myeloid Leukaemia - A Systematic Review (2002)
- Screening For Hepatitis C Among Injecting Drug Users And In Genitourinary Medicine (GUM) Clinics - Systematic Reviews Of Effectiveness, Modelling Study And National Survey Of Current Practice (2002)

Collaborations

Work for the NICE Centre for Public Heath Excellence is carried out in close collaboration with the West Midlands Health Technology Assessment Centre at the University of Birmingham. They were not involved directly in this review.

Acknowledgements

With many thanks to Jenny Lowe, Sue Whiffin and Bud Webb for administrative project support. Many thanks also to Kate Boddy who assisting with searching. Thanks to Rob Anderson and Mark Pearson (PenTAG), the CPHE team and members of the PDG for comments on an earlier draft of this review.

Declaration of authors' competing interests

The authors have no competing interests.

List of abbreviations

C	Celsius
CPHE	Centre for Public Health Excellence
EV	External validity
F	Fahrenheit
FOSP	Fencing of Swimming Pools Act 1987 in New Zealand
ICD	International Statistical Classification of Diseases and Related Health Problems
IV	Internal validity
KID-HCUP	Kids inpatient database, a national database of demographic, socioeconomic, treatment and outcome, hospital discharge data in the USA
NICE	National Institute for Health and clinical Excellence
NSW	New South Wales
NYC	New York City
PenTAG	Peninsula Technology Assessment Group
TMV	Thermostatic mixing valves

Glossary of terms

Children and young people	Those aged under 15
Compliance	"Compliance" in this protocol relates to those at whom legislation, regulation or standards are aimed. For example, in the case of fire alarms, this may be practitioners, such as fire office departments, who may be required to comply with regulation for their installation; or it may relate to parents or other carers, at whom standards about checking and maintaining the alarms are aimed.
Home risk assessment	A systematic assessment of a home to identify potential hazards, evaluate the risk, and provide information or advice on appropriate actions to reduce those risks. The assessment may either be by a trained assessor visiting the home, or by a householder assessing their own home.
Home safety equipment	Includes items such as smoke alarms, hot water restrictors, stair gates etc.
In the home	Within the geographical property boundary (e.g. house, garden and garage) of private residences (Note that this is a broader definition of the home than used for the public health intervention guidance currently also being developed). It will therefore, for example, include any strategic frameworks or safety legislation related to ponds or swimming pools. Children's homes will be included, but other specialist residential environments - such as young offenders' institutes, or residential psychiatric units - will not be included.
Multi-family dwelling	Multiple separate housing units for residential use within one building, most commonly as a block of flats.
Ordinance	A law or decree. In USA, a by-law.
One-family dwelling	Or "single family dwelling" – a detached house.
Strategic policies and regulatory or legal frameworks	- Legislation (primary and secondary), regulation, standards and their enforcement - Mass-media campaigns and initiatives (when this wholly or partly aims to encourage awareness of and compliance with the above).
Two-family dwelling	A house divided into separate accommodation for two households – a semi-detached house.
Unsafe incidents	Near misses or non-compliance identified or defined by risk assessments that do not result in actual unintentional injury.

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1. Summary

1.1. Introduction

This report is the fourth review in a linked series of five to inform the development of CPHE NICE programme guidance on how to prevent unintentional injuries among children and young people aged under 15.

1.2. Aim

The review aim is to locate, review and synthesise studies about the performance of strategic policies and regulatory or legal frameworks for guiding or promoting:

- the supply and/or installation of home safety equipment, and
- the provision and conduct of home risk assessments,

aimed at preventing unintentional injuries to children and young people in the home.

The review questions were:

In what ways can legislation, regulation and/or standards (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation or the operation/effectiveness of:

- programmes/initiatives to supply or install safety equipment in homes,
- programmes/initiatives to provide home risk assessments,

where they relate to the prevention of unintentional injuries to children and young people.

- Are mass media campaigns effective as a tool for encouraging compliance with such legislation, regulation and/or standards?
- Which other activities or circumstances are associated with higher (or lower) compliance with legislation, regulations and/or standards (relating to unintentional injury prevention or child safety in the home).

1.3. Methods

Standard methods of systematic review were used for this review, involving the development of a pre-defined protocol containing the strategy for methods of searching for screening identified research reports according to a inclusion and exclusion criteria, the methods for assessing study quality and standardised tools into which data were extracted.

Due to the disparate nature of studies identified, analysis and synthesis of the results was undertaken narratively.

1.4. Findings

Evidence statement 1: Smoke detector law

There is evidence from one controlled before and after study (+) in the USA that law requiring the installation of smoke detectors, increases the number of houses which have at least one functioning smoke detector and that this may reduce fatalities related to fires in targeted properties (McLoughlin et al, 1985).

Knowledge of the law and the penalty for non-compliance may be associated with greater smoke detector installation than knowledge of the law only.

The law assessed required smoke detectors in all bedroom areas of one-, two- and multi-family dwellings, applied retrospectively to homes built prior to the law, and can be enforced by a fine or jail time. In addition, sale of a property is contingent on appropriate smoke detectors being present.

Given the differences in legal systems, responsibilities and enforcement between the USA and the UK, and the high socioeconomic status of the studies communties, the applicability of this finding has been assessed as poor. However, the observations that systems of enforcement which involve regular inspection, with a system of warnings prior to prosecution are effective; that laws which reflect societal laws are effective and that media campaigns to support the introduction of new laws may be important, may be applicable across other settings.

Evidence statement 2: Window guard law

There is evidence from one comparative study in the USA (+) that window guard legislation in New York city reduces child injury related to falls from buildings by about half, despite greater numbers at risk as residents of multi family dwellings (1.5/100,000 children aged 0-18 compared with an average of 2.81/100,000 in 27 state other US states without legislation, and 3.0/100,000 in Massachusetts which introduced interventions without legislation) (Pressley & Barlow, 2005).

The law assessed required owners of multiple-family dwellings to provide window guards in apartments where children, aged 10 or under, live (half the injuries recorded in NYC were in those aged 11-18). Compliance is subject to annual enforcement. The introduction of the law was accompanied by a coordinated education and advertising programme (*Children Can't Fly*) which involved outreach, dissemination of literature, a media campaign and the distribution of free window guards.

Given the differences in legal systems, responsibilities and enforcement between the USA and the UK, and the differences in housing stock and management, the applicability of this finding has been assessed as poor. However, the observation that effective enforcement is a key element of legislative success may be applicable across a range of settings.

Evidence statement 3: Hot water tap temperature law

There is mixed evidence from four uncontrolled before and after studies about hot water tap temperature legislation (Erdmann et al, 1991, USA, [+]; Leahy et al, 2007, USA, [+]; NSW Health 1998 Australia, [+]; Spallek et al, 2007 Australia, [+])

Two studies reported that the annual incidence of burn injuries in children *increased* after the introduction of legislation (Leahy et al, 2007, New York, [+]; in children aged 0-4years; Spallek et al, 2007, Queensland, [+]; in children aged 4-13 years), and a further study (Erdmann et al, 1991, Washington state, [+]) found that injury rates were raised compared to the period immediately prior to legislation being introduced but fell in relation to an earlier comparator time-period (Erdmann et al 1991, [+]). Only the study by Spallek et al (2007, [+]) reported p-values, but this was a significant increase

(p=0.01).

One study (New South Wales) suggested there may be a decrease in the number of scald injuries however, the reported differences were non-significant (p=0.57) (NSW Health, 1998, [+]; in children aged 0-4).

The legislation assessed by the Australian studies was *Hot Water Burns Like Fire* which was a campaign to promote building code regulations introduced in 1994 (in New South Wales) and 1998 (in Queensland). These regulations require all new homes, and those undergoing major renovations, to install a tempering valve which limits bathroom hot water temperature to 50°C (122°F). This had been preceded in NSW by social marketing campaigns which focused on increasing awareness of the dangers of scalding for children and, in particular, the dangers of hot tap water, among parents, relevant industry and trade groups.

The USA studies assessed two different pieces of legislation. From 1997, title 27 of the New York City Administrative Code was amended to require water heaters in all newly built or renovated multi-unit dwellings to have a maximum temperature setting of 49°C (120°F). While in Washington state since 1983, all new water heaters have been required to be set at a maximum temperature of 49°C (120°F) and water heaters in rental properties must be reset to this temperature each time a new tenant moves in and warning labels must be displayed. The law is supported by the annual notices to gas and electric customers warning of the danger of hotter water and promoting lower temperature as safer providing energy savings. It is permitted, however, for home owners and tenants to turn up the thermostat if they prefer.

Given the differences in legal systems, responsibilities and enforcement between the USA and Australia and the UK, and the differences in housing stock and management, the applicability of these findings have been assessed as poor. However, the observation that legislation aimed at safety in the home may be limited in its effectiveness where it is implemented only in that housing stock where access and enforcement is easier (such as in rented or newly built accommodation only), may be applicable across a range of settings.

Evidence statement 4: Swimming pool fencing law

There is mixed evidence from four studies (2 case control, and 2 comparative) about swimming pool fencing legislation (Morgenstern et al, 1990, USA [+]; Morrison et al, 1999, New Zealand [-];Stevenson et al, 2003, Australia [+]; Van Weerdenburg et al,

2006, Australia [-]).

2 studies (1 USA and 1 Australia) suggest that legislation is ineffective where it only requires 3-sided fencing. The US study suggests no impact of such legislation on drowning in children aged <10 years old compared to no legislation (OR 1.27 95% CI 0.72, 2.25) (Morgenstern et al, 2000 [+]). The Australian study found the incident rate ratio of drowning in children aged <5 years old living in houses with three sided rather than four sided pool fencing was 1.78 (95% CI 1.14, 1.79) (Stevenson et al, 2003 [+]).

3 studies (2 Australia, 1 New Zealand) report on outcomes related to legislative management and compliance (Morrison et al, 1999 [-]; Stevenson et al, 2003 [+]; Van Weerdenburg et al 2006 [-]).

The New South Wales study found that a more structured and comprehensive approach to inspection (including a register of owners, annual inspections, and enforcement of the act including fines) resulted in twice the level of compliance as those with less structured/ detailed approaches (Van Weerdenburg et al, 2006 [-]). Key informant interviews also suggest that lack of clarity in the fencing act, and failure to detail *how* councils should ensure compliance, including how it should be funded, hampered effective implementation.

The Western Australia study suggests that compliance is highest immediately after legislation is introduced, and falls off thereafter, although regular inspection enhances compliance (Stevenson et al, 2003 [+]).

The New Zealand study found no association with compliance rates and: local authorities having written policies about locating and inspecting pools; a reinspection programme; or advertising of pool owners' obligations under the relevant act (Morrison et al, 1999 [-]).

The USA study is set in Los Angeles county, which has had an ordinance in place since 1967 requiring a 1.5m (5') fence or barrier with self-latching gates around all domestic swimming pools. The ordinance was interpreted by the Building and Safety Department to allow a residence wall, including doors and windows, to form part of the barrier (three-sided fencing). Until 1988, most cities in the county enacted their own locally enforced fencing ordinances for residential pools; however, all apply to in-ground and above-ground pools at least two feet

deep that are new or newly altered. Prior to 1996, they also allow three-sided fencing.

In New Zealand, the Fencing of Swimming Pools (FOSP) Act 1987 requires domestic swimming pools, including spa pools, to be fenced. This Act was supplemented by the 1991 Building Act which requires building consent for pools prior to construction, and this must demonstrate compliance with FOSP. The fence must surround only the pool, and immediate area around it. This cannot be simply a boundary fence although buildings can form part of it (three-sided fence). Local government authorities have responsibility for ensuring compliance with the FOSP Act.

Australian states require domestic swimming pool fencing and gates to comply with Australian Standard (AS1926.1). Pools installed before 1992 can have three-sided fencing, with the fourth permitted to include a wall that contains a door or window into the residence. Pools installed after 1992 must either be four-sided and isolated from the resident, or may include a wall with door or window if these can be locked. Inspection of pools has been mandatory since its 1992 introduction. The studies included here are based in Western Australia (Stevenson et al. 2003) and New South Wales (van Weerdenburg et al. 2006). The New South Wales study notes that councils there are required to “take appropriate steps to ensure they are notified of all swimming pools within their boundaries" and to “promote local swimming pool owners’ awareness of the requirement of the act”, although there is no legal mandate in the act for councils to fulfil this obligation.

Given the differences in legal systems, responsibilities and enforcement between the USA, Australia, New Zealand and the UK, and the low level of private swimming pool ownership in the UK, the applicability of these findings have been assessed as poor. However, some key lessons from these studies may be applicable across a range of settings, such as: the importance of adequate legal requirements in order to glean maximum benefit (as illustrated by three *vs.* four sided fencing here); the need for regular inspection regimes which are consistently enforced, and the related need for clear lines of responsibility and sufficient funding for these; the need for concurrent education to help owners comply with the spirit as well as the letter of the law (for example, the need for maintenance of equipment, and the valuing of safety over convenience) and finally the need for legislation which does not contradict or confuse other existing rulings.

2. Aims and Background

2.1. Objectives and Rationale

This report is the fourth review in a linked series of five to inform the development of CPHE NICE programme guidance on how to prevent unintentional injuries among children and young people aged under 15. Its aim is to locate, review and synthesise studies about the performance of strategic policies and regulatory or legal frameworks for guiding or promoting:

- the supply and/or installation of home safety equipment, and
- the provision and conduct of home risk assessments,

aimed at preventing unintentional injuries to children and young people in the home.

Other projects informing CPHE NICE guidance on how to prevent unintentional injuries among children and young people aged under 15 are:

- 'Preventing unintentional road injuries among under 15s: road design'. This guidance will focus on the design and modification of highways, roads and streets. It will be developed using the public health intervention process.
- 'Preventing unintentional road injuries among under 15s in the home'. This guidance will focus on the design and modification of highways, roads and streets. It will be developed using the public health intervention process
- 'Preventing unintentional injuries among under 15s in the external environment'. This guidance is expected to cover sports and leisure. It will be developed using the public health intervention process (draft scope will be currently under consultation).
- 'Preventing unintentional road injuries among under 15s: education and protective equipment'. This guidance is expected to cover safety equipment such as helmets and visibility clothing. It will be developed using the public health intervention process.

2.2. Background

Legislation, regulation and standards may be designed to prevent injury-producing events from occurring (such as safe hot water tap temperatures) or to prevent injury once the potentially injury-producing event has already occurred (such as smoke detecting alarms) (Schieber et al. 2000). Legislation and regulation may attempt to control individual behaviour, change a legal process (such as eligibility for a full driver's license) or to change the way a product is manufactured or packaged (Schieber et al. 2000). While some attempts to legislate behaviour may be controversial, it has been suggested that laws designed to protect children generally have more public acceptability (Schieber et al. 2000).

It has been suggested that a three pronged attack is required to protect against unintentional injuries: educate (persuade or change behaviours), legislate (require laws) and recreate (provide protection devices)(Gunnels 1996). As legislation is potentially a powerful tool for preventing injury, its development could be regarded as a test of commitment to child safety (Peden et al. 2008). Young children are particularly at risk from injury at home, where they spend most of their time (Dowswell et al. 1996). There is a negative social class gradient, especially for burns, with those from more deprived backgrounds at greatest risk. Although this report aimed to identify strategies and standards, as well as legislation, designed to prevent unintentional injury to children in the home, only reports linked to legislative changes were identified.

2.2.1. Smoke alarms

Government policy in the UK recommends that local authorities install battery-operated smoke alarms in all their properties. A recent survey of local authorities in England and Wales asked what smoke alarm provision was in place for public sector housing, and found that 9% did not provide smoke alarms (Rowland et al. 2002). Most authorities offered ionization sensor alarms (35%), optical sensor alarms (18%) or a combination of the two (25%). While beyond what is required by legislation, many offer hard wired (42%) or a combination of battery and hard-wired alarms (31%).

Of the 242 authorities offering alarms, 38% offered regular servicing, 21% offered repairs on demand, 4% gave maintenance advice and 4% offered free batteries to tenants (Rowland et al. 2002).

2.2.2. Pool fencing

A Cochrane review in 1998 identified three case control studies which indicated that pool fencing significantly lowers the risk of drowning in children aged 0-13; preventing approximately three-quarters of all child drowning in pools (Thompson et al. 1998). Various pool fencing laws have been enacted for domestic swimming pools in Australia, New Zealand and the USA, outlining the type of fencing and gate and latch systems required and these are assessed later in this review. There are currently no laws regulating domestic swimming pools in the UK, perhaps because they are less common.

2.2.3. Falls from windows

Falls from height were identified as a major cause of death in urban children in the early 1970s. In 1979, an amendment to the New York City Health Code was introduced which required owners of multiple dwellings to provide window guards in apartments where children aged 10 or younger reside. This was accompanied by annual enforcement. A coordinated education program, “Children Can’t Fly”, involved outreach, dissemination of literature and instruction, a media campaign and distribution of easy to install free window guards. Initial findings from the Paediatric Department at Harlem Hospital suggested this was very successful, reporting a 96% decrease in admissions in children aged under 16 due to falls (both accidental and non-accidental) from a height (only one fall from a window in 1979-1981, compared to the expected 16 based on 1970-1978 figures) (Barlow et al. 1983) .

2.2.4. Hot water tap scalds

A review by the USA Consumer Produce Safety Commission in 1997 found that a maximum residential hot water temperature of 54^{o}C (130^{o}F) would prevent many tap water scalds. Together with a 1980 Consumer Product Safety Commission Alert Sheet, this information informed the American National Standards Committee

guidelines for gas heaters: specifying a maximum temperature of 54^{o}C (130^{o}F), presence of accurate, well-marked temperature gauges and warning labels about the dangers of burns from water at higher temperatures. A flaw in this standard was that it was easily overridden after installation (Leahy et al, 2007). There are a number of state legislations in the USA which require mixing (tempering) valves which mix cold and hot water prior to release through the hot tap, or maximum hot water settings on heaters, to keep temperatures below a certain temperature.

Since May 2006, building regulations in Scotland have required new builds and refurbished bathrooms to contain thermostatic mixing valves (TMVs) limiting bath water temperature to 48^{o}C (118^{o}F). England is due to follow suit from the Autumn 2009, as announced by the current government in a press release of May 2009. These requirements will form part of the Building Regulations for *Sanitation, Hot Water Safety and Water Efficiency*.

3. Methods

3.1. Review questions

In what ways can legislation, regulation and/or standards (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation or the operation/effectiveness of:

- programmes/initiatives to supply or install safety equipment in homes,
- programmes/initiatives to provide home risk assessments,

where they relate to the prevention of unintentional injuries to children and young people.

Secondary questions are:

- are mass media campaigns effective as a tool for encouraging compliance with such legislation, regulation and/or standards?
- which other activities or circumstances are associated with higher (or lower) compliance with legislation, regulations and/or standards (relating to unintentional injury prevention or child safety in the home).

3.2. Key outcomes

Measures of compliance (with legislation, regulation, standards) relevant to the aim of the policy/regulatory change.

Rates of unintentional injuries, severity of unintentional injuries, or number of care episodes (e.g. hospitalisations) relating to unintentional injuries.

Rates of relevant safety behaviours or compliance rates (e.g. number/proportion of houses with working smoke alarms, number/proportion of families with children using stair gates, number/proportion of sales of trampolines with industry standard compliant side-netting) or unsafe incidents.

3.3. Identification of evidence

Systematic review of published and unpublished studies was undertaken.

3.3.1. Searches

Methods used to identify relevant studies are: bibliographic database searching, tagged references from two parallel CPHE reviews on related topics (*An evaluation of the effectiveness and cost-effectiveness of the supply and/or installation of safety equipment and risk assessments for preventing unintentional injuries in the home to children and young people aged under 15*, informing the development of CPHE intervention guidance and to be presented at PDG5 and *An overview and synthesis of international comparative analyses and surveys of injury prevention policies, legislation and other activities*, presented at PDG1), named websites searches, reference checking, and following up expert contacts and suggestions. The former review is of particular importance as the search strategy and methodology used for that provided the starting point for the current review, due to the similarities in many of the interventions searched for (see Appendix 3). This was supplemented with additional searches incorporating terms related to legislation, enforcement, strategies and regulatory frameworks for guiding, enforcing or promoting prevention of injuries in the home in children under 15 (see Appendix 2 for the complete search methodology and strategies).

We also received some reference suggestions from experts in the field and the team at CPHE.

Relevant systematic reviews were used as a potential source of primary studies.

3.3.2. Inclusion of relevant evidence

3.3.2.1. Inclusion criteria

Populations

Children and young people aged <15 years

Interventions

Initiatives which are included relate to the supply or installation of safety equipment in homes, or the provision of home risk assessments, or both. Crucially, they must report on the evaluation of:

- strategic policies and regulatory or legal frameworks, (and/or activities to promote or ensure their enforcement); and activities to increase compliance and awareness of these initiatives, such as mass-media campaigns;
- legislation, regulation or standards which have an intended or potential role in guiding or promoting (a) the supply and/or installation of home safety equipment, and (b) the provision and conduct of home risk assessments, for preventing unintentional injuries to children and young people in the home.

The focus on installation and supply means that items that need to be fitted into the home are included (for example, smoke alarms, or stair gates) but that items that do not require correct installation to be functional (such as safety devices on lighters) are not.

Settings

In the home, including gardens and other outside spaces within the property boundaries of the home.

