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# **Research evidence review report for Child Death Review**

## **Drowning in children and young people**

**Eleri Tyler**

**Teri Knight**

**Isabel Puscas**

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For further information please contact:

Public Health Wales Observatory,

36 Orchard Street,

Swansea

SA1 5AQ

Tel: 01792 607331

E mail: [teri.knight@wales.nhs.uk](mailto:teri.knight@wales.nhs.uk); [eleri.tyler@wales.nhs.uk](mailto:eleri.tyler@wales.nhs.uk)

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## Glossary and list of abbreviations

### Glossary

#### **Adjusted odds ratio**

Statistical adjustment of the odds ratio by taking into account the effects of other variables.

#### **Alcohol attributable fraction**

The extent to which alcohol contributes to a health outcome, such as alcohol poisoning, non-alcohol poisoning, road traffic injuries, falls, drownings, violence, and other unintentional or intentional injuries.

#### **Blood alcohol concentration**

The concentration of alcohol in the blood, expressed as the weight of alcohol in a fixed volume of blood and used as a measure of the degree of intoxication in an individual. The concentration depends on body weight, the quantity and rate of alcohol ingestion and the rates of alcohol absorption and metabolism.

#### **Confidence interval**

The confidence interval (CI) is a way of expressing the certainty about the findings from a study, using statistics. It gives a range of results that is likely to include the 'true' value for the population. The CI is usually stated as '95% CI', which means that the range of values has a 95 in a 100 chance of including the 'true' value.

#### **Odds ratio**

An odds ratio is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure.

#### **Randomised controlled trial**

A study in which a number of similar people are randomly assigned to 2 (or more) groups to test a specific drug or treatment. One group (the experimental group) receives the treatment being tested, the other (the comparison or control group) receives an alternative treatment, a dummy treatment (placebo) or no treatment at all. The groups are followed up to see how effective the experimental treatment was. Outcomes are

measured at specific times and any difference in response between the groups is assessed statistically. This method is also used to reduce bias.

### **Relative risk**

The ratio of the risk of disease or death among those exposed to certain conditions compared with the risk for those who are not exposed to the same conditions. If both groups face the same level of risk, the relative risk is 1. If the first group had a relative risk of 2, subjects in that group would be twice as likely to have the event happen. A relative risk of less than 1 means the outcome is less likely in the first group. Relative risk is sometimes referred to as risk ratio.

### **Risk ratio, see Relative risk**

### **Standardised mortality ratio**

Standardisation is used when comparing mortality in two populations that have different demographic structures. It removes the effect of differences in age (or other confounding variables that affect mortality rate) between the populations.

### **Abbreviations**

AAF	Alcohol attributable fractions
AOR	Adjusted odds ratio
BAC	Blood alcohol concentration
CAPIC	Collaboration for Accident Prevention and Injury Control
CDR	Child Death Review
CI	Confidence interval
NICE	National Institute for Health and Care Excellence
OR	Odds ratio
PHE	Public Health England
RCT	Randomised controlled trial
RR	Risk ratio/ relative risks
RoSPA	Royal Society for the Prevention of Accidents
SMR	Standardised mortality ratio
TACTICS	Tools to address childhood trauma, injury and childrens' safety
WHO	World Health Organisation

**This report documents the review of research evidence undertaken to inform the Child Death Review (CDR) Programme Team in their thematic review of deaths from drowning in children and young people, conducted during 2015. A summary of the evidence reviewed and conclusions drawn from it are presented, followed by the main body of the report, covering review methodology and findings.**

## **Summary and conclusions: Research evidence on risk and protective factors and effectiveness of interventions**

The objective of the evidence review was to identify, characterise and summarise research evidence on risk or protective factors for deaths from drowning in this age group which may be relevant to Wales and on measures or interventions that may have potential for preventing deaths from drowning in this age group in Wales.

The evidence review aimed to address the questions:

*What are the risk and protective factors associated with drowning in children and young people under 25 years of age?*

*What is the effectiveness of interventions aimed at addressing risk factors, increasing protective factors and preventing deaths from drowning in children and young people under 25 years of age?*

The methodology followed for reviewing the research evidence was based on systematic review principles of minimisation of bias and objectivity and transparency of process and used systematic reviews as the main source of evidence. Well conducted systematic reviews which consider the totality of the evidence are considered more reliable than the findings of single studies (Higgins and Green, 2011). Further details of the methodology are provided in section 4 and are set out in an *a priori* protocol (Annex 1).

## **Risk and protective factors**

### **Evidence from systematic reviews of primary research**

Knowledge of potentially modifiable risk factors for death from drowning or non-fatal drowning is important to enable programme developers and policy makers to develop appropriate interventions. Information about fixed risk factors (such as gender, age) enable identification of populations in which there is a need to intervene.

Few systematic reviews assessing the evidence for potentially modifiable risk factors for death from drowning or non-fatal drowning were identified;

only five systematic reviews or meta-analyses/modelling studies met the inclusion criteria (as set out in the protocol) for this evidence review. The authors of these systematic reviews and related NICE guidance (PH29 2010) point to a lack of multivariate observational analytical studies. Few of the available studies have been conducted in the UK and there is limited generalisability of some of the evidence drawn from other countries.

The systematic review by Pearson et al. (2009) commissioned to inform NICE guidance PH29 (2010) found no multivariate evidence on home-related risk factors for drowning in children and young people aged under 15 years. The review authors reported, from single studies (respectively), an inconsistent association of risk of drowning with entitlement to Medicaid<sup>i</sup>, no statistical evidence of risk of drowning being associated with being of Native American descent and no statistical evidence of risk of drowning being associated with the presence of "behavioural disorders". The generalisability of these findings to the UK is limited.

Purnell and McNoe (2008) searching for studies relating to non-recreational immersion, recreational swimming, underwater activities and fishing, found no analytical studies, such as case-control studies, investigating modifiable risk factors for drowning or near-drowning. From a review of descriptive or cross-sectional studies or retrospective analyses and an earlier systematic review, they identified four main areas as being *potential* modifiable risk factors associated with drowning and near-drowning, namely, alcohol use, lack of quality supervision, use of infant bath seats and risk taking behaviour. They caution however, that "Case-control studies or other studies using analytical study designs would be necessary to further elucidate the extent to which all these factors increase the risk of death from drowning."

## Alcohol

In a review of the role of alcohol in drowning associated with recreational aquatic activity such as swimming, surfing, boating, water skiing, underwater diving, and fishing, Driscoll et al. (2004) point to the lack of good quality epidemiological evidence. From the available studies, some of which have significant methodological limitations, they concluded that 30% to 70% of drowning victims have a measurable blood alcohol concentration, that the risk of drowning increases with increasing blood alcohol concentration and that the percentage of drowning deaths attributed to alcohol use appears to be between 10% and 30%.

Rehm et al. (2004) derived Alcohol Attributable Fractions (AAFs) for mortality from "drowning" for the sub-region EUR-A (which includes the UK) from data from four reviews: AAF 0-15 years, 0 for both males and

<sup>i</sup> Means tested programme in the United States providing access to health and medical resources for those on low incomes



females; AAF 15-29 years, 0.35 males and 0.33 females. The authors point out that, due to the overall poor quality of the underlying research for most alcohol-related acute outcomes, these figures may be subject to "considerable error". They also note that the relationship between alcohol consumption and injuries is context dependent and suggest +/- 30% of the point estimates to account for "additional assumptions".

### **Epilepsy**

Using data on adults (age 18-93 years) from the UK national registries, Bell et al. (2008) identified 22 deaths from drowning in people with epilepsy during 1999-2000, giving a Standardised Mortality Ratio (SMR) of 15.3 (95% CI 9.6 to 23.1). From a meta-analysis of published data for 51 cohorts they found 88 reported deaths by drowning in people with epilepsy, compared with 4.70 deaths expected, giving a SMR of 18.7 (95% CI 15.0 to 23.1). The authors suggest that the increased risk of death by drowning seen for epilepsy in their overall analysis may be lower for children compared with adults and that this may be due to increased supervision of children with epilepsy.

### **Lack of supervision**

Purnell and McNoe (2008) conclude from three, non-UK, studies that lack of supervision was a contributory factor in deaths from drowning in children aged 0-18 years. From two further studies (one UK), they conclude that "Lack of parental supervision was related to the use of bath seats and both were shown to be factors in non-recreational immersion incidents." A report from Public Health England and RoSPA (2015) also concluded that inadequate supervision of young children in the bath posed a risk for drowning but that the role of bath seats in drowning was unclear.

### **Risky behaviours**

Four different studies were discussed by Purnell and McNoe (2008) under the category of risk taking behaviour. They conclude from one descriptive study that males reported a higher level of exposure to risk behaviours including alcohol consumption when engaging in water-related activities. They conclude from one analytical study that "... significant numbers of flood deaths are attributable to unnecessarily risky behaviour." - 70% involved males and from two other analytical studies, that excessive speed and or/driver error, alcohol and/or drugs and not following standard safe diving practice guidelines, were contributory factors in drowning deaths.

### **Expert body reports**

There are a number of high level reports and guidelines which draw on epidemiological data supplemented with expert opinion and selected research literature to identify fixed and modifiable risk factors for death from drowning and/or near drowning. The most frequently cited risk factors include: male gender; very young age (stated ages varies but is

generally 0-5 years) or adolescence; lack of adequate supervision of children; risk-taking behaviour (particularly amongst teenagers); epilepsy; alcohol use when engaging in water-related activities. Reports using UK epidemiological data identify higher risk locations (mostly inland water), seasons (summer months) and activities (walking/running near water, swimming, boating, and angling).

## Interventions

### Evidence from systematic reviews of primary research

There is a paucity of research available with regard to interventions for the prevention of drowning. In many high income countries drowning is a rare event and this factor, in conjunction with ethical issues, mean that designing intervention studies measuring this outcome is challenging. Intermediate or indirect outcomes pertaining to known risk factors are often used in place of drowning or non fatal drowning, to assess the effect of an intervention.

Overall, seven systematic reviews and an Evidence Update from NICE contributed to the findings of this evidence review with regard to interventions. A protocol for a highly relevant systematic review of public health interventions to prevent children drowning (Crawford et al., 2014) was also identified but unfortunately the completed review had not been published in time for inclusion in this evidence review<sup>ii</sup>. Some of the drowning interventions identified covered all-age groups whereas others are more specific to infants and young children, children, or adolescents. The evidence identified regarding interventions is summarised with the evidence gradings outlined in Table 1. For an explanation of the colour coding for the evidence gradings see Annex 2.

**Table 1: Overview of the evidence-base underpinning interventions to prevent drowning**

Evidence Grading	Age/Stage of Development	Intervention	Outcome
This intervention is supported by moderate quality evidence of its effectiveness	Infant/ Preschool	Fencing for swimming pools	Drowning or near drowning
		Isolation (4-sided) fencing for swimming pools	Drowning

<sup>ii</sup> The systematic review was however, published (Leavy et al., 2015b) shortly after the evidence review had been completed and thus an assessment of what it adds is available in a Postscript on page 117.

Evidence Grading	Age/Stage of Development	Intervention	Outcome
There is some evidence supporting the use of these interventions but it is not conclusive	All ages	Personal flotation devices	Drowning
	Children	Education for beachgoers Swimming lessons	Intention never to swim at unpatrolled beaches, to swim between flags and managing rip currents Drowning
The evidence is inconsistent and it is not possible to draw a conclusion for these interventions	Infant/Preschool	Education for installation of pool fencing	Presence of fence
There is some evidence suggesting that this intervention is ineffective but it is not conclusive	Infant/Preschool	General home safety education	Never leaving a child alone in the bath Never leaving a child alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water after use
		Legislation allowing three-sided pool-fencing	Drowning
Evidence about the effectiveness of these interventions is lacking. The studies included in systematic reviews, meta-analyses or NICE guidance are of a design inappropriate for assessing effectiveness.	All ages	Drowning Prevention campaign	Life vest ownership/use by children or adults Drowning fatalities
		Education for lifeguards	Lifeguard behaviours Lifeguard impact on pool attendee behaviours
	Infant/Preschool	Enforcement activities	Compliance with pool fencing legislation
	Adolescent / Young adult	Minimum legal drinking age Education for coastal fishermen	Drowning Risky/protective behaviours

## All-age groups

The only primary studies included in systematic reviews (Ashfaq et al, 2009; Leavy et al, 2015) about the effectiveness of drowning prevention campaigns were uncontrolled before and after studies which means that any observed effects cannot be attributed to the intervention alone.

Some research on educational interventions associated with recreational activities was identified within a systematic review (Leavy et al, 2015). One controlled before and after study examining the effectiveness of education for beachgoers identified positive changes in some self-reported short term safety behaviours however consideration should be given as to whether the findings of this one study are generalisable to other settings. Reliable evidence about education of lifeguards and coastal fishermen is lacking as the two studies looking at this were an uncontrolled before and after study and a cross-sectional survey respectively, and neither study design can be used to attribute observed effects directly to the intervention alone.

One matched cohort study assessing the effectiveness of personal flotation devices identified by Leavy (2015) found that they reduced the risk of drowning. Risk of selection and confounding bias in this study limit the reliability of this finding.

## Infants and young children

NICE issued guidance on preventing unintentional injuries among the under 15s in the home (PH30, 2010) but did not include recommendations specific to the prevention of drowning.

One systematic review (Kendrick et al, 2012) suggests that general home safety education is an ineffective intervention to prevent children being left alone in the bath; meta-analysis of the studies identified tends towards no effect. This review also identified a single study suggesting that provision of tailored versus generic computer generated safety advice is ineffective in preventing a child from being left alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water after use. It is interesting to note that a Cochrane systematic review (Kendrick et al, 2013), which assessed parenting interventions to prevent unintentional child injury, searched for studies which had drowning as an outcome but did not appear to have found any relevant primary literature as no results or discussion was available for drowning or intermediate outcomes.

Other evidence identified that is specific to this age group pertains mostly to domestic swimming pools. There is moderate quality evidence that pool fencing is an effective intervention for the prevention of drowning and that isolation fencing (4-sided) is more effective than perimeter fencing (3-sided). Authors of the systematic review addressing this question

(Thompson and Rivara, 1998) specify that to be effective the fence needs to incorporate secure, dynamic self-latching gates. There is inconsistent evidence from another systematic review (Kendrick et al, 2012) on whether education is an effective intervention leading to the installation of pool fencing. In terms of legislation, a single study identified in a systematic review (Garside and Moxham, 2009) concluded that legislation which allows three-sided pool fencing is an ineffective intervention for the prevention of drowning. There is a lack of evidence about the effectiveness of enforcement activities to improve compliance with legislation where it has been introduced as the studies included in the systematic review (Garside and Moxham, 2009) are of inappropriate design to determine intervention effectiveness. NICE public health guidance PH29 (2010) included an evidence statement in relation to pool fencing legislation but no recommendation was made in regard to this as the applicability of the evidence was considered poor due to the low level of private swimming pool ownership in the UK.

## **Children**

The only evidence about swimming lessons for children to prevent drowning identified by included systematic reviews was a single, small, case-control study (Brenner, 2009).

NICE guidance on strategies to prevent unintentional injuries among the under-15s (PH29, 2010) provides recommendations relating to the provision of education and advice on water safety. When this guidance was originally published none of these recommendations were linked directly to evidence statements. An updated search for literature conducted by NICE (Evidence Update 29, 2013) identified Brenner (2009) subsequent to publication of the guidance. The commentary provided by NICE on this one study states:

"The evidence suggests that among younger children, formal swimming lessons may reduce drowning risk. Among older children, although not associated with risk reduction, formal lessons do not appear to increase risk."

## **Adolescents and young adults**

There is a lack of evidence about the effect of the minimal legal drinking age on the prevention of drowning as the only study identified by a systematic review (Leavy et al, 2015) examining this issue was a cross-sectional time series study which is unable to attribute any effect observed to a specific intervention.

## **Standards, recommendations and suggested actions captured in expert body reports**

A number of expert reports from Eurosafe, NICE and the World Health Organisation (WHO) were reviewed. These documents indicate support for a range of measures including installing barriers controlling access to water, legislation for swimming pool barriers, mandatory use of personal flotation devices, recertification and minimum numbers of lifeguards, water safety education and swimming lessons, risk assessments, boating regulation and training bystanders in safe rescue and resuscitation. The rationale for these interventions arises from a combination of expert opinion, targeting risk factors evident from epidemiological data and limited evidence from research data. The documents from Eurosafe and NICE include measures relevant to high-income countries whereas the WHO report outlines actions to prevent drowning in low and middle-income countries. All three reports encourage swimming competency.

## Conclusions:

### **What are the risk and protective factors associated with drowning in children and young people under 25 years of age?**

Expert body reports draw on epidemiological data, selected research studies and expert opinion and list a wide range of risk factors operating prior to, during and after, drowning events. These reports indicate that vulnerability varies with age/stage of development and that different risk factors may increase in importance at different stages of development. For young children, lack of adequate supervision is a major risk factor whereas for teenagers and young adults, alcohol use around water and other 'risky behaviours' such as swimming alone and in unsafe locations, are significant risk factors. Males are at a much higher risk than females regardless of age. Systematic review level evidence confirms that alcohol use around water significantly increases the risk of drowning and that people with epilepsy also have a significantly higher risk of drowning.

### **What is the effectiveness of interventions aimed at addressing risk factors, increasing protective factors and preventing deaths from drowning in children and young people under 25 years of age?**

There is limited systematic review-level evidence available regarding interventions for the prevention of drowning in children and young adults. As for risk factors, the findings of single studies are considered less reliable as evidence for the effectiveness of interventions than those of well conducted systematic reviews which consider the totality of the available evidence. A large proportion of the primary research identified by systematic reviews assessing this area has been conducted using study designs from which it is not possible to assign any effects to the intervention alone. Study design and other aspects of quality affect the reliability of study findings. Based on systematic review authors

judgments we conclude that there is moderate quality evidence for the installation of isolation fencing incorporating a secure, dynamic, self-latching gate to swimming pools. There is some evidence supporting the use of personal flotation devices, the provision of swimming lessons and education for beachgoers however for each intervention the evidence arising from systematic reviews is from a single study and therefore can not be considered 'conclusive'. There is also some evidence suggesting that general home safety education does not prevent a child being left alone in the bath and that legislation which allows 3-sided pool fencing is ineffective but this is also based on single studies. The evidence on the effectiveness of education for installation of pool fencing is inconsistent.

Some interventions for which there is research evidence available may not have been covered adequately by the secondary literature and are therefore not represented in this review.

## Plain English Summary

This evidence review aimed to locate and examine the findings of research on risk factors for drowning and on effective ways of preventing drowning in children and young people aged under 25 years. The sources of information used were systematic reviews and reports from expert bodies such as the World Health Organisation. Systematic reviews search for, assess the quality of, and summarise the findings from, relevant research, in a way which is as unbiased as possible. They are therefore considered to be reliable sources of information about what research can tell us about a particular topic. An overview of good quality systematic reviews is considered an efficient and fit-for purpose way of summarising the research evidence to inform broad policy questions in relatively short timescales.

The expert body reports included in this evidence review identified a wide range of risk factors for drowning in children and young people. These reports indicate that vulnerability to drowning varies with age/stage of development and that different risk factors are more important at different stages of development. For young children, lack of adequate supervision is a major risk factor whereas for teenagers and young adults, alcohol use around water and other 'risky behaviours' such as swimming alone and in unsafe locations, are significant risk factors. Males are at a much higher risk than females regardless of age.

Five systematic reviews of risk factors were identified as suitable for inclusion in this review. These provide a more detailed assessment of specific risk factors, confirming that alcohol use around water significantly increases the risk of drowning and that people with epilepsy also have a significantly higher risk of drowning. Lack of adequate supervision of

young children in or near water is also identified as a major risk factor for drowning.

Systematic reviews and expert body reports were also examined for information on how to prevent drowning. The seven systematic reviews included in this evidence review found that there were very few experimental studies assessing the effectiveness of interventions. A considerable number of the studies that systematic reviews did find were of a design unsuitable for testing the effectiveness of the intervention under investigation. In addition, where reliable studies were identified, often findings had not been replicated by other researchers; replication of findings is considered important in establishing the reliability of the evidence.

Expert body reports examined data on drowning in different populations, looked at some of the same research studies examined by the systematic reviews and also sought expert opinion and proposed a range of interventions to prevent drowning. These included installing barriers controlling access to water, legislation for swimming pool barriers, mandatory use of personal flotation devices, recertification and minimum numbers of lifeguards, water safety education and swimming lessons, risk assessments, boating regulation and training bystanders in safe rescue and resuscitation. However, not all of these have been examined by systematic reviews and of those which were, the most reliable evidence of effectiveness for preventing drowning was for having secure four-sided fences around swimming pools. The evidence supporting the effectiveness of other interventions identified in systematic reviews, including wearing of personal flotation devices, providing swimming lessons and educating beachgoers is based on the results of single studies.



# 1 Introduction

The Child Death Review (CDR) programme undertakes thematic reviews into specific categories of child deaths. These collate and interpret data on identified cases relevant to the theme of the review. The policy context and research evidence about risk or protective factors and of effective approaches to prevention are also considered, before recommendations are made and learning points identified, with the aim of preventing such deaths in the future.

This report documents the review of the research evidence undertaken to inform the CDR Programme thematic review of deaths from drowning in children and young people. This thematic review considered all such deaths in children and young people aged under 25 years that occurred in Wales between 1 October 2009 and 30 September 2014.

The objective of the research evidence review was to identify, characterise and summarise, research evidence on risk or protective factors for deaths from drowning in this age group which may be relevant to Wales and on measures or interventions that may have potential for preventing deaths from drowning in this age group in Wales.

# 2 Terminology

The following definition of drowning was adopted by means of consensus of conference attendees of the first World Congress on Drowning in 2002 (Van Beeck et al, 2005).

“Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid.”

It was also noted that drowning outcomes should be classified as death, morbidity and no morbidity.

# 3 Research evidence review questions

This review addressed 2 questions:

What are the risk and protective factors associated with drowning in children and young people under 25 years of age?

What is the effectiveness of interventions aimed at addressing risk factors, increasing protective factors and preventing deaths from drowning in children and young people under 25 years of age?

## 4 Review methodology

The methodology for this research evidence review report was based on systematic review principles and was detailed in an *a priori* protocol (Annex 1). There was one deviation from the protocol which is documented below. Systematic reviews aim to provide an objective, reliable synthesis of the evidence base through following explicit methodology which is transparent, repeatable and which aims to minimise bias (Higgins and Green, 2011). The sources of evidence used in this review were systematic reviews rather than primary research. This approach to evidence review is one which has been deemed fit-for-purpose by the CDR Programme and which has been used elsewhere in situations where appraisal and summary of evidence is required to inform decisions on broad policy questions, where timescales are relatively short and where resource constraints do not allow employment of large research teams (Caird et al, 2015).

The evidence sources located by the search strategy (which covered the period January 2000 – July 2015) were filtered for relevance and type of source and, with the exception of NICE Guidance and Cochrane or Campbell systematic reviews which use a methodology generally considered a gold standard, included sources were critically appraised using standardised checklists (available on request). Details of this filtering process are recorded in the PRISMA diagrams in section 5 and the Inclusion/Exclusion Tables in Annexes 6 and 7. This process was followed for both the risk factors and effectiveness of interventions parts of the evidence review and was undertaken independently by two reviewers (TK and ET) with disagreements resolved by discussion. For the latter, relevant data were then extracted from included sources, into an Evidence Summary Table (Annex 5) and an evidence grading (Annex 2) was then applied to reflect the quality, strength and direction of the evidence of effectiveness relating to different categories of intervention. This evidence grading reflects the opinion of the evidence reviewers about the evidence presented by the systematic review. Repeatability checks were conducted at key stages in the filtering and evidence grading process, as set out in the protocol. As the research evidence base underpinning the risk factors systematic reviews was relatively sparse, the findings from these are presented without evidence grading and thus this represents a deviation from the protocol.