Locations

Any

Time period

Our protocol stated that only studies published since 1990 would be included, however, this failed to identify any information about smoke alarms. Since this is a key intervention, about which it is known that there is legislation, we agreed with the CPHE team at NICE to redo the searches for smoke alarms only, and include relevant studies published prior to this date.

Study design

Any comparative study design (randomised and non-randomised controlled trials, controlled and uncontrolled before and after studies, case control studies, ecological studies, cross-sectional studies, prospective and retrospective cohort studies) where there are comparisons of groups of people or places or activities, both with and without the specified legislation, regulation, enforcement or mass-media campaigns to support them.

3.3.2.2. Screening

Studies identified through the searches were uploaded into Reference Manager and all titles and abstracts (where available) were screened by one reviewer (RG). A predefined checklist (see Appendix 5) was used to assess adherence to the inclusion criteria. Where studies appeared to meet the inclusion criteria, or could not be excluded on the basis of the information provided, full text copies were obtained. Due to resource limitations, we were unable to have a second reviewer check a proportion of the title and abstract hits as planned in the protocol.

Full text study reports were checked for inclusion by one reviewer (RG). The checklist used is shown in Appendix 5. One study was also excluded because it provided only summary data of a study which was reported in more detail in a longer, included report.

Where systematic reviews were identified, the lists of included and excluded studies were scanned to identify potentially relevant studies, the title and abstract of which were screened online, with full text study reports screened online or as a hard copy, using the same checklists and procedures as above. (Note that none of the papers in the Cochrane review of pool fencing (Thompson et al, 1998) met the inclusion criteria for the current review because they are published prior to 1990 and/or do not evaluate the impact legislation, regulation or standards)

3.4. Methods of analysis/synthesis

3.4.1. Data extraction

For each included study, one reviewer (RG) extracted key data about study characteristics, details of the legislation or regulation being evaluated and results into evidence tables which are shown in Appendix 7.

3.4.2. Quality assessment

We assessed study quality using the quality appraisal checklist for quantitative intervention studies in the CPHE Methods Handbook (2009).

3.4.3. Data analysis and synthesis

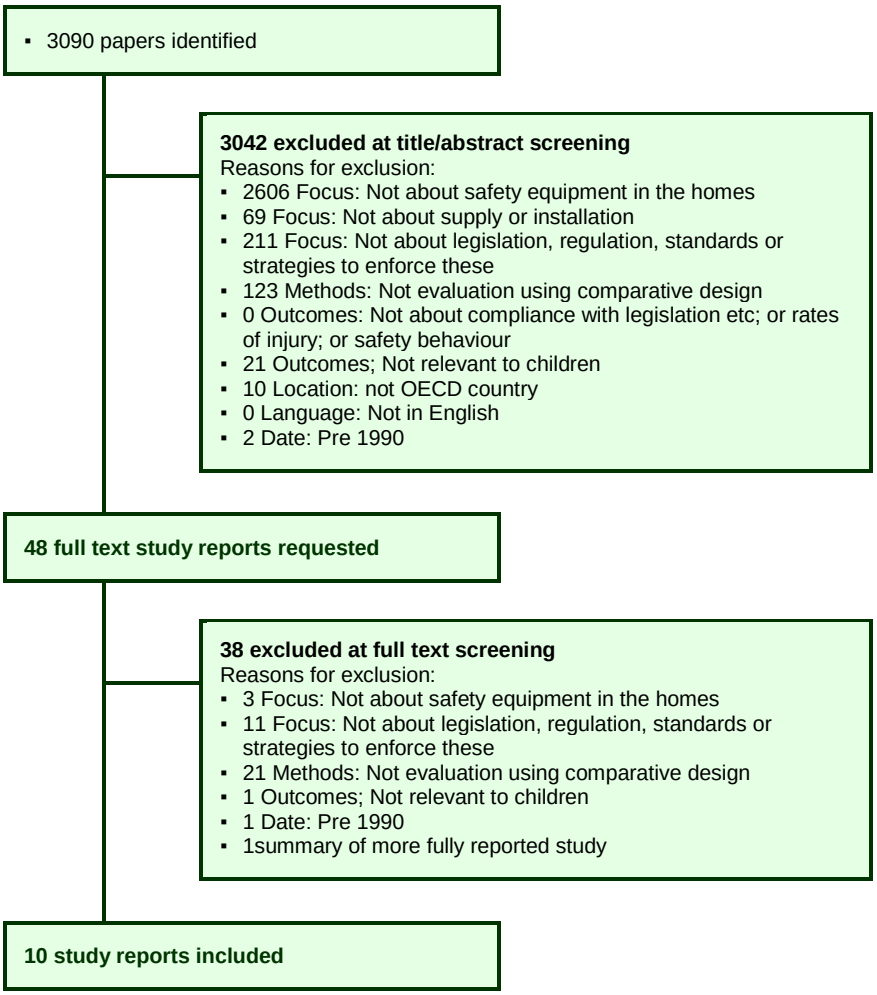
Data from the included studies was analysed and synthesised, and evidence statements produced. We used narrative synthesis methods rather than formal data pooling.

4. Summary of included studies

4.1. Identified studies

Process of study identification is shown in **FIGURE 1**.

FIGURE 1 *Review flowchart*



4.2. Included studies

We included a total of ten studies: one about smoke detectors (McLoughlin et al, 1985, USA), one about window guards to prevent falls (Pressley & Barlow, 2005

USA), four about hot tap water temperature (NSW Health Department, 1999 Australia; Erdmann et al, 1991 USA; Leahy et al, 2007 USA, Spallek et al, 2007 Australia) and four about swimming pool fencing (Morgenstern et al, 1990 USA; Morrison et al, 1999 New Zealand; Stevenson et al, 2003 Australia; Van Weerdenburg et al, 2006 Australia). Although domestic swimming pool fencing may not be a safety priority in the UK, these studies were the only ones to explore the impact of different inspection and enforcement strategies on compliance, and these may be applicable to the enforcement of other legislation requiring action by private households.

We did not identify any studies that assessed the impact of non-legislative strategies or policies for the reduction of unintentional injury of children in the home, nor did we identify any relevant studies about home risk assessments.

Full details of the studies and methods can be found in the evidence tables that form Appendix 7.

4.2.1. Quality appraisal

Included studies was assessed for quality using the assessment tool for quantitative studies from the CPHE Methods Guide 2009 (see Appendix 6). Where several types of data were collected through different mechanisms within a study, the assessment focussed on methods of assessing injury data. Further details of the studies, including study limitations can be seen in the evidence tables in Appendix 7 and the quality assessment is shown in Appendix 8. Two studies were considered to exhibit poor ("-") internal validity, usually due to uncertainty about the reliability of the outcome measures used or weaknesses in analysis. The remaining eight studies were judged "+".

4.2.2. Applicability

None of the studies came from the UK, limiting their applicability. This is the main reason that all were rated '-' for applicability. Despite this, it is possible that assessments concerning how to enhance compliance with legislation may be transferable to other locations, including the UK.

5. Results

The ten identified studies are reported in detail below, with separate sections describing studies relating to each intervention type: smoke detectors, window guards, hot tap water temperature control and domestic swimming pool fencing. Each section provides information about the legislation and associated activities that were being evaluated, the study characteristics and the results of each study. In addition, a "considerations" section for each type of intervention reports on any key study limitations, and any interpretations which the study authors provide to help interpret their findings.

Many of the studies consist of several linked parts, which may use different approaches to data collection and analysis. Full details can be seen in the extraction tables which form Appendix 7. For simplicity, where studies are characterised by study design in the descriptive tables and evidence statements of this review, PenTAG have reported the design which applies to the main part of the research, usually that which examines the impact on injury in children.

5.1. Smoke Detectors

One study was identified which assessed legislation related to smoke detectors (McLoughlin et al. 1985). Key study characteristics are reported in Table 1. Although we had originally intended to exclude studies that were published pre-1990, this inclusion criteria was relaxed for smoke detector studies when we failed to identify any studies about smoke detectors and legislation, regulation and enforcement after this date. Fire prevention is a key safety area, and injury to children due to fire exhibits a marked, negative social gradient. Although the McLoughlin et al (1985) study does not report child related outcomes separately, as smoke detectors protect households, rather than being aimed at specific vulnerable groups such as children, this inclusion criteria was also relaxed for smoke detector studies.

This study is set in the USA and compares households in Montgomery County, Maryland, with those in Fairfax county, Virginia. Montgomery County was the first major jurisdiction in the USA to adopt a retroactive law requiring the presence of smoke detectors in the bedroom area of all one-, two- and multi-family dwellings

regardless of when they were built. While earlier statutes had required smoke detectors to be fitted in the bedroom area of such newly built dwellings (Building Officials and Code Administrators International, 1975) it was not until 1978 that Montgomery County began to demand that detectors were retro-fitted. By 1983, (when this study was conducted) 29 states had followed suit. Enforcement of the legislation in Montgomery county includes a fine or jail time if detectors were not found by fire-fighters if called to a residence. In addition, sale of houses is contingent on there being certification of detectors.

Fairfax county was chosen as a control area due to similar demographic and socioeconomic profile, but with the presence of a different law; one requiring that smoke detectors be installed only in new build homes.

5.1.1. Smoke detectors: study characteristics

McCloughlin et al (1985) collected comparative data about smoke detector status in Montgomery and Fairfax counties using trained interviewers, who visited 500 single dwelling homes in Montgomery and 400 single dwelling homes in Fairfax selected randomly from tax assessors' lists. These homes mirrored the distribution of the county population among fire station response rates and the median property value of the houses was representative based on the census for each county. The interviewers also tested any smoke detectors found. Concern about refusals led to the project offering to give away detectors to those without, in return for survey participation.

Although there is no child specific data supplied although, as noted above, smoke detectors by their nature are aimed at protecting households and not confined to younger age groups, so these data are likely to have an impact on children and well as adults. Comparative statistics are not supplied in the report and have been calculated, where possible, by PenTAG.

Table 1 Smoke detector study characteristics

Reference	Aim	Method	Population	Location
McLoughlin et al, 1985 USA	To evaluate the Montgomery County law about smoke detectors which is the first in the USA to retrofit requirements.	Controlled before and after study	Single –dwelling households in 2 counties	Montgomery County, Maryland. Control - Fairfax County, Virginia.

5.1.2. Smoke Detectors: Results

Mcloughlin et al (1985) compared fatal fires in the two in counties, identifying a substantially greater reduction in fatal fires in Montgomery county compared to Fairfax, and fire deaths in single family dwellings were markedly less in Montgomery county (see Table 2), despite there being more single family fires in 1978-83 (2559 *v.* 2137 in Fairfax).

Table 2 Residential fire and fire deaths in Montgomery and Fairfax counties

		1972-77	1978-1983
Fatal fires	Montgomery	54	26
	Fairfax	40	27
Fire deaths	Montgomery	60	31
	Fairfax	56	40
Single family fire deaths	Montgomery	35	20
	Fairfax	46	40

Source: McLoughlin et al, 1985. Raw data not supplied, data extracted from a graph by PenTAG and therefore subject to inaccuracies. Montgomery = retrofit law. Fairfax = new build only.

Data was collected for 359/500 (72%) households approached in Montgomery Country and 287/ 400 (72%) in Fairfax county. Overall, single family dwellings in Montgomery county were statistically significantly more likely to have at least one working smoke detector than those in those in Fairfax county (41 *v.* 26% p=0.01), and less likely to have no detector at all (6% *v.* 15% p=0.005). However, they were no more likely to comply with their county code, and non-functioning detectors were found in similar proportions of both counties (see Table 3). It was not possible to explain these differences in terms of the requirement for only homes built after 1975 to have smoke

alarms installed in Fairfax; there were more houses built after this date in Fairfax than in Montgomery (25% *v.* 15%).

Table 3: Compliance with smoke detector codes

	Montgomery county N=359 n households (%)	Fairfax county N=287 n households (%)	p-value[a]
Conforms to 1978 code requiring a detector in each separate sleeping area on every level of the dwelling	53 (15)	56 (20)	0.21
Conforms to 1976 Montgomery code requiring detector for each separate sleeping area and in stairways leading to occupied areas	97 (27)	70 (24)	0.21
At least one working detector but does not conform to either code	145 (41)	76 (26)	0.01
Detectors present but none working	41 (11)	38 (13)	0.52
No detector	23 (6)	47 (16)	0.005

Source: McLoughlin et al, 1985. Montgomery = retrofit law. Fairfax = new build only.

About 80% of the interviewed population were aware, or assumed that there was a law about smoke detectors in Montgomery county. Compliance with smoke detector installation appears to have been positively affected by knowledge of both the law, and the penalty attached to it, so that compliance was greater in the 45% who were aware of the law and penalties for not complying, less among those who knew only there was a law and lowest among those who knew neither the law nor the penalty (see Table 4).

Table 4: Awareness of the law and smoke detector presence in Montgomery county

	No working detector at home (%)	Working detector but law not complied with %	Detectors Comply with law %	Total %
Law & Penalty known	5	18	22	45
Law known	7	13	14	34
Neither known	6	9	5	20

Source: McLoughlin et al, 1985. Raw data not supplied, data extracted from a graph by PenTAG and therefore subject to inaccuracies. Montgomery = retrofit law.

[a] Chi-squared calculated by PenTAG

5.1.3. Smoke detectors: Considerations

The study authors consider that building code requirements are an effective way of ensuring that smoke detectors are installed in homes, although it may require a gradual build up of working detectors (McLoughlin et al, 1985). They conclude that a retroactive law is enforceable, and that the mechanism of requiring certification when a property is sold is effective. Those inspecting homes for compliance with the legislation issue warning notices, and follow these up with re-inspection, to households where the law is not met. This is also judged as effective by the author, with only five summons (one prosecution) in five years noted, despite 500 warning notices issued. They suggest that the law may be effective because it fits with existing social norms: the vast majority of people interviewed believed the law to be a good idea (97% in Montgomery and 92% in Fairfax), but that media campaigns to support law introduction may be required.

Limitations noted by the study authors include the fact that the two counties included in the study are among the most affluent in the USA, and so had a low baseline risk of death from house fire. In addition, the data is restricted to single family dwellings which may further restrict the information to higher socio-economic groups. The relevance of these findings to other communities is not known.

Evidence statement 1: Smoke detector law

There is evidence from one controlled before and after study (+) in the USA that law requiring the installation of smoke detectors, increases the number of houses which have at least one functioning smoke detector and that this may reduce fatalities related to fires in targeted properties (McLoughlin et al, 1985).

Knowledge of the law and the penalty for non-compliance may be associated with greater smoke detector installation than knowledge of the law only.

The law assessed required smoke detectors in all bedroom areas of one-, two- and multi-family dwellings, applied retrospectively to homes built prior to the law, and can be enforced by a fine or jail time. In addition, sale of a property is contingent on appropriate smoke detectors being present.

Given the differences in legal systems, responsibilities and enforcement between the USA and the UK, and the high socioeconomic status of the studies communties, the applicability of this finding has been assessed as poor. However, the observations that systems of enforcement which involve regular inspection, with a system of warnings prior to prosecution are effective; that laws which reflect societal laws are effective and that media campaigns to support the introduction of new laws may be important, may be applicable across other settings.

5.2. Window guards

We identified one comparative study exploring the impact of legislation about window guards to prevent injury to children from falls (Pressley & Barlow 2005). The study is set in the USA and explores the impact of the 1976 amendment to the New York City Health Code which required owners of multiple family dwellings (of three or more apartments), usually landlords, to provide window guards where children aged 10 or under live. The exact nature of these guards is not described. Exceptions are made for windows that open onto fire escapes or a window on the ground floor that is needed as an emergency exit in a building in which there are fire escapes on the first floor and above.

Compliance is subject to annual enforcement although, again, it is not clear in the paper who is responsible for this. The introduction of the law was accompanied by a coordinated education and advertising programme called *Children Can't Fly* which involved outreach, dissemination of literature, a media campaign and the distribution of free window guards.

5.2.1. Window guards: Study characteristics

Pressley and Barlow (2005) compared data on hospital discharges in 2000 related to falls from buildings or structures (using relevant ICD codes) in those aged 18 or younger from 27 US states without legislation on window guards, with that from New York city in 2001. Study characteristics are shown in Table 5.

Table 5 Summary of identified study report about window guards

Reference	Aim	Method	Population	Location
Pressley & Barlow, 2005	To examine incidence, demographic factors and patterns of injury resulting form falls from buildings and structures in areas with and without a legislation based prevention programme *Children Can't Fly*.	Comparative	Those aged <19 experiencing a fall from a window or structure in a multi storey dwelling.	New York, USA

Census data provided denominators for incidence calculations, as well as identifying those buildings containing ten or more living units, which was used as a proxy for multi-storey dwellings.

5.2.2. Window guards: Results

A total of 1161 hospital discharges in children aged 18 and under were classified as resulting from falls from buildings and structures, of which 70 were classified as intentional and are not further discussed here. The remaining 1091 were unintentional falls. Thirty injuries (no deaths) from falls in New York City were recorded, with about one half occurring outside the age range covered by the window guard legislation (which covers residences of children aged 10 and under). In 1975, prior to the legislation, there were 159 falls and 19 deaths in children in New York city

(no age range reported, this data is referred to by Pressley and Barlow but the given sources are two reports in the *New York Times* (Pressley & Barlow 2005)).

The younger the child, the more likely they were to fall from their own home (88% in those aged 0-4 and 40% of those aged 15-18).

Although a higher proportion of people in New York live in multi-family dwellings than in the rest of the USA (54% *v.* 13%, p<0.0001), it has a lower incidence of injuries in children aged 18 and under resulting from falls from buildings and structures. Incidence in New York city in 2000 was about 1.5/100,000 compared with and average of 2.81/100,000 in the 27 US comparative states and 2.47/100,000 in areas of New York state *not* covered by legislation. Injury related to falls from buildings in New York city was thus about half that of states without legislation despite greater numbers at risk as residents of multi family dwellings (note that raw data for New York city was not supplied. PenTAG extracted data from a graph and it is thus subject to inaccuracy). Three states implemented non-legislation based interventions to reduce injury from falls, although only one, Massachusetts, was reported in the source database: 3.00/100,000.

Incidence of falls related unintentional injury among children aged 0-4years from minority ethnic groups was about double that among white children (Table 6 – note that the title is reproduced from the paper). Among younger children, a strong seasonal affect was seen, with higher numbers recorded in the summer months, whilst this was less pronounced among older children.

Table 6 Estimated cumulative incidence of emergent and urgent hospital admissions for unintentional falls from buildings or structures by age and race/ethnicity[a]

Age	White	Black	Hispanic	Total[b]
0-4	2.72	4.82	5.48	4.6
5-9	1.28	2.1	2.4	1.98

[a] cumulative incidence /100,000 per yr for children aged 0-18 hospitalised for falls from buildings or structures. Data source in KID-HCUP. Incidence is for acute hospitalised injury and does not include emergency department visits that did not require hospitalisation or patients who died before being hospitalised.

[b] Total includes “other” and “unspecified” races.

10-14	1.01	1.33	1.91	1.46
15-18	2.74	1.52	3.38	NR[a]
Total	1.87	2.42	3.37	2.81

Source: (Pressley & Barlow 2005).

5.2.3. Window guards: Considerations

The authors found that a window guard law aimed at multi-family dwellings, with annual enforcement (the nature of which is not explained) effectively reduces the incidence of injury due to falls in children aged 0-18 compared to no intervention or to non-legislation initiatives. The legislation was supported by the provision of free window guards, outreach, education and media. About half of the reported 30 injuries from falls were in those aged 11-18, not covered by the legislation. Based on other study reports (published pre-1990 and for which no data is reported), the authors suggest that, although injuries fell following the introduction of the law, steeper declines were seen with its enforcement, including the possibility of legal action against non-compliant landlords and continued education campaigns aimed at parents.

Study limitations noted by the authors include the fact that the hospital discharge data used did not allow falls from buildings (such as from fire escapes) to be distinguished from falls from windows. In addition, the data did not account for those dying before hospital admission, not seeking treatment, failing to receive the correct code or those treated and released from an emergency department. In addition, national fall injury estimates were made based on data from 27 states and it is not known if these are representative of the USA as a whole.

[a] Study authors note that as a large percentage were recorded as “unknown race”, this is not reported.

Evidence statement 2: Window guard law

There is evidence from one comparative study in the USA (+) that window guard legislation in New York city reduces child injury related to falls from buildings by about half, despite greater numbers at risk as residents of multi family dwellings (1.5/100,000 children aged 0-18 compared with an average of 2.81/100,000 in 27 state other US states without legislation, and 3.0/100,000 in Massachusetts which introduced interventions without legislation) (Pressley & Barlow, 2005).

The law assessed required owners of multiple-family dwellings to provide window guards in apartments where children, aged 10 or under, live (half the injuries recorded in NYC were in those aged 11-18). Compliance is subject to annual enforcement. The introduction of the law was accompanied by a coordinated education and advertising programme (*Children Can't Fly*) which involved outreach, dissemination of literature, a media campaign and the distribution of free window guards.

Given the differences in legal systems, responsibilities and enforcement between the USA and the UK, and the differences in housing stock and management, the applicability of this finding has been assessed as poor. However, the observation that effective enforcement is a key element of legislative success may be applicable across a range of settings.

5.3. Hot water tap temperature

Four uncontrolled before and after studies were identified which reported the impact of legislation about hot water tap temperature aimed at reducing injuries due to hot water scalds in children (Erdmann et al. 1991;Leahy et al. 2007;NSW Health Department 1998;Spallek et al. 2007). Two are from the USA, assessing legislation in Washington state and New York city respectively (Erdmann et al, 1991; Leahy et al, 1991) and two are from Australia, both of which relate to the *Hot Water Burns Like Fire* campaign in NSW and Queensland (NSW Health Department, 1998; Spallek et al 2007).

Since 1983, Washington state law has required all new water heaters to be set at a maximum temperature of 49°C (120°F). In addition, water heaters in rental properties must be reset to this temperature each time a new tenant moves in and warning labels must be displayed. The law is supported by the annual notices to gas and electric customers warning of the danger of hotter water and promoting lower temperature as safer providing energy savings. It is permitted, however, for home owners and tenants to turn up the thermostat if they prefer.

From 1997, title 27 of the New York City Administrative Code was amended to require water heaters in all newly built or renovated multi-unit dwellings to have a maximum temperature setting of 49°C (120°F) (Leahy et al 2007).

Hot Water Burns Like Fire was a campaign in Australia to promote building code regulations introduced in 1994 (in New South Wales, NSW) and 1998 (in Queensland) which requires all new homes, and those undergoing major renovations, to install a tempering valve which limits bathroom hot water temperature to 50°C (122°F) (NSW Health Department, 1999). This had been preceded in NSW by social marketing campaigns which focused on increasing awareness of the dangers of scalding for children (1992), and in particular the dangers of hot tap water (1994), among parents, relevant industry and trade groups. These aimed to create a supportive environment for change in policies and products (Spallek et al. 2007).

5.3.1. Hot water tap temperature: Study characteristics

Study characteristics are shown in Table 7. All four studies compare scald data in children before and after the introduction of the relevant legislation. The NSW study did plan to use data from the state of Victoria as a control, however, Victoria introduced its own regulations about hot water temperature during the course of the study, and the authors conclude that little meaningful can be understood from this data (NSW Health Department, 1998). It has therefore been considered as an uncontrolled before and after study. None of the other three studies reports a control group.

The Washington state study examines information about scald burns in children aged 0-14 from a children's hospital and a burns centre from 1979 to 1987 (Erdmann et al

1991). In addition, water temperature was objectively measured from homes which had installed new heaters before (n=77) or after (n=70) the 1993 law introduction (sampled from utility records of newly installed water heaters).

The New York City study compares tap water scalds data obtained from the New York State hospital discharge database for the city, together with medical and billing records from a regional burns centre in the city for 1996/7 (pre-legislation) and 1998-2003 (post-legislation) (Leahy et al 2007).

The NSW study conducted surveys with a random sample of parents of children aged 0-4 years, twice in 1992, and once in 1995 (NSW Health Department, 1998). Eight hundred NSW parents were surveyed. It also assessed sales data for tempering valves, and analysed hospital data for the ICD code relating to "burns due to liquids and steam" among children aged 0-4 over eight years 1988/9 to 1995/6.

The Queensland study compares hot water temperature in 1990 and 2002/3. 1990 data was objectively obtained data from a random sub-sample from homes participating in the Brisbane Household Survey (Spallek et al. 2007). Data for 2002/3 was obtained through surveying a sample of households containing children aged 4-13 to find out about scald injury and to measure hot water temperature. This sample was obtained through stratifying school by socioeconomic status based on area data and contacting randomly selecting households, only 25% of which agreed to participate. It is not known if they were representative of Queensland households.

Table 7 Summary of identified study reports about hot water tap temperature

Reference	Aim	Method	Population	Location
Erdmann et al, 1991	To evaluate the effectiveness of Washington State hot water legislation 5 years after inception to determine whether heaters set at safe temperatures stayed safely set, whether people were convinced to set back older heaters and whether changes in home water heater temperatures were accompanied by changes in the number of burn hospitalisations.	Uncontrolled before and after study	Patients <15 yrs old admitted to a hospital or burn unit.	Washington State, USA.
Leahy et al, 2007	To evaluate the impact of the title 27 water heaters policy on incidence of tap water scalds in New York City.	Uncontrolled before and after study	Those in NYC boroughs with tap water temperature legislation	New York City, USA
NSW Health Department, 1998	To evaluate the effectiveness of the NSW "Hot Water Burns Like Fire" campaign.	Uncontrolled before and after study	Children aged 0-4	New South Wales, Australia
Spallek et al, 2007	To quantify the effectiveness of the Queensland "Hot Water Burns Like Fire" campaign	Uncontrolled before and after study	Households with school aged children.	Queensland, Australia

5.3.2. Hot water tap temperature: Results

Injury outcomes

The reported impact of tap water temperature legislation on scald injury rates for the studies is shown in Table 8. It was not possible to pool results due to heterogeneity in the legislation tested, the age range in which burns were reported and different methods of analysing and reporting results.

Two of the studies, in Queensland and New York, found that burn injuries from hot water scalds actually increased after the introduction of legislation (Leahy et al, 2007; Spallek et al, 2007). For the New York study, however, it is not possible to say whether the *rate* of scald injury increased in children, since separate data for the under fives only relates to the *number* of burns (Leahy et al, 2007).

The Washington state study provides ambiguous results, with a higher rate of burns among 4-13 year olds in the period after legislation compared to the period immediately prior to the legislation (1.7/yr *v*. 0.3/yr) but a reduction compared to an earlier period (1.7/yr *v.* 3.9/yr) (Erdmann et al. 1991). These data do not appear to be adjusted for population exposure. The authors suggest that the results may be due to small number effects.

Finally, the mean annual burn incidence in 0-4 year olds per 100,000 reduced in NSW from 102 in to 94 after the initiation of *Hot Water Burns like Fire* (NSW Health Department, 1998).

Table 8 Reported effect of hot water legislation on tap water scald injury in children

Reference	Location	Population		Pre law	Post law	p-value
			1969-76	1979-June 83	July 1983-88	
Erdmann et al, 1991	Washington State	0-14 yr olds	3.9/yr	0.3/yr	1.7/yr	NR
				1996-97	1998-2003	
Leahy et al 2007	New York City	NYC residents		150/100,000	220/100,000	0.0003[d]
		0-4 yr olds		170/yr	182/yr	
				>85/yr[a]	>91/yr[a]	NR
				1988/9-1991/2	1992/3-1995/6	
NSW health dept, 1998	New South Wales	0-4 yr olds		102/100,000[b]	94/100,000[c]	0.62[d]
				1990	2002/3	
Spallek et al, 2007	Queensland	4-13 yr olds		113/100,000	170/100,000	0.01

Other outcomes

Since other reported outcomes are so disparate, they have not been tabulated and are reported here narratively. Full details can be seen in the evidence tables that form Appendix 7.

[a] Actual numbers are not supplied, it is stated that the under fives account for "more than 50%" of the total number of scald injuries.

[b] Mean of 4 annual rates, calculated by PenTAG

[c] Mean of 4 annual rates, calculated by PenTAG.

[d] Calculated by PenTAG

Despite the uncertain injury results, the Washington state study did report a significant reduction in mean hot water temperature in houses built in 1988 compared to those in 1977 (61^{o}C *v*. 50^{o}C, p<0.05); the latter not covered by the state law (Erdmann et al, 1991). Among householders surveyed the authors found no relationship between having a temperature of greater than or less than 54^{o}C and those who were aware that hot water could cause burns, or those who reported satisfactory heater function, dishwasher function, those who lowered their heater temperature setting, or those owned their own home (Erdmann et al, 1991).

A mixed picture for hot water tap temperature was reported in the Queensland study, which reported an increase in injury rate since the legislation was introduced (Spallek et al, 2007). The mean temperature in 1990 was 56.3^{o}C (95% CI 55.7, 56.0) significantly lower than 2002/3 at 58.7^{o}C (95% CI 58.1, 59.5, p<0.01). However, when the later sample was assessed by the presence of tempering valve, a significantly lower temperature was seen where one had been installed 55.5^{o}C (95% CI 54.3, 56.7) *v*. 60.1^{o}C (95% CI 59.3, 60.9, p<0.01).

Changes in the number of hospital stays due to scald injuries in NSW were also reported, with a 10% reduction in total cases and 27% reduction in total bed days reported for nought to four year olds in the two years after legislation compared to the six previous years (NSW Health Department, 1998). Hospitalisation due to minor scalds did not seem to be affected but there was a 36% reduction in total cases and 35% reduction in total bed days due to serious scalds (NSW Health Department, 1998).

In addition to the legal changes, the *Hot Water Burns like Fire* campaign in NSW distributed 24,000 brochures and temperature testing cards which were requested via a free call number and an additional 80,000 cards distributed through other means including health-centres, shopping centres and doctors' offices. A telephone survey indicated that 25% of a random sample of 800 parents contacted had received this. Compared with those who had *not* received brochure and testing card, those who *had* were significantly more likely to have: reported taking action to prevent scalds in the home (67% *v.* 49%) and turned down their hot water system (81% *v.* 70%). This suggests an effect could be seen with education alone (NSW Health Department, 1998).

In addition, survey data in the NSW study showed a significant increase in knowledge between baseline and 30 month follow up (<0.05) in the nomination of tempering valves as a way to prevent hot water scalds, unprompted mention of keeping hot drinks out of reach as a scald prevention strategy and of hot bath water as a main cause of scalds in children, and report that medical attention would be sought in the event of a scalded child. Some unintended, negative changes were also noted with significantly fewer parents nominating kettles or saucepans as main causes of childhood scalds (NSW Health Department, 1998).

5.3.3. Hot water tap temperature: considerations

Spallek and colleagues (2007) suggest that the different sampling methods and research teams used for collected data for the pre- and post- Queensland legislation comparisons may have influenced the findings which failed to show a positive reduction in scalds. It is possible that the function of the tempering valves fitted deteriorates over time, or that householders adjust them. In addition, the evaluation was taken shortly after the introduction of the legislation, so few new homes may have been built. It remains possible that the intervention failed in design or implementation. The authors suggest that interventions which target those most at risk may be more effective, though no evidence is provided for this.

In attempting to explain their negative results in Washington, Errdmann and colleagues (1991) note that more of the homes with hot water heaters installed pre-legislation reported safe hot water temperatures of <54^{o}C than anticipated. The chance of a type II error is therefore greater that calculated when planning the research design (that is, the study may falsely indicate that legislation has no effect on burn risk). They also note that, since the life of a hot water heater is about ten years, the impact of the legislation is likely to be felt only after a decade of implementation.

Leahy et al (2007) suggest that the New York city legislation is not effective due to its limited application to new-builds and to multiple occupancy units. They note that a quarter of scald injuries occurred in homes other than multiple unit dwellings and that all units where scalds occurred (for which a date of construction was available) were built before 1998 and so no covered by the legislation.

In addition, both the New York and Washington state studies used data relating to tap water scalds, the Australian studies used ICD data which reports injury due to hot liquids and steam, and so which may also include scalds from sources other than tap water.

Evidence statement 3: Hot water tap temperature law

There is mixed evidence from four uncontrolled before and after studies about hot water tap temperature legislation (Erdmann et al, 1991, USA, [+]; Leahy et al, 2007, USA, [+]; NSW Health 1998 Australia, [+]; Spallek et al, 2007 Australia, [+])

Two studies reported that the annual incidence of burn injuries in children *increased* after the introduction of legislation (Leahy et al, 2007, New York, [+]; in children aged 0-4years; Spallek et al, 2007, Queensland, [+]; in children aged 4-13 years), and a further study (Erdmann et al, 1991, Washington state, [+]) found that injury rates were raised compared to the period immediately prior to legislation being introduced but fell in relation to an earlier comparator time-period (Erdmann et al 1991, [+]). Only the study by Spallek et al (2007, [+]) reported p-values, but this was a significant increase (p=0.01).

One study (New South Wales) suggested there may be a decrease in the number of scald injuries however, the reported differences were non-significant (p=0.57) (NSW Health, 1998, [+]; in children aged 0-4).

The legislation assessed by the Australian studies was *Hot Water Burns Like Fire* which was a campaign to promote building code regulations introduced in 1994 (in New South Wales) and 1998 (in Queensland). These regulations require all new homes, and those undergoing major renovations, to install a tempering valve which limits bathroom hot water temperature to 50^{o}C (122^{o}F). This had been preceded in NSW by social marketing campaigns which focused on increasing awareness of the dangers of scalding for children and, in particular, the dangers of hot tap water, among parents, relevant industry and trade groups.

The USA studies assessed two different pieces of legislation. From 1997, title 27 of the New York City Administrative Code was amended to require water heaters in all newly built or renovated multi-unit dwellings to have a maximum temperature setting of 49^{o}C (120^{o}F). While in Washington state since 1983, all new water heaters have been required to be set at a maximum temperature of 49^{o}C (120^{o}F) and water heaters in rental properties must be reset to

this temperature each time a new tenant moves in and warning labels must be displayed. The law is supported by the annual notices to gas and electric customers warning of the danger of hotter water and promoting lower temperature as safer providing energy savings. It is permitted, however, for home owners and tenants to turn up the thermostat if they prefer.

Given the differences in legal systems, responsibilities and enforcement between the USA and Australia and the UK, and the differences in housing stock and management, the applicability of these findings have been assessed as poor. However, the observation that legislation aimed at safety in the home may be limited in its effectiveness where it is implemented only in that housing stock where access and enforcement is easier (such as in rented or newly built accommodation only), may be applicable across a range of settings.

5.4. Swimming pool fencing

Four studies, two case control and two comparative, were identified which assessed the impact of legislation and ordinances about domestic swimming pool fencing. One is from the USA (Morgenstern et al. 2000), one from New Zealand (Morrison et al. 1999) and two from Australia (Stevenson et al. 2003;van Weerdenburg et al. 2006).

The USA study (Morgenstern et al, 2000) is set in Los Angeles county, which has had an ordinance in place since 1967 requiring a 1.5m (5') fence or barrier with self-latching gates around all domestic swimming pools. The ordinance was interpreted by the Building and Safety Department to allow a residence wall, including doors & windows, to form part of the barrier (three-sided fencing). Until 1988, most cities in the county enacted their own locally enforced fencing ordinances for residential pools; however, all apply to in-ground and above-ground pools at least two feet deep that are new or newly altered. Prior to 1996, they also allow three-sided fencing.

In New Zealand, where the Morrison et al study is set, the Fencing of Swimming Pools (FOSP) Act 1987 requires domestic swimming pools, including spa pools, to be fenced. This Act was supplemented by the 1991 Building Act which requires building consent for pools prior to construction, and this must demonstrate compliance with FOSP. The fence must surround only the pool, and the immediate area around it. This cannot be simply a boundary fence although buildings can form part of it (three-

sided fence). Local government authorities have responsibility for ensuring compliance with the FOSP Act.

Australian states require domestic swimming pool fencing and gates to comply with Australian Standard (AS1926.1). Pools installed before 1992 can have three-sided fencing, with the fourth permitted to include a wall that contains a door or window into the residence. Pools installed after 1992 must either be four-sided and isolated from the resident, or may include a wall with door or window if these can be locked. Inspection of pools has been mandatory since its 1992 introduction. The studies included here are based in Western Australia (Stevenson et al. 2003) and New South Wales (van Weerdenburg et al. 2006). The New South Wales (NSW) study notes that while councils are required to "take appropriate steps to ensure they are notified of all swimming pools within their boundaries" and to "promote local swimming pool owners' awareness of the requirement of the act", there is no legal mandate in the act for councils to fulfil this obligation. This study reports that previous studies had found many councils were not monitoring compliance and that there was wide variation in the enforcement of pool fencing regulation (van Weerdenburg et al. 2006).

5.4.1. Swimming pool fencing: Study characteristics

Study characteristics for the four studies are shown in Table 9.

The Los Angeles study is in two parts (Morgenstern et al, 2000). The first uses data from the county coroner about children under ten years old, who drowned in domestic swimming pools to calculate drowning rate, and also uses regression analysis to assess the effect of selected socio-economic factors on the rate of childhood drowning. The second stage using these identified drownings as the cases in a case-control study. For each case, five control pools in the same geographical area were identified where a drowning did not occur in the same time period (1990-95).

The New Zealand study assessed compliance with FOSP, methods of identifying swimming pools, of enforcing the Act, barriers to successful enforcement and solutions (Morrison et al, 1999). This was done through a postal questionnaire to all 74 authorities in New Zealand, of which 64/74 responded, giving a response rate of 87%. A sample of 12 authorities was selected for telephone interview. Selection was

purposive, based on those reporting active enforcement of FOSP, with the aim of identifying examples of best practice (Morrison et al. 1999).

The Western Australia study conducted a retrospective review of coroners' reports about children under the age of five who had drowned in a domestic swimming pool in 1988-2000 (Stevenson et al. 2003). The reports contain details of pool fencing, including photographs. Details were used to calculate annual incidence of drowning and incidence risk ratio of three- and four-sided fencing in 1999.

In addition, an audit of swimming pool inspections was undertaken by Stevenson et al (2003). This was obtained by inspectors in each of the 25 shire or city councils randomly selecting a sample of 20 inspection records (total n=500) for examination. Participation was obtained among 68% of shire or city councils. Findings from the audit were used to estimate compliance with legislation and how long it took non-compliant pools to become compliant after inspection. In the final stage, face to face interviews were conducted with one nominated swimming pool inspector from each shire or city council in the Perth metropolitan area to explore perceived effectiveness of current legislation and identify any recommendations for change. This obtained 87% response rate in urban areas and 63% in rural areas.

Van Weerdenburg and colleagues (2006) compared the approaches of three councils in NSW for assessing compliance, and the impact of these approaches on compliance with the Act. The manner of data collection in each of the three councils varied, however, due to different methods of inspection and record keeping within each. Data about compliance from inspections 2002-2003 was supplied for this study. In addition to data about compliance with the swimming pool fencing Act, this NSW study also interviewed one key informant from each council in order to identify key issues and barriers to managing and enforcing the 1992 Act.

Table 9 Summary of identified study reports about Swimming Pool Fencing

Reference	Aim	Method	Population	Location
Morgenstern et al, 1990	To estimate the effects of local pool-fencing ordinances and other factors on the rate of childhood drowning in LA county California	Matched case-control.	Drownings in children those aged <10yrs in single family homes	Los Angeles, California, USA
Morrison et al, 1999	To identify the status of compliance with and enforcement of the Fencing of Swimming Pools (FOSP) Act 1987 10 yrs after introduction. To identify methods for improving compliance and the process of enforcement.	Comparative	All NZ local government authorities	New Zealand
Stevenson et al, 2003	To elucidate the causes of child drowning in private swimming pools and to determine the need for change in the legislation as well as improvements to inspection and enforcement of current legislation	Case control (historical controls)	Drownings in children aged <5yrs in private pools	Western Australia
Van Weerdenburg, 2006	To document the approaches to manage backyard swimming pool inspections and compliance in 3 local govt. areas of NSW Australia. To describe compliance levels and identify perceived barriers to effective management of pool inspection programs as described by council employees.	Comparative	Three local Councils	New South Wales, Australia

5.4.2. Swimming pool fencing: Results

Injury outcomes

Two studies report on drowning rates in domestic swimming pools (Morgenstern et al, 2000 Los Angeles, USA; Stevenson et al, 2003, Western Australia).

The Los Angeles county study identified 146 child drownings (aged <10 years old) in domestic swimming pools in 1990-95, giving an average annual drowning rate of 1.7/100,000 (Morgenstern et al. 2000). Of these, 68% occurred at the victim's home.

The date of pool construction was available for 112/128 of those drownings which occurred in single family dwellings (88%) and for 650/730 (89%) of the controls. The

odds ratio comparing the pools built or altered under pool fencing ordinance, or not, was 1.27 (95% CI 0.72, 2.25) – suggesting that it has not had a significant impact on the risk of childhood drowning, indeed 81% of drownings occurred in pools regulated by the ordinance. This study did not, however, measure compliance with the ordinance.

The Western Australia study (Stevenson et al, 2003) identified 50 child drownings (aged <5 years old) in domestic swimming pools in 1988-2000, giving a average annual drowning rate of 2.15/100,000 in 1989-1997 and with a peak in 1999 of 7.86/100,000, although data from 2000 is more in keeping with previous rates (Stevenson et al. 2003). Of these, 44% occurred at the victim's home. Most of the drownings occurred in pools with three-sided fencing (70%) and of the 30% that occurred where there was four-sided fencing, all related to the gate being propped open, or faults with the self-closing/-latching gate mechanism. Incident rate ratio for children aged less than five who lived in or visited houses with three-sided, rather than four-sided, fencing was 1.78 (95% CI 1.4, 1.79 reported by study authors).

Management and Compliance Outcomes

Three studies report on the ways in which local government agencies enact their responsibilities to enforce the relevant pool fencing legislation (Morrison et al, 1999, New Zealand; Stevenson et al, 2003, Western Australia; van Weerdenburg et al, 2006, NSW).

The NSW study compared the approaches of three local government areas in NSW (van Weerdenburg et al, 2006). As Council A had no swimming pool register and had not conducted a pool inspection for some time, a random sample of 1003 pools, installed from 1991 onwards, was selected for inspection by independent water safety organisation inspectors. The sampling frame was a list from the council's database of properties with approved swimming pool development applications. Any pools found to have faults were re-inspected in about six weeks. Council B kept a swimming pool register (for pre and post 1992 pools) which was linked to a property based record keeping system. Pools in this register were originally identified through an aerial survey and development application records. An annual "inspection blitz" was carried out to check compliance with the Act, and results from that carried out in November 2002 were used in this study. Council C also had a swimming pool register (for pre

and post 1992 pools) based on aerial maps and approved development applications. However this had not been updated for many years and no regular inspections were conducted.