Using a review of reviews methodology presents a number of challenges relevant to this evidence review which are discussed in depth by Caird et al. (2015) and are considered in the following paragraphs.

Quality assessment in reviews of reviews has to include both an assessment of the reliability of each included review and an assessment of the quality of the evidence presented by each review. Critical appraisal of reviews aims to identify those which, due to aspects of their methodology, maybe at risk of bias (limiting reliability). Some reviews may be excluded on this basis. However, exclusion of reviews risks loss of important data from the primary research. The extent to which the assessment of the quality of the primary research included in reviews is reported can vary and in some cases it is not always sufficient for assessing reliability of the findings of these studies. In this evidence review the aim was to strike a balance between maximising reliability and minimising loss of data by only excluding reviews which fell considerably short of the most important quality criteria for systematic reviews (adequate search strategy, objectivity in study selection and consideration of study quality) and by examining the primary studies included in a review to obtain further details where necessary.

There may be considerable commonality of studies across included reviews and thus over-representation of the findings from some primary studies may be a risk. In order to minimise this risk, the evidence reviewers mapped primary studies across reviews and, where there was considerable overlap, made decisions on whether to use just the most up-to-date and/or most reliable review rather than presenting the findings of multiple reviews covering the same primary studies. These decisions are recorded in the Inclusion/Exclusion Tables in Annexes 6 and 7.

Scope and context of reviews may vary and may not always match exactly that of the evidence review. For example, some reviews included in this evidence review were very broad in scope, covering unintended injuries in general whereas others were drowning specific. This may mean that some outcomes of main interest to the evidence review may only receive peripheral coverage in the included review and may not feature in the review conclusions. Where this was the case, evidence reviewers examined the primary studies included in the review in order to obtain further relevant detail. Where necessary we have also examined the included primary studies in order to extract data necessary for assessing applicability and generalisability if these were not reported in sufficient detail in the reviews.

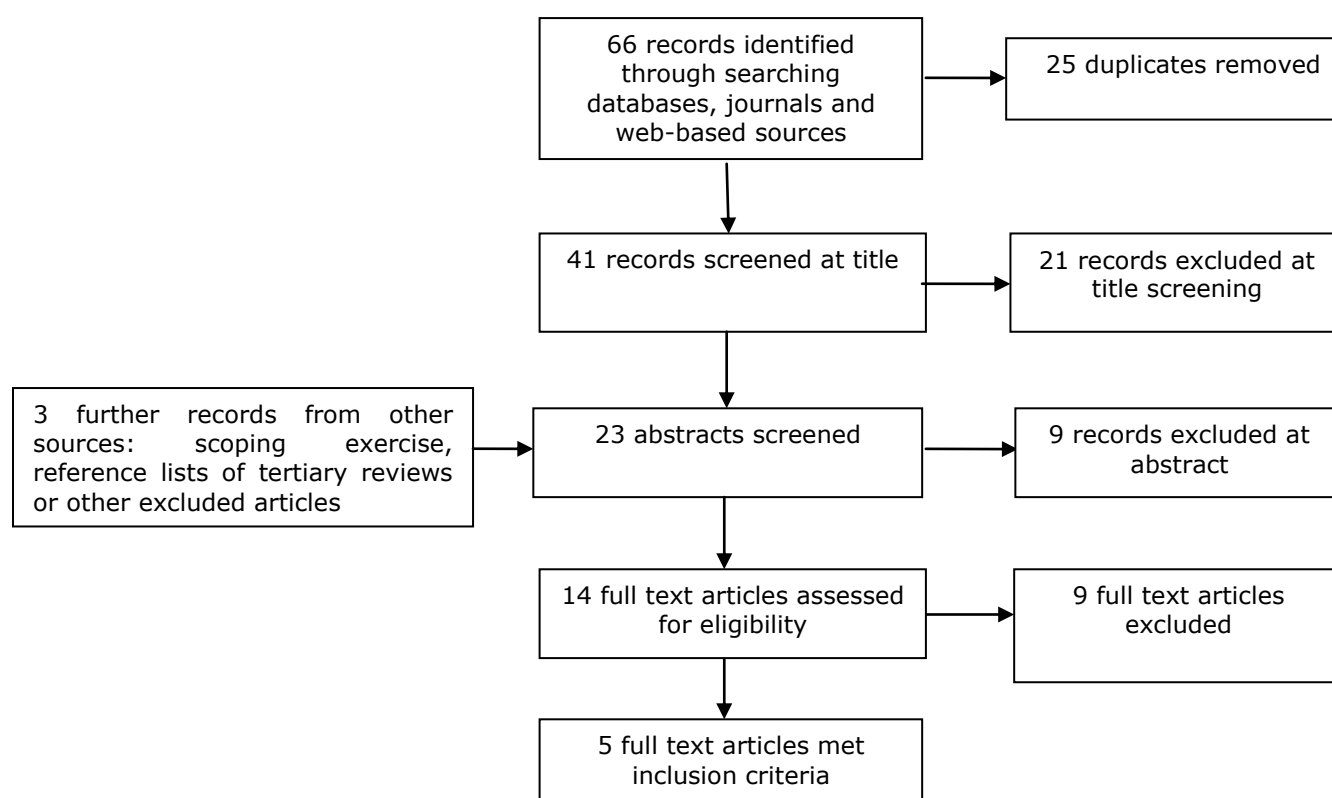
Authors of reviews may have their own conceptual and interpretive biases which may lead to mismatches between reviews in terms of conclusions drawn about the evidence base. Whilst this evidence review relies on reviews as sources of evidence and thus on review conclusions, evidence reviewers needed to be aware of this potential problem and to interpret authors findings accordingly. The Evidence Summary Table (Annex 5) therefore contains 'Comments' to this effect.

## 5 Research evidence review findings

### 5.1 Risk and protective factors

#### 5.1.1 Evidence from systematic reviews of primary research

**Figure 1: Flow of information through the risk factors evidence review**



Investigation of risk factors for drowning in high-income countries such as the UK is challenging due to the relatively low incidence of the outcome of interest. Research studies on modifiable risk/protective factors for drowning are observational (e.g. case-control, cohort studies, cross-sectional, case-series) rather than experimental (trials) given the nature of the outcome of interest. Conclusions about cause-effect relationships cannot be directly inferred from observational studies where an appropriate comparator or control population is lacking. If however, multiple, good quality observational studies consistently demonstrate similar, strong statistical associations between the factor and the outcome, after appropriately taking into account possible confounding factors, this is usually considered to indicate the probability of a cause-effect relationship (NICE, 2014). The findings of single studies are

considered less reliable as evidence than those of well conducted systematic reviews which consider the totality of the evidence.

This evidence review included five relevant systematic reviews and meta-analyses/modelling studies which assessed the evidence-base for risk factors for drowning. One source was very broad in scope, covering risk factors for unintentional injuries, one was focussed on drowning risk factors and three dealt with specific topics (alcohol and epilepsy).

The systematic review by Pearson et al. (2009) sought to identify risk factors for unintentional injuries among children and young people aged under 15 years; it was commissioned to underpin NICE guidance PH29 (2010) and followed NICE systematic review methodology. The systematic review sought research relating to injuries in the home and outside the home separately. It only included studies published from 1997 which were multivariable (i.e. based on  $\geq 1$  potential predictor factor) and undertook a multivariate analysis (i.e. an analysis that adjusts for possible confounders using methods such as regression analysis). No multivariate evidence was found that examined home-related risk factors for drowning but three studies (two from Canada, one from the US) looking at drowning deaths or drowning-related injury, in other environments, were reviewed. These studies looked for "child and family" factors that were statistically significant and positively associated with the risk of drowning. The authors concluded from one study that there was "weak to moderate" evidence of association of risk of drowning with entitlement to Medicaid<sup>iii</sup> in 5 to 14 year olds. Whilst this might be interpreted as implying an association between deprivation and risk of drowning, the authors point out that this association was reversed in children aged 0 to 4 years in that those from non-Medicaid entitled families had a higher probability of drowning. None of the three included studies tested for the association between unintentional injury occurring through drowning and broader indicators of socio-economic status, education level or income. The authors concluded from another study that there was no statistical evidence of risk of drowning being associated with the presence of behavioural disorders (defined by prescription for methylphenidate) in young people aged under 19 years. The third study they reviewed examined the risk of drowning being associated with being of Native American descent and thus these findings are not generalisable to Wales. The authors suggest that the small proportion of the evidence from the UK (none for drowning) "... puts into question the external generalisability of the findings of this review..." and that "...inclusion of pre-1997 studies may have generated a wider body of UK evidence."

<sup>iii</sup> Means tested programme in the United States providing access to health and medical resources for those on low incomes

The authors reported that no studies tested for associations between the age or sex of children, broader indicators of socio-economic status, educational level or income and injuries occurring through drowning. They point out that their review included all forms of comparative observational study design (i.e. cohort and case control studies) but that "...reviews of observational studies are particularly prone to publication bias (i.e. more likely to identify studies demonstrating a significant association between a risk factor and unintentional injury in children and conversely less likely to identify statistically non-significant risk factors." The very small number of studies the authors found for drowning outcomes could reflect this bias but may also be the result of a lack of multivariate risk factor research.

NICE guidance PH29 (2010) notes, in its chapter discussing gaps in the evidence, the lack of studies addressing the quantitative correlates of drowning.

A systematic review by Purnell and McNoe (2008) aimed to identify and summarise evidence on risk factors for drowning. The systematic review updated one published in 2004 (Chalmers et al, 2004). Purnell and McNoe (2008) report that "Chalmers et al. (2004) identified a number of knowledge gaps relating to activities in which unintentional drowning was a concern. Analytical studies were seen as necessary to quantify the independent effects of the various postulated risk factors for drowning." Their search of both published and grey literature (2004 to 2007 inclusive) however, found no "analytical" studies, such as case-control studies, investigating modifiable risk factors. These authors therefore provided a narrative review of 13 published plus two 'grey literature', descriptive or cross-sectional studies or retrospective analyses and their discussion includes conclusions drawn from the earlier review. It was not possible to obtain a copy of the Chalmers et al. (2004) review in order to verify the methodology used or to obtain details about the quality of studies included in it.

On the basis of the earlier review (Chalmers et al, 2004) and the studies they reviewed, Purnell and McNoe (2008) identified four main areas as being *potential* modifiable risk factors associated with drowning and near-drowning, namely, alcohol use, lack of quality supervision, use of infant bath seats and risk taking behaviour. Their findings on these potential risk factors are included in the topic specific sections that follow. They do however state that only results that relate to one of the four activity categories in which the majority of drowning deaths in New Zealand occur, will be highlighted in their discussion. These are non-recreational immersion, recreational swimming, underwater activities and fishing. It is possible therefore that the reviewed or excluded studies contain information about other potential risk factors which has not been extracted.

Purnell and McNoe (2008) state that the knowledge gap identified by Chalmers et al. (2004) "...still remains as all of the studies on risk factors in this report were descriptive, retrospective analyses or cross-sectional in design, and not analytical." They note: "Case-control studies or other studies using analytical study designs would be necessary to further elucidate the extent to which all these factors increase the risk of death from drowning. It is likely that alcohol interacts with the other risk factors mentioned here and warrants further attention."

There was no overlap of studies included in the Pearson et al. (2009) and Purnell and McNoe (2008) reviews. This may have arisen due to the narrower search criteria for the latter review; Purnell and McNoe searched only 2004-2008 and for studies relating to four specific water-related contexts. Pearson et al. (2009) also searched only for multivariate studies whereas Purnell and McNoe (2008) included non-analytic study designs.

## Alcohol

### Risk of drowning associated with alcohol use

Purnell and McNoe (2008) report that the earlier Chalmers et al. (2004) review "...summarised evidence that alcohol use is associated with a substantial proportion of drowning incidents including road-vehicle incidents and with hazardous behaviour such as diving into water of an unknown depth and swimming in an unauthorized area." They provide a narrative review of more recent studies but conclude that "Determining the extent to which alcohol might increase the risk of drowning is also not possible from the above studies given their designs. Comparison groups are necessary to determine this."

Driscoll et al. (2004) aimed to assess the role of alcohol in drowning associated with recreational aquatic activity. Critical appraisal of this review suggested that the search may have been prone to publication and language bias and there was no systematic explicit appraisal of study quality, although study quality was taken into account in forming conclusions. The authors defined 'recreational aquatic activities' as those "...explicitly related to water that are undertaken for fun, pleasure or amateur sport...". They included swimming, surfing, boating, water skiing, underwater diving, and fishing in settings such as oceans, beaches, rivers, creeks, lakes, and public and private swimming pools. They excluded (where possible) studies where water-related death was "...incidental..." such as falling in while near water, or where the activity was not recreational.

The authors found that "Very few direct measures of risk of serious or fatal injury related to aquatic recreational activities are available." They report on just three studies from the US which present relative risks (RR) for drowning deaths relating to:

Boating: RR 2.9 for "any drinking" (blood alcohol levels >0g/100ml)  
RR 10.6 for 0.10g/100ml or above  
(no confidence intervals (CI) given, "small" study)

Aquatic activities: RR 4.6 (95% CI 1.6, 13.1) for >0g/100ml  
RR 31.8 (95% CI 5.8, 176) for >0.10g/100ml

Recreational boating: RR 1.3 (95% CI 1.2, 1.4) at 0.01g/100ml  
RR 3.7 (95% CI 2.8, 4.7) at 0.05g/100ml  
RR 10.4 (95% CI 6.9, 15.7) at 0.1g/100ml  
RR 52.4 (95% CI 25.9, 106.1) at 0.25g/100ml.

In this study deaths are "predominantly drowning". RRs were reportedly similar if data for those who were voluntarily swimming from a boat were excluded and were similar for boat operators and boat passengers.

The authors stress the importance of understanding whether the involvement of alcohol in a drowning death was contributory or causal, the role played by confounding factors such as polydrug use and experience of the activity and of knowing when the blood used for blood alcohol level estimation was taken in relation to both the incident and the death. They present data on some of these factors, where available. From these it is clear that there is variation in the reporting of such information across studies and that the reliability of the findings from some studies is questionable.

#### Proportion of drowning deaths associated with alcohol use

Driscoll et al., (2004) also include data from two other (US) studies which present the percentage of boating deaths which alcohol was estimated to have either "caused", been "involved" with or "contributed to". Drawing on these plus the three studies discussed above, the authors, whilst recognising that "The quality of information on alcohol involvement in individual studies ranges from poor to very good", conclude that: "Alcohol consumption significantly increases the likelihood of immersions resulting in drowning during aquatic activities." They estimate that 30% to 70% of drowning victims have a measurable blood alcohol concentration; the risk of drowning increases with increasing blood alcohol concentration and the percentage of drowning deaths attributed to alcohol use appears to be between 10% and 30%.

The authors also conclude (mostly from telephone surveys or face-to-face interviews conducted in the United States) that the prevalence of drinking alcohol on board boats is around 30%–40%, is higher in men than women, that the level of alcohol consumed is higher in men and that men tend to "...behave in higher risk aquatic activities in association with drinking than women." As full methodological details on included studies



are lacking it is not possible to ascertain the extent to which these findings may have been subject to response or other biases.

Most of the data reviewed in Driscoll et al., (2004) came from the US with some from Australia, Canada, South Africa and Scandinavia. The legal and social context in relation to alcohol in which these studies were set therefore differs to some extent to that of Wales (for example, minimum legal drinking age). However, the basic finding of this review, that alcohol use during aquatic activities increases the risk of drowning, is transferable to Wales.

Rehm et al. (2004) report in detail on an extensive multi-level modelling analysis of the association between alcohol and death from different causes, including drowning, across different global sub-regions. Only conditions for which evidence of a causal relationship was "...conclusive..."<sup>iv</sup> were included in the review. The analysis derived alcohol-attributable fractions<sup>v</sup> (AAFs) for mortality from "drowning" for the sub-region EUR-A (which includes the UK) using data from four reviews/meta-analyses (US 1 study, Canada 1 study, Australia 2 studies). The AAFs relevant to the age-range covered by this evidence review are: 0, for both males and females aged 0-15 years and 0.35 for males and 0.33 for females aged 15-29 years. The limitations of the data used in the analysis are discussed in depth and the authors point out that "... the overall quality of the underlying research for most alcohol-related acute outcomes is of poor quality and derived AAFs may be subject to considerable error." They also note that the relationship between alcohol consumption and injuries (including drowning) is context dependent, thus findings the transferability of findings (from one context to another) is "...questionable." They suggest applying +/- 30% of the point (AAF) estimate to account for "additional assumptions". Their estimate is not inconsistent with that of Driscoll et al. (2004).

## Epilepsy

Bell et al. (2008) conducted a meta-analysis using data from published articles and national registries in the UK in order to quantify the excess risk of drowning in populations of people with epilepsy. Data on adults (age 18-93 years) from the UK national registries for 1999-2000 identified 22 deaths from drowning, giving an overall SMR of 15.3 (95% CI 9.6 to 23.1). The UK National Registry data recorded no drowning deaths in "children" (we assume they are therefore categorising under 18 years as children).

<sup>iv</sup> They defined this as consistency across several studies; established experimental biochemical evidence of mediating processes or at least physiological plausibility; strength of the association (effect size); and temporality (i.e. cause before effect).

<sup>v</sup> The proportion of each outcome i.e. number of deaths or injuries that is attributable to alcohol on the basis of a counterfactual scenario of no alcohol consumption.

Using all the published data available to them (from 51 cohorts) they found that, in total, there were 88 reported deaths by drowning in people with epilepsy, compared with 4.70 deaths expected (as calculated from the relevant population rates), giving a Standardised mortality ratio (SMR) of 18.7 (95% CI 15.0 to 23.1). Sub-analyses excluding small studies with no deaths due to drowning, studies in which the accuracy of the data had been difficult to ascertain and studies of African cohorts produced SMRs which were of similar magnitude and significance.

The authors report a ("just significantly") smaller SMR for children, 7.76 (95% CI 2.85 to 16.9) than that of adults, 20.04 (95% CI 12.2 to 31.0); ratio 0.39 (95% CI 0.13 to 0.999). The authors conclude that "...the increased risk of drowning may not be as great in children as it is in adults...". They suggest that this "...may be due to increased supervision of children with epilepsy in an age-group in which the rate of drowning is generally the highest." They note however, that few of the cohorts studied covered "...purely childhood years." and that of the 15 studies featuring predominately children, only four recorded any drowning deaths.

The authors point to limitations of their analyses: they may not have identified all relevant cohorts; the number of deaths due to drowning is small; studies reporting no such deaths tended to be small but in total made up one quarter of the total person years of follow-up (sub-analyses suggest their inclusion has a relatively small inflationary effect on the SMR); the population data came from published sources thus the year and age of death of each person had to be estimated. It is clear however, from the size of the effect and consistency of the findings of the included studies, that the authors' conclusions that "...people with epilepsy are at increased risk from death due to drowning..." and "It is imperative that people with epilepsy and their families are appropriately counselled..." are justified.

One other review of epilepsy as a risk factor for drowning deaths or injury, Tan and D'Souza (2013), did not meet the inclusion criteria for this evidence review as it did not follow systematic review methodology. We noted however, that of 14 studies discussed in this review, only one overlapped with the studies located by Bell et al. (2008) even though all were published prior to the Bell et al. (2008) review search end date. Bell et al. (2008) do not provide a list of excluded studies so it has not been possible to ascertain whether these studies were not found or whether they were excluded. Tan and D'Souza do not provide search details so it is not possible to judge how their search might have differed from that of Bell et al, (2008). The overall conclusions of Tan and D'Souza do not however, differ from those of Bell et al. (2008).

**Lack of supervision and use of infant bathtub seats**

Purnell and McNoe (2008) found two descriptive studies (From Canada and Australia) and one retrospective analysis (Canada) relevant to lack of quality supervision as a risk factor in deaths from drowning of children (0-18 years). They report that in all three studies, lack of supervision was identified as a contributory factor in deaths from drowning. They included two further retrospective analyses (one small study of six deaths and a larger study of 54 deaths from the UK) which explored infant bath-tub seats as a risk factor for drowning in children aged under two years and they concluded that "Lack of parental supervision was related to the use of bath seats and both were shown to be factors in non-recreational immersion incidents."

**Risk-taking behaviour**

Three different studies were discussed by Purnell and McNoe (2008) under the category of risk taking behaviour. One descriptive study of 1073 young adults (not defined) explored self-reported factors associated with self-reported 'non-fatal drowning incidents'. Alcohol featured in the findings of this study but information on the amounts consumed was not collected. Purnell and McNoe (2008) conclude from this one study that "Overall, males reported a higher level of water confidence, exposure to risk behaviours and unsafe locations and more non-fatal drowning incidents than females, and those males who were most confident in the water were more likely to engage in water-related activities (but not boating) after drinking alcohol." The reliance on self-report weakens the reliability of these findings.

Purnell and McNoe (2008) concluded from a retrospective analysis of 247 flood-related fatalities (approximately two-thirds occurred through drowning) from the US and Europe that "... significant numbers of flood deaths are attributable to unnecessarily risky behaviour." 70% involved males. One third of total deaths were vehicle-related drowning and these mainly occurred when people tried to drive through flood water.

They also refer to an unpublished report by the Child Death Review Unit of British Columbia on nine child deaths in eight vehicle submersion incidents, concluding that "Excessive speed and or/driver error was a contributory factor in five deaths. Alcohol and/or drugs were factors in one half of the cases."

Finally, they report on one retrospective analysis providing data on diving-related (scuba-diving and snorkelling) drowning deaths and concluded that lack of experience and not following standard safe diving practice guidelines were contributory factors.

### 5.1.2 Expert body reports

During scoping for the evidence review, a number of relevant learned body guidelines/reports were identified and these are listed in the bibliography in section 7. Some of these covered drowning within the broad context of unintentional injury (eg World Health Organisation European and World Reports on Child Injury Prevention, 2008) and water safety (World Health Organisation *Guidelines for safe recreational water environments* 2006), whereas others were drowning specific (eg World Health Organisation's, *Global report on drowning*, 2014) or risk factor specific (Public Health England and Royal Society for the Prevention of Accidents, 2015). Although somewhat variable in content, generally they aim to provide: information about the burden of morbidity/ mortality arising from these causes through analyses of epidemiological data; information about risk/protective factors through examination of epidemiological data and reference to the research literature and expert judgment; and also suggest, either using expert judgement, inference from risk/protective factors or with reference to research literature, ways in which such mortality/morbidity can be prevented.

Epidemiological data can provide information about the circumstances in which deaths from drowning occur and thus enable identification of higher risk situations. The National Water Safety Forum<sup>vi</sup>, using data collected by the Water Incident Database Service, report 338 drownings and water-related deaths<sup>vii</sup> in the UK in 2014 (Table 2). More than half of the deaths were in inland waters and a high proportion of deaths occurred whilst walking or running alongside water, predominantly in rivers and coastal water. The majority of the deaths were in males with a higher number of deaths for males than females in every single age bracket recorded. A fifth of deaths occurred in children and young people aged under 25 years. The number of deaths spiked in July (43, compared with 20 in June and 29 in August), but the number of deaths also rose in January (38).

Analyses of the same source of data for 2011 were used to inform the Royal Society for the Prevention of Accidents (RoSPA) water safety fact sheet (n.d.) which provides a similar profile to that described above in terms of gender, age location, seasonality, activity, for UK drowning deaths.

<sup>vi</sup> Available at: <https://nationalwatersafety.wordpress.com/2015/06/12/number-of-uk-drownings-at-lowest-since-records-began/>

<sup>vii</sup> The figures, include deaths in water that resulted from natural causes such as a heart attack, drowning or other fatal injuries resulting from falls into water and those that occurred during the course of water-based activities. Totals for each sub-section do not always equal 338 as some records were excluded from analyses.

**Table 2: Deaths from drowning in the UK during 2014**

	Number of deaths (%)
<b>Location</b>	
Inland waters	174 (54.0%)
Sea, coast, beach, shoreline	111 (34.5%)
Ports, harbours, docks, marinas	15 (4.7%)
Bath, Jacuzzi, Hot-tub	7 (2.2%)
Swimming pools	12 (3.7%)
Drains, well-pits	3 (0.9%)
<b>Activity</b>	
Walking or running alongside water	138 (40.8%)
Swimming in unsupervised places	36 (10.7%)
Waterside activity/in water play	31 (9.2%)
Other	133 (39.3%)
<b>Gender</b>	
Males	267 (79%)
Females	71 (21%)
<b>Age</b>	
0-4	9 (2.8%)
5-14	8 (2.5%)
15-19	21 (6.5%)
20-24	27 (8.3%)
25 and over	259 (80.0%)

Source: The National Water Safety Forum (2015) using data collected by the Water Incident Database Service

The WHO *Global report on drowning* (2014) takes an international perspective with a focus on children and young people and low and middle-income countries. It draws on original analyses of national mortality statistics and data reported to the WHO along with selected, cited other reports, articles and input from an Advisory Committee. No methodology is described for literature review. The report states that "...drowning is among the 10 leading causes of death of children and young people in every region of the world, with children aged under 5 years disproportionately at risk and males twice as likely to drown as females. Over half of casualties are aged under 25 years." The different age-profile (higher proportion of death in young children compared with the UK figures) reflects the inclusion of data from low-and middle-income countries. The report concludes that "Children's vulnerability changes with age."

"Children aged under 12 months are relatively immobile and entirely dependent on caregivers. They can drown very quickly and in very little water, and in water containers that

may not be perceived as risks (for example, in a bucket or a toilet). Children who are mobile but too young to recognize danger or to get out of water are at risk, especially in the absence of barriers and capable supervision. Adolescents tend to be less supervised and are more likely to engage in risky behaviour around water, including consuming alcohol.”

The report authors conclude from the data analysis and selected papers that “Even in countries with large coastlines such as Australia, Canada, New Zealand and Viet Nam, most drowning happens inland. Whether in a bucket, bathtub, pond or pool, almost all water is a risk for drowning – especially where young children are concerned.” The risk factors for drowning identified by the report are included in Table 3.

The WHO World and European Reports on Child Injury Prevention (2008) draw on analyses of mortality statistics and other epidemiological data, expert opinion, case-studies and published literature. No methodology is given for literature review. The European report states that “Drowning is the second leading cause of injury deaths among children (aged 0-19) in the WHO European Region and the leading cause of childhood injury death in some countries.” It identifies a number of risk factors which are included in Table 3.

The WHO *Guidelines for safe recreational water environments* (volumes 1 and 2, 2006) “... represent a consensus view among experts on the risk to health represented by various media and activities and on the effectiveness of control measures in protecting health. They are based on critical review of the available evidence.” There are no details of the review methodology employed. In addition to the risk factors identified by the other WHO reports, immersion cooling/cold shock resulting from exposure to cold water, high temperatures in hot-tubs and attempted rescue are suggested as risk factors for drowning (the latter, to rescuers) (Table 3).

Another report, located during scoping, came to similar conclusions about the key risk factors, for drowning in children and young people in the US. The American Academy of Paediatrics Technical Report on Prevention of Drowning (2010) additionally lists “above ground inflatable and portable pools” and “drain entrapment” as posing a drowning risk, on the basis of US Consumer Product Safety data.

Public Health England has recently released a Child Safety Update on the use of bath seats (Public Health England and RoSPA 2015). This states that “Inadequate supervision - leaving an infant in a bath seat unattended or co-bathing (with another child) for any period of time is the most common factor associated with accidents due to a child’s vulnerability.” and that “...babies and infants are more likely to be placed in a bath seat

and young children are at risk of drowning if supervision is absent. Children aged 0 to 4 years are most at risk.” The methodology used to produce this document is unavailable. A small number of papers and ‘expert body’ documents are given in a reference list in the Child Safety Update. Of these, Sibert et al (2005) report on an analysis of UK data (1989-2003) on children under two years drowning in the bath and a literature review which found that only four relevant papers had been published since 1966. They call for more research to be conducted to clarify whether or not “...putting a baby in a bath seat represents an increased risk of drowning compared with a baby without a seat.” Of the references listed in the PHE Safety Update four post-date the Sibert et al. (2005) review and of these, none are primary studies addressing this issue. It appears therefore that the evidence-base remains sparse.

**Table 3: Risk Factors identified by the WHO Guidelines for Safe Recreational Water Environments (2006), WHO World and European Reports on Preventing Child Injuries (2008), the WHO Global Report on Drowning (2014)**

Age/Stage of Development	Risk Factors (for mortality and/or morbidity)
	<b>Pre-event</b>
<b>All (non-age specific)</b>	<p><b>Person-related</b>  Male gender  Low socio-economic status/poverty  Underlying conditions such as epilepsy, seizure disorder, autism and certain cardiac arrhythmias  Lack of awareness of risks  Lack of knowledge/recognition of water safety signs and symbols</p> <p><b>Agent-related</b>  Unsafe water transportation vessels  Lack of/inadequate safety (Personal Floatation Devices) measures/ signage/equipment</p> <p><b>Physical environment-related</b>  Unprotected water hazards  Strong currents  Inadequate physical infrastructure eg bridges  Floods/coastal storms (and lack of warning of)  High temperatures in hot-tubs</p> <p><b>Socio-economic-related</b>  Failure to protect water hazards  Lack of water safety instruction</p>



<b>Infant/ Preschool/ Child specific (0-4, 5-12 years)</b>	<b>Socio-economic related</b> Alcohol consumption by parent/carer
<b>Adolescent and Young Adult specific (12-25 years)</b>	<b>Adolescent/young person related</b> Alcohol consumption
	<b>Event</b>
<b>All (non-age specific)</b>	<b>Person-related</b> Swimming alone Lack of swimming/water survival skills Lack of strength/fitness Over-estimation of swimming ability Lack of comprehension of situation Panic response Lack of knowledge of emergency signals Lack of personal alerting devices Not wearing PFD Immersion cooling/cold shock <b>Agent-related</b> Deep/cold water Strong currents Lack of PFDs/other life-saving devices on boats Lack of/too few adequately trained life-guards Submerged vehicles High temperatures in hot-tubs <b>Physical environment-related</b> Variable water depth

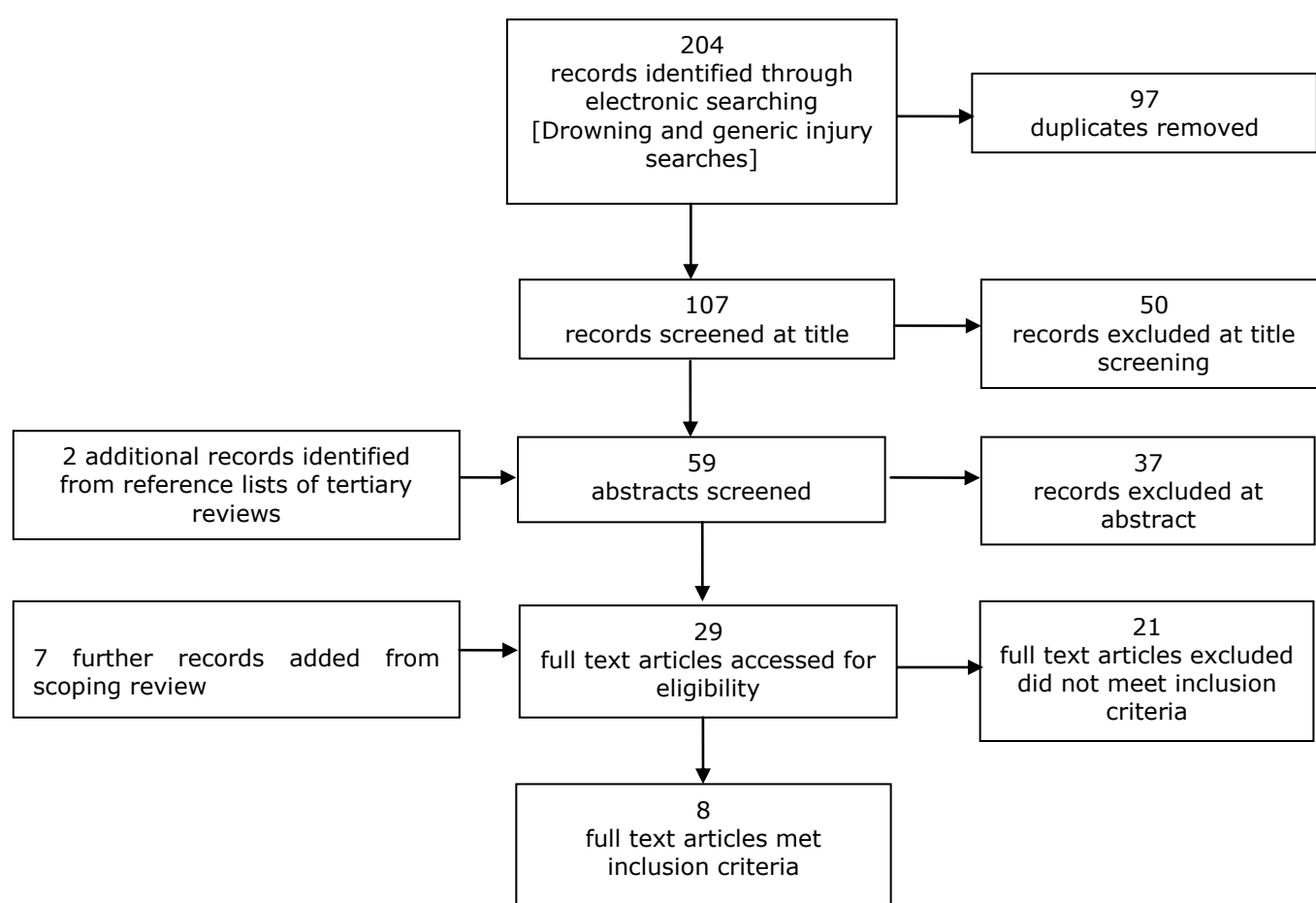
	<p>Unstable footing Lack of escape mechanism, e.g. ladder, ropes, flotation device Snags in water</p> <p><b>Socio-economic-related</b> Poor access to information and resources for minimising risk Inadequate communications or infrastructure to call for emergency services</p>
<b>Infant/ Preschool/ Child specific (0-4, 5-12 years)</b>	<p><b>Socio-economic-related</b> Parent/carer under-estimates risk, as child can swim</p>
<b>Adolescent and Young Adult specific (12-25 years)</b>	No risk factors identified specific to this age-group
	<b>Post-event</b>
<b>All (non-age specific)</b>	<p><b>Person-related</b> Delay in rescue Attempted rescue (risk to rescuers) Inaccessible first-aid kits Lack of alerting mechanisms (such as mobile phone, flares)</p> <p><b>Agent-related</b> Victim carried away from shore by current</p> <p><b>Physical environment-related</b> Long emergency services response time Inadequate rescue skills Poor access to water</p>

	<b>Socio-economic-related</b> Inadequate first response/care
<b>Infant/ Preschool/ Child specific (0-4, 5-12 years)</b>	<b>Child-related</b> Lack of knowledge by caregiver about what to do immediately/infant or child appropriate first response
<b>Adolescent and Young Adult specific (12-25 years)</b>	No risk factors identified specific to this age-group

## 5.2 Effectiveness of interventions

### 5.2.1 Evidence from systematic reviews of primary research

**Figure 2: Flow of information through the interventions evidence review**



Overall, seven systematic reviews and an Evidence Update from NICE contributed to the findings of this evidence review with regard to interventions. Relevant NICE public health and clinical guidelines, where available, have been included.

A headline statement on the overall state of the evidence base has been given for each intervention topic. These are followed by separate statements for each included source relevant to that section. Many of the sources identified partially overlapped in terms of primary studies. Where this is the case this evidence review has formulated a statement based on the best quality source.

An evidence grading colour scheme (Annex 2) has been applied to indicate the extent to which the potential effectiveness of an intervention is supported by the research evidence contained within the source. In brief:

- Green indicates good (Grade A) or moderate (Grade B) evidence that an intervention is effective
- Yellow indicates inconclusive evidence that an intervention is effective
- Orange indicates inconsistent evidence
- Light red (Grade G) indicates inconclusive evidence that an intervention is ineffective
- Dark red indicates moderate (Grade H) and purple, good (Grade I), evidence that an intervention is ineffective.
- Grey indicates a lack of evidence about the effectiveness of an intervention

Effect sizes have been given, where available, only for those interventions judged to have good or moderate evidence of effectiveness (those highlighted in green) or ineffectiveness (those highlighted in dark red/purple). Further details of the results and conclusions of the included sources are given in the Evidence Summary Table (Annex 5) which should be consulted for a more in-depth explanation of the reasons behind the evidence grading assigned to each source.

**All age groups****Drowning prevention campaign**

Evidence that a drowning prevention campaign can increase life vest (personal floatation device) ownership and /or use is lacking. Evidence that a drowning prevention campaign reduces drowning fatalities is lacking.

**Intervention:** Drowning prevention campaign

**Outcome 1:** Life vest (PFD) ownership in children aged 1-14

**Outcome 2:** Life vest (PFD) use post campaign compared to baseline in children aged 1-14

**Evidence statement Grade J (grey) :** Evidence about the effectiveness of the intervention is lacking

Ashfaq K et al. (2009). *Strategies, policies and regulatory or legal frameworks and/ or mass media campaigns to prevent unintentional injury to children during play and leisure*. Birmingham: West Midlands Health Technology Assessment Collaboration. University of Birmingham. Access [here](#).

**Intervention:** Drowning prevention campaign

**Outcome:** Drowning fatality

**Evidence statement Grade J (grey):** Evidence about the effectiveness of the intervention is lacking

Ashfaq K et al. (2009). *Strategies, policies and regulatory or legal frameworks and/ or mass media campaigns to prevent unintentional injury to children during play and leisure*. Birmingham: West Midlands Health Technology Assessment Collaboration. University of Birmingham. Access [here](#).

**Intervention:** Drowning prevention campaign

**Outcome:** Use of Personal floatation device (PFD) by adults

**Evidence statement Grade J (grey) :** Evidence about the effectiveness of the intervention is lacking

Leavy JE et al. (2015). Recreational drowning prevention interventions for adults 1990-2012: a review. *J Community Health* 40: 725-35

## Education

A single study examining education for beachgoers reported positive short-term changes in their "intention never to swim at unpatrolled beaches" and "intention in managing rip currents" but no significant differences for their intention to swim between the flags

Evidence about the effect of education on lifeguard behaviours and lifeguard impact on pool attendees is lacking.

Evidence about the effect of education on the behaviour of coastal fishermen is lacking.

### Intervention: Education for beachgoers

#### Outcomes:

Intention never to swim at unpatrolled beaches

Intention to swim between flags

Intention in managing rip currents

Leavy JE et al. (2015). Recreational drowning prevention interventions for adults 1990-2012: a review. *J Community Health* 40:725-35

**Evidence statement Grade C (yellow):** There is some evidence supporting the use of this intervention but it is not conclusive

### Intervention: Education for lifeguards

#### Outcomes:

Lifeguard distraction

Scanning by lifeguards

Risky pool attendee behaviours (running, pushing under, jumping near others)

Leavy JE et al. (2015). Recreational drowning prevention interventions for adults 1990-2012: a review. *J Community Health* 40: 725-35

**Evidence statement Grade J (grey):** Evidence about the effectiveness of the intervention is lacking.

### Intervention: Education for fishermen

#### Outcome:

Avoiding fishing in bad weather

Checking weather beforehand

Use of lifejacket

Use of gumboots/waders

Alcohol consumption

Turning back on sea

Leavy JE et al. (2015). Recreational drowning prevention interventions for adults 1990-2012: a review. *J Community Health* 40:pp. 725-35

## Taking a cell-phone

**Evidence statement Grade J (grey):** Evidence about the effectiveness of the intervention is lacking.

**Personal floatation device**

There is some evidence that wearing a personal flotation device is an effective intervention for prevention of drowning.

**Intervention:** Wearing a personal flotation device (PFD)

**Outcome:** Deaths from drowning

Leavy JE et al. (2015). Recreational drowning prevention interventions for adults 1990-2012: a review. *J Community Health* 40:pp.725-35

**Evidence Statement Grade C (yellow):** There is some evidence supporting the use of this intervention but it is not conclusive

**Infants and young children**

NICE has issued guidance on preventing unintentional injuries among the under-15s in the home (PH30). The guidance does not include recommendations specific to the prevention of drowning. Most of the underlying evidence identified to develop recommendations related to other types of injury.

**NICE GUIDANCE****Preventing unintentional injuries among the under-15s in the home**

This guidance is for commissioners and providers of health services, environmental health services, housing services and associations, local authority children's services, local authority health and wellbeing boards, local authorities and their strategic partnerships, local safeguarding children boards, police, fire and rescue services, Sure Start and children's centres.

It is also for practitioners who visit families and carers with children and

National Institute for Clinical Excellence. (2010). *Preventing unintentional injuries among the under-15s in the home*. PH30. London: NICE. Access [here](#)

Pearson M et al. (2009). *Systematic reviews of effectiveness and cost-effectiveness of home safety equipment and home risk assessment schemes*. Exeter: Peninsula Technology Assessment Group (PenTAG). Access



young people aged under 15 (including [here](#) GPs, midwives, social workers and health visitors).

The recommendations focus on providing home safety assessments, supplying and installing home safety equipment and providing education and advice when carrying out these activities.

The guidance includes the following advice:

- prioritise households at greatest risk
- establish partnerships with local community organisations
- offer home safety assessments and advice
- offer appropriate safety equipment including door guards, cupboard locks, safety gates, smoke and carbon monoxide alarms, thermostatic mixing valves and window restrictors.

### General home safety education

There is some evidence that home safety education is an ineffective intervention to prevent children being left alone in the bath; meta-analysis of the studies identified tends towards no effect.

There is evidence from a single study that provision of tailored versus generic computer generated safety advice is ineffective in preventing a child from being left alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water after use.

**Intervention:** General home safety education

**Outcome:** Never leaving a child alone in the bath

**Evidence statement Grade G (red):**

There is some evidence suggesting that this intervention is ineffective but it is not conclusive

Kendrick D et al (2012). Home safety education and provision of safety equipment for injury prevention. *Cochrane Database Syst Rev* Issue 9. Art. No.: CD005014. DOI: 10.1002/14651858.CD005014.pub3. Access [here](#).

**Intervention:** General home safety education

**Outcome:** Never leaving a child alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water after use

**Evidence statement Grade G (red):** There is some evidence suggesting that this intervention is ineffective but it is not conclusive

Kendrick D et al. (2012). Home safety education and provision of safety equipment for injury prevention. *Cochrane Database Syst Rev* Issue 9. Art. No.: CD005014. DOI: 10.1002/14651858.CD005014.pub3. Access [here](#)

## Pool fencing

### Pool fencing

There is moderate evidence that pool fencing is an effective intervention for prevention of drowning. There is also moderate evidence that isolation fencing (4-sided) is more effective than perimeter fencing (3-sided) to prevent drowning

**Intervention:** Fenced versus unfenced pool

**Outcome 1:** Risk of drowning or near drowning

**Outcome 2:** Risk of drowning

**Intervention:** Isolation fencing versus perimeter fencing

**Outcome:** Risk of drowning

**Evidence Statement Grade B (light green):**  
This intervention is supported by moderate quality evidence of its effectiveness

Thompson DC and Rivara F. (1998). Pool fencing for preventing drowning of children. *Cochrane Database Syst Rev* Issue 1. Art. No.: CD001047. DOI: 10.1002/14651858.CD001047 Access [here](#)

### Education for installation of pool fencing

There is inconsistent evidence on whether education is an effective intervention leading to the installation of pool fencing.

**Intervention:** Education/information related to installation of pool fencing

**Outcome:** Presence of fence

**Evidence Statement Grade D (orange):** The evidence is inconsistent and it is not possible to draw a conclusion

Kendrick D et al. (2012). Home safety education and provision of safety equipment for injury prevention. *Cochrane Database Syst Rev* Issue 9. Art. No.: CD005014. DOI: 10.1002/14651858.CD005014.pub3 Access [here](#)

### Pool fencing legislation

Evidence from a single study suggests that legislation allowing three-sided pool fencing is an ineffective intervention for the prevention of drowning. Evidence about the effect of enforcement activities on compliance with legislation is lacking.

**Intervention:** Legislation allowing three-sided pool fencing

**Outcome:** Drowning

**Evidence statement Grade G (red):** There is some evidence suggesting that this intervention is ineffective but it is not conclusive

Garside R and Moxham T. (2009). *Preventing unintentional injury in children. Review 4: Strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury in children*. Exeter: Peninsula Technology Assessment Group (PenTAG). Access [here](#).

**Intervention:** Enforcement activities

**Outcome:** Compliance with pool fencing legislation

**Evidence Statement Grade J (grey):** Evidence about the effectiveness of the intervention is lacking.

Garside R and Moxham T. (2009). *Preventing unintentional injury in children. Review 4: Strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury in children*. Exeter:

## Children

NICE has issued guidance on strategies to prevent unintentional injuries among the under-15s (PH29). Recommendations 13 and 14 relate to providing education and advice on water safety. These recommendations are not directly related to underlying evidence statements. The guidance includes one evidence statement in relation to legislation for pool fencing however no specific recommendations with regard to this issue are included in the guidance. The systematic review notes that the applicability of research on pool fencing legislation is poor because of the low level of private swimming pool ownership in the UK and differences between legal systems, responsibilities and enforcement between the settings where research was conducted and that which operates in the UK.

### **NICE GUIDANCE** Strategies to prevent unintentional injuries among the under-15s

This guidance is for commissioners and providers of health services, local authority children's services, local authorities and their strategic partnerships, local highway authorities, local safeguarding children boards, police, fire and rescue services, policy makers, professional bodies, providers of play and leisure facilities, and schools.

National Institute for Health and Care Excellence. (2010), *Strategies to prevent unintentional injuries among the under-15s* PH29. London: NICE. Access [here](#)

It is also for other public, private, voluntary and community organisations and services which have a direct or indirect role in preventing unintentional injuries among under-15s.

The recommendations cover:

- Planning and coordinating local activities.
- Workforce training and capacity building through national standards and curricula.
- Injury surveillance to monitor the incidence of unintentional injuries among under-15s and plan preventive initiatives.
- Fitting permanent safety equipment and carrying out home safety assessments
- Outdoor play and leisure, including policies to ensure public play spaces are safe, and education and advice on water

and firework safety.

- Road safety, including strategies to help reduce vehicle speed in areas near where children and young people are present and managing road safety partnerships.

## Swimming Lessons

There is evidence from a single study that swimming lessons reduce drowning risk in children under 5 and do not increase the risk for those aged 5-19.

**Intervention:** Swimming lessons

**Outcome:** Deaths from drowning in children

**Evidence Statement Grade C (yellow):** There is some evidence supporting the use of this intervention but it is not conclusive

NHS Evidence. (2013). *Strategies to prevent unintentional injuries among children and young people aged under 15*. Evidence update 29.

## Adolescents and young adults

### Minimum Legal Drinking Age

Evidence about the effect of minimum legal drinking age on the prevention of drowning is lacking.