The three different approaches are summarised in Table 10 and the results of compliance with the Act at first inspection in Table 11 (van Weerdenburg et al, 2006). Full details about the nature of compliance failure are not reproduced here as they are only fully available for one council, but these can be seen in the evidence table in Appendix 7. Council B, which had the most comprehensive strategy to enforce pool fencing regulations, reported twice the levels of compliance of the other two councils. It should be noted that 399/1262 (32%) of pools on the register in Council B, and 181/645 (28%) on Council C's register, had not been inspected so were of unknown status.

Table 10 Comparison of different approaches to Pool Fencing legislation in NSW

Factor	Council A	Council B	Council C
Property management database (pool development application)	Y	Y	Y
Swimming pool register	N	Y	Y (reactivated in 2000)
Individual with designated responsibility for management of existing pools & enforcement of Act	N	Y	Y
Pool inspection program	N	Annual blitz	Annual blitz since 2000
Enforcement of act	N	Y	Limited
Pool owner contact	N	At inspection and during campaigns	At inspection and during campaigns
Process to manage non-compliance	Y	Y	Y

Source: Van Weerdenburg et al 2006

Key informant interviews with employees from each council suggested this inconsistency of approach related to lack of clarity in the Act and its failure to specify *how* councils should ensure notification of newly constructed pools and how to ensure compliance with the Act. They also noted that there were conflicting interpretations of the 1992 Swimming Pool Act and 1998 Swimming Pool Regulations and other related Australian Standards, particularly in relation to the acceptability of self-closing/latching doors in boundary walls. Another key criticism was the mechanism for funding pool inspections, which was generally revenue from ratepayers. It was

suggested that an inspection fee could be charged to pool owners, and that this could form a voluntary part of the Act. The 1998 Regulation allows for on-the-spot fines for non-compliance, and this had been used effectively by one council.

Table 11 Compliance rates in three NSW councils at first inspection

Inspection results – n (%)	Council A[a] (N=1003)	Council B[b] (N=863)	Council C (N=464)
Compliant	487 (48.6)	835 (96.8)	212 (45.7)
Non-compliant	516 (51.4)	28 (3.2)	252 (54.3)

Source: Van Weerdenburg et al 2006

Council A also supplied figures for re-inspection of those pools not initially complying with the Act. Of the 227 pools reinspected (44% of those failing at first inspection), 125/227 (55%) were compliant at second inspection.

The survey of pool owners in council A only achieved a 20% response rate but, of those that did reply, very high levels of support for pool fencing law was seen (96%).

The Western Australia study also discusses compliance with the legislations, finding that rates were highest just after it was introduced in 1992 (59%) but has been stable at about 40% since 1997. Inspection does appear to increase compliance with regulations; examination of a random selection of inspection records showed that 45% complied at first inspection, increasing to 57% four years later and 71% by the third inspection (Stevenson et al, 2003).

The New Zealand study surveyed all 74 authorities in New Zealand about compliance with the FOSP Act, and achieved 87% response rate (Morrison et al, 1999). This identified 47% compliance, 19% non compliance and 33% not known. Only 9% of authorities had written policies or procedures related to locating and inspecting pools, but there was no association with having such a policy and reported compliance rates (chi-squared 0.45, p=0.45). It was more common to have a reinspection programme to ensure continued compliance (25%) but no association with this and reported compliance rates (chi-squared 0.71, p=0.40). Just over half the surveyed authorities

[a] Results from first inspection

[b] 1262 pools on register, 399 of unknown status

(52%) had notified the public of their obligations under the FOSP Act in the previous 12 months, usually through advertisements in newspapers. Again, no association with this and reported compliance rates was found (chi-squared 0.05, p=0.82). The authors note, however, that it is possible that the failure to identify associations between these mechanisms and greater compliance could be due to those authorities more actively engaged with pool fencing requirements being more aware of lack of compliance in their area, confounding the results because councils with a less rigorous approach to inspection programmes may overestimate actual compliance. This is in opposition to the findings from NSW reported above (van Weedenburg et al, 2003).

Asked to identify enforcement problems, 86% of authorities identified one or more problem: pool owner resistance (84%), locating existing pools (76%), cost of administration (63%) and problems with interpretation of Act (64%). These latter problems included defining "immediate pool area" and whether it was acceptable to have access to the pool area via house doors (41% each). The authors note that guidelines about the former have been produced but, as they do not carry the weight of law, they can be contested. For the latter, 38% of authorities reported that they require self closing mechanisms on sliding access doors from the house. Authorities also varied in their interpretation of whether building consent was required for above ground, as well as below ground, pools.

Suggestions made for improving compliance included publicity and education for the public (44%), amendments to the Act (14%), making additional resources available to cover cost of enforcement (11%) and greater use of litigation including instant fines (8%).

5.4.3. Swimming pool fencing: considerations

The Los Angeles study found that rates of drowning in children were not lower in pools regulated by fencing ordinances, suggesting that these are ineffective (Morgenstern et al, 2000). However, we know from other studies that four-side fencing may lower the risk of drowning for children. The authors suggest a possible bias in the study if homes with young children, on whom data is collected here, tend

to have newer pools and so are more likely to have been built under ordinances for fencing (Morgenstern et al. 2000)

A number of problems and barriers to effective legislation are noted by the included studies. It is suggested by the Los Angeles study that there was inadequate community education and awareness of the law and the dangers of pools for children (Morgenstern et al. 2000). In New Zealand, Morrison and colleagues (1999) suggest that pool retailers could take responsibility for informing purchasers of the fencing requirements, and could notify authorities when a new pool is installed. The NSW study also suggested an electronic register identifying all pools would be helpful, although they acknowledge that this could be costly (van Weerdenburg et al. 2006).

In Los Angeles, the authors note the inadequacy of the law to protect children, due to the nature of three-sided fencing which allows access from the house (Morgenstern et al. 2000). Stevenson and colleagues (2003) also found that three-sided fencing offers less protection than four-sided, and note that their research precipitated a change to require four-sided pool fencing in Western Australia from 2002.

It was suggested that inadequate fencing may be doubly compromised as it not only offers children less protection than four-sided, but may also give parents a false sense of security, lowering supervision and further increasing risk (Morgenstern et al, 2000, Los Angeles).

Morgenstern and colleagues also highlight inadequate enforcement of the ordinance by building and safety departments in Los Angeles as contributing to the failure of legilstaion (Morgenstern et al. 2000). Related to inspection processes in Western Australia, Stevenson and colleagues (2003) found that inspection was successful at increasing compliance, and suggest that more regular inspections (eg upping to biennial from the existing four-yearly process). The NSW study also found that repeat inspection until compliance was achieved seemed to be an effective strategy (van Weerdenburg et al. 2006). Morrison and colleagues (1999) also found inconsistencies in enforcement in New Zealand. They suggest that cost may be a barrier to inspection and enforcement for some authorities and further identify lack of specific inspection obligations in the Act as a barrier. The NSW study also identifies cost as a barrier, and suggest that permission for councils to charge a inspection fee should form part of the regulation (van Weerdenburg et al. 2006).

Two studies identify inadequate operation or maintenance of fencing, gates, latches and alarms by pool owners (Morgenstern et al, 2000, Los Angeles; van Weerdenburg et al, 2006, NSW). Van Weerdenburg and colleagues (2006) study found gate faults in particularly led to failure to comply with the pool regulation, and they note that simple homeowner maintenance could avoid such problems. Owners may also value short term gains, such as the convenience, over abstract risk leading to, for example, gates being propped open, negating the effectiveness of the fencing.

In New Zealand, Morrison and colleagues (1999) note inconsistencies between the way in which the fencing Act was enforced. This is due to inconsistencies or ambiguities in the legislation itself. The NSW study also found contradictions between different legislation and regulation relating to pool fencing which contributed to misunderstandings and confusion (van Weerdenburg et al. 2006).

Evidence statement 4: Swimming pool fencing law

There is mixed evidence from four studies (2 case control, and 2 comparative) about swimming pool fencing legislation (Morgenstern et al, 1990, USA [+]; Morrison et al, 1999, New Zealand [-];Stevenson et al, 2003, Australia [+]; Van Weerdenburg et al, 2006, Australia [-]).

2 studies (1 USA and 1 Australia) suggest that legislation is ineffective where it only requires 3-sided fencing. The US study suggests no impact of such legislation on drowning in children aged <10 years old compared to no legislation (OR 1.27 95% CI 0.72, 2.25) (Morgenstern et al, 2000 [+]). The Australian study found the incident rate ratio of drowning in children aged <5 years old living in houses with three sided rather than four sided pool fencing was 1.78 (95% CI 1.14, 1.79) (Stevenson et al, 2003 [+]).

3 studies (2 Australia, 1 New Zealand) report on outcomes related to legislative management and compliance (Morrison et al, 1999 [-]; Stevenson et al, 2003 [+]; Van Weerdenburg et al 2006 [-]).

The New South Wales study found that a more structured and comprehensive approach to inspection (including a register of owners, annual inspections, and enforcement of the act including fines) resulted in twice the level of compliance as those with less structured/ detailed approaches (Van Weerdenburg et al, 2006 [-]).

Key informant interviews also suggest that lack of clarity in the fencing act, and failure to detail *how* councils should ensure compliance, including how it should be funded, hampered effective implementation.

The Western Australia study suggests that compliance is highest immediately after legislation is introduced, and falls off thereafter, although regular inspection enhances compliance (Stevenson et al, 2003 [+]).

The New Zealand study found no association with compliance rates and: local authorities having written policies about locating and inspecting pools; a reinspection programme; or advertising of pool owners' obligations under the relevant act (Morrison et al, 1999 [-]).

The USA study is set in Los Angeles county, which has had an ordinance in place since 1967 requiring a 1.5m (5') fence or barrier with self-latching gates around all domestic swimming pools. The ordinance was interpreted by the Building and Safety Department to allow a residence wall, including doors and windows, to form part of the barrier (three-sided fencing). Until 1988, most cities in the county enacted their own locally enforced fencing ordinances for residential pools; however, all apply to in-ground and above-ground pools at least two feet deep that are new or newly altered. Prior to 1996, they also allow three-sided fencing.

In New Zealand, the Fencing of Swimming Pools (FOSP) Act 1987 requires domestic swimming pools, including spa pools, to be fenced. This Act was supplemented by the 1991 Building Act which requires building consent for pools prior to construction, and this must demonstrate compliance with FOSP. The fence must surround only the pool, and immediate area around it. This cannot be simply a boundary fence although buildings can form part of it (three-sided fence). Local government authorities have responsibility for ensuring compliance with the FOSP Act.

Australian states require domestic swimming pool fencing and gates to comply with Australian Standard (AS1926.1). Pools installed before 1992 can have three-sided fencing, with the fourth permitted to include a wall that contains a door or window into the residence. Pools installed after 1992 must either be four-sided and isolated from the resident, or may include a wall with door or window if these can be locked. Inspection of pools has been mandatory since its 1992 introduction. The studies included here are based in Western Australia (Stevenson et al. 2003) and New South Wales (van Weerdenburg et al. 2006). The New South Wales study notes that councils there are required to "take appropriate steps to ensure they are notified of all swimming pools within their boundaries" and to "promote local

swimming pool owners' awareness of the requirement of the act", although there is no legal mandate in the act for councils to fulfil this obligation.

Given the differences in legal systems, responsibilities and enforcement between the USA, Australia, New Zealand and the UK, and the low level of private swimming pool ownership in the UK, the applicability of these findings have been assessed as poor. However, some key lessons from these studies may be applicable across a range of settings, such as: the importance of adequate legal requirements in order to glean maximum benefit (as illustrated by three *vs.* four sided fencing here); the need for regular inspection regimes which are consistently enforced, and the related need for clear lines of responsibility and sufficient funding for these; the need for concurrent education to help owners comply with the spirit as well as the letter of the law (for example, the need for maintenance of equipment, and the valuing of safety over convenience) and finally the need for legislation which does not contradict or confuse other existing rulings.

6. Discussion

6.1. Statement of principal findings

We identified ten studies using comparative designs to evaluate the effectiveness of legislation, regulation, standards, strategies or enforcement. In fact, all were primarily about legislation, with no formal evaluations of written standards or strategies of a non-legal nature. The studies were about smoke detectors, window guards, hot water tap temperature, and swimming pool fencing.

Mixed results were seen, with reductions in injury risk found after the implementation of legislation about smoke detectors (among higher socio-economic groups) and window guards (in a city with many multi-home dwellings), but more mixed findings, including possible increased injury, for hot water tap temperature control and swimming pool fencing. Interpretation is made more difficult since the legislative change rarely took place in isolation, with accompanying strategies including educational campaigns, advertising, annual reminders, distribution of free safety equipment and social marketing campaigns, singly or in combination, also forming part of a package of safety promotion activities, which were not evaluated separately. One study about hot water tap temperature in NSW found that legislation and accompanying publicity had some unintended consequences, such as a lessening of public awareness around alternative sources of scalds in children, like hot drinks and kettles.

A number of possible explanations for the varied impact of legislation and accompanying strategies are given within the studies themselves. Taken together, these can be used to build an understanding of the ways in which legislation might operate, and key attendant activities to ensure that they are enacted successfully:

A need for legislation must be recognised both by the relevant legislative authority and the people at whom the law is addressed. Positive attitudes in the population towards the need for legislation may require awareness-raising about the risks to children and the effectiveness of the proposed measures. Legislation which fits with social norms which expect children to be protected may meet with the greatest success.

The drafted law needs to be clear in terms of aims and wording – problems encountered by studies in this review included ambiguity within the law itself, apparent contradictions with related pieces of legislation, and the adoption of easier to implement, but less effective, interventions (for example, three-sided rather than four-sided pool fencing, or initial but not permanent hot water temperature limits). In addition, the law needs to be aimed at populations most at risk from the specific injury targeted: while positive outcomes were seen with window guard legislation aimed at those in apartment blocks, this was not seen with a similar limitation for hot water tap temperature limits.

There needs to be a way of implementing changes in appropriate households and so of identifying households at risk due to ages (window guards were required in households which included children under the age of 10), or physical structure (for example, the presence of swimming pools). Possible ways of doing this include census data, aerial survey (for example to identify houses with swimming pools), links with providers/ agents to identify homes where the relevant population or equipment is present and the development of a register (which will require regular updating).

Maintenance is also a potential issue. Study authors suggested that the lack of evidence for the effectiveness of hot water tempering valves may indicate that they ceased to work after some time. Similarly, drownings in domestic swimming pools where regulations about fencing were met in theory, often showed that self-closing mechanisms on gate latches failed, or that the gates were propped open for convenience. These findings suggest that ongoing vigilance is needed, both by the householder, to recognise the need to actively maintain equipment and meet requirements, and by appropriate agencies who need to remind people of the reason for the rules and the detail of ongoing requirements. In addition, low maintenance, reliable product designs may be needed.

Clear lines of responsibility, both for enforcing (for example, by local authority/ trading standards) and enacting the law are needed (landlords or occupants). Methods of funding enforcement activities are also required, and may come from fines or fees for inspection. Other key considerations related to inspection include deciding how frequently this is required, whether an annual scheduled or random programme is implemented, if those homes not complying are reinspected and, if so, when. These

decisions will need to balance cost, effectiveness and practicality. The purpose of this inspection should also be considered – whether it is primarily aimed at identifying homes that need assistance to meet safety requirements, or whether prosecution is the main focus. A system of warnings and reinspection prior to legal summons may ensure higher levels of compliance. Better knowledge of both requirements, and the penalty for not meeting them, may enhance compliance. Where the person who is responsible for meeting a requirement is not the person who will benefit (for example, landlords) it may be particularly important for the consequences of not meeting these requirements to be known. Linking certification to sale or new tenancy agreements for properties may enhance adoption through ensuring periodic checks and compliance.

Methods of ensuring all appropriate homes adopt the law needs to consider how to bring older homes up to standard – mechanisms identified in studies reviewed included requiring certification on sale of a property, linking adjustments to new tenancy agreements, attaching the law to manufacturing (for example, water heaters) so that new versions will be adopted gradually as old versions are replaced. Where these mechanisms are used however, it is possible that poorer housing stock which is subject to less consistent maintenance and improvement, may fall further behind in quality and safety, potentially widening existing social gradients related to childhood injury risk.

6.2. Methodological considerations

Generally, the evidence base was weak, with only a single controlled before and after study providing evidence for effectiveness of smoke detectors, and four studies of uncontrolled comparative designs identified about hot water tap temperature, window guards and swimming pool fencing. Our restriction on publication dates was taken for pragmatic reasons, and may have restricted the amount of evidence we identified.

We did not include studies relating to home safety equipment which does not require correct installation to function (for example, bath temperature thermometers or playpens) although, in practice, it seems unlikely that such items would be subject to legislation, regulation and/or enforcement.

We did not identify any evaluations of non-legislative regulations or strategies aimed at reducing unintentional injury to children in the home, although many of the included studies actually assessed both legislation and a range of activities that supported it, including educational campaigns, mass media campaigns, annual reminders distributed through regulatory authorities or associated trade organisations (such as gas and electricity companies), distribution of free safety equipment (temperature cards, window guards) and social marketing campaigns. These were usually used in combination, forming part of a package of safety promotion activities alongside the legislative launch and its continuation. Details of these activities were often minimal, and as they were not separately evaluated, we do not know which aspects, singly or in combination, might comprise the crucial elements successful programme to reduce unintentional injury.

None of the studies came from the UK and we therefore rated the external validity of all the studies as poor, given differences in legal structures, methods of enforcement and responsibility, national and local government arrangements and responsibilities and cultural expectations. It remains possible, however, that mechanisms to support the adoption of safety equipment to prevent unintentional injury to children in the home may be similar, though we have no way of measuring this.

It is not clear that the topic areas identified by the review are those most pertinent to UK injury patterns (especially in relation to swimming pool fencing). However, it is possible that mechanisms for advertising, enforcing and enhancing legislation may be common to different topics aimed at unintentional injury prevention.

Resource limitations made this an essentially one-person review, with the attendant risks for accuracy and limited interpretation.

6.3. Further research

It would be helpful if future research attempted to separately evaluate the impact of different elements of interventions which consists of multiple activities and elements in order to understand which aspects – education, advertising, outreach, free safety equipment or legislation, are critical to success.

Where legislation does not apply retroactively, but only applies to newly built or renovated buildings, or to newly installed equipment, sufficient follow up is required to assess the impact.

The impact of strategies and regulations around home risk assessments should be evaluated.

Appendix 1 Review Protocol

Overall PUIC Programme details outlined by the CPHE Scope

This project is one of five pieces of work informing NICE guidance on how to prevent unintentional injuries among children and young people aged under 15. The others are:

- Preventing unintentional injuries among under 15s: Correlates review'. This identified and quantified factors (e.g. cultural, social, economic, environmental and organisational) that have been shown to be related to the incidence of unintentional childhood injury.
- 'Preventing unintentional road injuries among under 15s: road design'. This guidance will focus on the design and modification of highways, roads and streets. It will be developed using the public health intervention process.
- 'Preventing unintentional injuries among under 15s in the external environment'. This guidance is expected to cover sports and leisure. It will be developed using the public health intervention process. A scope will be produced at a later date.
- 'Preventing unintentional road injuries among under 15s: education and protective equipment'. This guidance is expected to cover safety equipment such as helmets and visibility clothing. It will be developed using the public health intervention process.

Population groups that will be covered

- Children and young people aged under15, particularly those in disadvantaged circumstances (for example, those living with families on a low income, living in overcrowded housing or with a lone parent).
- Parents and carers of children and young people aged under15.

Population groups that will not be covered

- Anyone aged 15 or over, except the parents or carers of children and young people aged 15 or over.

Interventions/Activities that will be covered

- Activities/interventions that will be covered by the Programme guidance

This guidance will focus on: design and modification to highways, roads and streets, the supply and/or installation of home safety equipment, home risk assessments and prevention activities in the external environment. It will cover the following measures:

- primary and secondary legislation
- regulation and standards
- enforcement.

The guidance will also cover compliance with the above and supporting mass-media campaigns.

In addition, it will cover the following in relation to preventing unintentional injuries in children under 15:

- injury surveillance, data collection and analysis
- workforce training, support and capacity building.

Steps will be taken to identify ineffective as well as effective approaches.

Activities/measures that will not be covered by the Programme guidance

Legislation, regulation, standards, enforcement and compliance relating to:

The technical efficacy of products (including, for example, airbags, brakes and smoke detectors).

Tertiary prevention, including emergency services, treatment and rehabilitation to limit long-term impairments and disability caused by injury.

Strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury to children and young people in the home environment

Key terms/Glossary

For the purposes of this review, the following definitions are used throughout.