**Intervention:** Minimum legal drinking age

**Outcome:** Deaths from drowning

**Evidence statement Grade J (grey):** Evidence about the effectiveness of the intervention is lacking

Leavy JE et al. (2015). Recreational Drowning prevention interventions for adults 1990-2012: a review. *J Community Health* 40:pp.725-35

### 5.2.2 Standards, recommendations and suggested actions captured in expert body reports

EuroSafe have developed Child Safety Report Cards in an attempt to ascertain the level of safety provided to children and adolescents with respect to unintentional injuries across nine injury areas, one of which is water safety/ drowning prevention. The report cards are published intermittently and compare data across a number of European countries including Wales; 31 countries contributed data in 2012. The report card for water safety/ drowning prevention is reproduced in Annex 3 and includes elements regarding legislation for pool barriers, mandatory use of personal floatation devices while on water, the recertification of lifeguards and minimum numbers of lifeguards for water leisure activities. The report card also includes several elements in support of water safety education during home visits, as part of the school curriculum and includes swimming lessons. National standards for pools, signage, policies around risk assessments and accountability for water safety at the government level are also specified.

This report card was developed from the *Child safety good practice guide* (MacKay et al, 2006) which is a combination of research evidence and expert opinion of effective policies with a focus at the national level. The document defines good practice as:

- "1. A prevention strategy that has been evaluated and found to be effective (either through a systematic review or at least one rigorous evaluation) OR
- 2. A prevention strategy where rigorous evaluation is difficult but expert opinion supports the practice and data suggest it is an effective strategy (e.g. use of personal floatation devices (PFD) to prevent drowning) OR
- 3. A prevention strategy where rigorous evaluation is difficult but expert opinion supports the practice and there is a clear link between the strategy and reduced risk but a less clear link between the strategy and reduced injuries (e.g. secure storage of poisons) AND
- 4. The strategy in question has been implemented in a real world setting so that the practicality of the intervention has also been examined."

The evidence statements contained within the *Child safety good practice guide* (MacKay et al, 2006) that pertain to child water safety are linked to limited rigorous interventions research, the one exception being a reference to the Cochrane systematic review on pool fencing (Thompson and Rivara, 1998). Three case studies are documented but these describe limited evaluation and the data provided are unable to unambiguously attribute observed change to the interventions. In the 2012 Child safety

report card summary, it was noted that there was no clear pattern of reduced mortality for those countries with higher water safety scores on the report card, with authors noting that levels of exposure to risk and the degree of implementation and enforcement of policy measures could confound any correlation. The differences between the methods used for developing the Eurosafe good practice guide and those used to identify evidence for this review have resulted in discordant findings.

NICE public health guidance on strategies to prevent unintentional injuries among the under 15s (PH29, 2010) outlines some recommendations in relation to water safety (Annex 4). One set of recommendations pertains to providing education and advice on water safety directed at injury prevention co-ordinators and health practitioners, lifeguards, outdoor activity and holiday centre managers, schools, swimming instructors, swimming pool managers. Separate recommendations regarding water safety advice for leisure providers such as leisure centre and pool operators, boat hire companies, hoteliers, holiday companies and tour operators was also given. None of the recommendations provided in relation to drowning are linked directly to specific evidence statements; the guidance notes that they are inferred from evidence. The only evidence statement compiled from the underlying systematic reviews was in relation to pool fencing legislation (Garside and Moxham, 2009) as discussed earlier.

The recommendations from NICE are much narrower in scope when compared with the elements of water safety/drowning prevention documented by the Eurosafe child safety report cards. Some similarities exist in that both refer to the use of risk assessment in recreational environments, the provision of water safety information and both also encourage swimming competency. NICE is more specific in the components of some recommendations, for example, it is noted in the guidance that information and education should stress the importance of proper supervision and that advice should be timely for example, that is it provided in holiday season and during extreme weather conditions.

The WHO *Global report on drowning* (2014) outlined ten actions to prevent drowning; namely:

1. Install barriers controlling access to water
2. Provide safe places (for example a crèche) away from water for pre-school children, with capable child care.
3. Teach school-age children basic swimming, water safety and safe rescue skills.
4. Train bystanders in safe rescue and resuscitation
5. Strengthen public awareness of drowning and highlight the vulnerability of children
6. Set and enforce safe boating, shipping and ferry regulations

7. Build resilience and manage flood risks and other hazards locally and nationally
8. Coordinate drowning prevention efforts with those of other sectors and agendas.
9. Develop a national water safety plan
10. Address priority research questions with well-designed studies

It should be noted that this report has a focus on risk factors and interventions relevant to low and middle-income countries where the greatest incidence of drowning occurs. The report identifies one additional cohort study of 80,000 children (4-12 yrs), conducted between 2006 and 2010, in which a reduction in fatal drowning was observed in those receiving swimming training as part of the Swimsafe programme in Bangladesh. This study was too recently published to have been considered by the systematic reviews included in this review (Rahman et al, 2012) and therefore has not been subject to critical appraisal of reliability. Interestingly, one of the actions highlighted by the WHO report concerned immediate resuscitation at the scene of the incident. Interventions in this area were not identified by the systematic reviews included in this evidence review. This evidence review only includes research evidence from systematic reviews and guidelines relevant to the topic area that have been published or updated since 2000 onwards.

## 6 Limitations of the review

There are limitations to the approach taken for this evidence review, which are important to consider when interpreting the findings:

- This is not an extensive review of all of the systematic review level evidence. Only sources published or updated in the last 15 years have been included
- The main sources of evidence are systematic reviews. Well-conducted systematic reviews are regarded as reliable summaries of the evidence however there are a myriad of interacting risk factors and circumstances that lead to a drowning event. As such it is possible that not all risk factors/ interventions that have been assessed by primary studies have been subject to systematic review, for example, immediate resuscitation.
- The nature of the sources used means that innovative technologies and novel approaches which have yet to be formally evaluated and published are less likely to have been included
- The evidence grades assigned to different interventions are designed to give an indication of the strength and direction of the evidence as reviewed by the authors of this evidence review. For NICE guidance and systematic reviews the quality assessment of the primary research studies included within the reviews is that of the secondary source author.



## 7 References for systematic reviews included in the evidence review

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**Annex 1**

**GIG**  
CYMRU  
**NHS**  
WALES

Arsyllfa Iechyd  
Cyhoeddus Cymru  
Public Health  
Wales Observatory

# Protocol for Child Death Review Programme Research Evidence Review – Drowning in Children and Young People

Authors: Eleri Tyler, Advanced Evidence and Knowledge Analyst/ Researcher, Teri Knight, Consultant in Public Health, Isabel Puscas, Senior Evidence and Knowledge Analyst

**Date:** 29 April 2015

**Version:** 1

**Publication/ Distribution:**

- Child Death Review Programme Core Team
- Thematic Review Professional Lead
- OES Team

**Review Date:** not applicable

**Purpose and Summary of Document:**

This document describes the process to be followed for collating and assessing the research evidence to be fed into the CDR Programme Thematic Review of Drowning in Children and Young People.

**Protocol amendments:**

150915: amendment to wording of section 5.2.5- interventions outcome exclusion criteria - to further clarify what is meant by 'knowledge'. Amendment in response to comments on draft report from CDR Team.

**Work Plan reference:**

## 1 Background

The Child Death Review Programme (CDR) undertakes Thematic Reviews into specific categories of child deaths. Thematic Reviews collate and interpret data on identified cases relevant to the theme of the review and also consider background information, the policy context and research evidence of risk factors and effective approaches to prevention, before making recommendations and identifying learning points.

The **purpose** of this protocol is to set out the process to be followed for collating and assessing the research evidence to inform a CDR Programme Thematic Review of Drowning in Children and Young People.

### Case-definition:

The current thematic review will consider all deaths from drowning in children and young people aged under 25 years old between 1 October 2009 and 31 December 2014.

## 2 Aim of the thematic review

The aim of the review is to develop a report with recommendations to appropriate agencies, to contribute to the prevention of future deaths through drowning, based on evidence and the knowledge and experience of the panel, and to communicate these findings in order to inform action.

## 3 Research Evidence Review questions

This evidence review will address the questions:

What are the risk and protective factors associated with drowning in children and young people under 25 years of age?

What is the effectiveness of interventions aimed at addressing risk factors, increasing protective factors and preventing deaths from drowning in children and young people under 25 years of age?

## 4 Research Evidence Review Team

Co- reviewer: Eleri Tyler  
Co-reviewer: Teri Knight  
Information specialist: Isabel Puscas

Professional lead for CDR team: Sarah Jones

## 5 Methods

### 5.1 Scoping

A scoping search was conducted and a report written for the CDR team to inform the development of this protocol. The scoping report included a description of the types and quantities of high-level evidence identified by the scoping search, which appeared relevant to the topic, and specific queries arising from that material in relation to the parameters of the review. Discussion of the findings of the scoping report in a meeting held between the Research Evidence Review Team and the Child Death Review Core Team (17/3/15) enabled the finalisation of review questions in section 3 and informed the methods below.

### 5.2 Research evidence review methodology

#### 5.2.1 Scope of the research evidence review

The research evidence review will cover prevention of drowning (primary prevention), first response to a drowning event and management of a drowning/near-drowning case (secondary prevention/prevention of death from drowning) until arrival at a medical facility ( e.g. treatment centre/hospital). Drowning relating to occupation or water-birth will be included. It will include causes of death that are drowning-related but where drowning is not the primary cause of death. Only evidence from a context relevant to that in Wales will be considered.

Systematic reviews will be the main source of evidence on both risk/protective factors and interventions. In each case, following the initial search for systematic reviews and inclusion/exclusion process, the reviewers will meet with the CDR core team to determine whether there are any specific circumstances under which searching for or reviewing the primary literature would be of value and whether this is achievable within the available timescale. If this is agreed, amendments will be made to this protocol for that process.

#### 5.2.2 Search strategy

A search concept model/framework developed to inform the building of the search strategy is included in the Search Technical Document for this review. If it is agreed that the primary research literature will be searched for specific topic areas, a supplementary Search Technical Document will be produced for this purpose.

#### **Electronic searches**

To minimise selection bias this search needs to be as comprehensive as possible. The following databases will be searched:

#### **Health**

See Search Technical Document

Public Health Wales	Research evidence review report for Child Death Review on drowning
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### **Topic specific databases**

See Search Technical Document

### **Specialist databases**

See Search Technical Document

### **Meta search engines**

GOOGLE/GOOGLE scholar

**Hand-searching** Tertiary reviews (reviews of reviews) identified by the search will be hand-searched to identify relevant systematic reviews which may not have been located by the search.

### **Search terms**

See Search Technical Document for full details.

The search will aim to maximise sensitivity, using database subject headings – MESH, EMBASE, PsychInfo and wide ranging free text, keywords and synonyms. For the purpose of this search a standardised search filter will be used across the databases.

### **Limits**

There will be no follow up of reference lists other than those in tertiary reviews.

Only include systematic reviews published since 2000.

Guidance documents, expert statements and similar types of (non-research evidence) sources identified by the search will be catalogued but not included.

### **5.2.3 Reference management**

A Reference Manager database will be created to manage the search results. References from other sources, such as submitted by the professional lead, core team or thematic review panel, will be annotated as such on the database.

### **5.2.4 Risk factors inclusion/exclusion criteria:**

#### **Types of sources**

Include: Systematic reviews and meta-analyses of observational/epidemiological studies.

Exclude: Primary research papers, non-systematic literature reviews

#### **Types of participants**

Include: Children and young people under 25 years of age

Exclude: Systematic reviews/meta-analyses only considering data from studies of subjects outside this age range



Public Health Wales	Research evidence review report for Child Death Review on drowning
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### **Types of study subject**

Include: Studies of prevalence of established risk or protective factors, or studies seeking to identify risk or protective factors

Exclude:

### **Types of outcome measures**

Include: Drowning-related death, death by drowning, non-fatal drowning and relevant intermediate outcomes

Exclude: Other outcome measures

## **5.2.5 Interventions inclusion/exclusion criteria:**

### **Types of sources:**

Include: Systematic reviews and meta-analyses of intervention/experimental studies, NICE or other international guidelines (Non-UK guidelines to be collated but not included).

Exclude: Primary research papers, non-systematic literature reviews

### **Types of participants:**

Include: Children and young people under 25 years

Exclude: Systematic reviews only considering data from studies of subjects outside of this age range

### **Types of interventions:**

Include: Interventions aimed at reducing risk factors for drowning  
Interventions aimed at increasing protective factors for drowning  
Interventions aimed at preventing or reducing the risk of drowning (fatal and non-fatal) including secondary prevention in terms of first response and management during transport to a medical facility

Exclude: Other interventions

### **Types of outcome measures:**

Include: Fatal drowning, non-fatal drowning, behavioural change, reductions in prevalence of risk factors, increase in prevalence of protective factors and relevant intermediate outcomes

Exclude: Self-reported changes in attitude and/or knowledge or awareness of, for example, risk associated with certain behaviours

First for risk factors papers and then for interventions papers, the information specialist will undertake screening of titles. Two reviewers will independently undertake the inclusion/exclusion process for abstracts and then full-texts. If a large number of sources are identified a co-reviewer may review a random sample. Kappa scores will be calculated and disagreements resolved through discussion with the professional lead or a third reviewer. The outcome of this process should be reported in the review report. The outcome of this process will be recorded in the Reference Manager database and reported using a PRISMA diagram.

## **5.2.6 Critical appraisal**

NICE guidance and Cochrane reviews will not be subject to formal critical appraisal. Critical appraisal of full-texts of other systematic reviews will be undertaken by one reviewer using a standardised checklist for critical appraisal of systematic reviews. Depending on the number of included studies a co-reviewer will either also critically appraise all papers or a random sample. Kappa scores will be calculated and disagreements resolved through discussion with the professional lead or a third reviewer. Where there is major concern about the quality of any systematic review these will be discussed by the reviewers and may lead to exclusion. If an SR is excluded on quality grounds the review team may need to obtain, screen and appraise the primary literature included in that SR. This would impact on the time required for the review and would be discussed with the CDR core team once the scale of the task had been assessed. Any minor concerns about quality will be noted in the Evidence Summary Table. The outcome of the critical appraisal process will be recorded in the Reference Manager database, the PRISMA diagram and in the evidence review report.

Whilst a systematic review or other source might itself be subject to critical appraisal, the conclusions drawn for this research evidence review will be informed by the systematic review authors' conclusions as to the quality and reliability of the primary research evidence. A 'traffic light' grading scheme will be used to indicate this in the Evidence Summary Table.

### 5.2.7 Data extraction

Data will be extracted into the Evidence Summary Table by the reviewer. Depending on the number of included papers, the co-reviewer will either look at all papers or a selected sample (to include different types of sources and more complex sources) of at least 25%.

### 5.2.8 Synthesis

Narrative synthesis will be undertaken by the co-reviewers with support from the professional lead. This will be organised according to stages of childhood in ranges suited to the data available and using the theoretical model chosen for the Thematic Review. The synthesis will take the form of a set of 'evidence statements' for different risk/protective factors or interventions, with supporting text. A set of conclusions will be drawn in order to inform the recommendations to be made by the Thematic Panel Members. The findings from the review will be entered into the Research Evidence Review Report template (modified according to the theoretical model if appropriate). The draft report will be read by all members of the CDR core team and any amendments agreed and undertaken. Following this, the report will be finalised and submitted to the core team.

### 5.2.9 Review outputs

1. Search results recorded in the Search Technical Document
2. Inclusion/exclusion table
3. Evidence Summary Table (Technical Report)
4. Final report

## Annex 2 Evidence grading scheme for Interventions

A (dark green): This intervention is supported by good quality evidence of its effectiveness	NICE Recommended intervention/systematic review, of mostly good quality studies, with meta-analysis of majority of studies favouring intervention effect
B (light green): This intervention is supported by moderate quality evidence of its effectiveness	Systematic review of moderate to good quality studies with majority, or meta-analysis demonstrating positive effect. NICE grade B recommendation.
C (yellow): There is some evidence supporting the use of this intervention but it is not conclusive	Systematic review of poor quality studies with majority, or meta - analysis favouring intervention or systematic review or where the number of studies is too small to allow firm conclusions to be drawn
D (orange): The evidence is inconsistent and it is not possible to draw a conclusion	Systematic review of studies with inconsistent findings
E (bright orange): There is good evidence to suggest that this intervention has a sound theoretical basis or that work in this area is likely to have an impact but this has not been demonstrated in trials (this would apply particularly to pilot or novel interventions)	Systematic review of moderate to good non-analytical observational studies (e.g. case series or case-reports) or qualitative studies
F (blue): Expert opinion, formal consensus based on experience not research evidence	Recommended good practice based on clinical experience of an expert group e.g. NICE good practice recommendation
G (red): There is some evidence suggesting that this intervention is ineffective but it is not conclusive	Systematic review of poor quality studies with majority or meta - analysis favouring no effect intervention or where the number of studies is too small to allow firm conclusions to be drawn
H (dark red): There is moderate to good quality evidence that this intervention is unlikely to be effective	Systematic review of moderate to good quality studies with majority in favour of control/no effect
I (purple): There is high quality evidence of ineffectiveness or a specific recommendation that these interventions should not be introduced in the UK	NICE specifically recommends this intervention should not be adopted or there is high quality review level evidence from meta-analysis of good quality studies that demonstrates no effect
J (grey): Evidence about the effectiveness of the intervention is lacking.	Systematic review, NICE guidance or Public Health Wales reviewers conclude that no reliable evidence of effectiveness or ineffectiveness, is available either because there are no relevant studies or because the studies available are of a design inappropriate for assessing effectiveness.

## **Annex 3      Extract from the Eurosafe Child Safety Report Card: Assessment criteria for water safety /drowning prevention**

National law requiring barrier fencing for public pools

National law requiring barrier fencing for private pools (e.g., domestic pools; those associated with a residence or dwelling)

National law requiring national recertification for lifeguards on a regular basis

National law stating minimum number of lifeguards required on beaches or other areas specifically specified for water leisure activities

National law stating minimum number of lifeguards required at public pools

National standard for public swimming pools that mandates water depth markings, step edges marked with contrasting colours, onsite safety equipment, suction outlet covers and chemical standards

National standard for water safety signs and symbols (e.g. no diving signs, red flag indicating 'do not enter water', etc.)

National policy requiring qualified risk assessment of all designated public water recreational areas (e.g., assessment conducted by qualified inspector)

National policy governing water safety for leisure/recreational programming at the community level (e.g., minimum levels of supervision, training or safety equipment, etc.)

National policy making water safety education, including swimming lessons, a compulsory part of the school curriculum

Investment programme (either national or regional with national coverage) to renew infrastructure to provide equitable access to public swimming pools for swimming lessons for school age children

National law requiring mandatory use of personal floatation device/lifejacket while on the water (e.g., while boating, sailing, etc.)

National ministry/government department with mandated responsibility for child and adolescent water safety

Government approved national injury prevention strategy with specific targets and timelines related to child and adolescent water safety

National programme of child home visits that includes education on child water safety

National media campaign at least once in past five years targeting child and adolescent water safety

## **Annex 4      Water safety recommendations from NICE guidance PH29 *Strategies to prevent unintentional injuries among the under - 15s***

### **Recommendation 13 Providing education and advice on water safety**

#### **Who should take action?**

- Injury prevention coordinators and health practitioners (for example, health visitors and school nurses).
- Lifeguards.
- Outdoor activity and holiday centre managers.
- Schools.
- Swimming instructors.
- Swimming pool managers.

#### **What action should they take?**

- Know which groups of children and young people are at high risk of drowning – and when that risk is increased. For example, children with certain medical conditions may be more at risk and boys are more likely to be at risk than girls. In addition, older children are more likely to drown outside the home.
- Provide children, young people, their parents and carers with information [12] and education on water safety in play and leisure environments. This should be appropriate to the age, developmental stage and experience of the child or young person and meet the household's particular needs and circumstances. It should be readily available in a suitable format. It should also be factually correct and consistent.
- Ensure the information and education:
  - helps parents, carers, older children and young people identify and address the potential risks from water in the wider environment (this includes lakes, canals, rivers and on the coast)
  - stresses the importance of proper supervision, particularly for younger children, and describes in detail what this means.
- Provide timely information and advice, for example, during the holiday season and for dealing with conditions such as heatwaves and extreme cold. (Ice might form on ponds, rivers and lakes during extreme cold spells.) This could include clearly displayed information at appropriate locations.
- Encourage children, young people, their parents and carers to become competent swimmers and to learn other water safety skills (for example, so that they know how to effect a rescue).
- Ensure swimming lessons include general and specific water safety information. Specific information could include detail on the meaning of different coastal warning flags. It should also raise children and young people's awareness of how difficult it is to assess and manage the hazards posed by water in a range of different outdoor environments.

## **Annex 4 continued**

### **Recommendation 14 Water safety advice for leisure providers**

#### **Who should take action?**

Leisure facility providers such as leisure centre and pool operators, boat hire companies, hoteliers, holiday companies and tour operators.

#### **What action should they take?**

- Use risk analysis and management procedures to identify where there may be a risk of drowning. Minimise that risk, wherever possible, without discouraging swimming.
- Provide water safety information in a range of languages and formats. This could include clearly displayed information at appropriate locations. Ensure provision is timely. For example, ensure it is provided during the holiday season and in extreme weather conditions such as heatwaves and extreme cold. (Ice might form on ponds, rivers and lakes during extreme cold spells.)

## Annex 5 Evidence summary tables for included systematic reviews and studies

*These tables use text copied directly from systematic reviews and guidelines. In some instances, however, where the amount of information in the source documents is extensive, the findings have been summarised. Information under the comments section is the views of the authors of this report.*

### Interventions

Study details	Results of the review	Main findings and evidence grading
<b>Pool fencing</b>		
<p>Thompson DC and Rivara F. (1998). <b>Pool fencing for preventing drowning of children</b>. <i>Cochrane Database Syst Rev</i> Issue 1. Art. No.: CD001047. DOI: 10.1002/14651858.CD001047</p> <p><b>Type of source:</b> Cochrane Systematic Review</p> <p><b>Interventions:</b> Fencing Isolation fencing Perimeter fencing</p> <p><b>Relevant Outcomes:</b> Drowning Drowning or near-drowning</p> <p><b>Study Population:</b> Children 14 years of age or younger</p> <p><b>Studies were included up to:</b> Oct 2006</p>	<p><b>Description of included studies</b></p> <p>Three case-control studies met the selection criteria. Two examined fenced versus unfenced pools and one compared perimeter versus isolation fencing.</p> <p><b>Quality of included studies</b></p> <p>Major problems, encountered in all three of the studies, revolved around the selection of appropriate control/comparison groups, and measuring the exposure to pools of children in various age groups. None of the studies adjusted for the possible confounding influence of parental and child behaviour. It is possible that parents who are more safety conscious would fence their pools and supervise their children more carefully.</p> <p><b>Synthesis</b></p> <p>Odds ratios reported are those arising from single studies, no meta-analysis was conducted.</p> <p><b>Findings</b></p> <p>Authors report that the studies indicated that pool fencing significantly reduced the risk of drowning and that isolation fencing (enclosing pool only) is superior to perimeter fencing (enclosing property and pool).</p> <p>The OR for the risk of <b>drowning and near drowning</b> in a fenced pool</p>	<p><b>Intervention:</b> Fenced versus unfenced pool</p> <p><b>Outcome 1:</b> Risk of drowning or near drowning <b>Outcome 2:</b> Risk of drowning</p> <p><b>Intervention:</b> Isolation fencing versus perimeter fencing</p> <p><b>Outcome:</b> Risk of drowning</p> <p><b>Evidence Statement Grade B (light green):</b> This intervention is supported by moderate quality evidence of its effectiveness</p> <p><b>Author's conclusions</b></p> <p>Pool fences should have a dynamic and secure gate and should isolate the pool from the house (that is, four-sided fencing). Legislation should require isolation fencing with secure, self-latching gates for all pools, public, semi-public and private. Legislation should require fencing of both newly constructed and existing pools and include enforcement provisions, in order to be effective.</p>

Study details	Results of the review	Main findings and evidence grading
<p><b>Included study types:</b> Case-control studies</p>	<p>compared to an unfenced pool was reported as 0.27 (95% CI 0.15 to 0.47) (Pitt and Balanda, 1991). Separate analyses for in-ground pools and above ground pools were also conducted for the outcome of drowning and near drowning; in-ground pools OR 0.24 [95% CI 0.13 to 0.48] and above ground pools OR 0.23 [95% CI 0.06 to 0.92]. In this study the unfenced category included pools with both no fencing and three-sided fencing.</p> <p>The risk of <b>drowning</b> in a fenced pool with the risk in an unfenced pool was reported as OR 0.29 (95% CI 0.16 to 0.55) (Fergusson and Horwood, 1984). In this study the fencing was not specifically defined as three or four sided.</p> <p>The OR for the risk of <b>drowning</b> in a pool with isolation fencing (4-sided) compared to a pool with three-sided fencing was reported as 0.16 (95% CI 0.06 to 0.44) (Intergov WA, 1988).</p> <p>Authors suggest that further case-control studies with pools as the unit of analysis and collecting exposure for children of various ages should be conducted to provide a more precise estimate of the protective effect of fencing. However in 2010 the review was declared stable and will not be updated as authors considered that future research will focus mainly on the effectiveness of pool fencing legislation.</p>	<p><b>Comment</b></p> <p>This systematic review identifies and elaborates on studies pertaining to pool fencing legislation within the discussion and conclusions. It should be noted that assessing the effects of legislation and enforcement of pool fencing legislation was not an objective of this review and as such these studies may not have been identified, included, appraised and analysed using systematic methods. See the separate section on legislation for pool fencing.</p>
<p>Garside R and Moxham T. (2009). <i><b>Preventing Unintentional Injury in Children Review 4: Strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury in children.</b></i> Exeter: Peninsula Technology Assessment Group (PenTAG)</p> <p><b>Type of source:</b> Systematic Review commissioned by NICE Centre for Public Health Excellence to support PH29</p> <p><b>Interventions:</b> Three-sided versus four-sided pool fencing (where 3 sided</p>	<p><b>Description of included studies</b></p> <p>The review included one case-control study (historical controls) examining three versus four-sided pool fencing (Stevenson et al, 2003).</p> <p><b>Quality of included studies</b></p> <p>These authors assign this study a moderate quality rating.</p> <p><b>Findings</b></p> <p>The incident rate ratio of drowning in children aged &lt;5 years old who lived in or visited houses with three-sided rather than four sided pool fencing was 1.78 (95% CI 1.4, 1.79).</p>	<p><b>Author's conclusions</b></p> <p>The Australian study found the incident rate ratio of drowning in children aged &lt;5 years old who lived in or visited houses with three-sided rather than four sided pool fencing was 1.78 (95% CI 1.4, 1.79).</p> <p><b>Comment</b></p> <p>The study included by these authors was also identified by the Cochrane review (Thompson and Rivara, 1998) on pool fencing but was excluded by the authors of that systematic review. The Cochrane review refers to this study as a time series study as opposed to a case-control study. Cochrane authors note that the study was excluded because the incident rate ratio was calculated for 1999 data. No numerator data was provided and it was not clear which denominator was used, the average 12 year</p>



Study details	Results of the review	Main findings and evidence grading
<p>includes a wall containing a door or window permitting direct access between the enclosed area and the residence whereas fencing referred to as 4-sided fencing any such direct access must have locks)</p> <p><b>Relevant Outcomes:</b> Drowning</p> <p><b>Study Population:</b> Individuals aged under 15 Residences with pools</p> <p><b>Studies were included:</b> 1990-2009</p> <p><b>Included study types:</b> Case control</p>		<p>population of children under 5 or the population for 1999.</p> <p>No evidence statement is presented for this study because of its exclusion by the focused Cochrane review however its findings do not conflict with that presented in that review comparing isolation versus perimeter fencing.</p>
<p>Wallis BA et al. (2014). <b>Interventions associated with drowning prevention in children and adolescents: systematic literature review</b> <i>Inj Prev</i> 2014 Sep 4. pii: injuryprev-2014-041216. doi: 10.1136/injuryprev-2014-041216.</p> <p><b>Type of source:</b> Systematic Review</p> <p><b>Interventions:</b> Pool fencing</p> <p><b>Relevant Outcomes:</b> Fatal and non-fatal drowning.</p> <p><b>Study Population:</b> Children and adolescents 0-19</p>	<p><b>Quality of Review</b></p> <p>Reviewers searched a number of databases between 1980 and 2010 for interventions relating to prevention of drowning in the age group 0-19; grey literature searching and hand searching was not conducted. Multiple reviewers were used for inclusion/exclusion of studies but it is unclear whether repeatability checks were conducted at critical appraisal stage. The quality of included studies was assessed with studies being assigned a level of evidence were assessed using Australian National Health and Medical Research Council guidance.</p> <p><b>Description of included studies</b></p> <p>The review included one case-control study on comparing fenced and unfenced pools (Pitt and Balanda, 1991).</p> <p><b>Quality of included studies</b></p> <p>This review assigned the level of evidence as III-2 in accordance with guidelines produced by the National Health and Medical Research Council for Australia. This level is assigned based on the study design. Information relating to the biases of</p>	<p><b>Author's conclusions</b></p> <p>Few studies employ rigorous methods and high levels of evidence to assess the impact of interventions designed to reduce drowning. Seven studies met the inclusion criteria and demonstrate that interventions such as education, pool fencing and swimming and water safety are possible effective strategies to prevent children from drowning, particularly those 2-4 years of age. There were a number of promising studies identified that did not meet the inclusion criteria. Future research could validate the potential prevention strategies around many of these. Such as cardiopulmonary resuscitation training and wearing of PFDs. Drowning is a significant public health challenge globally. And there is a need for rigorous, well-designed studies that use consistent terminology to demonstrate effective prevention solutions.</p> <p><b>Comment</b></p>

Study details	Results of the review	Main findings and evidence grading
<p>years of age</p> <p><b>Studies were included:</b> 1980-2010</p> <p><b>Included study types:</b> Case-control</p>	<p>each individual study included in the systematic review is not detailed in the tables, instead a general section on quality was provided.</p> <p><b>Findings</b></p> <p>Compared to fenced domestic pools  RR=3.76 all unfenced domestic pools (95% CI 2.14 to 6.62)  RR=4.10 unfenced in-ground pools (95% CI 2.11 to 8.00)  RR=4.30 unfenced above-ground pools (95% CI 1.09 to 16.97)</p>	<p>The study identified by this systematic review was included in Cochrane systematic review on pool fencing (Thompson and Rivara, 1998) therefore no additional evidence statement is provided. This review did not locate the other two studies identified by the Cochrane systematic review, nor refer to that review in its discussion. It is broader in its scope which likely influenced search strategies.</p>

Study details	Results of the review	Main findings and evidence grading															
Education for installation of pool fencing																	
<p>Kendrick D et al. (2012). <b>Home safety education and provision of safety equipment for injury prevention.</b> <i>Cochrane Database Syst Rev</i> Issue 9. Art. No.: CD005014. DOI: 10.1002/14651858.CD005014.pub3</p> <p><b>Type of source:</b> Cochrane Systematic Review</p> <p><b>Interventions:</b> Education Information Risk assessment</p> <p><b>Relevant Outcomes:</b>  Pool fully fenced Acquisition/installation of swimming pool fencing</p>	<p><b>Description of included studies</b></p> <p>Six studies reported a range of outcomes related to pool fencing. Four of these were randomised controlled trials and two were controlled before and after studies. Most provided some degree of education/information regarding hazards in the home. Some included specific risk assessment of the home.</p> <p><b>Quality of included studies</b></p> <p>Information is provided in the review with regard to biases</p> <table><tr><th>Study</th><th>Blinding</th><th>Balance</th><th>Outcomes 80%</th><th>Selection bias</th></tr><tr><td>Babul et al (2007) RCT (n=600, three arms)</td><td>n</td><td>n/a</td><td>n</td><td>low risk</td></tr><tr><td>Coggan et al (2000) CBA-community level (2 communities) (n=4000)</td><td>uncertain</td><td>n</td><td>y</td><td>unclear risk</td></tr></table>	Study	Blinding	Balance	Outcomes 80%	Selection bias	Babul et al (2007) RCT (n=600, three arms)	n	n/a	n	low risk	Coggan et al (2000) CBA-community level (2 communities) (n=4000)	uncertain	n	y	unclear risk	<p><b>Intervention:</b> Education/information related to installation of pool fencing</p> <p><b>Outcome:</b> Presence of fence</p> <p><b>Evidence Statement Grade D (orange):</b> The evidence is inconsistent and it is not possible to draw a conclusion</p> <p><b>Author’s conclusions</b> <b>Drowning Prevention: Data not included in the meta-analysis (never leaving a child alone in the bath)</b> Six studies reported a range of outcomes not included in the meta analysis. Five studies reported domestic swimming pool fencing (Babul 2007; Coggan 2000; Girasek 2010; Nansel 2002; Paul 1994); one of which found the intervention group were significantly more likely to acquire pool fencing (Coggan 2000).Finally one study found no significant difference in drowning mortality rates (Zhang 2003).</p>
Study	Blinding	Balance	Outcomes 80%	Selection bias													
Babul et al (2007) RCT (n=600, three arms)	n	n/a	n	low risk													
Coggan et al (2000) CBA-community level (2 communities) (n=4000)	uncertain	n	y	unclear risk													

Study details	Results of the review						Main findings and evidence grading
<div>Erecting fencing to prevent access to pools or rivers Pool has fence with locked gate</div> <div>Study Population: Children and young people (aged 19 years and under) and their families</div> <div>Studies were included up to: May 2009</div> <div>Included study types: RCTs</div>	Intervention community had higher child injury rates at baseline than control community						<div>Comment</div> <div>The evidence statement given is based on our conclusion having drawn data from the review and also consulting the primary papers directly. We did not undertake formal critical appraisal of these papers and report the review authors' assessment. We note potential problems with baseline confounding in Coggan et al (2000) and Zhang et al (2003) which are the only two studies finding positive impact.</div>
	Girasek (2010) RCT (unpublished data)	y	n/a	y		Low-risk	
	Nansel et al (2002) RCT (n=213, two arms)	unclear	n/a	y		low risk	
	Paul (1994) RCT (n=198 families)	unclear	n/a	n		unclear risk	
	Zhang et al (2003) CBA-community level (12 communities) Intervention areas had higher baseline injury rates than control areas.	n	n	n		unclear risk	
	*Outcomes 80% refers to completeness of follow-up (80% or more in both treatment arms)						
<div>Findings</div> <div>See author's conclusions</div>							

Study details	Results of the review	Main findings and evidence grading
<b>Pool fencing legislation</b>		
<p>Garside R and Moxham T. (2009). <i>Preventing Unintentional Injury in Children Review 4: Strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury in children</i>. Exeter: Peninsula Technology Assessment Group (PenTAG)</p> <p><b>Type of source:</b> Systematic Review commissioned by NICE Centre for Public Health Excellence to support PH29</p> <p><b>Interventions:</b> Pool fencing legislation Enforcement activities</p> <p><b>Relevant Outcomes:</b> Drowning Compliance with pool fencing legislation</p> <p><b>Study Population:</b> Individuals aged under 15 Residences with pools</p> <p><b>Studies were included:</b> 1990-2009</p> <p><b>Included study types:</b> Case control Comparative</p>	<p><b>Description of included studies</b></p> <p>Four studies were included, 1 case-control study, 1 study using audit data and 2 comparative studies. One study is from the USA, one from New Zealand and two from Australia.</p> <p><b>Quality of included studies</b></p> <p>The case-control study (Morgenstern et al, 2000) was determined to be of moderate quality, whereas the comparative studies (Van Weerdenburg et al, 2006 and Morrison et al 1999) were more susceptible to bias. The data on legislation from Stevenson et al (2003) arises from an audit of a random sample of first and sequential inspection reports in an area of Western Australia.</p> <p><b>Synthesis</b></p> <p>Narrative synthesis</p> <p><b>Findings</b></p> <p>There is evidence from one moderate quality case-control study (Morgenstern et al, 2000) that legislation which allows 3 sided fencing is ineffective in preventing drowning. The odds ratio for drowning in children aged under 10 years old, living in areas where built or altered pools were covered by legislation allowing 3-sided pool fencing, was not significantly different to that for children living in areas not covered by such legislation OR 1.27 (95%CI 0.72, 2.25).</p> <p>The audit of sequential inspection reports (Stevenson et al, 2003) describes compliance with legislation as highest immediately after legislation is introduced, falling off thereafter, with regular inspection enhancing compliance.</p> <p>The study reported by Van Weerdenburg et al (2006), set in Australia, 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. Key informant interviews also suggested 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.</p>	<p><b>Intervention:</b> Legislation requiring three-sided pool fencing.</p> <p><b>Outcome:</b> Drowning</p> <p><b>Evidence statement Grade G (red):</b> There is some evidence suggesting that this intervention is ineffective but it is not conclusive</p> <p><b>Intervention:</b> Enforcement activities</p> <p><b>Outcome:</b> Compliance with pool fencing legislation</p> <p><b>Evidence Statement Grade J (grey):</b> Evidence about the effectiveness of the intervention is lacking.</p> <p><b>Author's conclusions</b></p> <p>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.</p>

Study details	Results of the review	Main findings and evidence grading
	<p>The New Zealand study (Morrison et al, 1999) found no association with compliance rates and</p> <ul style="list-style-type: none"> <li>Local authorities having written policies about locating and inspecting pools</li> <li>A reinspection programme</li> <li>Advertising of pool owners' obligations under the relevant act.</li> </ul>	<p><b>Comment</b></p> <p>The conclusions on legislation rely on four studies, 3 of which are not of a suitable design to assess intervention effectiveness.</p> <p>There is conflicting evidence from two poor quality comparative studies and audit data from Stevenson et al (2003) of the impact of enforcement on compliance.</p>
<p>Wallis BA et al. (2014). <b>Interventions associated with drowning prevention in children and adolescents: systematic literature review</b>, <i>Inj Prev</i> 2014 Sep 4. pii: injuryprev-2014-041216. doi: 10.1136/injuryprev-2014-041216.</p> <p><b>Type of source:</b> Systematic Review</p> <p><b>Interventions:</b> Pool fencing legislation</p> <p><b>Relevant Outcomes:</b> Fatal pool drowning</p> <p><b>Study Population:</b> Children and adolescents 0-19 years of age</p> <p><b>Studies were included up to:</b> 2010</p> <p><b>Included study types:</b> Case-control</p>	<p><b>Quality of the review</b></p> <p>Reviewers searched a number of databases between 1980 and 2010 for interventions relating to prevention of drowning in the age group 0-19; grey literature searching and hand searching was not conducted. Multiple reviewers were used for inclusion/exclusion of studies but it is unclear whether repeatability checks were conducted at critical appraisal stage. The quality of included studies was assessed with studies being assigned a level of evidence were assessed using Australian National Health and Medical Research Council guidance.</p> <p><b>Description of included studies</b></p> <p>One case-control study (Morgenstern et al, 2000) from the USA related to legislation for pool fencing was included by the systematic review.</p> <p><b>Quality of included studies</b></p> <p>This review assigned the level of evidence as III-2 in accordance with guidelines produced by the National Health and Medical Research Council for Australia. This level is assigned based on the study design. Authors note that the confounding effects of community campaigns and household characteristics were not ruled out. They note that the study did compensate for the non-retrospective nature of some ordinances by restricting the control sample selection to pools built before 1996; however the study did not document the presence or configuration of the fencing in existence to test the level of enforcement.</p> <p><b>Findings</b></p> <p>The findings of the included studies have already been provided in the entry for Garside and Moxham (2009).</p>	<p><b>Author's conclusions</b></p> <p>Few studies employ rigorous methods and high levels of evidence to assess the impact of interventions designed to reduce drowning. Seven studies met the inclusion criteria and demonstrate that interventions such as education, pool fencing and swimming and water safety are possible effective strategies to prevent children from drowning, particularly those 2-4 years of age. There were a number of promising studies identified that did not meet the inclusion criteria. Future research could validate the potential prevention strategies around many of these. Such as cardiopulmonary resuscitation training and wearing of PFDs. Drowning is a significant public health challenge globally. And there is a need for rigorous, well-designed studies that use consistent terminology to demonstrate effective prevention solutions.</p> <p><b>Comment</b></p> <p>No additional evidence statement is provided since the study identified by this systematic review was included in NICE commissioned systematic review (Garside and Moxham, 2009) on strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury in children.</p>

Study details	Results of the review	Main findings and evidence grading																														
General home safety education																																
<p>Kendrick D et al. (2012). <b>Home safety education and provision of safety equipment for injury prevention.</b> <i>Cochrane Database Syst Rev</i> Issue 9. Art. No.: CD005014. DOI: 10.1002/14651858.CD005014.pub3</p> <p><b>Type of source:</b> Cochrane Systematic Review</p> <p><b>Interventions:</b> General home safety education</p> <p><b>Relevant Outcomes:</b> Never leaving a child alone in the bath Never leaving a child alone in the area of a paddling or swimming pool Never leaving a paddling pool full of water after use</p> <p><b>Study Population:</b> Children and young people (aged 19 years and under) and their families</p> <p><b>Studies were included up to:</b> May 2009</p> <p><b>Included study types:</b> RCTs Non-randomised controlled trials</p>	<p><b>Description of included studies</b></p> <p>Five studies were included in the meta-analyses for the outcome of never leaving a child alone in the bath, three of which were RCTs and two were non-randomised controlled trials. One other RCT examined a different outcome of never leaving a child alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water after use.</p> <p><b>Quality of included studies</b></p> <table><tr><th></th><th>Blinding</th><th>Balance</th><th>Outcomes 80%</th><th>Selection bias</th></tr><tr><td>Babul et al (2007) RCT (n=600, three arms)</td><td>n</td><td>n/a</td><td>n</td><td>low risk</td></tr><tr><td>Kendrick et al (1999) non-randomised controlled trial ( at GP practice level)</td><td>n</td><td>y</td><td>mixed</td><td>unclear risk</td></tr><tr><td>Nansel et al (2002) RCT (n=213, 2 arms)</td><td>unclear</td><td>n/a</td><td>y</td><td>low risk</td></tr><tr><td>Nansel et al (2008) non-randomised controlled trial</td><td>n</td><td>n</td><td>n</td><td>unclear risk</td></tr><tr><td>Posner et al (2004) RCT (n=136, 2 arms)</td><td>y</td><td>n/a</td><td>n</td><td>low risk</td></tr></table>		Blinding	Balance	Outcomes 80%	Selection bias	Babul et al (2007) RCT (n=600, three arms)	n	n/a	n	low risk	Kendrick et al (1999) non-randomised controlled trial ( at GP practice level)	n	y	mixed	unclear risk	Nansel et al (2002) RCT (n=213, 2 arms)	unclear	n/a	y	low risk	Nansel et al (2008) non-randomised controlled trial	n	n	n	unclear risk	Posner et al (2004) RCT (n=136, 2 arms)	y	n/a	n	low risk	<div><p><b>Intervention:</b> General home safety education</p><p><b>Outcome:</b> Never leaving a child alone in the bath</p><p><b>Evidence statement Grade G (red):</b> There is some evidence suggesting that this intervention is ineffective but it is not conclusive</p></div> <div><p><b>Intervention:</b> General home safety education</p><p><b>Outcome:</b> Never leaving a child alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water after use</p><p><b>Evidence statement Grade G (red):</b> There is some evidence suggesting that this intervention is ineffective but it is not conclusive</p></div> <p><b>Author’s conclusions</b></p> <p>There was a lack of evidence that home safety interventions were effective in preventing children being left alone in the bath.</p> <p>One study reported never leaving a child alone in the area of a paddling or swimming pool and never leaving a paddling pool full of water after use (Nansel 2002), and did not find significant effects for either of these outcomes.</p> <p><b>Comment</b></p> <p>In the meta-analysis of the outcome never leaving a child alone in the bath, the point estimate of the OR for the outcome favours home safety education in 4/5 studies. When the large non-randomised study is excluded from the meta-analysis the OR for this</p>
	Blinding	Balance	Outcomes 80%	Selection bias																												
Babul et al (2007) RCT (n=600, three arms)	n	n/a	n	low risk																												
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Study details	Results of the review	Main findings and evidence grading					
	<table><tr><td></td><td></td><td></td><td></td><td></td></tr></table> <p><b>Findings</b></p> <p><i>Outcome: Never leaving a child alone in the bath (Babul et al(2007), Kendrick et al (1999), Nansel et al (2002), Nansel et al (2008), and Posner et al (2004))</i></p> <p>There was a lack of evidence that home safety interventions were effective in preventing children being left alone in the bath (OR 1.21, 95% CI 0.85 to 1.72), with no significant heterogeneity amongst effect sizes. Repeating the analyses using non-integers for the numerators and denominators for cluster randomised studies produced a similar effect size (OR 1.22, 95% CI 0.85 to 1.75). Sensitivity analyses excluding each study in turn indicated that findings became significant when the study by Kendrick was excluded (OR 1.89, 95% CI 1.08 to 3.32). Authors note that the effect of interventions did not differ by child age, gender or any of the social variables.</p> <p><i>Outcome: Never leaving a child alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water after use (Nansel 2002)</i></p> <p>One RCT, comparing provision of tailored versus generic computer generated safety advice to parents of children aged 6-20 months attending well child check, did not find significant effects for either of the outcomes of never leaving a child alone in the area of a paddling or swimming pool or never leaving a paddling pool full of water.</p>						outcome becomes significant.
Wallis BA et al. (2014). <b>Interventions associated with drowning prevention in children and adolescents: systematic literature review</b> <i>Inj Prev</i> 2014 Sep 4. pii: injuryprev-2014-041216. doi: 10.1136/injuryprev-2014-041216.  <b>Type of source:</b> Systematic Review  <b>Interventions:</b> Home safety education Provision of safety equipment  <b>Relevant Outcomes:</b> Possession of non-slip bath	<p><b>Quality of the review</b></p> <p>Reviewers searched a number of databases between 1980 and 2010 for interventions relating to prevention of drowning in the age group 0-19; grey literature searching and hand searching was not conducted. Multiple reviewers were used for inclusion/exclusion of studies but it is unclear whether repeatability checks were conducted at critical appraisal stage. The quality of included studies was assessed with studies being assigned a level of evidence were assessed using Australian National Health and Medical Research Council guidance.</p> <p><b>Description of included studies</b></p> <p>The systematic review included one randomised controlled trial related a home safety intervention involving education delivered to parents attending and emergency department with a child (age&lt;5) for unintentional injury (Posner, 2004).</p> <p><b>Quality of included studies</b></p>	<p><b>Author’s conclusions</b></p> <p>Few studies employ rigorous methods and high levels of evidence to assess the impact of interventions designed to reduce drowning. Seven studies met the inclusion criteria and demonstrate that interventions such as education, pool fencing and swimming and water safety are possible effective strategies to prevent children from drowning, particularly those 2-4 years of age. There were a number of promising studies identified that did not meet the inclusion criteria. Future research could validate the potential prevention strategies around many of these. Such as cardiopulmonary resuscitation training and wearing of PFDs. Drowning is a significant public health challenge globally. And there is a need for rigorous, well-designed studies that use consistent terminology to demonstrate effective prevention solutions.</p>					