Key term	Definition
Children and young people	Those aged under 15
Compliance	"Compliance" in this protocol relates to those at whom legislation, regulation or standards are aimed. For example, in the case of fire alarms, this may be practitioners, such as fire office departments, who may be required to comply with regulation for their installation; or it may relate to parents or other carers, at whom standards about checking and maintaining the alarms are aimed.
Home risk assessment	A systematic assessment of a home to identify potential hazards, evaluate the risk, and provide information or advice on appropriate actions to reduce those risks. The assessment may either be by a trained assessor visiting the home, or by a householder assessing their own home.
Home safety equipment	Includes items such as smoke alarms, hot water restrictors, stair gates etc.
In the home	Within the geographical property boundary (e.g. house, garden and garage) of private residences (Note that this is a broader definition of the home than used for the public health intervention guidance currently also being developed). It will therefore, for example, include any strategic frameworks or safety legislation related to ponds or swimming pools. Children's homes will be included, but other specialist residential environments - such as young offenders' institutes, or residential psychiatric units - will not be included.
Strategic policies and regulatory or legal frameworks	- Legislation (primary and secondary), regulation, standards and their enforcement - Mass-media campaigns and initiatives (when this wholly or partly aims to encourage awareness of and compliance with the above).
Unsafe incidents	Near misses or non-compliance identified or defined by risk assessments that do *not* result in actual unintentional injury.

Aim

To locate, review and synthesise studies about the performance of strategic policies and regulatory or legal frameworks for guiding or promoting:

- the supply and/or installation of home safety equipment, and

- the provision and conduct of home risk assessments,

for preventing unintentional injuries to children and young people in the home.

Audience

The audience for this review will be the Programme Development Group (PDG) members convened for this CPHE programme topic.

Questions to be addressed

In what ways can legislation, regulation and/or standards (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation or the operation/effectiveness of:

- Programmes/initiatives to supply or install safety equipment in homes,
- Programmes/initiatives to provide home risk assessments,

where they relate to the prevention of unintentional injuries to children and young people.

Are mass media campaigns effective as a tool for encouraging compliance with such legislation, regulation and/or standards?

Which other activities or circumstances are associated with higher (or lower) compliance with legislation, regulations and/or standards (relating to unintentional injury prevention or child safety in the home).

Key outcomes

Measures of compliance (with legislation, regulation, standards) relevant to the aim of the policy/regulatory change.

Rates of unintentional injuries, severity of unintentional injuries, or number of care episodes (e.g. hospitalisations) relating to unintentional injuries.

Rates of relevant safety behaviours or compliance rates (e.g. number/proportion of houses with working smoke alarms, number/proportion of families with children using stair gates, number/proportion of sales of trampolines with industry standard compliant side-netting) or unsafe incidents.

Methods

Systematic review of published and unpublished studies.

Time period to be covered

Studies conducted or published since 1990.

Inclusion criteria for studies

Included studies will:

- Evaluate strategic policies and regulatory or legal frameworks, (and/or activities to promote or ensure their enforcement); and activities to increase compliance and awareness of these initiatives, such as mass-media campaigns;[a]
- Report on legislation, regulation or standards which have an intended or potential role in guiding or promoting (a) the supply and/or installation of home safety equipment, and (b) the provision and conduct of home risk assessments, for preventing unintentional injuries to children and young people in the home.
- Be of any comparative study design (randomised and non-randomised controlled trials, before and after studies, case control studies, ecological studies, cross-sectional studies, prospective and retrospective cohort studies) where there are comparisons groups of people or places or activities both with and without the specified legislation, regulation, enforcement, mass-media campaign, or workforce training/support programme etc.
- Be written in English

Quality assessment and Data Extraction

Included studies will be quality assessed using a structured format appropriate for the study design. Where appropriate, these will be based on those found in the CPHE Methods Guidance 2009 documentation and agreed with the team at CPHE.

[a] when this wholly or partly aims to encourage awareness of and/or compliance with the strategic policies and regulatory or legal frameworks.

Key data about methodology and results will be extracted for each included study into an evidence table, modeled on those found in the NICE CPHE methods guidance and adapted where appropriate to the identified study designs.

Quality assessment and data extraction will be undertaken by a single reviewer and 10% checked by a second reviewer.

Data synthesis and presentation

Data from the included studies will be analysed and synthesised, and evidence statements will be produced. We anticipate that narrative synthesis methods will be used rather than formal data pooling.

Appendix 2 Search Strategy part I

PART I: Concurrent CPHE reviews on prevention of unintentional injury

A) A concurrent piece of intervention stream work entitled, "An evaluation of the effectiveness and cost-effectiveness of the supply and/or installation of safety equipment and risk assessments for preventing unintentional injuries in the home to children and young people aged under 15" required a search to be done that encompassed the interventions covered by this piece of work. Citations that appeared relevant to this review were tagged at the time of screening. Please see Appendix 3 for the search protocol and strategy related to the intervention stream of work.

B) A recently completed piece of work within this Programme of work entitled 'An overview and synthesis of international comparative analyses and surveys of injury prevention policies, legislation and other activities' is also relevant for this review. When assessing studies for the inclusion into the overview and synthesis work some were tagged for consideration for this current review.

PART II: Reference Lists

Searching reference lists particularly of reviews and reports is a common component of finding studies for reviews. For this review we searched references lists of:

a) included reports, journal articles, and reviews from this review

b) excluded reports (from this review), journal articles, and reviews that were deemed of potential interest for this review

PART III: Database Searches

The same databases that were searched for the intervention stream of work related to this review ("Preventing unintentional injuries among under 15s in the home": Search protocol and strategies appear in Appendix 3) were searched for in this review. Combinations of terms already searched for were not repeated but instead focused on terms related to legislation, enforcement, strategies and regulatory frameworks for guiding, enforcing or promoting prevention of injuries in the home in children under 15. NOTE: All database searched included a limit of English language and the years

1990-current. Where this was not possible these restrictions were added at screening stage. All search term examples use Ovid Medline thesauri and limitation terms.

Terms used to find components specific to the interventions for this review:
Health Promotion/
Mass Media/
(campaign or campaigns or media).ti.
(poster* or billboard* or televis* or tv or leaflet* or pamphlet* or postal or posted or mail*).ti.
(poster* or billboard* or televis* or tv or leaflet* or pamphlet* or postal or posted or mail*).ab.
(Program* or Strat* or Polic* or Legislat* or Regulat* or Complianc* or Standard* or enforce* or law*).ti.
“social marketing".tw.
advert*.tw.
Scheme*
Consult*
This terms were combined (“AND”) with the following device terms from the Intervention stream of work:

1 Protective Devices/
2 (safety adj2 (device* or equipment* or appliance*)).mp.
3 ((fire* or smoke* or carbon or CO) adj2 alarm*).tw.
4 ((fire* or smoke* or carbon or CO) adj2 detector*).tw.
5 (temperature adj3 (restrictor* or restricter*)).tw.
6 (thermostat* or TMV).tw.
7 ((cut-off or cut off) adj2 (tap* or valve*)).mp.
8 water AJD2 tap*.tw.
9 (temperature adj3 (control* or regulat*)).tw.
10 (anti-scald* or anti scald*).mp.
11 (stair* gate* or stair* guard*).mp.
12 ((bed* or bath*) adj3 (guard* or gate*)).mp.
13 fireguard*.mp.
14 (fire* adj2 guard*).mp.
15 door* guard*.tw.
16 ((oven* or stove*) adj2 guard*).mp.
17 ((child* or resistant* or lock*) adj4 container*).tw.
18 ((cupboard* or appliance*) adj4 (lock* or latch*)).tw.
19 ((window* or door*) adj2 (locks or latch*)).tw.
20 rail guard*.tw.
21 (safe* adj2 (glass* or film)).tw.
22 (wall adj2 strap*).tw.
23 (door adj3 (cover* or jamm* or stop*)).tw.
24 (bath* adj4 (mat* or rail* or handle*)).tw.
25 (corner adj2 cushion*).tw.
26 ((electrical* or blind*) adj2 cord).tw.
27 ((outlet or radiator*) adj2 cover*).tw.
28 (thermometer* adj2 room*).tw.
29 socket* cover*.tw.
30 (window* adj2 (guard* or safe* or mechanism* or bar*)).mp.

31 ((poison adj2 cabinet) or harness).tw.
32 or/1-31
33 Consumer product safety/
34 Accidents, Home/
35 33 or 34
36 32 or 35

The intervention terms were then also combined with these “External home environment term”:

1 fencing.tw.
2 fence.tw.
3 lawn mower.mp.
4 lawnmower.mp.
5 mower.tw.
6 ((swim* or paddl*) adj2 pool*).tw.
7 trampoline*.tw.
8 "Play and Playthings"/
9 (climb* adj2 frames).tw.
10 (treehouse* or tree-house* or tree house*).tw.
11 (outdoor adj2 play).tw.
12 home play.tw.
13 ((backyard or yard or back) adj yard).tw.
14 sandpit*.tw.
15 strimmer*.tw.
16 (garden adj3 (pond or ponds)).tw.
17 (pond or ponds).tw.
18 (garden or gardening).tw.
19 (climb* adj2 frames).tw.
20 (Garden* adj2 equipment).tw.
21 (Garden* adj2 tool*).tw.
22 (Garden adj2 implement*).tw.
23 or/1-22
24 swing.tw.

PART IV: Website Searches

In addition to the websites searched for the Intervention the following additional websites were searched:

http://www.capt.org.uk

http://www.childreninwales.org.uk/

http://www.injuryobservatory.net/uk_britain.html

http://www.capic.org.uk/

http://www.swpho.nhs.uk/

http://www.rospa.org http://www.consumerdirect.gov.uk/

http://www.everychildmatters.gov.uk

http://www.instituteofhomesafety.co.uk

http://www.iscaip.net/)

www.rp7integris.eu/en/pages/home-1.aspx

http://www.eurosafe.eu.com

PART V: Targeted Searches and Citation Searching

Due to fire alarm safety having been recognised and legislated for primarily prior to the dates of this review an additional search was done for pre 1990 information on fire alarms using the following search strategy:

PRE 1990 fire alarm searches

Ovid MEDLINE(R) 1950 to June Week 1 2009

Search Date: 110609

1 ((fire* or smoke* or carbon or CO2) adj2 alarm*).tw.		158
2 ((fire* or smoke* or carbon or CO2) adj2 detector*).tw.		263
3 1 or 2	409	
4 limit 3 to english language	391	
5 (animals not humans).sh.	3292558	
6 4 not 5	375	
7 limit 6 to yr="1902 - 1990"	75	

PART VI: EXPERT CONTACT AND SUGGESTIONS

Experts' literature and contact suggestions were followed up

Appendix 3 Search strategy part II

Interventions to prevent unintentional injury to children in the home.

Search protocol and search strategies

This Annex relates to the search strategies for all reviews covered under the named intervention(s) above

Searches will be performed to find relevant primary research using a comparative design, qualitative studies, and cost-effectiveness studies. The reference list of systematic reviews of found studies will also be utilised. Searches will be conducted in medical, social science and policy databases along with a search for grey literature.

All searches will be limited to those in English published since 1990, where possible.

PART 1: Bibliographic Databases

The following databases will be searched. Use of "core and topic specific" based on NICE guidance wording:

From the "core databases":

- ASSIA (Applied Social Science Index and Abstracts)
- CINAHL
- Database of Abstracts of Reviews of Effectiveness (DARE); NHS EED; HTA (all in the CRD database)
- HMIC (or Kings Fund catalogue and DH data)
- MEDLINE
- PsycINFO

(i) Social Science Citation Index

(ii) Cochrane Database of Systematic Reviews [predominantly for reference checking]

(iii) EconLit

From the "topic-specific databases":

- SafetyLit

- EPPI Centre databases
  - Bibliomap
  - DoPHER
  - TRoPHI
- The Campbell Collaboration

Search Strategy

Search Strategies for the bibliographic databases will be based on text words and thesaurus headings applicable to the individual database. The searches will be carried out in 3 parts but the results will be de-duplicated against each other before the screening process.

The Medline search strategy examples follow and will be "translated" according to the appropriate thesaurus terms for each individual database. Where a database does not have a thesaurus or does not have a search facility to incorporate thesaurus searching, text words only will be used. All searches where possible will be limited to English language and with a publication or database entry date from 1990-current.

Ovid MEDLINE(R) 1950-current (online version)

Search a): Safety Devices AND injuries in the home

1. (accident* or injur*).tw.
2. (home* or house* or residen*).tw.
3. 1 and 2
4. Accidents, Home/
5. exp Accident Prevention/
6. 1 or 4 or 5
7. Protective Devices/
8. (safety adj2 (device* or equipment* or appliance*)).mp.
9. ((fire* or smoke* or carbon or CO) adj2 alarm*).tw.
10. ((fire* or smoke* or carbon or CO) adj2 detector*).tw.
11. (temperature adj3 (restrictor* or restricter*)).tw.
12. (thermostat* or TMV).tw.
13. ((cut-off or cut off) adj2 (tap* or valve*)).mp. [mp=title, original title, abstract, name of substance word, subject heading word]
14. water AJD2 tap*.tw.
15. (temperature adj3 (control* or regulat*)).tw.
16. (anti-scald* or anti scald*).mp.
17. (stair* gate* or stair* guard*).mp.
18. ((bed* or bath*) adj3 (guard* or gate*)).mp.
19. fireguard*.mp.
20. (fire* adj2 guard*).mp.

21. door* guard*.tw.
22. ((oven* or stove*) adj2 guard*).mp.
23. ((child* or resistant* or lock*) adj4 container*).tw.
24. ((cupboard* or appliance*) adj4 (lock* or latch*)).tw.
25. ((window* or door*) adj2 (locks or latch*)).tw.
26. rail guard*.tw.
27. (safe* adj2 (glass* or film)).tw.
28. (wall adj2 strap*).tw.
29. (door adj3 (cover* or jamm* or stop*)).tw.
30. (bath* adj4 (mat* or rail* or handle*)).tw.
31. (corner adj2 cushion*).tw.
32. ((electrical* or blind*) adj2 cord).tw.
33. ((outlet or radiator*) adj2 cover*).tw.
34. (thermometer* adj2 room*).tw.
35. socket* cover*.tw.
36. (window* adj2 (guard* or safe* or mechanism* or bar*)).mp.
37. ((poison adj2 cabinet) or harness).tw.
38. or/7-30
39. 6 and 38
40. limit 39 to (english language and yr="1990 - 2009")
41. (animals not humans).sh.
42. 40 not 41

Search b): Type of scheme AND injuries in the home

1. (accident* or injur*).tw.
2. (home* or house*).tw.
3. 1 and 2
4. Accidents, Home/
5. exp Accident Prevention/
6. 4 or 3 or 5
7. (giveaway* or give-a-way).mp.
8. distribut*.mp.
9. discount*.mp.
10. free.tw.
11. home deliver*.tw.
12. (low-cost* or (low adj2 cost*)).tw.
13. loan*.tw.
14. (subsidized or subsidised).tw.
15. (fit or fitted).tw.
16. instal*.tw.
17. (provision* or provid*).mp.
18. suppl*.tw.
19. scheme*.tw.
20. or/7-19
21. 6 and 20
22. (device* or equipment*).mp.
23. 21 and 22
24. limit 23 to (english language and yr="1990 - 2009")
25. (animals not humans).sh.

26. 24 not 25

Search c): Home Assessments AND injuries

1. (accident* or injur*).tw.
2. (resident* or home* or house*).tw.
3. 1 and 2
4. Accidents, Home/
5. exp Accident Prevention/
6. 4 or 3 or 5
7. (home adj4 visit*).tw.
8. inspect*.tw.
9. visit.tw.
10. (safety adj2 (assessment* or check*)).tw.
11. home visit*.tw.
12. safety consult*.tw.
13. (home adj2 (assessment* or evaluation*)).tw.
14. 8 or 13 or 9 or 11 or 7 or 12 or 10
15. 6 and 14
16. limit 15 to (english language and yr="1990 - 2009")
17. (animals not humans).sh.
18. 16 not 17
19. (1 or 5) and 2
20. 19 or 4
21. (visit* or inspection* or assessment* or check* or evaluation* or (safety adj consult*)).tw.
22. 20 and 21
23. limit 22 to (english language and yr="1990 - 2009")
24. 23 not 17
25. 18 or 24

Part 2: Organisation web-sites and in-house databases:

Websites of the following relevant organisations will also be searched for published and unpublished research:

- Child Accident Prevention Trust (http://www.capt.org.uk)
- Children in Wales (http://www.childreninwales.org.uk/areasofwork/childsafety)
- Injury Observatory for Britain & Ireland (http://www.injuryobservatory.net)
- Public Health Observatory website for the South West (lead on Injuries) http://www.swpho.nhs.uk/)
- The Royal Society for the Prevention of Accidents (http://www.rospa.org)
- International Society for Child and Adolescent Injury Prevention (http://www.iscaip.net/)
- Integris (EU Injuries programme for coordinating injury data) www.rp7integris.eu/en/pages/home-1.aspx

- Eurosafe

And may include the following, should time and resources allow:

- Scottish Executive
- Welsh Assembly Government

PART 3: Additional Searches

If, as a results of the above searching methods, additional terminology is found for schemes, key devices, and/or home assessments these will be done as an additional search in the core databases.

Named programmes will also be searched for separately (e.g. Dangerpoint and Sure Start). Named programmes will be searched for on the core databases and through a general web-site engine such as Google.

PART 4: Citation and Reference Searching

Where a reference is found pertaining to a includable piece of research with incomplete data or only an interim report has been identified a citation search will be conducted. The reference lists of recent (2004-2009) systematic reviews and/or key reports will be searched for potentially missed studies. Should time and resources allow further systematic review reference lists will be searched.

PART 5: EXPERT CONTACT AND SUGGESTIONS

Experts' literature and contact suggestions will be followed up.

Appendix 4 OECD countries

Austria

Australia

Belgium

Canada

Czech republic

Denmark

Finland

France

Germany

Greece

Hungary

Iceland

Ireland

Italy

Japan

Korea

Luxembourg

Mexico

Netherlands

New Zealand

Norway

Poland

Portugal

Slovak republic

Spain

Sweden

Switzerland

Turkey

United Kingdom

United States

Appendix 5 Exclusion criteria used for screening

0		Include
Exclusion codes and reasons:		
1	Focus	Not about safety equipment in the home or garden (or home risk assessments)
2	Focus	Not about the supply or installation of safety equipment
3	Focus	Not about legislation, regulation, standards, strategies or enforcement (incl. media to promote these)
4	Methods	Not an evaluation using comparative design
5	Outcomes	don't assess: compliance with standards OR rates of injury (care/H) OR rates of safety behaviour
6	Outcomes	aren't relevant to children
7	Location	Not OECD country
8	Language	Not in English
9	Date	Pre 1990

Appendix 6 Quality appraisal tool

Questions below are assessed as ++, +, -, NR or NA

Population
1.1 Is the source population well described? *Was the country (e.g. developed or non-developed, public or private health care system), setting (primary schools, community centres etc), location (urban, rural), population demographics etc adequately described?*
1.2 Eligible population representative of the source population? *Was the recruitment of individuals/clusters well defined (eg advertisement, birth register etc)?* *Did the inclusion/exclusion criteria ensure the eligible population was representative of the source population? Were important groups underrepresented?*
1.3 Do the selected participants represent the eligible population? *Was the method of selection of participants from the eligible population well described?* *What % of selected individuals/clusters agreed to participate? Were there any sources of bias?* *Were the in-/exclusion criteria explicit and appropriate?*
Method of allocation
2.1 Allocation to intervention (or comparison) groups- how was confounding minimised? *Was allocation to exposure and comparison randomised? Was it truly random ++ or pseudo-randomised + (eg consecutive admissions)?* *If not randomised, was significant confounding likely (-) or not (+)?* *If a cross-over, was order of intervention randomised?*
2.2 Interventions (and comparisons) well described and appropriate? *Were intervention & comparison conditions described in sufficient detail (i.e. enough for study to be replicated)?* *Was comparison appropriate (eg usual practice rather than no treatment)?*
2.3 Allocation concealed? *Could the person(s) determining allocation of subjects/clusters to intervention or comparison groups have influenced the allocation?* *Adequate allocation concealment (++) would include centralised allocation or computerised allocation systems.*
2.4 Participants and/or investigators blind to exposure and comparison? *Were participants AND investigators- those delivering and/or assessing the intervention kept blind to intervention allocation? (Triple or Double blinding score ++, Single blinding score +)* *If lack of blinding is likely to cause important bias, score -.*
2.5 Exposure to intervention and comparison adequate? *Could reduced exposure to intervention or control be related to the intervention (eg adverse effects leading to reduced compliance) or fidelity of implementation (eg reduced adherence to protocol)?* *Was lack of exposure sufficient to cause important bias?*
2.6 Contamination acceptably low? *Did any of the comparison group receive the intervention or vice versa?* *If so, was it sufficient to cause important bias?* *If a cross-over trial, was there a sufficient wash-out period between interventions?*
2.7 Other interventions similar in both groups? *Were the groups treated equally by researchers or other health care workers?* *Did either group receive additional interventions or have services provided in a different manner, e.g. at home?* *Was this sufficient to cause important bias?*
2.8 All participants accounted for at study conclusion? *Were those lost-to-follow-up (ie dropped/lost pre-/during/post- intervention) acceptably low (ie typically <20%)?* *Did the proportion dropped differ by group? For example, were drop-outs related to the adverse effects of the intervention?*

2.9 Did the setting reflect usual practice? *Did the setting differ significantly from best or usual practice? For example, did subjects receive intervention (or comparison) condition in a hospital rather than a community-based setting?*
2.10 Did the intervention or control comparison reflect usual practice? *Did the intervention or control comparison differ significantly from best or usual practice? For example, did subjects receive intervention (or comparison) conditions delivered by specialists rather than GPs? Were subjects monitored more closely?*
Outcomes
3.1 Outcome measures reliable? *How reliable (ie how objective or subjective) were outcome measures (e.g. biochemically validated nicotine levels ++ vs self-reported smoking -).* *Was there any indication that measures had been validated (eg inter- or intra-rater reliability scores)?*
3.2 Outcome measurement complete? *Were all/most study participants who met the defined study outcome definitions likely to have been identified?*
3.3 Were all important outcomes assessed? *Were all important benefits and harms assessed?* *Was it possible to determine the overall balance of benefits and harms of the exposure/comparison?*
3.4 Were outcomes relevant? *Where surrogate outcome measures were used, did they measure what they set out to measure?* *e.g. a study to assess impact on physical activity assesses gym membership -a potentially objective outcome measure- but a reliable predictor of physical activity?*
3.5 Similar follow-up time in exposure and comparison groups? *If groups are followed for different lengths of time, then more events are likely to occur in the group followed up for longer distorting the comparison.* *Analyses can be adjusted to allow for differences in length of follow-up (eg using person-years).*
3.6 Was follow-up time meaningful? *Was follow-up long enough to assess long-term benefits/harms?* *Was it too long, e.g. participants lost to follow-up?*
Analyses
4.1 Exposure and comparison groups similar at baseline? If not, were these adjusted? *Were there any differences between groups in important confounders at baseline?* *If so, were these adjusted for in the analyses (e.g. multivariate analyses or stratification).* *Were there likely to be any residual differences of relevance?*
4.2 Intention to treat analysis? *Were all participants (including those that dropped out or did not fully complete the intervention course) analysed in the groups (ie intervention or comparison) to which they were originally allocated?*
4.3 Estimates of effect size given or calculable? *Were effect estimates (e.g relative risks, absolute risks) given or possible to calculate?*
4.4 Analytical methods appropriate? *Were important differences in follow-up time, likely confounders etc adjusted for?* *If a cluster design, were analyses of sample size (and power), and effect size performed on clusters (and not individuals)?* *Were sub-group analyses appropriate?*
4.5 Precision of intervention effects given or calculable? Were they meaningful? *Were confidence intervals &/or p-values for effect estimates given or possible to calculate?* *Were CI's wide or were they sufficiently precise to aid decision-making? If precision is lacking, is this because the study is under-powered?*
4.6 Was the study sufficiently powered to detect an intervention effect (if one exists)? *A power of 0.8 (ie it is likely to see an effect of a given size if one exists, 80% of the time) is the conventionally accepted standard.* *Is a power calculation presented? If not, what is the expected effect size? Is the sample size*

adequate?
Summary
5.1 Are the study results internally valid (ie unbiased)? *How well did the study minimise sources of bias (i.e. low systematic error)?* *Were there significant flaws in the study design?*
5.2 Are the findings generalisable to the source population (ie externally valid)? *Are there sufficient details given about the study to determine if the findings are generalisable to the source population? Consider: participants, interventions and comparisons, outcomes, resource and policy implications.*

Appendix 7 Evidence tables

SMOKE DETECTORS

Study details	Population and setting	Methods	Notes
Authors **McLoughlin, Marchone, Hanger, German, Baker** **Year (of publication)** **1985** **Aim of study** **To evaluate the Montgomery County law about smoke detectors which is the first in the USA to retrofit requirements.** **Study design** **Controlled before and after study.** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** Montgomery Country, Maryland compared with Fairfax county Virginia (similar in demographic and socio-economic characteristics but with law that only applies to new build homes), USA. **Nature of Law/ standard** In 1975, Building Officials and Code Administrators International (BOCA) amended to require a **smoke detector** protecting the bedroom area in each dwelling area of one- two- and multi-family dwellings. In 1983, 29 states required smoke detectors in all new classes of residential construction and 22 require one or more classes of residential housing to be retro-fitted with smoke alarms. Montgomery County Maryland was the first major jurisdiction to adopt retrofit law – a detector for each separate sleeping area and in stairways leading to occupied areas effective from July 1978. Enforcement in Montgomery includes a fine/jail if detectors not found by firefighters called to the home for a fire or other emergency; and sale of houses contingent on there being certification of detectors. **Study year** July 1983-December 1983	**Characteristics of the 2 counties** Information about demographic characteristics of the two counties obtained form the 1980 census. Current tax assessors' lists used to draw a systematic random sample of all owner occupied single family homes in each county – 500 homes in Montgomery and 400 in Fairfax. These mirrored the distribution of the county population among fire station response rates. Median value of the houses in the sample similar to that in the census for each county. **Interview strategy** All interviewers were trained. Concern about refusals to participate was addressed by the Project offering to give away enough battery-powered photo electric detectors to bring non-complying households into compliance in return for survey participation. **Smoke alarm status categories** A. EVERY LEVEL Dwelling conforms to National Fire Protection Association 1978 requiring a detector for each separate sleeping area and on every level of the dwelling. B. YES BY CODE Dwelling conforms to past code 1976 which requires a detector for each separate sleeping	**Limitations identified by author** Participating counties among the most affluent in the USA – therefore low risk of fire death. Sample confined to single family dwellings. **Limitations identified by review team** No child specific data. Not clear how the offer to supply non-compliant households with free detectors might affect participation, although only 11% in Montgomery and 6% in Fairfax refused. No comparative statistics presented. No data for multivariate model presented. Data extracted from graphs is subject to inaccuracies. **Evidence gaps and/or recommendations for future research** **Source of funding** **Observations from the Discussion section about barriers & facilitators** Building code requirements effective but gradual to build presence of working fire alarms. Building codes should required wired

Study details	Population and setting	Methods	Notes
	Eligible population: Households in Montgomery County, Maryland and Fairfax County, Virginia.	area and in stairways leading to occupied areas. (Current Montgomery County law.) C. WORKING DETECTORS Dwelling has at least one working detector, but not in sufficient number or location to comply with either code. D. NONE WORKING Dwelling has detector units in home, but these are either not working or not installed. E. NO DETECTOR Dwelling has no detector. **Statistical analysis** Linear logistic models generated for predicting at least one working detector in the counties individually and combined. 14 variable were entered in the model and then eliminated in a backward procedure until only those making a significant contribution ($p<0.05$) to prediction remained. Fire data collected for 1972-1983. Fire data for single family homes in each county available only for 1976-1983.	detractors. Retrofit smoke detector requirement appears to be enforceable, despite some initial concerns – mechanism of requiring certification when house is sold is effective. Use of warning notices also seems effective (over 5 yrs 500 warnings delivered and only 5 summons & 1 prosecution). May be effective because it fits with social norms – most people believe the law to be a good idea (97% Montgomery, 92% Fairfax). Mass media campaign support may be needed to introduce a law.

Results

72% of original sample in each county had completed interviews (Montgomery County 11% not home, 11% refused, 6% other. Fairfax 14% not at home, 6% refused, 8% other).

Distribution of homes built before and after 1975 according to category of detector protection

(est. from graph)	Complies (%)	Working (%)	Not working (%)
Pre 1975 homes	37	37	27
Post 1975 homes	69	26	4

Study details	Population and setting	Methods	Notes

Comparison between category of detector protection in Montgomery County and Fairfax county

	Montgomery % (n) N=359	Fairfax % (n) N=287	Total
Every level	15 (53)	20 (56)	109
Yes by code	27 (97)	24 (70)	167
Working detectors	41 (145)	26 (76)	221
None working	11 (41)	13 (38)	79
No detector	6 (23)	16 (47)	70

Although similar levels complied with every level and yes by code score, there were substantial differences over "working detectors" (82% Montgomery vs 70% Fairfax) and "no detector" (6% Montgomery v. 16% Fairfax).
Differences cannot be explained by the 1975 building requirement since on 15% on Montgomery houses build post-1975 v. 25% in Fairfax.

Weak association between house being sold in last 5 years and detector protection in Montgomery county (p=0.06, but only 18% of homes sold in this period).

In Montgomery, 80% knew or assumed there was a law (12% no/don't think so and 8% DK) but only 11% knew detail that detectors were required for each sleeping area and stairwells.

Compliance most likely among the 45% who knew that there were penalties attached, less likely in the 34% of those who nknew a law but not about penalities, and least likely in the 20% it was not known there was a law.

MONTGOMERY Country compliance (estimated from graph)

	Not working %	Working %	Complies %	Total %
Penalty known	5	18	22	45
Law known	7	13	14	34
Neither known	6	9	5	20

Predicting presence of working detector – Date of home built was the most important in all logistic models. Belief that the law required detectors present in Montgomery and both combined. Factors associated with economic variables (less income, low property values, fewer no. of storeys in home) related to lower detector presence in Montgomery county. Six variables not associated – smokers, children>10, or elders over 65, married couple, no. of people in household, education level of head of household. (data not presented!)

Maintenance of fire detectors 84% sounded when tested – same in both counties.
81% of battery powered and 92% of wired detectors sounded.

Substantially greater reduction in fatal fires in Montgomery v. Fairfax

No. of fires and fatalities in the 2 counties

		1972-77	1978-1983

Study details	Population and setting	Methods	Notes

Fatal fires	Montgomery	54	26
	Fairfax	40	27
Fire deaths	Montgomery	60	31
	Fairfax	56	40
Single family fire deaths	Montgomery	35	20
	Fairfax	46	40

All estimated from graph

Single family fire deaths markedly less in Montgomery, despite there being more single family fires in 1978-83 (2559 v. 2137 in Fairfax.)

WINDOW GUARDS

Study details	Population and setting	Methods	Notes
Authors **Pressley & Barlow** **Year (of publication)** **2005** **Aim of study** **To examine incidence, demographic factors and patterns of injury resulting form falls form buildings and structures in areas with and without a legislation based prevention programme.** **Study design** **Comparative** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** **Country** USA New York vs 27 states **Nature of Law/ standard** 1976 amendment to the New York City Health Code requiring owners of multiple dwellings to provide **window guards** in apartments where children aged<=10 years reside. Annual enforcement. Also undertaken were coordinated education program, "Children Can't Fly" involved outreach, dissemination of literature and instruction, a media campaign and distribution of easy to install free window guards in the early 1970s. **Study year** 2000 calendar year for 27 states. 2001 for NY hospitalisations **Eligible population:** Age <=18	**Data sources** The Kids Inpatient Database (KID-HCUP) provided a national sample of state-wide care hospital discharges from 27 states. This cross sectional data set contained unweighted hospital discharge data on 2,516,833 paediatric admissions to community, non-rehabilitation hospitals (aged <=19), and 7,291,032 weighted discharges. Those aged 19 were excluded. 61 routine, elective or scheduled admissions for falls from buildings or structures were excluded as unlikely incident injury. For KID-HCUP, 2 states did not have month of discharge and 6 reported all races as "other/unknown". They were thus excluded from incidence calculations by race and ethnicity, but appear in totals not stratified by race and ethnicity. New York Statewide Planning and Research Cooperative System (SPARCS) provided data at the zip code level for New York residents for 2001. This allowed annual injury incidence for New York city to be examined. US census used to provide denominator data. This also supplied number of units in housing structures 1-50+. 10 or more units was used as a proxy for exposure to multi-storey	**Limitations identified by author** Information did not allow falls from buildings (such as from fire escapes) to be distinguished from falls from windows. National estimates were made based on data from 27 states and it is not known if these are representative of the us as a whole. Unable to include incidence calculation for those dying before hospital admission, not seeking treatment, failing to receive the correct code or those treated and released from an emergency dept. Data include zip code for residence, not place of injury for those not injured at home (little impact for younger children by in older children, fewer than half of falls occur at home). **Limitations identified by review team** **Evidence gaps and/or recommendations for future research** Documentation and completeness of injury coding in medical records is needed. **Source of funding** National Center for Minority health and Health Disparities

Study details	Population and setting	Methods	Notes
		dwelling. Acute injury was defined to include urgent or emergent admissions or admission through an emergency dept. resulting form falls from buildings or structures. Codes from ICD-9-CM were used, which exclude jumps/falls to escape fire. **Statistical analyses** Cumulative incidence (/100,000 per year) for falls calculated using weighted KID-HCUP (numerators) for New York city/ New York State using SPARCS data (numerators) and the US census (denominators). For NY City, the 5 boroughs covered by window legislation were grouped. Multivariable logistic regression used to identify independent factors and odds ratios for factors associated with falls from buildings. "Cases" were injuries resulting from falls from buildings/ structures, "non-cases" were children hospitalised for other reasons. Chi-sq used in univariate analysis of categorical variables, (significance at 0.05 level)	**Observations from the Discussion section about barriers & facilitators** A window guard law, with annual enforcement, has been effective in NY city, where exposure to high-rises associated with multifamily dwelling is higher than the national average but incidence of injury due to falls is far lower. In 1975 159 falls and 19 deaths in NY city in one report. In 2001 30 children were hospitalised and there were no reported window fall deaths. Many falls were in older adolescents, not covered by the law. Declines were noted following introduction of the law, but steeper declines were noted with enforcement of the legislation – this included legal action with criminal charges against landlords, and continued education al efforts aimed at parents, "Children Can't Fly".
Results **(Full details of total population characteristics for all falls not extracted – table 1 in paper** **Data about intentional falls, types of unintentional injury, seasonal data, race and socioeconomic status, cost of hospital care not extracted.)** **1161 discharges were classified as due to acute injury due to falls from buildings and structures, 70 were intentional.** **1091 unintentional falls.** **Incidence for the state of NY state altogether lower than the national average (2.47 v. 2.81 per 100 000) but this was due to lower incidence in NY city, in areas not covered by legislation - NY state, incidence was slightly higher than the national average (1.5 v. 2.81 per 100 000 - estimated from graph – figure 3)**			

Study details	Population and setting	Methods	Notes

Boston, Massachusetts and Chicago, Illinois implemented no-legislative base interventions programmes. KID-HCUP did not contain data for Illinois or separate data for Boston, for Massachusetts tended to be higher than New York State (3.00 v 2.47 per 100,000) and the US (3.00 v. 2.81 per 100 000).
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NY city has a higher proportion of population living in multifamily dwellings with 10 or more units compared to nationally (54% *vs*.13%, p<0.0001), but incidence of injury from falls from buildings was nearly half that observed in the US.

30 falls occurred in NY city, approx half occurred outside the age range covered by the legislation.

Estimated cumulative incidence of emergent and urgent hospital admissions for unintentional falls from buildings or structures by age and race/ethnicity*

Age	White	Black	Hispanic	Total
0-4	2.72	4.82	5.48	4.6
5-9	1.28	2.1	2.4	1.98
10-14	1.01	1.33	1.91	1.46
15-18	2.74	1.52	3.38	NA
Total	1.87	2.42	3.37	2.81

*** cumulative incidence /100,000 per yr for children aged 0-18 hospitalised for falls from buildings or structures. Data source in KID-HCUP. Incidence is for acute hospitalised injury and does not include emergency dept. visits that did not require hospitalisation or patients who dies before being hospitalised.**
Total includes "other" and "unspecified" races.
NA – not reported. Large % unknown race.

Falls 0-4 age group: blacks 48% Hispanics 46% Whites 33%
15-18 age group: Blacks 14% Hispanics 21% whites 30%
Falls among blacks clustered in communities with zip codes below the national median while most falls among whites associated with incomes higher than the national median.

Percentage of those falling, falling from home (estimated from graph)
Age 0-4 88%, age 5-9 52%, age 10-14 74% age 15-18 40%

Mental health diagnoses were uncommon in very young age groups, increased with age. Mental health diagnoses including substance abuse were highest in older groups 15-18yrs (p<0.0001)
Concomitant mental health or substance abuse diagnoses occurred twice as frequently

HOT WATER TAP TEMPERATURE

Study details	Population and setting	Methods	Notes
Authors **Erdmann, Feldman, Rivara, Heimbach, Wall.** **Year (of publication)** **1991** **Aim of study** **To evaluate the effectiveness of Washington State hot water legislation 5 years after inception. determine whether heaters set at safe temperatures stayed safely set, whether people were convinced to set back older heaters and whether changes in home water heater temperatures were accompanied by changes in the number of burn hospitalisations.** **Study design** **Before and after study.** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** Seattle, Washington State, USA. **Nature of Law/ standard** Washington State law requires preset maximum temperatures to be set on new heaters at 49^{o}C (120^{o}F) since July 1983. Heaters in rental units have to be reset at 49^{o}C each time a new tenant occupies the unit, warning labels must be displayed on units, annual notices are provided to utility customers warning of the hazards of hotter water and energy savings of lower water temperature. Home owners and tenants are permitted to turn up the thermostat if preferred. **Study year** 1979 – 1988 (to July 1983 pre-law) **Eligible population:** Patients younger than 15 admitted to a hospital or burn unit.	All patients under 15yrs admitted to Children's Hospital and Medical Centre (CHMC) or Northwest Regional Burn Centre of Harborview Medical Centre (HMC) for scald burns were identified. CHMC charts for 1 July 1979 to 31 May 1988 were used – tap water scalds identified for final review. HMC charts 1 Jan 1982 to 31 December 1987 used – only those coded as tap water burns. All pre 1 July 1993 considered prelaw, others postlaw. To minimise effect of referral patterns changes, only those within King County included. Charts form patients in a previous study were reviewed and 1969 through 1976 King County cases used for comparison. Hot water in 50 households with hot water heaters installed since 1983 tested in summer 1988 and compared with to households with hot water heaters installed before July 1983. A random sample of 2% of all Seattle City Light customers established which had a new heater. Households were categorised by zip code and were chosen non-randomly to provide the widest possible distribution of zip codes. These were contacted by telephone and home interview secured with 50/70 case households (69%) and 50/77 controls (65%).	**Limitations identified by author** Although sample size chosen to have 90% chance of detected a significant difference in 30% more cases than control homes had water temperatures of <54^{o}C, there were many more control homes with water at safe temperatures than anticipated – making a type II error (failing to detect significance due to small sample) more likely. Some trends are not amenable to statistical testing – annual admissions for HMC plus CHMC was less before than after July 1983 (legislation introduced). The effect of large short term variations on small incidences is seen here – if the 5 pts admitted in the later half of 1983 are reclassified as "prelaw", incidence in the 2 time periods is virtually equal. As the useful life of water heaters is about 10 years, it would be expected that the full effect of legislation would only begin to be felt after a decade. **Limitations identified by review team** **Evidence gaps and/or recommendations for future research** Ongoing study required to assess the impact of lower water temperature on

Study details	Population and setting	Methods	Notes
		Water temperature objectively measured after 30 sec and 120 sec of water flowing. Means compared using Student's t test and chi-sq for categorical data. Incidence rates in the two time periods compared using chi-sq.	scald injuries. **Source of funding** Harborview Injury Prevention and Research Centre grant form CDC and Seattle City Light Dept. **Observations from the Discussion section about barriers & facilitators** Reduction in hot water may be due to legislation, education or both – as 70% of control homes recorded safe temperatures, education alone may account for most of the reduction.

Results
1979-1988
16/146 patients admitted with scald burns had tap water burns (10.8%) 10 from King's County
1982-1087
20/326 patients admitted with scald burns had tap water burns (6.1%) 8 from King's County
Annual admission rate 1.1 per year for CHMC and 1.3 per year. Combined 2.6 per year for King's county (56% reduction from combined admission rate of 5.5 per year for 1969-1976)
Simultaneous 22% in <15 yr old population (318,000 in 1970 to 249,000 in 1985 (RG note - data from 1980 seems to be missing)
Authors state that different periods sampled at CHMC and HMC, small samples sizes and changing county referrals preclude meaningful statistical comparison.

(Data describing injury details not extracted)

50% of current patients had abuse related burns vs 31% in 1970. Data below relates to unintentional injury only – intentional and totals not extracted.

Non-intentional injury - Site	1 Jan 1969- 31 Dec 1976		1 July 1979- 30 June 1983 (prelaw)		1 July 1983- 31 May 1988 (postlaw)	
	N	Rate	N	Rate	N	rate
CHMC	19	2.4	1	0.3	4	0.8
HMC	3	1.5	0	0	4	09
Total	22	3.9	1	0.3	8	1.7

Rate = patients per year

Study details	Population and setting	Methods	Notes

No difference in frequency of households with water temperatures > or < 54°C (130°F) for those who: reported heater functions satisfactorily, lowered heater temperature setting, owned own home, reported satisfactory dishwasher function, or knew hot water could cause burns.
(some details about turning up hot water not extracted)

Significant reduction in mean hot water temperature.

	1977 Homes	All 1988 homes	1988 homes with pre 7/83 water heaters	1988 homes with post 6/83 water heaters
Temperature after 120s mean +/- 2 SD. °C (°F)	61 +/-14* (142 +/-26)	50 +/-14* (122 +/-25)	50 +/-11¤ (122 +/- 20)	50 +/-17¤ (121 +/-30)
Homes <54°C (130°F)				
No (%)	11 (10)*	77 (77)*	35 (70)**	42 (84)**
Sample n	57	100	50	50

* **p<0.05;** ** **0.05<p>0.1;** ¤ **p>=0.1 non sig**.