Study details	Results of the review	Main findings and evidence grading
<p>decal</p> <p><b>Study Population:</b> Children and adolescents 0-19 years of age</p> <p><b>Studies were included up to:</b> 2010</p> <p><b>Included study types:</b> RCT</p>	<p>This review assigned the level of evidence as II in accordance with guidelines produced by the National Health and Medical Research Council for Australia. This level is assigned based on the study design.</p>	<p><b>Comment</b></p> <p>Additional outcomes related to knowledge as measured on a home safety questionnaire by Posner (2004) have not been reported as changes in knowledge are excluded within the protocol of this review.</p>
<p>Pearson et al. (2009). <i><b>Systematic reviews of effectiveness and cost-effectiveness of home safety equipment and home risk assessment schemes.</b></i> Exeter: Peninsula Technology Assessment Group (PenTAG)</p> <p><b>Type of source:</b> Systematic Review commissioned by NICE Centre for Public Health Excellence to support PH30</p> <p><b>Interventions:</b> Home safety education Provision of safety equipment Home risk assessment</p> <p><b>Relevant Outcomes:</b> Various</p> <p><b>Study Population:</b> Individuals aged under 15</p> <p><b>Studies were included:</b> 1990-2009</p> <p><b>Included study types:</b> RCTs</p>	<p><b>Description of included studies</b></p> <p>This systematic review included three randomised controlled trials of relevance.</p> <p><b>Quality of included studies</b></p> <p>The systematic review authors rated Posner et al (2004) as methodologically strong, Babul et al (2007) as moderate and Paul (1994) as weak.</p>	<p><b>Author's conclusions</b></p> <p>There is weak evidence from one RCT (Babul et al 2007 [+]) that a home risk assessment and free or discounted supply of home safety equipment does not improve home safety knowledge and behaviour about preventing drowning (Babul et al 2007).</p> <p><b>Comment</b></p> <p>Outcomes related to knowledge as measured on a general home safety questionnaire by Posner (2004) have not been reported in this table. Changes in knowledge or awareness of, for example, risk associated with certain behaviours, are excluded within the protocol of this review.</p> <p>No evidence statement has been provided for any further outcomes from Paul (1994). This study has already been discussed by the Cochrane SR on home safety (Kendrick et al, 2012) under the intervention education for installation of pool fencing.</p> <p>The data from Babul et al (2007) relating to behaviour has already been included in the Cochrane SR on home safety (Kendrick et al, 2012) within the meta-analysis of never leaving a child alone in the bath therefore no additional evidence statement has been written for this study.</p>



Study details	Results of the review	Main findings and evidence grading
<b>Drowning prevention campaign</b>		
<p>Ashfaq et al. (2009). <i>Strategies, policies and regulatory or legal frameworks and/ or mass media campaigns to prevent unintentional injury to children during play and leisure</i>. Birmingham: West Midlands Health Technology Assessment Collaboration. University of Birmingham</p> <p><b>Type of source:</b> Systematic Review commissioned by NICE Centre for Public Health Excellence to support PH29</p> <p><b>Interventions:</b> Drowning Prevention Campaign</p> <p><b>Relevant Outcomes:</b> Self-reported life vest ownership Self-reported life vest use Drowning fatality rates</p> <p><b>Study Population:</b> Individuals aged under 15</p> <p><b>Studies were included:</b> 1990-2009</p> <p><b>Included study types:</b> Uncontrolled before and after study</p>	<p><b>Description of included studies</b></p> <p>This systematic review included one uncontrolled before and after study of a regional drowning prevention campaign called "stay on top of it" conducted in the United States (Bennet et al, 1999). The campaign aimed to increase general water safety awareness, increase life vest use among children aged 1-14 years on boats, docks, beaches or at pools, and increase life vest ownership. The duration of the study was three years and outcomes were collected prior to, during and post intervention. It utilised mass media communication methods and involved loan programs, discount coupons and incentives for bulk buy of life vests.</p> <p><b>Quality of included studies</b></p> <p>Systematic reviewers note some limitations to the methodology including using self-reported information, issues with sampling methods and consistency of methods pre- and post campaign, and interviewed families having higher incomes than a representative sample of the population.</p> <p><b>Findings</b></p> <p>Reported ownership of vests for all age groups increased from 69% in the pre-campaign survey to 75% in the post-campaign survey. Among those aware of the campaign, ownership increased to 80%. The odds for reported use of a life vest by a child at beaches, pools or docks were greater among those surveyed after the campaign compared with the baseline survey: odds ratio 1.6 (95% CI 1.1 to 2.5). The association remained significant after controlling for other potential confounders- child vest ownership, parent age, parent's confidence fitting a vest, child's swimming ability, parent use of a vest, perceived susceptibility to drowning, parent's education and income, and perceived efficacy of vest.</p> <p>During the three years before the campaign, 12 children aged 1-14 years drowned in King County, compared with eight deaths in the campaign. The rate ratio for drowning mortality during the campaign, compared with what it might have been if King County had followed the trend of the state was 0.58 (95% CI 0.21 to 1.58).</p>	<p><b>Intervention:</b> Drowning prevention campaign</p> <p><b>Outcome 1:</b> Life vest (PFD)ownership in children aged 1-14 <b>Outcome 2:</b> Life vest (PFD) use post campaign compared to baseline in children aged 1-14</p> <p><b>Evidence statement Grade J (grey) :</b> Evidence about the effectiveness of the intervention is lacking</p> <p><b>Intervention:</b> Drowning prevention campaign</p> <p><b>Outcome:</b> Drowning fatality in children aged 1-14</p> <p><b>Evidence statement Grade J (grey):</b> Evidence about the effectiveness of the intervention is lacking</p> <p><b>Author's conclusions</b></p> <p>There was weak evidence from one uncontrolled before and after study, in the USA, that a comprehensive, community-based campaign to increase the use of life vests (buoyancy aids) increased their use by children. However, the main outcomes were both self-reported-life vest use and life vest ownership, and there was no control area/group in the study.</p> <p><b>Comment</b></p> <p>An uncontrolled before and after study is not a robust design for testing an intervention. The study design means that a causal link between the intervention and the outcome cannot be established.</p>

Study details	Results of the review	Main findings and evidence grading
<p>Wallis BA et al. (2014). <b>Interventions associated with drowning prevention in children and adolescents: systematic literature review</b> <i>Inj Prev</i> Sep 4. pii: injuryprev-2014-041216. doi: 10.1136/injuryprev-2014-041216.</p> <p><b>Type of source:</b> Systematic Review</p> <p><b>Interventions:</b> Drowning prevention campaign</p> <p><b>Relevant Outcomes:</b> Self-reported life vest ownership Self-reported life vest use Drowning fatality rates</p> <p><b>Study Population:</b> Children and adolescents 0-19 years of age</p> <p><b>Studies were included up to:</b> 2010</p> <p><b>Included study types:</b> Uncontrolled before and after study</p>	<p><b>Quality of the review</b></p> <p>Reviewers searched a number of databases between 1980 and 2010 for interventions relating to prevention of drowning in the age group 0-19; grey literature searching and hand searching was not conducted. Multiple reviewers were used for inclusion/exclusion of studies but it is unclear whether repeatability checks were conducted at critical appraisal stage. The quality of included studies was assessed with studies being assigned a level of evidence were assessed using Australian National Health and Medical Research Council guidance.</p> <p><b>Description of included studies</b></p> <p>This systematic review included one uncontrolled before and after study of a regional drowning prevention campaign (Bennet et al, 1999).</p> <p><b>Quality of included studies:</b></p> <p>This systematic review assigned a level of evidence as III-3 to Bennet et al (1999) in accordance with guidelines produced by the National Health and Medical Research Council for Australia. This level is assigned based on the study design.</p> <p><b>Findings</b></p> <p>The findings of the included study have already been provided in the entry for Ashfaq et al (2009).</p>	<p><b>Author's conclusions</b></p> <p>Few studies employ rigorous methods and high levels of evidence to assess the impact of interventions designed to reduce drowning. Seven studies met the inclusion criteria and demonstrate that interventions such as education, pool fencing and swimming and water safety are possible effective strategies to prevent children from drowning, particularly those 2-4 years of age. There were a number of promising studies identified that did not meet the inclusion criteria. Future research could validate the potential prevention strategies around many of these. Such as cardiopulmonary resuscitation training and wearing of PFDs. Drowning is a significant public health challenge globally. And there is a need for rigorous, well-designed studies that use consistent terminology to demonstrate effective prevention solutions.</p> <p><b>Comment</b></p> <p>No additional evidence statement is included for the study identified by Wallis et al (2014) as this has been previously considered by Ashfaq et al (2009).</p>
<p>Leavy JE et al. (2015). <b>Recreational drowning Prevention Interventions for Adults 1990-2012: a review.</b> <i>J Community Health</i> 40:pp.725-35</p> <p><b>Type of source:</b> Systematic Review</p> <p><b>Interventions:</b></p>	<p><b>Quality of the review</b></p> <p>A number of databases were searched for the period 1990-2012. Searching of grey literature or for unpublished work was not undertaken but some hand searching based on expert input and reference list review was conducted. Two reviewers were used throughout the process and authors report a flow diagram mapping the identification and exclusion of studies. A quality appraisal checklist tailored from NICE was used to assess studies in conjunction with Joanna Briggs assessment and review instruments. Authors did discuss the poor quality of literature identified.</p>	<p><b>Intervention:</b> Drowning prevention campaign</p> <p><b>Outcome:</b> Use of Personal floatation device (PFD) by adults</p> <p><b>Evidence statement Grade J (grey) :</b> Evidence about the effectiveness of the intervention is lacking</p>

Study details	Results of the review	Main findings and evidence grading
<p>Drowning Prevention Campaign</p> <p><b>Relevant Outcomes:</b> Personal Floatation Device (PFD) use</p> <p><b>Study Population:</b> Adults (14+) in a recreational setting</p> <p><b>Studies were included up to:</b> 2012</p> <p><b>Included study types:</b> Uncontrolled before and after study</p>	<p><b>Description of included studies</b></p> <p>The systematic review included one uncontrolled before and after study involving assessment of a drowning prevention campaign (Treser et al, 1997). Although the campaign is not named by Treser et al it is believed to be the same campaign as reported by Bennett et al (1999) as it occurs in the same area, at the same time and the paper acknowledges editorial input from some of the authors of Bennet 1999. The behaviour of recreational boaters was observed pre- and post campaign by volunteers trained to develop inter-rater reliability.</p> <p><b>Quality of included studies</b></p> <p>Systematic review authors note that changing attitudes about general safety could have played a role in elevating usage rates.</p> <p><b>Findings</b></p> <p>PFD use significantly increase in adult males and females (14.2% in 1992 to 24.7% in 1994, <math>p &lt; 0.001</math>).</p>	<p><b>Author's conclusions</b></p> <p>Overall the intervention effects in this review were short-term and not replicated, and could be summarised as insufficient evidence to determine intervention effectiveness. Drowning prevention designs and the measurements used to evaluate the interventions need to be more robust if the level of observed evidence is to be influential with policy makers. There is an acute need for adult drowning interventions to use appropriate study designs, objective, valid and reliable measures, larger representative samples, and quality evaluations of sufficient time period. Furthermore, it is essential that results are reviewed for rigour and published in the peer reviewed literature.</p> <p><b>Comment</b></p> <p>The author's conclusions provided above are reproduced from the discussion of the systematic review to represent an overview of that found and its limitations. The conclusion of the systematic review is a more general request for better research and is less specific as to the issues with research currently published.</p> <p>An uncontrolled before and after study is not a robust design for testing an intervention. The study design used for assessing this drowning prevention campaign means that a causal link between the intervention and the outcome cannot be established.</p>

Study details	Results of the review	Main findings and evidence grading
<b>Swimming and water safety lessons</b>		
<p>NHS Evidence. (2013). <i>Strategies to prevent unintentional injuries among children and young people aged under 15</i>. Evidence Update 29.</p> <p><b>Type of Source:</b> Systematic search and commentary to support PH29</p> <p><b>Interventions:</b> Swimming lessons</p> <p><b>Relevant Outcomes:</b> Drowning</p> <p><b>Study Population:</b> Individuals aged under 15</p> <p><b>Studies were included:</b> 1 Jan 2009- 29 August 2012</p> <p><b>Included study types:</b> Case-control</p>	<p><b>Description of included studies</b></p> <p>One case-control study (Brenner et al, 2009) investigating the association between swimming lessons and drowning risk among 301 children (88 cases, 213, controls) aged 1-19 years was identified in a search for recently published research applicable to NICE guidance PH29. Cases were included where death caused by submersion in liquid and where history of swimming lessons was known, but excluded intentional drownings, those where intent was uncertain or where swimming ability was unlikely to affect risk (such as ice water or bathtubs). A minimum of two matched controls were sought for all cases, matched for age, sex, and country of residence. For children up to 4 years, having a swimming pool at home was also matched for. Families were interviewed to obtain information about water exposure, swimming ability and participation in swimming lessons (either formal or informal). Analysis was stratified into two age groups, 1 to 4 years (61 cases, 134 controls) and 5 to 19 years (27 cases, 79 controls) and adjusted for confounding factors of education and household income of the interviewees.</p> <p><b>Quality of included studies</b></p> <p>The sample size, particularly of the older age group was small. For cases, data on water exposure, swimming ability and participation in swimming lessons was gathered from medical examiner reports in the majority of cases rather than by interview which may have introduced bias.</p> <p><b>Findings</b></p> <p>Participation in formal swimming lessons was significantly lower among cases of drowning versus controls (3% vs 26%, adjusted OR 0.12 (95% CI 0.01- 0.97) in children aged 1 to 4 years.</p> <p>In children aged 5-19 years there was no significant difference in formal swimming instruction between cases and control (27% vs 53% adjusted OR 0.36 (95% CI 0.09 to 1.51).</p> <p>For informal swimming lessons, no significant differences were found between cases and control for either age group.</p> <p>The mechanism by which swimming lessons may exert a protective effect was not examined and Brenner et al advised that swimming lessons alone were</p>	<p><b>Intervention:</b> Swimming lessons</p> <p><b>Outcome :</b> Deaths from drowning in children aged 1 to 19</p> <p><b>Evidence Statement Grade C (yellow):</b> There is some evidence supporting the use of this intervention but it is not conclusive</p> <p><b>Author's conclusions</b></p> <p>The evidence suggests that among younger children, formal swimming lessons may reduce drowning risk. Among older children, although not associated with risk reduction, formal lessons do not appear to increase risk (there have been concerns that swimming lessons may have the potential to increase exposure to water or reduce parental vigilance). These results appear to be broadly consistent with recommendations in NICE PH29 to encourage children and young people to become competent swimmers.</p> <p><b>Comment</b></p> <p>PH29 guidance from NICE made recommendations with regard to swimming lessons. At that time, no underpinning evidence was identified. This case-control study was identified during an evidence update search for the PH29 guidance. The conclusions arrived at rely on this single small study. No formal quality assessment is reported.</p>

Study details	Results of the review	Main findings and evidence grading
	unlikely to prevent drowning; half of those who had drowned in the older age group were relatively strong swimmers.	
<p>Wallis BA et al. (2014).  <b>Interventions associated with drowning prevention in children and adolescents: systematic literature review</b>  <i>Inj Prev</i> 2014 Sep 4. pii: injuryprev-2014-041216. doi: 10.1136/injuryprev-2014-041216.</p> <p><b>Type of source:</b>  Systematic Review</p> <p><b>Interventions:</b>  Swimming skills and water safety tuition  Swimming lessons</p> <p><b>Relevant Outcomes:</b></p> <p><b>Study Population:</b>  Children and adolescents 0-19 years of age</p> <p><b>Studies were included up to:</b>  2010</p> <p><b>Included study types:</b>  RCT  Case-control</p>	<p><b>Quality of the review</b></p> <p>Reviewers searched a number of databases between 1980 and 2010 for interventions relating to prevention of drowning in the age group 0-19; grey literature searching and hand searching was not conducted. Multiple reviewers were used for inclusion/exclusion of studies but it is unclear whether repeatability checks were conducted at critical appraisal stage. The quality of included studies was assessed with studies being assigned a level of evidence were assessed using Australian National Health and Medical Research Council guidance.</p> <p><b>Description of included studies</b></p> <p>Two studies included in this systematic review related to interventions involving swimming lessons and water safety. One study compared swimming skills and water safety lessons delivered twice weekly for 8 weeks (n=48) or 12 weeks (n=61) duration for children aged 24-42 months (Asher et al, 1995). The other study was the case- control study by Brenner et al (2009).</p> <p><b>Quality of included studies</b></p> <p>This systematic review assigned a level of evidence as III-3 to Asher et al (1995) and III-2 to Brenner et al (2009) in accordance with guidelines produced by the National Health and Medical Research Council for Australia. This level is assigned based on the study design. The study by Asher et al (1995) was small, had no control group in which no swimming skills nor water safety education was provided. Asher's study also used a simulated risk as a proxy for drowning.</p> <p>Payment incentives were offered in both studies and both were susceptible to volunteer bias.</p> <p><b>Findings:</b></p> <p>Data extracted from Asher et al (1995) by Wallis et al (2014) notes:</p> <ul style="list-style-type: none"> <li>Swimming ability significantly improved in both 8 and 12- week groups p&lt;0.001</li> <li>Deck behaviour not improved p&lt;0.03</li> <li>Water recovery showed significant improvement in both groups p&lt;0.001</li> <li>Jump and swim improved over time in both groups p&lt;0.005</li> </ul> <p>Odds ratios extracted from Brenner et al (2009) as provided in NICE</p>	<p><b>Author's conclusions</b></p> <p>Few studies employ rigorous methods and high levels of evidence to assess the impact of interventions designed to reduce drowning. Seven studies met the inclusion criteria and demonstrate that interventions such as education, pool fencing and swimming and water safety are possible effective strategies to prevent children from drowning, particularly those 2-4 years of age. There were a number of promising studies identified that did not meet the inclusion criteria. Future research could validate the potential prevention strategies around many of these. Such as cardiopulmonary resuscitation training and wearing of PFDs. Drowning is a significant public health challenge globally. And there is a need for rigorous, well-designed studies that use consistent terminology to demonstrate effective prevention solutions.</p> <p><b>Comment</b></p> <p>No statement is provided for the data contained in Asher et al (1995) as this study did not have a control group in which no swimming or water safety instruction was received; it is a comparison of 8 weeks of swimming and water safety lessons versus 12 weeks of the same provision and outcome data appears to be versus baseline assessment.</p> <p>No evidence statement is presented for the data provided in Brenner et al (2009) as this has already been discussed when identified in the NICE evidence update for PH29.</p>

Study details	Results of the review	Main findings and evidence grading
	commentary above	

Study details	Results of the review	Main findings and evidence grading
<b>Education</b>		
<p>Leavy JE et al. (2015). <b>Recreational drowning prevention interventions for adults 1990-2012: a review.</b> <i>J Community Health</i> 40:pp. 725-35</p> <p><b>Type of source:</b> Systematic Review</p> <p><b>Interventions:</b> Education</p> <p><b>Relevant Outcomes:</b> <i>Quasi experimental study</i> Recall of educational messages Intention never to swim at unpatrolled beaches Intention to swim between flags Intention in managing rip currents <i>Observational studies</i> Lifeguard behaviour Pool attendee behaviours Fisherman knowledge, attitudes and behaviours</p> <p><b>Study Population:</b> Adults (14+) in a recreational setting</p> <p><b>Studies were included up to:</b> 2012</p> <p><b>Included study types:</b></p>	<p><b>Quality of the review</b></p> <p>A number of databases were searched for the period 1990-2012. Searching of grey literature or for unpublished work was not undertaken but some hand searching based on expert input and reference list review was conducted. Two reviewers were used throughout the process and authors report a flow diagram mapping the identification and exclusion of studies. A quality appraisal checklist tailored from NICE was used to assess studies in conjunction with Joanna Briggs assessment and review instruments. Authors did discuss the poor quality of literature identified.</p> <p><b>Description of included studies</b></p> <p>Three studies were included in the review relating to educational interventions. All were conducted in high income countries namely Australia, New Zealand and the United States. Two of these were observational with one being a quasi-experimental study. The quasi-experimental study examined education for beachgoers in Australia (Hatfield et al, 2012). The study examining education for lifeguards (n=14) was an uncontrolled before and after study conducted in the US (Schwebel et al, 2007). The cross-sectional survey data related to an educational campaign targeted at rock fishing participants in New Zealand (Moran, 2011).</p> <p><b>Quality of included studies</b></p> <p>Systematic review authors note the following for the included studies:</p> <p><i>Hatfield et al (2012)</i> This controlled before and after study utilised less than optimal participant recruitment and sampling and that there was contamination between control and intervention sites. Additionally pre- and post intervention samples were treated as independent, although some may have been interviewed at both stages. Outcome measures were self-reported.</p> <p><i>Schwebel et al (2007)</i> This was a small (n=14) uncontrolled before and after study with poor statistical</p>	<p><b>Intervention:</b> Education for beachgoers</p> <p><b>Outcomes:</b> Intention never to swim at unpatrolled beaches Intention to swim between flags Intention in managing rip currents</p> <p><b>Evidence statement Grade C (yellow):</b> There is some evidence supporting the use of this intervention but it is not conclusive</p> <p><b>Intervention:</b> Education for lifeguards</p> <p><b>Outcomes:</b> Lifeguard distraction Scanning by lifeguards Risky pool attendee behaviours (running, pushing under, jumping near others)</p> <p><b>Evidence statement Grade J (grey):</b> Evidence about the effectiveness of the intervention is lacking.</p> <p><b>Intervention:</b> Education for fishermen</p> <p><b>Outcome:</b> Avoiding fishing in bad weather Checking weather beforehand Use of lifejacket Use of gumboots/waders Alcohol consumption Turning back on sea Taking a cell-phone</p> <p><b>Evidence statement Grade J (grey):</b> Evidence about the effectiveness of the intervention is lacking.</p>

Study details	Results of the review	Main findings and evidence grading
Controlled before and after study Uncontrolled before and after study Cross-sectional survey	<p>power for analyses. It included observational data of lifeguard scanning practices however lifeguards were aware that they were being observed. Missing data and the small sample resulted in poor power calculations and limited generalisability.</p> <p><i>Moran (2011)</i> This study included self-reported data in repeated annual cross-sectional surveys (n=107-250 per year). It involved convenience-based sampling. Over 30% of the sample was in the age range 16-29</p> <p><b>Synthesis</b></p> <p>Narrative</p> <p><b>Findings</b></p> <p>Of the three educational interventions all reported some positive changes in short term effects.</p> <p>Hatfield et al (2012) report post-intervention respondents in the intervention area compared to the control area were more likely (relative to baseline data for beachgoers 9 months earlier) to report correct swimming intentions for rips (p=0.019) and intention never to swim at unpatrolled beaches (p&lt;0.001). There were no significant differences for intention to swim between the flags.</p> <p>Schwebel et al (2007) report that post-education lifeguard scanning behaviour significantly increased (p&lt;0.01) and distraction significantly decreased (p&lt;0.01). Three out of five risky patron behaviour measures significantly reduced post intervention; running (p&lt;0.01), pushing under (p≤0.05) and jumping near others (p&lt;0.01).</p> <p>Moran et al (2011) report that there was no change in terms of avoiding fishing in bad weather between 2006 and 2010 but that there was a significant decrease in fishers reporting they never wear a lifejacket and never wear gumboots or waders. There was a significant decrease in fishers reporting never drinking alcohol while fishing. No significant changes were found in behaviours such as turning your back to the sea, taking a cell-phone and checking the weather beforehand.</p>	<p><b>Author's conclusions</b></p> <p>Overall the intervention effects in this review were short-term and not replicated, and could be summarised as insufficient evidence to determine intervention effectiveness. Drowning prevention designs and the measurements used to evaluate the interventions need to be more robust if the level of observed evidence is to be influential with policy makers. There is an acute need for adult drowning interventions to use appropriate study designs, objective, valid and reliable measures, larger representative samples, and quality evaluations of sufficient time period. Furthermore, it is essential that results are reviewed for rigour and published in the peer reviewed literature.</p> <p><b>Comment</b></p> <p>The author's conclusions provided above are reproduced from the discussion of the systematic review to represent an overview of that found and its limitations. The conclusion of the systematic review is a more general request for better research and is less specific as to the issues with research currently published.</p> <p>Only one of these studies examining education as an intervention included a control group. Uncontrolled before and after studies and cross-sectional surveys are not robust designs for testing an intervention. Using such study designs to assess educational interventions for lifeguards and fishermen cannot establish a causal link between the intervention and the outcome.</p>
Wallis BA et al. (2014). <b>Interventions associated with drowning prevention in</b>	<p><b>Quality of the review</b></p> <p>Reviewers searched a number of databases between 1980 and 2010 for</p>	<p><b>Author's conclusions</b></p> <p>Few studies employ rigorous methods and high levels</p>