Study details	Population and setting	Methods	Notes
Authors **Leahy, Hyden, Bessey, Rabbitts, Freudenberg, Yurt.** **Year (of publication)** **2007** **Aim of study** **To evaluate the impact of the title 27 water heaters policy on incidence of tap water scalds in New York City.** **Study design** **Before and after study** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** New York City, USA **Nature of Law/ standard** In 1996, title 27 of the New York City Administrative Code was amended to require **water heaters** in all multiunit dwellings constructed or renovated after 1997 to have maximum setting of 120^{o}F (49^{o}C) **Study year** 1996-97 pre-legislation data 1998-2003 post-legislation data **Eligible population:** Those in NYC boroughs with tap water temperature legislation.	Several sources used: Tap water scalds discharge data from NY state hospital discharge database, zip code data used to identify New York city data. Medical and billing records from all tap water scald patients admitted to regional burn centre in New York City which also provided data about location of burn injury, and type of dwelling. Public access building records maintained by local Dept of Buildings. Interviews with building contractors, vendors and city officials. Continuous variables reported as mean (standard error)	**Limitations identified by author** Although city wide discharge data were used to obtain an overall incidence of scalds, the patient specific findings included were limited to the subpopulation of burn injured patients treated at this institution, which is one of four burn centres in the city. The public access databases used may be limited by record completion or availability. **Limitations identified by review team** Most statistics are reported for whole population not children only. **Evidence gaps and/or recommendations for future research** NR **Source of funding** NR **Observations from the Discussion section about barriers & facilitators** The authors conclude that new legislation is needed to prevent scalds in NY city. Limitations of the current law include the small number of houses built after 1998 and the current limitations to multiunit dwellings.
Results **Before and after tap water scald burns rates:**			

Study details	Population and setting	Methods	Notes
1996-1997 15 per 1,000,000 NYC residents (170/year). **1998-2003 22 per 1,000,000 NYC residents (182/year)** **19 deaths occurred.** **50% were to those aged under 5 (median 3.9; range 0.1month – 94years)** **Hispanic 32%** **African American 29%** **Caucasians 26%** **Asians 8%** **Others 5%** **(data on type of injury not extracted)** **259 (92%) within the five boroughs of NY city for which date of construction verifiable in 210/259. Of these 100% of tap water burns occurred in pre1998 construction of renovation buildings.** **261 cases (93%) in residential setting** **214 (76%) in multi-unit dwelling** **Overall societal costs estimated at $71,500 and $103,700 per scald injured patient** **$20-29 million for the 281 patients treated at this institution.** **Estimated total costs to NY city 1996-2003 = $102-149 million**			

Study details	Population and setting	Methods	Notes
Authors **Spallek, Nixon, Bain, Purdie, Spinks, Scott, McClure** **Year (of publication)** **2007** **Aim of study** **To quantify the effectiveness of the Queensland "Hot Water Burns Like Fire" campaign** **Study design** **Before and after study ("opportunistic evaluation")** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** Queensland Australia **Nature of Law/ standard** Public education and environmental modification through legislation. "**Hot Water Burns Like Fire**" 1998 scald prevention campaign promoting the installation of devices to limit domestic hot water temperature to 50°C (122°F). Building code legislation passed in April 1998 required the installation of a temperature-tempering valve set at 50°C to deliver water to bathroom area of all new homes and all home that underwent major renovations or had a hot water system replaced. **Study year** Pre intervention data 1990 Post intervention data 2002-2003 **Eligible population:** Households in Queensland. 2002-2003 data limited to households with school aged children.	Hot water temperatures, demographic and social variables taken from 2 random sample household risk surveys in 1990 and 2002-3. **Impact measures** In 1990, the Brisbane Household Survey was used. 6 households chosen in each of 165 randomly selected Australian Bureau of Statistics collector districts. 1003/1399 eligible to participate took part (72% participation rate). Hot water temperatures were available for a random sub-sample of 872. In 2002-3 a survey was conducted to collect data for a longitudinal cohort study of injury of Brisbane children aged 4-13 to obtain frequency and distribution of injury. School stratified into high (n=10), medium (n=10) and low (n=16) socioeconomic status (SES) based on postcode and Socio-economic Indicator for Areas (SEIFA). Over-sampling for low SES. 2 excluded and 2 refused to participate (94% participation, n=32). Depending on school size, 17-350 children randomly selected using school rolls and random number tables. 871/3508 families contacted included in the survey (25% participation). For both surveys, water temperature objectively measured by trained interviewers. No effort made to verify	**Limitations identified by author** Primary studies from which data were drawn used different sampling strategies and were conducted by 2 different groups of researchers (pre-intervention sample based on randomly identified houses stratifies by small area census statistics, post-intervention used 2 level school based sample leaving just homes with school aged children and weight in those in lower SES categories.) Direction of potential bias unclear. **Limitations identified by review team** Only 25% participation rate in the 2002-3 survey – not explored whether this was representative. No objective check of presence of water tempering device, so possible over reporting. Use of SES for school attended may not be a good proxy for individuals' SES. Number of homes reporting tempering valve presence is different in the text and the table. (I think they have worked backwards from a known percentage for the text numbers, using the wrong denominator (that for 1990) so that % and the n reported in the table is the correct one) **Evidence gaps and/or recommendations for future research** Although it is suggested in the

Study details	Population and setting	Methods	Notes
		reported presence of tempering device. **Outcome measures** Injury outcomes from the Queensland Hospital Admitted Patient Data Collection (QHADPDC). Due to changes in ICD codes, different codes were used pre 1996, 1996-99 and post 1999. Mapping was used to enable a consistent set of injuries to be recorded over time. Annual incidence was calculated to account for the increase in 0-4 year olds recorded by the census over time. **Analysis** Univariate descriptive analysis for impact evaluation. Normal distribution. Difference between 2 means tested with independent samples t-test. All homes were classified into one of three SES groups based on the SES of school attended and ANOVA used to explore defences in the SES distribution. Rate of hospital admission grouped into 2 categories: scald injuries per year prior to the introduction of hot water valve legislation and scald injuries per year after. Difference in mean rates evaluated using t-test. Rates plotted on a scatter plot by year and linear regression used to quantify the relationship between rates of scald injury and year.	literature that passive intervention devices are more effective that relying on behaviour change mechanisms alone, how to deliver such interventions effectively is not known. May be more effective if targeted at high risk populations. Further rigorous evaluations are required for major health promotion programmes. **Source of funding** NR **Observations from the Discussion section about barriers & facilitators** Possibel explanations – short follow up after legislation, possible failure of countermeasure, possible failure in the programme implementation. Community wide uptake depends on the number of new houses being built or renovations undertaken which may not have been sufficiently rapid to produce sufficiently high saturation of the valve use to show a difference in injury rates. Not known if the valves were installed correctly, whether function deteriorates over time or whether those that are adjustable are set at higher than recommended temperatures. Awareness raising may have been effective at the time of the legislation introduction, but this effect may have attenuated over time and might not provide any protection for new families.

Study details	Population and setting	Methods	Notes

Results
Different numbers about tempering valve presence are given in text and table, See below for table, text reports presence in 264 (30.3%), absence in 571 (65.6%) and 28 (3.2%) not known.
In 55.9% of homes reporting tempering valve, temperature was >55 ^{o}C – the maximum level that a correctly functioning valve would maintain. A sig. difference between mean temperatures at houses reporting presence and absence of tempering valve was nevertheless seen. Also sig diff. for whole group between 1990 and 2002-3.
ANOVA showed non sig. diff in temperature by SES (p=0.90)

Hot water temperature by year and tempering valve presence

			Temperature ^{o}C					
Year	**Variable**	**N**	**Minimum**	**Median**	**Maximum**	**Mean**	**95% CI**	**SD**
1990	Entire sample	872	24.0	57.5	87.0	56.3*	55.7-56.9	9.5
2002-2003	Entire sample	842	16.0	60.0	93.0	58.7*	58.1-59.5	9.8
2002-2003	Tempering valve							
	Installed	256	31.0	56.5	93.0	55.5*	54.3-56.7	10.0
	Not installed	559	16.0	61.0	86.0	60.1*	59.3-60.9	9.5
	Unknown	27	41.0	63.0	83.0	61.8	58.2-65.3	8.9

P<0.01 for these comparisons

Year by year incidence of scald injuries graphically presented (full detail not extracted).
Linear regression line for best fit slope = 10.43 (p<0.01), r^2 = 0.79.
Significant increase in scald injury after introduction of Scald Prevention Campaign – 2-fold increase over 10-years to 170.36/100,000 from 113.41/100,000 (p=0.01)

Study details	Population and setting	Methods	Notes
Authors **NSW public Health (Elkington & Gaffney)** **Year (of publication)** **1998** **Aim of study** **Study design** **Evaluation of *Hot water Burns Like Fire*** **Which aimed to:** **Reduce the number of burns in young people by 28% over 10 yrs form 1992-2001;** **Increase proportion of households with hot tap water at <55^{o}C;** **Increase the availability and number of household products with scalding minimising features;** **Increase marketing by industry of safety feature of products;** **Strengthen public policy to support scalds prevention;** **Improve the knowledge and skills of parents and carers of young children about scald injuries, their prevention & first aid treatment** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**<u>Source area/s</u>** New South Wales, Australia **<u>Nature of Law/ standard</u>** First phase (agenda setting/awareness raising) of the campaign in 1992 focused on increasing awareness of the hazards associated with causing scalds (kettles, tea and coffee, hot water tap, saucepans) in the campaign and on creating an environment for change through supportive policies and products. The second phase in 1994, focused on the risk of hot tap water – educating parents and industry (energy authorities, hot water heater manufacturers, scald safety products) and trade groups (builders, plumbers and electricians) – and on policy changes that address the temperature of hot water in the home. Both phases had a social marketing strategy. After consultation with stakeholders and industry, NSW introduced a new Health Policy recommending max. 50^{o}C hot water delivery in new bathrooms, signed by CMO in May 1994. This policy laid the foundation for an amendment to the National Plumbing Code (Australian standard AS3500.4) which also adopted 50^{o}C max delivery temperature in new bathrooms.	**3 telephone surveys** with a random sample of parents aged 0-4yrs. (Sept. 1992, Nov. 1992, May 1995) in NSW (intervention baseline n=372, FU n=800) and Victoria (control baseline n = 250, FU n=400). Sampling frame was all parents and caregivers listed in electronic white telephone directory. Screening question identified those responsible for a child aged <5yrs. 2 call backs to maximise response rates. Powered to detect a change of 8.05% with 80% power at 0.05 significance level (assuming 50% prevalence at baseline). Computer assisted interviewing system used to record data. 52 item (piloted) survey on KAP exposure to campaign info and products and changes in the home environment. Telemarketing campaign used to distribute 24,000 temperature cards and info brochures to those who dialled a free phone number. A summary of sales data for tempering valves. Survey of hot water temperature among families including 0-4 children in 1994 (to be repeated in 1998) Analysis of NSW hospital separations	**Limitations identified by author** Changes in the control area occurred at the same time and when increases in awareness were adjusted for this change, most were no longer significant. **Limitations identified by review team** Tables don't provide raw data, only % so not clear what denominator is being used, p values cannot be calculated, amount of missing data unclear. In addition, there appear to be some transcription errors (for eg same % of those aware pf tap water as a scald risk but marked as a sig. change) and anomalous results – (for eg, apparent fall in overall awareness of scald prevention devices in Victoria, but specific device knowledge seems to have increased) All outcomes are unverified self report. **Evidence gaps and/or recommendations for future research** **Source of funding** **NR** **Observations from the Discussion section about barriers & facilitators** Staffing and resource limitations restricted the amount of attention to details that could be paid to all

Study details	Population and setting	Methods	Notes
	Study year Surveys 1992, 1994, 1995 Hospital scald data through 1988/89 to 1995/96 **Eligible population:** Children aged 0-4	data for scalds (using ICD-9 E924.0 codes – "burns due to liquids and steam") among children aged 0-4 over eight years 1988/9-1995/6. (also shadow shopper survey to collect qualitative data about availability of scald prevention products; consumer satisfaction survey in 100 NSW homes that trialled lowering hot water temperature)	aspects of the project. Improvements could be: Earlier involvement of industry. Better contact with colleagues on the USA. More process evaluation strategies. Better, more complete cost data collected. Keep issue of policy makers agenda to secure future funding and promotion. Greater involvement of public housing sector. Evaluate in terms of impact with NESB groups. Develop standardised evaluation protocol to be used at local levels. Seek alternative funding sources.

Results
Phase one: 2 months after the campaign began, 69% of parents had seen information about scalds vs 53% at baseline.
P values below are Z scores.
For recall information, most had seen advertising on TV (30%), newspaper lift out/advertorial (3%), leaflet (1%), poster (1%) and info at an early learning centre (0.5%)
(outcomes for relevance)

Variable	NSW			Victoria		
	Baseline %	**30 months %**	**P**	**Baseline %**	**30 months %**	**P**
Campaign recall						
Recall scalds info.	53	59	Sig	23	32	sig
Recall campaign slogan	15	53	Sig	12	24	sig
Main ways a child can be scalded						
Hot tap water	49	49	Sig (must be typo?)	50	66	Sig
Bath water	55	63	Sig	50	66	Sig
Kettle	67	48	Sig	62	50	sig
Saucepan	79	70	sig	77	71	ns
Hot beverage	52	48	NS	34	36	NS
Chance that a child could be scalded						
1 in 20	37	47	Sig	34	42	Sig

Study details	Population and setting		Methods		Notes
Action you would take if child scalded					
Remove clothing	5	5	Ns	2	3	ns
Immerse in cold water	85	81	Sig	77	82	ns
Keep child warm	8	7	Ns	2	3	ns
Get medical assistance	56	70	Sig	77	82	ns
Believe cold water should be used to treat a scald					
Yes	63	63	Ns	63	63	ns
In what situations would you seek medical assistance					
Immediately	38	42	Ns	9	11	ns
If hands or face	10	9	Ns	9	11	ns
If burn was large	26	19	Sig	25	24	Ns
If child was in pain	23	23	Ns	26	24	Ns
Aware of products that can be bought to prevent scalds					
Yes	31	37	Sig	76	34	Sig
What products are you aware of that can help prevent scalds					
Thermostatic mixing devices	8	24	Sig	7	19	sig
Stove guards	46	37	Ns	28	41	ns
Bench guards	8	6	NS	7	7	NS
Appliance straps	11	7	NS	20	6	Sig
Barrier in hallway	5	1	Sig	2	3	NS
Cord coiler	8	4	NS	3	4	NS
Cord shortener	3	3	NS	8	3	NS
What actions can be taken to prevent scalds from hot water taps					
Supervision	38	35	Ns	32	35	ns
Keep taps out of reach	14	17	Ns	11	9	ns
Turn taps off tightly	34	25	Sig	21	24	ns
Use hot and cold taps together	28	20	Sig	21	24	ns
Test water first	16	12	Ns	10	15	sig
What actions can be taken to prevent scalds from hot beverages?					
Supervision	35	26	Ns	30	24	Ns
Keep cups out of reach	68	74	SIG	64	71	SIG
Move cups to	27	26	NS	28	19	SIG

Study details	Population and setting		Methods		Notes
centre of table					
Don't use table cloths	14	18	SIG	6	5	NS
What actions can be taken to prevent scalds from kettles?						
Supervision	23	19	NS	17	15	NS
Keep kettles out of reach	80	81	NS	81	86	NS
Keep cords away	49	42	SIG	32	33	NS
What action can be taken to prevent scalds from saucepans						
Supervision	27	22	SIG	12	19	SIG
Keep out of reach	40	39	NS	43	42	NS
Turn handles inwards	79	76	NS	70	82	SIG
Did you receive a brochure / hot water cards?						
Yes	90	84	SIG	88	88	NS
When your hot water is at its hottest, is it hot enough to scald a child?						
Yes	58	64	NS	63	64	NS
Ever turn down your hot water temp?						
Yes	58	64	NS	663	64	NS
Would you if you could?						
Yes	76	76	NS	65	73	NS

See above, increase in knowledge in some, most static and some negative impacts. When adjusted for control site impacts, most changes were non significant.

Telemarketing
Relatively expensive: $2.40 per pack to make and distribute. In random sample of parents, ¼ had the information and the telemarketing strategy was approx. 2.75 time more effective at reaching the parents of 0-4 yr old population (67% of those contacting the info line reported having a card, v. 24% of those who had not).
Cardholders were significantly more likely to undertake many types of scald prevention actions.

	Cardholders n=499		Non-cardholders n=371		
	N	%	N	%	P
Have you taken any action at home to prevent scalds?					
Yes	67	336	49	183	SIG
What kind of action have you taken					
Turned down hot water (unprompted)	32	159	14	53	SIG
Constant supervision	13	67	14	53	NS

Study details	Population and setting		Methods		Notes
Explain dangers to child	9	43	9	33	NS
Keep hot liquid out of reach	7	35	7	26	NS
Keep kettles out of reach	8	39	8	25	NS
Turn saucepan handles inwards	8	39	8	25	NS
Supervise baths	6	27	2	80 (TYPO?)	NS
Keep bathroom door locked	6	29	4	14	NS
Ever measured the temp of hot water at home?					
Yes	84	419	60	12/20	NS
Have you ever turned down the temp of your hot water system?					
Yes	81	187/229	70	86/128	Sig
What can be done to help prevent scalds from hot water?					
Turn down hot water system	23	116	14	55	Sig
Use tap covers	12	60	7	24	SIG
Constant supervision	30	149	36	135	SIG
Keep taps out of reach	15	74	15	58	NS
Turn off taps tightly	24	122	29	96	NS
Use hot and cold together	25	123	20	73	NS
Test water first	9	45	13	51	NS
Child restraint taps	4	19	19	19	NS
Close doors/ make barriers	9	43	5	19 (? TYPO)	NS

Policies

One company producing tempering valves advised that sales of this product increased by 42% in NSW (not echoed in other states) during phase 2 of the campaign (July-August 1994).

After new Australian Standard was publicised (Sept. - Dec. 1994) national sales increased significantly for all 4 models of tempering valve form 40% increase in one model to 1000% in another.

Efforts to promote regulations for "curly cords" to be sold as standard with kettles, and scalds reducing coffee mug did not succeed

(Shadow shopper survey not extracted)

Scalds outcomes

Number of cases and hospital bed days for serious and less serious scalds in children aged 0-4 years, NSW, 1988/9 to 1995/6

Financial year	Less serious scalds (1-4 days stay)	Serious scalds (5+ days stay)	Total

Study details	Population and setting	Methods	Notes

	Cases	H bed days	Cases	H bed days	Cases	H bed days
1988/9	204	396	217	2431	421	2827
1989/90	275	471	174	2299	449	2770
1990/91	251	440	197	2477	447	2917
1991/2	246	437	178	2257	424	2694
1992/3	244	445	168	2143	412	2588
1993/4	277	452	168	2183	445	2635
1994/5	295	506	111	1430	406	1936
1995/6	269	434	127	1624	375	2058

Source : Hot Water Burns Like Fire: the NSW scalds prevention campaign phases 1 & 2 1992-1994. Final report NSW Dept. of Health. Jan 1999
15.7% fall in hospitalisation in final 2 years and total bed days have fallen by 21.9%.

Age standardised hospital separations due to scalds in children aged 0-4 years, NSW, 1988-89 to 1995/6

	Male	Female	Rates / 100,000
1988/9	107.7	89.8	99.0
1989/90	122.2	87.1	105.0
1990/91	121.2	87.1	105.0
1991/2	110.7	84.3	97.8
1992/3	116.2	71.5	94.4
1993/4	110.2	92.8	101.7
1994/5	109.7	74.9	92.7
1995/96	101.6	68.7	85.6

Information relating to the planning and implementation, and costs of the project have not been extracted.

SWIMMING POOL FENCING

Study details	Population and setting	Methods	Notes
Authors **Morgenstern, Bingham, Reza.** **Year (of publication)** **2000** **Aim of study** **To estimate the effects of local pool-fencing ordinances and other factors on the rate of childhood drowning in LA county California** **Study design** **Matched case-control study** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** **Country** Los Angeles, USA **Nature of Law/ standard** Swimming pool fencing Since 1967 Los Angeles county ha shad an ordinance requiring a 5ft (1.5m) fence or barrier with self-latching gates around all residential pools in unincorporated areas. This has been interpreted by the Building & Safety Dept. to allow a dwelling wall, including doors & windows to serve as part of the barrier (3-sided fencing). Until 1988, most cities in the county enacted their own locally enforced fencing ordinances for residential pools all of which apply to in ground and above ground pools at least 2 ft deep that are new or newly altered, and pre-1996 allow 3-sided fencing. **Study year** 1990-1995 **Eligible population:** Childhood drownings in those aged <10, in residential pools in single family homes.	2 part study: Stage 1 a retrospective dynamic cohort study to estimate effects of selected socio-economic and geographical factors on the rate of childhood drowning. Stage 2 a matched case-control study of residential swimming pools to estimate the effect of ordinances on childhood drowning. **Stage 1: Dynamic cohort study** Drowning death rates in under 10s in residential pools estimated from LA county coroner office (numerators) and 1990 census (denominators). Poisson regression used to model drowning rates as function of age, sex, race/ethnicity and 3 ecologic (aggregate) variables in the areas where drowning occurred – median family income, %adults with >high school education and residential pool density (no. in each zip code obtained from a private firm). **Stage 2: Case-control study** Cases were all drownings identified at Stage 1. For each case, 5 control pools where a drowning did not occur in the same period were identified from same geographical area. A private firm identified all residential pools and used a random number generator to select 5 controls per case and supplied their address. ***Exposure variable*** presence or	**Limitations identified by author** It was not possible to ascertain presence or absence of pool-fencing or measure compliance with ordinances. **Limitations identified by review team** Because all the control pools were in single family homes, the analysis was restricted to case pools in single family homes. This was because there was an association between dwelling type and exposure status. Analysis therefore concerned 128/146 of all drownings **Evidence gaps and/or recommendations for future research** Future research should incorporate analyses of access to pools (here by taking pool density into account) **Source of funding** Southern California Injury Prevention Research Center **Observations from the Discussion section about barriers & facilitators** As overall rate of drowning was not lower in pools regulated by fencing ordinances, it suggests that these are ineffective. Possible explanations: 1. the success of local ordinances

Study details	Population and setting	Methods	Notes
		absence of a pool-fencing ordinance in the jurisdiction of each pool when that pool was built or last altered. (therefore exposure status not diluted by the non-retroactive nature of LA fencing ordinances). **Sample sizes** **Cases n=** 146 **Control n=** 760	may be depend critically on community education and awareness. 2. Inadequacy may relate to nature of 3-sided, rather than 4-sided law which allows access form the house. 3. Inadequate enforcement by building and safety depts. Inadequate fencing may also give parents a false sense of security, lowering supervision. Inadequate operation or maintenance of fencing, gates, latches and alarms by pool owners. 4. Possible bias if homes with young children tend to have newer pools, more likely to have been built under ordinances for fencing

Results
146 chid drownings (aged<10) identified in LA county 1990-1995. Annual average drowning rate of 1.7/ 100,000 per year.
99/146 (68%) occurred at victim's residence
128/146 at single family dwellings.
Rates higher in toddlers (aged 1-4), boys & lower in Hispanics than other ethnic groups. Also positively associated with the 3 ecological variables.
Results of fitting the Poisson regression suggest that crude effects of ethnicity are confounded by pool density, and crude effects of income and education also largely confounded by effect of pool density – a measure of differential access to pools (data presented but not extracted).