Study details	Results of the review	Main findings and evidence grading
<p><b>children and adolescents: systematic literature review, <i>Inj Prev</i> Sep 4. pii: injuryprev-2014-041216. doi: 10.1136/injuryprev-2014-041216.</b></p> <p><b>Type of source:</b> Systematic Review</p> <p><b>Interventions:</b> Injury prevention curriculum delivered in schools</p> <p><b>Relevant Outcomes:</b> Water safety knowledge</p> <p><b>Study Population:</b> Children and adolescents 0-19 years of age</p> <p><b>Studies were included up to:</b> 2010</p> <p><b>Included study types:</b> RCT</p>	<p>interventions relating to prevention of drowning in the age group 0-19; grey literature searching and hand searching was not conducted. Multiple reviewers were used for inclusion/exclusion of studies but it is unclear whether repeatability checks were conducted at critical appraisal stage. The quality of included studies was assessed with studies being assigned a level of evidence were assessed using Australian National Health and Medical Research Council guidance.</p> <p><b>Description of included studies</b></p> <p>This systematic review included one study that examined the water safety component of an injury prevention curriculum delivered in schools (Gresham et al, 2001).</p> <p><b>Quality of included Studies</b></p> <p>This systematic review assigned a level of evidence as II to Gresham et al (2001) in accordance with guidelines produced by the National Health and Medical Research Council for Australia. This level is assigned based on the study design.</p> <p><b>Findings</b></p> <p>No findings relevant to the outcomes of interest in this review.</p>	<p>of evidence to assess the impact of interventions designed to reduce drowning. Seven studies met the inclusion criteria and demonstrate that interventions such as education, pool fencing and swimming and water safety are possible effective strategies to prevent children from drowning, particularly those 2-4 years of age. There were a number of promising studies identified that did not meet the inclusion criteria. Future research could validate the potential prevention strategies around many of these. Such as cardiopulmonary resuscitation training and wearing of PFDs. Drowning is a significant public health challenge globally. And there is a need for rigorous, well-designed studies that use consistent terminology to demonstrate effective prevention solutions.</p> <p><b>Comment</b></p> <p>No evidence statement has been written for this study as outcomes related to changes in knowledge (as opposed to changes in behaviour) were excluded within the protocol of this review.</p>

Study details	Results of the review	Main findings and evidence grading
<b>Personal floatation device</b>		
<p>Leavy JE et al. (2015) <b>Recreational Drowning Prevention Interventions for Adults 1190-2012: a review.</b> <i>J.Community Health</i> Jan 25.</p> <p><b>Type of source:</b> Systematic Review</p> <p><b>Interventions:</b> Wearing a personal floatation</p>	<p><b>Quality of the review</b></p> <p>A number of databases were searched for the period 1990-2012. Searching of grey literature or for unpublished work was not undertaken but some hand searching based on expert input and reference list review was conducted. Two reviewers were used throughout the process and authors report a flow diagram mapping the identification and exclusion of studies. A quality appraisal checklist tailored from NICE was used to assess studies in conjunction with Joanna Briggs assessment and review instruments. Authors did discuss the poor quality of literature identified.</p>	<p><b>Intervention:</b> Wearing a personal floatation device PFD</p> <p><b>Outcome :</b> Deaths from drowning</p> <p><b>Evidence statement Grade C (yellow):</b> There is some evidence supporting the use of this intervention but it is not conclusive</p> <p><b>Author's conclusions</b></p>



Study details	Results of the review	Main findings and evidence grading
<p>device</p> <p><b>Relevant Outcomes:</b> Deaths from Drowning</p> <p><b>Study Population:</b> Adults (14+) in a recreational setting</p> <p><b>Studies were included up to:</b> 2012</p> <p><b>Included study types:</b> Retrospective matched cohort</p>	<p><b>Description of included studies</b></p> <p>The systematic review included one matched cohort study (Cummings, 2011) comparing drowning deaths of recreational boaters who entered the water wearing a PFD versus those from the same vessel entering the water without a PFD. Data was gathered for recreational boaters (n=1,597 boaters in 625 vessels) from US Coast Guards boating accident report database</p> <p><b>Quality of included studies</b></p> <p>There was possible selection and confounding bias and missing information for age and sex.</p> <p><b>Findings</b></p> <p>Wearing a personal floatation device reduced the risk of drowning by almost half [Adjusted RR 0.49 (95%CI 0.31-0.78)]</p>	<p>Overall the intervention effects in this review were short-term and not replicated, and could be summarised as insufficient evidence to determine intervention effectiveness. Drowning prevention designs and the measurements used to evaluate the interventions need to be more robust if the level of observed evidence is to be influential with policy makers. There is an acute need for adult drowning interventions to use appropriate study designs, objective, valid and reliable measures, larger representative samples, and quality evaluations of sufficient time period. Furthermore, it is essential that results are reviewed for rigour and published in the peer reviewed literature.</p> <p><b>Comment</b></p> <p>The author's conclusions provided above are reproduced from the discussion of the systematic review to represent an overview of that found and its limitations. The conclusion of the systematic review is a more general request for better research and is less specific as to the issues with research currently published.</p>

Study details	Results of the review	Main findings and evidence grading
<b>Minimum legal drinking age</b>		
<p>Leavy JE et al. (2015). <b>Recreational Drowning Prevention Interventions for Adults 1990-2012: a review.</b> <i>J Community Health</i> 40: 725-35</p> <p><b>Type of source:</b> Systematic Review</p>	<p><b>Quality of the review</b></p> <p>A number of databases were searched for the period 1990-2012. Searching of grey literature or for unpublished work was not undertaken but some hand searching based on expert input and reference list review was conducted. Two reviewers were used throughout the process and authors report a flow diagram mapping the identification and exclusion of studies. A quality appraisal checklist tailored from NICE was used to assess studies in conjunction with Joanna Briggs assessment and review instruments. Authors did discuss the poor quality of</p>	<p><b>Intervention:</b> Minimum legal drinking age</p> <p><b>Outcome:</b> Deaths from drowning</p> <p><b>Evidence statement Grade J (grey):</b> Evidence about the effectiveness of the intervention is lacking.</p>

Study details	Results of the review	Main findings and evidence grading
<p><b>Interventions:</b> Minimum legal drinking age</p> <p><b>Relevant Outcomes:</b> Deaths from drowning</p> <p><b>Study Population:</b> Adults (14+) in a recreational setting</p> <p><b>Studies were included up to:</b> 2012</p> <p><b>Included study types:</b> Pooled cross-sectional time series</p>	<p>literature identified.</p> <p><b>Description of included studies</b></p> <p>One reasonably large (n= 1008) pooled cross sectional time series analysis (Howland, 1998) using US data examining associations between drowning and minimum legal drinking age was included in the systematic review.</p> <p><b>Findings</b></p> <p>No significant association between drowning and minimum legal drinking age was found for any of the adults age groups analysed (ages 15-23).</p>	<p><b>Author's conclusions</b></p> <p>Overall the intervention effects in this review were short-term and not replicated, and could be summarised as insufficient evidence to determine intervention effectiveness. Drowning prevention designs and the measurements used to evaluate the interventions need to be more robust if the level of observed evidence is to be influential with policy makers. There is an acute need for adult drowning interventions to use appropriate study designs, objective, valid and reliable measures, larger representative samples, and quality evaluations of sufficient time period. Furthermore, it is essential that results are reviewed for rigour and published in the peer reviewed literature.</p> <p><b>Comment</b></p> <p>The author's conclusions provided above are reproduced from the discussion of the systematic review to represent an overview of that found and its limitations. The conclusion of the systematic review is a more general request for better research and is less specific as to the issues with research currently published.</p> <p>The design of the included study on minimum legal drinking age study does not allow causality to be inferred.</p>

## ANNEX 6 CDR Drowning Risk Factors Include/Exclude table

At each stage: abstract, full-text and critical appraisal, two reviewers independently screened each article. The independent decisions were compared and where there was a disagreement to include or exclude, this was resolved by discussion. Both sets of decisions were then merged to produce this table which provides a record of those decisions and any final decision reached.

	Reference	Include/exclude: e: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
1.	Bell GS et al. (2008). Drowning in people with epilepsy: How great is the risk? <i>Neurology</i> 71 (8):pp. 19	Include  Include	Include  Include	Include  Include	Some issues identified in CA need to be mentioned in discussion
2.	Borse NN, Hyder AA. (2009). Call for more research on injury from the developing world: results of a bibliometric analysis. <i>Indian J Med Res</i> 129 (3): pp. 321-26	Exclude - not SR  Exclude – not SR			
3.	Doocy S et al. (2009).The human impact of floods: a historical review of events 1980-2009 and	Include  Include	Exclude  Include? Note all flood related deaths not just		Although it appears to be a systematic

	Reference	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	systematic literature review. <i>PLoS Curr</i>		drowning – still useful?  Agreed exclude		review it includes many descriptive studies and only one from UK is from 1953 floods (Baxter).
4.	Doocy S et al. (2013). The human impact of tsunamis: a historical review of events 1900-2009 and systematic literature review. <i>PLoS Curr</i>	Exclude - not relevant to Welsh context  Exclude - Tsunami related			
5.	Doocy S et al. (2013). The human impact of tropical cyclones: a historical review of events 1980-2009 and systematic literature review. <i>PLoS Curr</i>	Exclude - Not relevant to Welsh context  Exclude - Tropical Cyclones			
6.	Driscoll TR, Harrison JA and Steenkamp M.	Include	Include	Include	Some issues identified in

	Reference	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	(2004). Review of the role of alcohol in drowning associated with recreational aquatic activity. <i>Inj Prev</i> 10 (2): pp.107-13	Include	Include	Include	CA need to be mentioned in discussion.
7.	Flores G. (2010). Technical Report- Racial and ethnic disparities in the health and health care of children. <i>Pediatrics</i> 124(4): pp.979-1020	Include Include	Exclude – not relevant to Welsh context  Include? Limited data on ethnic differences in deaths from drowning in the US – limited relevance to Wales  Agreed- Exclude but possibly use for comparison/comment	No CA unless decide to directly use data	
8.	Fuhr DC et al. (2014). Contribution of suicide and injuries to pregnancy-related mortality in low-income and middle-income countries: A systematic review and meta-analysis. <i>Lancet</i>	Exclude Exclude			

	Reference	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	<i>Psychiatry</i> 1 (3):pp. 01				
9.	Girasek DC, Gielen AC and Smith GS. (2002). Alcohol's contribution to fatal injuries: A report on public perceptions. <i>Ann Emerg Med</i> 39(6):pp.622-30	Exclude- primary study  Exclude			
10.	Hyder AA et al. (2003). Death from drowning: defining a new challenge for child survival in Bangladesh. <i>Inj Control Safety Promot</i> 10 (4): pp.205-10	Include  Include	Exclude- SR component only included papers which included key words of Bangladesh or South East Asia.  Exclude? Not enough detail to judge SR methodology. South Asia focus  Agreed exclude		
11.	Hyder AA et al. (2008). The burden of unintentional injuries among the under-five population in South Asia. <i>Acta Paediatr</i> 97 (3):	Exclude  Include  Agreed include	Exclude  Include? Gives gender ratio of drowning deaths but very limited relevance to Wales as	No CA unless decide to directly use data	

	Reference	Include/exclude: e: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	pp.267-75		South Asia only?  Agree exclude (possibly use in discussion for comparison/comment)		
12.	Imamura JH et al. (2912). What types of unintentional injuries kill our children? Do infants die of the same types of injuries? A systematic review. <i>Clinics (Sao Paulo)</i> 67 (9): pp.1107-16	Include  Exclude - incidence of childhood injury  Agreed include	Exclude- some country comparison rates on drowning only  Exclude - mortality rates with no useful data on gender or other risk factors		
13.	Large MM and Nielssen OB. (2010). Suicide in Australia: Meta-analysis of rates and methods of suicide between 1988 and 2007. <i>Med J Aust</i> 192 (8): pp.19	Exclude- not Welsh data  Exclude			
14.	Martin J et al. (2010). Alcohol-attributable mortality in Ireland. <i>Alcohol Alcohol</i> 45 (4):	Include  Exclude - attributable risk due	Exclude  Exclude		Agreed to get REHM 2004 to access relative risk

	Reference	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	pp.379-86	to alcohol  Agreed include			or cross match with that from Driscoll.  <a href="http://www.who.int/publications/cra/chapters/volume1/0959-1108.pdf">http://www.who.int/publications/cra/chapters/volume1/0959-1108.pdf</a>
15.	Rehm J et al. (2004). Alcohol use. In: <i>Comparative quantification of health risks. Global and regional burden of disease attributable to selected major risk factors</i> . [Online]. World Health Organisation. Geneva: WHO. Vol. 1, Chpt 12: pp:959-1091	Include  Include	Include  Include	Not standard methodology – no checklist available – uses meta-analyses and modelling. Explained methods well and appears robust.	
16.	Mayes BN. (2008). Review: persons with epilepsy have higher risk	Exclude- review of Bell			



	Reference	Include/exclude: e: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	for death by drowning than does the general population. <i>ACP J Club</i> 149 (6): pp.14	Exclude			
17.	Morovatdar N et al. (2013). Most common methods of suicide in Eastern Mediterranean Region of WHO: A systematic review and meta-analysis. <i>Arch Suicide Res</i> 17 (4): pp.335-44	Exclude  Exclude – Incidence of suicide			
18.	Pinette MG, Wax J and Wilson E. (2004). The risks of underwater birth. <i>Am J Obstet Gynecol</i> 190 (5): pp.1211-15	Exclude  Include  Agreed to include to check FT	Exclude – not SR  Exclude – not SR		
19.	Purnell M, McNoe B. (2008). <i>Systematic review of drowning interventions and risk factors and an international comparison of water safety policies</i>	Include  Include	Include?  Include but note that only covered a few years as updated previous review – so need to see earlier	Very difficult to tell which are included studies and which are incorporated as reviews. No analytical studies. Note major potential modifiable	Found during web searching for scoping – not database search.

	Reference	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	<i>and programs.</i> Otago: University of Otago.		review – plus also includes both SRs and primary studies	risk factors only?  See CA undertaken for interventions review – concerns about methods reporting – was excluded from interventions review on this basis given it did not add anything new/different to other available SRs.  Include but caution re: methods	Includes SRs and primary studies – check if SRs already found and check overlap of single studies with other SRs.  Update of previous SR – Chalmers – need to try and get this.
20.	Tan M and D'Souza W. (2013). Seizure-related injuries, drowning and vehicular crashes. A critical review of the literature. <i>Curr Neurol Neurosci Rep</i> 13 (7): pp.361	Exclude  Include  Agree to include to check methodology at FT	Exclude not SR  Exclude- methodology no locating for studies/determining quality.		Seizure related RF  Cannot include as systematic review as no methodology given. Relevant topic and

	Reference	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
					<p>recent.</p> <p>Studies referred to in reference list are mostly not included in meta-analysis of Bell - Wakamoto is exception.</p> <p>Don't know if these excluded by Bell as no list of excluded studies in that but all published Prior to Bell search end date.</p>
21.	Warner M et al. (2000). Drowning and alcohol in New Zealand: what do the coroner's files tell us? <i>Aust N Zeal J Public</i>	<p>Exclude -Not SR</p> <p>Exclude -primary review of coroners files</p>			

	Reference	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal	Comments:
	<i>Health</i> ;24 (4): pp.387-90				
22.	Hingson R and Howland J. (1993). Alcohol and non-traffic unintended injuries. <i>Addiction</i> 88: pp.877-83	Include  Include	Exclude – not SR and old and discussed in Driscoll  Exclude – not SR and old		Identified from the generic injury search
23.	Pearson M et al. (2009). <i>Preventing unintentional injuries among under-15s in the home. Report 1. Systematic reviews of effectiveness and cost-effectiveness of home safety equipment and risk assessment schemes.</i> Exeter: Peninsula Technology Assessment Group.  [SR1 supporting NICE PH30]	Include  Include	Include  Include	Include  Include	Included only studies that undertook a multivariate analysis

## ANNEX 7 CDR Drowning Interventions Include/exclude table

At each stage: abstract, full-text and critical appraisal, two reviewers independently screened each article. The independent decisions were compared and where there was a disagreement to include or exclude, this was resolved by discussion. Both sets of decisions were then merged to produce this table which provides a record of those decisions and any final decision reached.

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
1.	Crawford G et al. (2014). Development of a systematic review of public health interventions to prevent children drowning. <i>Open J Prev Med.</i> 2014;04 (03): 100-106 IN PROGRESS	Include  Include but only to point to SR in process (not available)	Include if available  Include but only to point to SR in process (not available)  Exclude- published review not available in time		No data available for extraction, mention in discussion of evidence review.
2.	Dinh-Zarr T et al. Interventions for preventing injuries in problem drinkers. (2004). <i>Cochrane Database Syst Rev</i> Issue 3. Art. No.: CD001857. DOI: 10.1002/14651858.CD001	Include – it is not clear whether 'injuries' includes drowning so need to check FT  Include- FT review required	Exclude – does not include drowning outcomes  Exclude- no data on drowning included		

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	857.pub2				
3.	Ellsaser G, Trost-Brinkhues G, Albrecht M. (2014). [Injury prevention in young children]. [German]. <i>Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz</i> 57(6):pp. 681-86	Exclude – this looks like a tertiary review so check ref list for missed SRs  Include- FT review required (language issue)  Agreed to review at full text	Exclude – this is a tertiary review  Language issue, go with TK suggestion for review of reference list only.		Refs checked and followed up – Towner And Kendrick Parenting Interventions found Cochrane refs found
4.	Foxcroft DR et al. (2014). Motivational interviewing for alcohol misuse in young adults. <i>The Cochrane Database Syst Rev</i> Issue 8. Art.No.:CD007025.DOI: 10.1002/14651858.CD007025.pub2.	Include – probably not relevant as outcomes are mostly measures of alcohol consumption but does look at alcohol related risky behaviour which might be relevant so check FT  Include- FT review required	Exclude – no studies included which measured drowning related outcomes.  Exclude- no useable data of specific relevance to drowning-composite measure from alcohol related injury to unprotected sex.		

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
5.	Kendrick D et al. Home safety education and provision of safety equipment for injury prevention. (2012). <i>Cochrane Database Syst Rev</i> Issue 9. Art. No.: CD005014. DOI: 10.1002/14651858.CD005014.pub3.	<p>Include – probably not relevant but lack of detail in abstract about what outcomes ‘injury rates’ might include therefore look at FT</p> <p>Include- FT review required, no specific data on drowning in abstract but have to take a view on face-to face/’ in the home’ data and check for detail/comments on absence of evidence for drowning</p>	<p>Include – 9 studies in the SR which measured drowning related outcomes/interventions</p> <p>Include - meta-analysis available of never leaving a child alone in the bath plus references to studies of never leaving them alone near other bodies of water etc.</p>	<p>No CA as Cochrane</p> <p>Automatic include</p>	<p>Check FT for refs for studies on education for installation of pool fencing as limited information in review despite studies being quality graded by SR authors.</p>
6.	Leavy JE et al. (2015). Recreational drowning prevention interventions for adults, 1990-2012: A Review. <i>J.Community Health</i> Jan 25.	<p>Include as need to check FT re: age range (not specified in abstract)</p> <p>Include- FT review required</p>	<p>Include – relevant age range studied.</p> <p>Include</p>	<p>Include</p> <p>Include</p>	<p>Come back to how to represent the findings after data extraction</p>

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
7.	NICE. (2010). <i>Preventing unintentional injuries among the under-15s in the home</i> . London: NICE.	Include – covers drowning  Include	Include guidance – see Comment  Not sure- see B11 and B12 page 40/41. Not specific to drowning. Discuss	No formal CA but need to double-check that Pearson followed NICE SR methodology  Automatic include	Need to see the full SRs which underpin this guidance  Received from Isabel
8.	Pearson M et al. (2009). <i>Preventing unintentional injuries among under-15s in the home. Report 1: Systematic reviews of effectiveness and cost-effectiveness of home safety equipment and risk assessment schemes</i> . Exeter: Peninsula Technology Assessment Group (PenTAG).  [SR1 supporting NICE PH30]	Include	Include	Automatic include	No evidence grading for Babul, Posner and Paul studies data as knowledge excluded in protocol for CDR and behaviour covered in meta-analysis by Kendrick.
9.	NICE. (2010). <i>Strategies to prevent unintentional injuries among the under-</i>	Include – covers drowning	Include guidance – Ev stmt 4.4 relates to pool fencing. See Comment	No formal CA but need to double-check that these followed NICE	Need to see the full SRs which underpin this



	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	15s. PH29. London: NICE	Include	Include	SR methodology  Automatic include	guidance  Received from Isabel
10.	<p>Garside R and Moxham T. (2009). <i>Preventing unintentional injury in children review 4: Strategic and regulatory frameworks for guiding, enforcing or promoting activities to prevent unintentional injury in children</i> Exeter: Peninsula Technology Assessment Group. (PenTAG).</p> <p>[SR4 supporting NICE PH29]</p>	Include	Include	Automatic include	<p>Use Cochrane review for evidence grading on pool fencing. Study included in this SR excluded by Cochrane which is more reliable/more focused review.</p> <p>Use this review for evidence grading pool fencing legislation as only other SR including studies on</p>

	<b>Reference:</b>	<b>Include/exclude: abstract</b>	<b>Include/exclude: full text</b>	<b>Include/exclude: Critical appraisal or data extraction</b>	<b>Comments:</b>
					this was Wallis and had less information on quality grading.
11.	<p>Ashfaq et al. (2009). <i>Strategies, policies and regulatory or legal frameworks and/ or mass media campaigns to prevent unintentional injury to children during play and leisure.</i> Birmingham: West Midlands Health Technology Assessment Collaboration University of Birmingham.</p> <p>[SR5 supporting NICE PH29]</p>	Include	Include	Automatic include	Evidence grade Bennett from this SR rather than Wallis as more detail available to review.
12.	<p>Park A-La et al. (2009). <i>Current practice and innovative approaches to prevent childhood unintentional injuries: An overview and synthesis of</i></p>	Include	Include	Automatic include	Excluded by SJ relevance

	<b>Reference:</b>	<b>Include/exclude: abstract</b>	<b>Include/exclude: full text</b>	<b>Include/exclude: Critical appraisal or data extraction</b>	<b>Comments:</b>
	<i>international comparative analyses and surveys of injury prevention policies, legislation and other activities,</i>  [SR 1 supporting NICE PH29]				
13.	Thompson DC, Rivara FP. (1998). Pool fencing for preventing drowning in children. <i>Cochrane Database Syst Rev</i> Issue 1. Art. No.: CD001047. DOI: 10.1002/14651858.CD001047	Include  <b>Include</b>	Include  <b>Include</b>	No CA as Cochrane  <b>Automatic include</b>	Use this review for evidence grading pool fencing- most reliable /most focussed
14.	Wallis BA et al. (2014). Interventions associated with drowning prevention in children and adolescents: systematic literature review. <i>Inj Prev</i> Sep 4. pii: injuryprev-2014-041216. doi: 10.1136/injuryprev-2014-041216.	Include  <b>Include</b>	Include  <b>Include</b>	Include  <b>Include but note broad review. Overlap with other reviews for most studies. Care not to over represent.</b>	Come back to how to represent the findings after data extraction.  This is a very broad review and as such the search

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
					<p>will not have been as focused as e.g. Thomson and Rivara. For pool fencing some studies identified by Cochrane review not found here Use Cochrane for Evidence grading, most reliable more focused.</p> <p>Do pool fencing legislation Garside and Moxham has more clarity on quality</p> <p>Knowledge excluded in protocol</p>

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
					therefore Posner data home safety score not required. Posner covered by Kendrick
15.	<p>Purnell M and McNoe B. (2008). <i>Systematic review of drowning interventions and risk factors and an international comparison of water safety policies and programs</i>. Otago: University of Otago ; 2008.</p> <p><a href="http://www.acc.co.nz/PRD_EXT_CSMP/idcplq?IdcService=GET_FILE&amp;dID=3794&amp;dDocName=PI00344&amp;allowInterrupt=1">http://www.acc.co.nz/PRD_EXT_CSMP/idcplq?IdcService=GET_FILE&amp;dID=3794&amp;dDocName=PI00344&amp;allowInterrupt=1</a></p>	<p>Include</p> <p>Include</p>	<p>Include</p> <p>Include</p>	<p>Include but note includes SRs and singles studies – Check if SRs already found and check overlap of single studies with other SRs.</p> <p>Update of previous SR - Chalmers</p> <p>Discuss</p> <p>Did not fully meet all criteria; critical appraisal not fully reported. Different approach done for CA interventions, not done for risk factors.</p> <p>Excluded because of</p>	<p>Found during web searching for scoping – not database search.</p> <p>Quality assessment p. 11 says only studies meeting level I, II-1 or II-2 will be presented in evidence tables yet of the 5 in the table two are II-3.</p> <p>Kendrick old</p>

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
				above and further comments plus did not add anything additional over other SRs	version, meta- analysis only three studies.  Posner water safety score- knowledge  Leclerc- no outcomes related to drowning
16.	Wallace LDJ. (2002). <i>Evidence-Based effective strategies for preventing injuries: child restraints, seat belts, reducing alcohol-impaired driving, teen drivers, child abuse prevention, bike helmets, residential fire, and drowning.</i> Atlanta: Centers for Disease Control and Prevention. <a href="http://www.cdc.gov/injury/prevention/documents/david%20wallace%20effective">http://www.cdc.gov/injury/prevention/documents/david%20wallace%20effective</a>	Exclude – tertiary level briefing – check refs for SRs we may have missed.  Exclude but follow up refs	Source of refs only  Discuss-Tertiary review -Include as source of references only		Found during web searching – not database search.  Refs list followed up – nothing relevant

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	<a href="#">%20stategies.pdf</a>				
17.	Wintemute GJ. (1992).From research to public policy: the prevention of motor vehicle injuries, childhood drownings, and firearm violence. <i>Am J Health Promot</i> 6 (6): pp.451-64	Include – may not be SR but check FT  Include but old	Exclude – not an SR  Exclude- not an SR		Interesting discussion – pool fencing – no overlap with other SRs but studies all pre-91 and may not be experimental design
18.	Kendrick D et al. (2013). Parenting interventions for the prevention of unintentional injuries in childhood. <i>Cochrane Database Syst Rev</i> Issue 3. Art. No.: CD006020. DOI: 10.1002/14651858.CD006020.pub3.	Include – abstract does not specify which injuries are included so check FT  Include- check FT	Include- does not specifically cover drowning but some included studies looked at home safety scores which may have included risks relating to drowning -if they do, then findings are of some relevance  Include	Cochrane – no CA required.	Identified from ref 3.  Overarching scoring systems not drowning specific  SR searched for drown* but no drowning related parenting interventions

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
					were identified.
19.	Towner E et al. (2001). <i>What works in preventing unintentional injuries in children and young adolescents? An updated systematic review.</i> London: Health Development Agency.	Include  Include check FT	Include although may only have a very limited amount of relevant data  Include	Exclude  Exclude  This SR claims to have identified all literature on unintentional injury 1975-2000 but it is a very broad review and there are issues around quality assessment standards versus 2015 expectations.  Concerns <ul style="list-style-type: none"> <li>studies on pool fencing included in Cochrane SR published within the time period but not identified by</li> </ul>	Identified from ref 3  Only one study (Bennet 1999) related to drowning lifejackets- decide how to use this - CA primary source? Covered by Wallis and Ashfaq.



	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
				<p>this review.</p> <ul style="list-style-type: none"> <li>one study (Kendrick 1999) on never being left alone in the bath from Cochrane SR not identified by this review</li> </ul>	
20.	Brenner RA et al. (2009). Association between swimming lessons and drowning in childhood: a case-control study. <i>Arch Pediatr Adolesc Med.</i> 163(3):pp.203-10.	Include	<p>Exclude: Not an SR – no details of search strategy, inclusion, no quality appraisal, only 1 reviewer</p> <p>Not an SR/meta-analysis</p>		<p>Identified from scoping</p> <p>Check refs are included in – other SRs</p> <p>Possibly look at refs-interesting discussion</p> <p>No refs</p>
21.	Carl R, Leo H and Cox E. (2001). Recreational water	Include	Exclude: Not an SR – no details of search		Identified

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	safety in Wisconsin. <i>WMJ</i> 100 (2):pp.43-6		strategy, inclusion, no quality appraisal, only 1 reviewer  Exclude not an SR/meta-analysis		from scoping  Check refs are included in other SRs if relevant?  Only Kyriacou picked up below (31) and (50)
22.	Fenner P. (2000).Drowning awareness. Prevention and treatment. <i>Aust Fam Physician</i> 29 (11) pp.1045-49.	Include	Exclude: Not an SR – no details of search strategy, inclusion, no quality appraisal, only 1 reviewer  Exclude not an SR/meta-analysis		Identified from scoping  Check refs are included in other SRs if relevant?  Ref 10 picked up in another  Ref 13 deep water resuscitation  Manolios N, Mackie I,

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
					Drowning and near drowning on Australian beaches patrolled by lifesavers: a 10 year study, 1973-1983. Med J Aust 1988; 148 (4): 165-161.
23.	Grenfell R. (2003). Drowning management and prevention. <i>Aust Fam Physician</i> 32 (12): pp.990-93	Include	Exclude: Not an SR – no details of search strategy, inclusion, no quality appraisal, only 1 reviewer  Exclude not an SR/meta-analysis		Identified from scoping  Check refs are included in other SRs if relevant?  Ref 5 100% oxygen (textbook) – agreed to exclude

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
24.	McDonald GK and Giesbrecht GG. (2013). Vehicle submersion: a review of the problem, associated risks, and survival information. [Review]. <i>Aviation Space &amp; Environmental Medicine</i> 84 (5):pp.498-510	Include	Include  Include	Does not meet minimum criteria but uniqueness of topic makes this worth including as write up of relevant studies is detailed – if not covered by other SRs then consider using  Discuss  Does not meet minimum criteria. Signpost to the document within the report but do not extract data.  Agreed exclude from PRISMA	Identified from scoping  Worth appraising even though may not have quality scored  IP updated search and nothing found. Verified verbally with Isabel on 28/7/15
25.	Sibert JD et al. (2001). Drowning in children: Epidemiology and prevention. <i>Care of the Critically Ill</i> 17(4);pp.121-23.	Include	Exclude – not SR  Exclude – not an SR		Identified from scoping  Pick up ref 13 for discussion  Fenner PJ,

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
					Harrison SL, Williamson JA Williamson BD, Success of surf lifesaving resuscitation s in Queensland, 1973-1992, Med J Australia 1995; 163 (11-12): 580-3
26.	Warner M, Smith GS and Langley JD. (2000). Drowning and alcohol in New Zealand: what do the coroner's files tell us? <i>Aust N Z J Public Health</i> 24(4):pp.387-90.	Include	Exclude – not SR (primary study of alcohol involvement in deaths – risk factor)  Not an SR/meta- analysis		Put in RF list?
27.	NHS Evidence. (2013). <i>Strategies to prevent unintentional injuries among children and young</i>	Include	Include	Include	Identified in scoping search

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	<i>people aged under 15.</i> Evidence Update 29.				
Subsequent refs gathered from search for SRs in general injury combined with keyword drown* because of identification of Cochrane SR on parenting interventions					
28.	Alpert B. (2003). Bathtub drowning: unintentional, neglect, or abuse <i>Med Health R I.</i> 86(12):pp.385-6	No abstract: exclude-bathtub drowning covered by Kendrick with later search date.			
29.	American Academy of Pediatrics Committee on Injury VaPP. (2010). Prevention of drowning. <i>Pediatrics</i> 126 (1): pp.178-85	Include	Exclude not an SR/meta-analysis		Also found in scoping
30.	Anon. (1999). <i>The prevention of unintentional injury among American Indian and Alaska Native children: a subject review.</i> Committee on Native American Child Health and Committee on Injury and Poison Prevention. American Academy of Pediatrics. [Review]]	Exclude not relevant			

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	<i>Pediatrics</i> 104 (6): pp1397-399				
31.	Berger LR, Wallace LJ and Bill NM. (2009). Injuries and injury prevention among indigenous children and young people. [Review] <i>Pediatr Clin North Am</i> 56 (6):pp.1519-537	Exclude not relevant			
32.	Beyda DH. (1998). Childhood submersion injuries. [Review] <i>J Emerg Nurs</i> 24 (2):pp.140-44	Exclude not an SR/meta-analysis			
33.	Cherry DC, Huggins B and Gilmore K. (2007). Children's health in the rural environment. [Review] <i>Pediatr Clin North Am</i> 54 (1):pp.121-33	Exclude not an SR/meta-analysis			
34.	Crawley T. (1996) Childhood injury: significance and prevention strategies. <i>J Pediatr Nurs</i> 11 (4): pp.225-32	Exclude not an SR/meta-analysis			
35.	DeMuri GP, Purschwitz MA. (2000). Farm injuries in children: a review.	Exclude not an SR/meta-analysis			

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	[Review] <i>WMJ</i> 99 (9): pp.51-5				
36.	DeNicola LK et al. (1997). Submersion injuries in children and adults. [Review] <i>Critical Care Clinics</i> 13 (3): pp.477-502	Unlikely SR but include for FT review	Not SR or meta-analysis		References checked  Kyriacou DN et al, Effect of immediate resuscitation on children with submersion injury, <i>Pediatrics</i> 94: 137-142, 1994.
37.	Hingson R and Howland J. (1993). Alcohol and non- traffic unintended injuries. <i>Addiction</i> 88 (7): pp. 877- 83	Exclude not interventions			Possibly useful for risks, may have been superseded.
38.	Ibsen LM and Koch T. (2002). Submersion and asphyxial injury. [Review] <i>Crit Care Med</i> 30 (11:Suppl):S402 -8	Exclude not an SR/meta-analysis			



	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
39.	Imamura JH, Troster EJ and Oliveira CA. (2012). What types of unintentional injuries kill our children? Do infants die of the same types of injuries? A systematic review. <i>Clinics.(Sao Paulo)</i> 67 (9): pp.1107-16	Exclude not interventions			
40.	Kallas HJ and O'Rourke PP. (1993).Drowning and immersion injuries in children. [Review] <i>Curr Opin Pediatr</i> 5 (3): 295-302	Exclude- not prior to reaching healthcare setting			
41.	Kemp A and Sibert J. (1997). Childhood accidents: epidemiology, trends, and prevention. [Review] <i>Journal of Accident &amp; Emergency Medicine</i> 14 (5): pp.316-20	Exclude not an SR/meta-analysis			
42.	Liu X, Si D and Shi D. (2000). [The risk factors of childhood injuries and their intervention and control]. [Review]	Exclude - language issue			

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	[Chinese]. Chung-Hua Yu Fang i Hsueh Tsa Chih [Chinese Journal of Preventive Medicine] 34 (4): pp.250-52				
43.	Macnab AJ. (1995). Effective interventions for nearly drowned children. [Review] <i>Can Fam Physician</i> 41: pp.1545-8, 1551-2, 1555-6.	Include	Exclude not an SR/meta-analysis		Be aware of Kemp A, Sibert JR. Drowning and near drowning in children in the United Kingdom: lessons for prevention. <i>BMJ</i> 1992; 304: 1143-6 for risks?
44.	McInnes RJ, Williamson LM and Morrison A. (2002). Unintentional injury during foreign travel: a review. <i>J Travel Med</i> 9 (6): pp.297-307	Exclude not an SR/meta-analysis			

	<b>Reference:</b>	<b>Include/exclude: abstract</b>	<b>Include/exclude: full text</b>	<b>Include/exclude: Critical appraisal or data extraction</b>	<b>Comments:</b>
45.	Paes CE and Gaspar VL. (2005). [Unintentional injuries in the home environment: home safety]. <i>J Pediatr (Rio J.)</i> 81 (5 Suppl): S146-S154	Exclude not an SR/meta-analysis			
46.	Pinette MG, Wax J and Wilson E. (2004). The risks of underwater birth. [Review] [34 refs]. <i>Am J Obstet Gynecol</i> 190 (5):pp.1211-15	Exclude not an SR/meta-analysis			
47.	Popovic V et al. (2011). [Out-of-hospital treatment in case of drowning]. <i>Med Pregl</i> 64 (1-2): pp.64-7	Exclude not an SR/meta-analysis			
48.	Rivara FP and Aitken M. (1998). Prevention of injuries to children and adolescents. [Review] <i>Adv Pediatr</i> 145:pp.37-72	Exclude not an SR/meta-analysis			
49.	Ross JL. (2005). Summer injuries: near drowning. [Review] <i>RN</i> 68 (7):pp.	Exclude not an SR/meta-analysis			

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	36-8.				
50.	Sachdeva RC. (1999)Near drowning. [Review] <i>Critical Care Clinics</i> 15 (2): pp.281-96	Exclude not an SR/meta-analysis			
51.	Schnitzer PG. (2006). Prevention of unintentional childhood injuries. <i>Am Fam Physician</i> 74 (11): pp.1864-69	Exclude not an SR/meta-analysis			
52.	Sleet DA, Ballesteros MF and Borse NN. (2010).A review of unintentional injuries in adolescents. <i>Annu Rev.Public Health</i> 31 pp.195-212	Exclude not an SR/meta-analysis			
53.	Stiglets C. (2001) Unintentional injuries in the young adult male. <i>J Am Acad Nurse Pract</i> 13 (10): pp.450-54	Exclude interventions not			
54.	Swick D. (1997). Submersion injuries in	Exclude not an			

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	children. [Review] <i>Int J Trauma Nurs</i> 3 (2): pp.59-64	SR/meta-analysis			
55.	Theurer W and Bhavsar AK. (2013).Prevention of unintentional childhood injury. <i>Am Fam Physician</i> 287 (7): pp.502-09	Exclude- not SR picked up refs 9 and 26 (Brenner 2009).			Kyriacou DN, Arcinue EL, Peek C, Kraus JF. Effect of immediate resuscitation on children with submersion injury. <i>Pediatrics</i> . 1994; 94(2 pt 1):137- 142.
56.	Weaver NL et al. (2008). Translation of an evidence-based tailored childhood injury prevention program. <i>J.Public Health Manag Pract</i> 14 (2):pp.177-84	Exclude not an SR/meta-analysis			
57.	Wilson I et al. Injuries, ill-health and fatalities in white water rafting and white water paddling.	Exclude not interventions			

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
	[Review]. <i>Sports Medicine</i> 2013;43 (1):pp.65-75				
58.	Wright S, Marlenga B and Lee BC. (2013). Childhood agricultural injuries: an update for clinicians. [Review]. <i>Current Problems in Pediatric &amp; Adolescent Health Care</i> 43 (2): pp.20-44	Exclude not an SR/meta-analysis			
59.	Goldcamp M, Hendricks KJ and Myers JR. (2004). Farm fatalities to youth 1995□□2000: A comparison by age groups. <i>J Safety Res</i> 35 (2): pp.151-57	Exclude not an SR/meta-analysis			
60.	Guillemont J et al. (2009). Alcohol as a risk factor for injury: lessons from French data. <i>Int J Inj Contr Saf Promot</i> 16 (2): pp.81-7	Exclude not an SR/meta-analysis			

	Reference:	Include/exclude: abstract	Include/exclude: full text	Include/exclude: Critical appraisal or data extraction	Comments:
61.	Moran K and Webber J. (2013). Leisure-related injuries at the beach: An analysis of lifeguard incident report forms in New Zealand, 2007-12. <i>Int J Inj Contr Saf Promot</i> 21 (1): pp.68-74	Exclude - injuries other than drowning			
62.	O'Hare D et al. (2002). Mortality and morbidity in white water rafting in New Zealand. <i>Int J Inj Contr Saf Promot</i> 9 (3):pp.193-98	Exclude not an SR/meta-analysis			
63.	Petrass L and Blitvich JD. (2013). Unobtrusive observation of caregiver-child pairs at public pools and playgrounds: Implications for child unintentional injury risk. <i>IJARE</i> 7 (3): pp.204-13	Exclude- Primary study, not an intervention			Possibly interesting for risk factors
64.	Robertson L et al. (1992). Home and leisure injury prevention. Part 1: Selected injuries. <i>J Safety</i>	Exclude not an SR/meta-analysis			

	<b>Reference:</b>	<b>Include/exclude: abstract</b>	<b>Include/exclude: full text</b>	<b>Include/exclude: Critical appraisal or data extraction</b>	<b>Comments:</b>
	Res 123 (2): pp.121-26				
65.	Simpson JC and Nicholls J. (2011). Preventing unintentional childhood injury at home: injury circumstances and interventions. <i>Int J Inj Contr Saf Promot</i> 19 (2): pp.141-51	Exclude not an SR/meta-analysis			
66.	Valeeva RF and van Beeck EF. (1996). The epidemiology of swimming pool injuries in The Netherlands. <i>International Journal for Consumer and Product Safety</i> 6 (2): pp.79-86	Exclude not an SR/meta-analysis			



## **POSTSCRIPT: Leavy et al., (2015b). A review of drowning prevention interventions for children and young people in high, low and middle income countries**

The protocol for this systematic review was identified during searching for this evidence review. Communication with the authors indicated that it was unlikely to be completed within the time period available for the evidence review and thus it was not possible to include it. It was however, published shortly after the evidence review had been completed, findings had been presented to the CDR Drowning Thematic review Panel and this report had been written. Whilst the systematic review was not available in time to influence the thematic review recommendations, it was nonetheless considered important to represent the findings of the systematic review in this report.

### **Brief description of systematic review**

#### *Methodology*

The stated aim of the review was to "...identify, assess and analyse public health interventions to reduce child drowning and investigate the use of behavioural theories and evaluation frameworks to guide child drowning prevention." The review adopted the WHO definition of drowning as per this evidence review (see page 18 above). Studies were included in the review if they: (1) described drowning prevention interventions for those aged 0–18 years; or (2) interventions aimed at both those aged 0–18 years and aged over 18 years, when there was clear reporting on the impact of the intervention on children; (3) described interventions that constituted primary prevention; and (4) reported on interventions developed at an individual, community or population level. The search was restricted to relevant peer-review articles written in English, published before May 31<sup>st</sup> 2013. A search for grey literature was not conducted. The review was conducted according to standard systematic review methodology including *a priori* specification of inclusion criteria, stated search strategy, independent screening of articles by two or more reviewers and critical appraisal of study quality. A narrative synthesis was undertaken.

#### *Results*

15 studies were included in the review. Data were extracted from included studies into four categories: (1) education and information; (2) denial of access–barriers and regulations; (3) provision of supervision; (4) acquisition of survival skills. The proportion of interventions using multiple strategies was also considered. The majority (seven) of the studies were from the USA, four from Australia, two from Bangladesh and one each from Greece and Grenada. The authors comment on the mix of study designs; randomised control trials, randomised uncontrolled trial, observational/audit study, intervention/ control comparison, pre-post testing, case-control, cohort, time-series and mixed (case-control with cohort). Only one third of studies measured impact on drowning. Others

reported intermediate outcomes and the authors note the reliance on self-report and observational data which “....reduces confidence in reported findings.”

### *Discussion and conclusions*

This review found that all of the included studies used education and information as a key strategy to prevent drowning with 40% of the studies relying on it as a sole strategy. Authors highlight the importance of considering the context in which the educational intervention is delivered. The difficulties of implementation and lack of effectiveness data on low-cost barrier measures in low and middle-income countries is described. Only two studies examined the provision of supervision as an intervention, both set in low- middle income countries, however the review notes that supervision should continue to be “ a realistic and integral component for all drowning prevention programs globally.” The systematic review also highlights that intervention programs should emphasise swimming and water safety education as opposed to swimming skills alone. Only three studies used a multi strategy approach and only two used behavioural theory or frameworks during intervention design. Outcomes were mostly around awareness, satisfaction, knowledge, perceptions and intention. Weaknesses in methodologies were identified; an over-reliance on self-report measures, lack of control groups and small samples “...all of which diluted the robustness and generalisability of the findings.” The conclusions note “This review reveals an over reliance on education and information as an intervention strategy to prevent drowning, with only three studies providing evidence of a multi-strategy approach to this important public health issue. There is an immediate requirement to support interventions that use a range of strategies that are shaped by theory and planning and evaluation frameworks, and are robust in regard to intervention design, delivery and evaluation methodology.”

### **What does this review add?**

Eight of the studies included in this review had not been included in the systematic reviews used in this evidence review. Of these ‘new’ studies however, seven are not of a suitable design to attribute effects to the intervention as there is no control group and so the systematic review does not add substantially to the evidence-base in relation to the interventions assessed by these studies. These studies covered a range of interventions involving: school-based water safety education, swimming and life saving skills, supervision, swimming pool safety inspection programmes, and legislation for pool fencing.

The systematic review does however include additional evidence from one retrospective matched cohort study in relation to the themes of provision of supervision and acquisition of survival skills; the PRECISE programme in Bangladesh, which aimed to deliver child injury prevention through the village-based crèche for children aged 1-5 (Anchal) and the Swimsafe

swimming, water safety and safe rescue skills programme for children aged 4-12 years. The analysis of the PRECISE programme compared participants in the programme to matched non-participants. The study showed large and statistically significant reductions in risk of drowning in participants of the programme for both components; Anchal RR 0.181 (95%CI 0.057-0.577), Swimsafe RR 0.072 (95%CI 0.017-0.307). The systematic review authors do however highlight a number of limitations with this study including:

- differences in average age and gender between participants and non-participants
- the possibility that Swimsafe graduates could rescue both Anchal participants and control individuals from drowning
- the children in the control group could have been exposed to the community education and prevention aspects of PRECISE, which would understate the effect.

### **Would inclusion of this systematic review have altered the conclusions of the evidence review?**

The inclusion of Leavy et al 2015 would not have altered the conclusions of the evidence review overall. Lack of supervision had already been identified as a key risk factor and swimming competency and water safety skills are already recommended by NICE and Eurosafe. The PRECISE programme does add evidence for the positive effects of supervision. Interventions by which supervision practices could be enhanced in Wales, to decrease drowning and non fatal drowning incidents, would however differ considerably in design to that offered in Bangladesh and so the evidence about this specific intervention is not directly transferable. PRECISE offers additional evidence in support of combined basic swimming, water safety and safe rescue skills for primary school children.

### **Reference**

Leavy JE et al. (2015b). A review of drowning prevention interventions for children and young people in high low and middle income countries. *J Commun Health* DOI 10.1007/s 10900-015-0105-2. Available at <http://link.springer.com/article/10.1007/s10900-015-0105-2#> [Accessed: 12 Nov 2015]