Date of pool construction available for 112/128 (88%) cases and 650/730 (89%) controls.
Overall rate ratio (odds ratio) comparing pools built or altered under pool fencing ordinance or not 1.27 (95% CI =0.72, 2.25) 81% of all drownings occurred in pools regulated by pool fencing ordinances.

Adding pool cost as a covariate gave adjusted rate-ratio of 1.52 (95%CI = 0.80, 2.87). A $1000 increase on the cost of the pool was associated with a 10% (95% CI = 5%, 15%) reduction in rate of drowning (further regression analyses provided but not extracted).

Study details	Population and setting	Methods	Notes
Authors **Morrison, Chalmers, Langley, McBean** **Year (of publication)** **1999** **Aim of study** **To identify the status of compliance with and enforcement of the FOSP Act 10 yrs after introduction. To identify methods for improving compliance and the process of enforcement.** **Study design** **Surveys** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** New Zealand **Nature of Law/ standard** Fencing of Swimming Pools Act 1987 (FOSP Act) requires domestic swimming pools, including spa pools to be fenced. Local govt authorities have responsibility for ensuring compliance. Act supplemented by 1991 Building Act which requires building consent for pools prior to construction which include compliance with code (and FOSP). The fence must surround only the pool and immediate area around it. A boundary fence alone is insufficient. Buildings can form part of the fence. **Study year** 1997	Postal questionnaire to 74 authorities in NZ. 64/74 (87%) response rate. About pool compliance, methods of identifying and enforcing, barriers and solutions. Publicity. Sample of 12 authorities selected for telephone interviews on the basis of more active enforcement of FOSP – to identify examples of best practice. Summary statistics presented. Pool estimates for those not providing this information was estimated by taking the geometric mean of those neighbouring authorities for which figures were available.	**Limitations identified by author** Lack of association with compliance and the three testing means of encouraging or monitoring may have been due to methods used to estimate compliance. Those that did have written policies, re-inspection procedures or publicity about the act may well have had more awareness of the lack of compliance in their area. Other areas may base their estimates on status at installation or when act initiated – not reflecting current compliance status, and likely to over estimate it. Alternatively, authorities with more aggressive policies may overestimate the effect of enforcement, or may not actually produce better compliance. **Limitations identified by review team** Comparative methods not described. Percentages usually given without numbers, so not clear what sample is being reported. **Evidence gaps and/or recommendations for future research** NR **Source of funding** Accident Rehabilitation and compensation insurance corporation & Health Research Council of NZ.

Study details	Population and setting	Methods	Notes
			Observations from the Discussion section about barriers & facilitators Major factors limiting act's effectiveness: 1. Inconsistencies between authorities enforcement of particular requirements, largely due to ambiguities in the legislation (acceptability of spa pool covers, definition of "immediate pool area", acceptability of sliding doors without self closing mechanism) 2. Some authorities making little attempt to locate pools or monitor compliance. Authors suggest that pool retailers might take on responsibility for informing purchasers of fencing requirements, or could notify authority when a new pool is installed. Cost of enforcement may be a barrier to some regulatory authorities.
Results **Since introduction of act average number of preschoolers drowning in private pools has halved from 8 to 4 (cited in introductory text as Water Safety NZ data, unpublished)** **53/74 provided information about number of pools – 47,383 identified. Estimated 46 pools/ 1000 dwelling, 16 pools/ 1000 persons.** **Compliance = 47% (n=22448); non compliance 19% (9125); not known 33% (15810).** **Few authorise 9% had written policies or procedures for locating and inspecting pools, but there was no statistically significant relationship between having a policy and reported rate of compliance (Chi-sq = 0.58, p=0.45).** **More common to have a re-inspection programme to ensure pools continued to comply – 25%, but there was no statistically significant relationship between having a progamme and reported rate of compliance (Chi-sq = 0.71, p=0.40).** **During 12 months before survey 52% of authorities had notified public about their obligations under the act, usually via newspaper articles (37%). No statistically significant relationship between public notification and reported compliance levels (chi-sq = 0.05, p=0.82).**			

Study details	Population and setting	Methods	Notes
Asked to identify enforcement problems 86% of authorities identified one or more problem: pool owner resistance 84%, locating existing pools 76%, cost of administration 63%, interpretation of act 64%. **Interpretation problems included defining "immediate pool area", acceptability of access via house doors (41% each). Guidelines about the former have been produced but do no carry the weight of law and can be contested. For the latter 38% require self closing mechanisms on sliding access doors form the house.** **Authorities varied about whether building consent was required for above ground pools.** **If pool fence includes perimeter fence, neighbour actions can influence by altering fencing or placing objects near that permit it to be scaled. Enforcement difficult.** **Suggestions for improving compliance included publicity/ education (44%), amendments to the act (14%) additional resources to cover cost of enforcement (11%), greater use of litigation including instant fines (8%).**			

Study details	Population and setting	Methods	Notes
Authors **Stevenson, Rimajova, Edgecombe, Vickery** **Year (of publication)** **2003** **Aim of study** **To elucidate the causes of child drowning in private swimming pools and to determine the need for change in the legislation as well as improvements to inspection and enforcement of current legislation** **Study design** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** **Country** Western Australia **Nature of Law/ standard** All Australian states require pool fencing and gates comply with Australian Standard (AS1926.1) Pools installed before 1992 can have 3-sided fencing and allows the 4th to include a wall that contains a door or window into the residence. Those installed after 1992 can be 4-sided and isolated form the resident, or may include a wall with door or window if it can be locked. Inspection of pools has been mandatory since its 1992 introduction. **Study year** 1988-2000 **Eligible population:** Drownings in children aged <5 in private pools in Western Australia.	**Stage 1** Retrospective review of coroners records in Western Australia. Details included nature of fencing verified by photographs of swimming pools. **Stage 2** Audit of swimming pool inspections. Obtained by inspectors randomly selecting a sample of 20 inspection records (n=500). 68% of shire or city councils participated. This was used to estimate compliance with legislation and how long it took non-compliant pools to become compliant after inspection. **Stage 3** Face to face interviews with one nominated swimming pool inspector from each shire or city council in Perth. 87% compliance in urban and 63% in rural areas. This was to assess effectiveness of current legislation and recommendation for change. Annual incidence of drowning estimated as (No. of under 5 child drownings in private pools in Western Australia /total population of under 5s in Western Australia.) Incident Risk Ratio also calculated to estimate the risk of 3- and 4-sided fencing in 1999. Denominator for swimming pool estimates obtained from estimates provided by councils and weighted by	**Limitations identified by author** **Limitations identified by review team** No description of how audit records were “randomly” selected. Survey data and interview data does not supply a denominator. **Evidence gaps and/or recommendations for future research** NR **Source of funding** Dept. Health of Western Australia, Dept of Local Government and Regional development. **Observations from the Discussion section about barriers & facilitators** Greatest compliance immediately after law introduced. (although caution as small numbers) Compliance after inspection is excellent – only 45% at first, but up to 80% within 4 weeks, and after 8 years 71%. Most have continuous inspection process – might be more efficient if focussed on summer months when most drownings happen. Biennial, rather than 4-yrly inspections are also likely to increase compliance.

Study details	Population and setting	Methods	Notes
		findings of a random survey of pool owners conducted by the authors. Variations in proportions assessed using Person chi-sq test with continuity correction where appropriate. Mean comparison for continuous variables used independent t tests. Compliance rate for legislation (no. compliant pools/ total no. pools assessed for compliance) x 1000per yr.	This research precipitated change to uniform law requiring 4-sided pool fencing from March 2002.

Results
Stage 1:
50 children aged <5 drowned 1988-200. Rates declined in 1988, stayed stable at 2.15 cases per 100,000 per year 1989-1997, and increased to 7.86/ 100,000 per year in 1999.

22/50 (44%) occurred at victim's residence.
35/50 (70%) in pools with 3-sided fencing
15/50 (30%) in pools with 4 sided fencing (all due to gate propped open, or fault with self-closing/ latching gate mechanisn)

IRR for children <5 who lived in or visited houses with 3-sided fencing vs 4-sided fencing 1.78 (95% CI 1.40, 1.79)

23/44 (52%) pools inspected after drowning were compliant with legislation. Of these -
10/23 (43%) child gained access through house (suggestion pre-1992 3-sided fencing in use).
10/23 (43%) access was through a propped open gate.
3/23 (14%) inadequate supervision was a contributing factor.

Stage 2:
162 (45%) of inspected pools met compliance at first inspection. Gate access not closing/ latching was the fault in 24%, with a further 8% general gate problems.
It took the owner an average of 1 month (mean 37 days, range 5-91) to comply.
Compliance with legislation increased to 57% at 2nd inspection 4 yrs later, and 71% by third inspection.

Compliance rates highest in the period just after 1992 legislation introduced (590 compliant pools per 1000) Since 1997 rate is stable at approx 400 per 1000.

Study details	Population and setting	Methods	Notes
Stage 3 **89% (n=15) of inspectors reported inspection was effective in identifying no-compliance.** **57% (n= 16) believed it covered necessary aspects.** **79% (n=22) did not think legislation adequate 13 of these wanted uniform legislation and 11 compulsory 4-sided fencing.** **46% (n=10) though legislation should be changed** **32% (n=7) though inspection frequency should increase.** **65% (n-17) wanted more education for pool owners** **62% (n=16) greater awareness of legislation and pool safety.**			

Study details	Population and setting	Methods	Notes
Authors **Van Weerdenburg, Mitchell, Wallner.** **Year (of publication)** **2006** **Aim of study** **To document the approaches to manage backyard swimming pool inspections and compliance in 3 local govt areas (LGAs) in NSW. To describe compliance levels and identify perceived barriers to effective management of pool inspection programs as described by council employees.** **Study design** **Comparative** **Internal validity score** **[++, + or -]** **External validity score** **[++, + or -]**	**Source area/s** **Country** Australia **Nature of Law/ standard** Swimming pools Act introduced in New South Wales in 1992, requiring pools built post1990 to have isolation fencing for pools. Councils in NSW are required to "take appropriate steps to ensure they are notified of all swimming pools within their boundaries" and to "promote local swimming pool owners' awareness of the requirement of the act." Although responsible for fencing, there is no legal mandate in the act for councils to fulfil this obligation. Surveys have suggested that many councils were not monitoring compliance and there was wide variation in the enforcement of pool fencing regulations. **Study year** 2002/3 **Eligible population:** Councils in NSW Convenience sample – 3 councils were invited to participate and all agreed. 2 – B&C – had recently completed or had an inspection program at the time of the study.	**Sample** **Council A** had no swimming pool register and had not conducted a pool inspection for some time. A random sample of 1003 pools, installed from 1991 onwards, was selected for inspection by independent water safety organisation inspectors (list from the council's database of properties with approved swimming pool development applications) 118/1003 (12%) were excluded and replaced form original sample as pools had been removed, letter returned, property could not be accessed. Any pools found to have faults were re-inspected in 6 wks approx. ***Pool owner survey*** voluntary written survey sent to all 1003 pool owners inspected in Council A. Demographics plus opinions of fencing and inspections. No FU. **Council B** had a swimming pool register (pre and post 1992) linked to a property based record keeping system. Pools in register originally identified through an aerial survey and development application records. Annual inspection blitz to check compliance carried out in November 2002. **Council C** had a swimming pool	**Limitations identified by author** Councils used were a convenience sample. Differences in pool inspection practices may have existed. Not all faults could be obtained. Low response rate for pool owners. **Limitations identified by review team** Council A replaced 12% of originally randomly selected pools fro inspection – some of these were due to the letter being returned or inspectors being unable to access the property – this may bias the findings perhaps in favour of compliant pools. No methods of comparison between council figures are described. Data for compliance at follow up visits is based on accessed pools. No information about how interviews analysed. **Evidence gaps and/or recommendations for future research** **Source of funding** NR **Observations from the Discussion section about barriers & facilitators** Compliance depends on resources to perform checks, competing priorities, perceptions of community opinion, political will in the council, lack of specific

Study details	Population and setting	Methods	Notes
		register (pre and post 1992) based on aerial maps and approved development applications. However this had not been updated for many years and no regular inspections were conducted. Data form inspections 2002-2003 was supplied. ***Interviews with council employees.***1 from each council interviewed about management of backyard swimming pools and enforcement of 1992 Act. Interview semi-structured, face to face, taped and transcribed. Key issues and barriers documented.	obligation to conduct inspection under the 1992 Act. Many gate faults are the result of lack of understanding about the need for simple maintenance. Repeat inspection until compliance was observed by council B seems to have achieved high rates. Contradictions between bits of legislation contributed to confusion and misinterpretations. Swimming Pools regulation 1998 allowed for fines for non-compliance but not an inspection fee which would allow cost recovery. Identification, for example through electronic register would help identification (though costly to establish).

Results

Council Management process for backyard swimming pools

Factor	Council A	Council B	Council C
Property management database (pool development application)	Y	Y	Y
Swimming pool register	N	Y	Y (reactivated in 2000)
Individual with designated responsibility for management of existing pools & enforcement of Act	N	Y	Y
Pool inspection program	N	Annual blitz	Annual blitz since 2000
Enforcement of act	N	Y	Limited
Pool owner contact	N	At inspection and during campaigns	At inspection and during campaigns
Process to manage non-compliance	Y	Y	Y

Pool inspections & compliance

Study details	Population and setting	Methods	Notes

Council A
516/1003 (51%) of inspected pools were not compliant at first inspection.
227/516 (44%) re-inspected, (59/516 (11%) due to property access issues, 230/516 (45%) due to contractor failure to complete re-inspection)
125/227 (55%) re-inspected compliant at 2nd inspection, 1 converted to a fish pond, 101/227 non-compliant (45%).

First inspection compliance rates and types of faults

	Council A[a] (N=1003) n(%)	Council B[b] (N=863) N (%)	Council C[d] (N=464) N (%)
Inspection results			
Compliant	487 (48.6)	835 (96.8)	212 (45.7)
Non-compliant	516 (51.4)	28 (3.2)	252 (54.3)
Faults			
Fence-related faults		[c]	63 (25.0)
Not isolation fence	27 (5.2)	(5)	
Ht less than 1200mm	36 (7.0)	(5)	
Defective condition	15 (2.9)		
Incorrect vertical space	25 (4.8)		
Incorrect horizontal space	24 (4.7)		
Excess space (>100mm) under fence	94 (18.2)		
Climbable objects too close (<1.2m)	132 (25.6)	[e]	
Gate-related faults			78 (30.9)
Ht less than 1200mm	13 (2.5)		
Not opening outwards	36 (7.0)		
Not self-closing	163 (31.6)	[E]	
Not self-latching	234 (45.3)	[e]	
Latch related faults			105 (41.6)
Latch not 15000mm (externally)	53 (10.3)		
Latch not 15000mm (internally)	25 (4.8)		
No latch shield	33 (4.6)		
Other faults		(50)[e]	
Door access to pool area	44 (8.5)	(10)	
Window access to pool area	30 (5.8)	(30)	
No/inadequate signage	169 (32.8)	[e]	82 (32.5)

a Results from first inspection
b 1262 pools on register, 399 of which are still to be inspected of unknown status.

Study details	Population and setting	Methods	Notes
c Based on estimates from expert opinion. Council B's pool register cannot tally specific faults in specific categories. d there are 645 pools on Council C's register, 181 were still not inspected e Other faults included gates not closing or self latching, climbable objects too close to fence or inadequate signage. Pool owner survey 205/1003 pool owner resident in Council A responded (20%) 96% believed that fencing should be required by law and supported council checks on compliance. Interviews with council employees Inconsistent approach and lack of commitment related to the Act's lack of clarity and directives about council responsibilities. In particular it was felt that the Act should specify *how* councils should ensure notification of pools and how to ensure compliance. There were also conflicting interpretations about the allowance of self-closing/latching doors in boundary walls due to inconsistencies in the 1992 Swimming Pool Act and the 1998 Swimming Pool Standards. Lack of retrospection for pools build pre1990 and exemptions for very small, very large and/or waterfront properties were criticised. Inspections usually funded about of general ratepayer revenue – suggested by one that it should be borne by those with pools. Voluntary use of an inspection fee within the act was endorsed. On the spot fines introduced by Swimming Pool Regulation 1998 had been effective in one council.			

Appendix 8 Quality assessment of included studies

	Erdmann et al 1991	Leahy et al 2007	Mcloughlin et al 1985	Morgensten et al 1990	Morrison et al 1999	NSW health 1998	Pressley & Barlow 2005	Spallek et al 2007	Stevenson et al 2003	Van W'denburg et al 2006
Study design:	B&A	B&A	Comparative	Matched case-control	Comparative	B&A	Controlled B&A	B&A	Case-control	Comparative
Section 1: Population										
1.1 Is the source population well described?	+	+	+	++	+	+	+	+	++	+
1.2 Eligible population representative of the source population?	NR	+	-	+	NA	+	NR	+	+	NA
1.3 Do the selected participants represent the eligible population?	++	++	+	++	+	++	++	-	++	NA
Section 2: Method of Allocation to intervention (or comparison)										
2.1 Allocation to intervention (or comparison) groups- how was confounding minimised?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.2 Interventions (and comparisons) well described and appropriate?	+	++	++	++	+	+	+	+	++	++
2.3 Allocation concealed?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.4 Participants and/or investigators blind to exposure and comparison?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.5 Exposure to intervention and comparison adequate?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.6 Contamination acceptably low?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.7 Other interventions similar in both groups?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

	Erdmann et al 1991	Leahy et al 2007	Mcloughlin et al 1985	Morgensten et al 1990	Morrison et al 1999	NSW health 1998	Pressley & Barlow 2005	Spallek et al 2007	Stevenson et al 2003	Van W'denburg et al 2006
2.8 All participants accounted for at study conclusion?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.9 Did the setting reflect usual practice?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.10 Did the intervention or control comparison reflect usual practice?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Section 3: Outcomes										
3.1 Outcome measures reliable?	++	++	++	++	-	++	+	++	++	+
3.2 Outcome measurement complete?	+	+	++	++	+	+	+	+	++	-
3.3 Were all important outcomes assessed?	+	+	-	++	-	+	++	++	++	-
3.4 Were outcomes relevant?	+	+	+	+	+	+	+	+	+	+
3.5 Similar follow-up time in exposure and comparison groups?	+	+	++	+	+	+	++	++	++	++
3.6 Was follow-up time meaningful?	+	++	++	+	+	+	++	++	++	++
Section 4: Analyses										
4.1 Exposure and comparison groups similar at baseline? If not, were these adjusted?	NR	NR	+	+	+	NR	NR	+	NR	NR
4.2 Intention to treat analysis?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4.3 Estimates of effect size given or calculable?	+	-	-	++	-	-	+	+	++	-
4.4 Analytical methods appropriate?	+	+	+	+	+	+	+	+	+	-
4.5 Precision of intervention effects given or calculable? Were they meaningful?	-	-	-	++	+	-	+	+	++	-

	Erdmann et al 1991	Leahy et al 2007	Mcloughlin et al 1985	Morgensten et al 1990	Morrison et al 1999	NSW health 1998	Pressley & Barlow 2005	Spallek et al 2007	Stevenson et al 2003	Van W'denburg et al 2006
4.6 Was the study sufficiently powered to detect an intervention effect (if one exists)?	-	NR	NR	NR	NR	NR	NR	NR	NR	NR
Section 5: Summary										
5.1 Are the study results internally valid (ie unbiased)?	+	+	+	+	-	+	+	+	+	-
5.2 Are the findings generalisable to the source population (ie externally valid)?	-	-	-	-	-	-	-	-	-	-

Appendix 9 Studies excluded at full text stage

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