Systematic Review of Drowning Interventions and Risk Factors and an International Comparison of Water Safety Policies and Programs

Report to the Accident Compensation Corporation

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Executive Summary

Background

Death by drowning is the third leading cause of unintentional death in New Zealand[1]. In 2005, the Accident Compensation Corporation (ACC) launched the Drowning Prevention Strategy to co-ordinate the efforts of those involved in water safety and establish a water safety culture in New Zealand. This program of research was commissioned by ACC to help achieve the objectives of the first five years of the Strategy.

Objective

The main objective of this program of research was to provide a systematic review and horizon scan of the scientific and grey literature on drowning risk factors, drowning prevention interventions and barriers to drowning prevention interventions for the period 2004 - present, together with an international comparison of water safety policies and programmes in countries similar to New Zealand.

Main Findings

- Scientifically robust evaluations of drowning prevention interventions were found to be lacking for the period 2004 to present. Out of the five eligible studies found, the best evidence comes from one well designed meta-analysis that showed that *general* home safety education did *not* prevent children from being left alone in the bath[2].

- Findings from twelve studies showed that risk-taking behaviour by swimming pool patrons, lifeguard behaviour, ethnicity, multi-media marketing and personal perceptions may all mediate the effect of drowning prevention interventions. Inspection programmes were shown to facilitate compliance to pool fencing requirements rather than act as a barrier[3], and those parents who have children enrolled in swimming lessons may have an overly optimistic view of the protective role of swimming ability in toddler drowning prevention[4].

- Alcohol use, lack of parental supervision, use of bath seats and risk-taking behaviour were identified as the main modifiable *potential* risk factors for drowning and near-drowning as a result of non-recreational immersion and recreational swimming, angling/net/shell fishing and underwater activities identified in the fifteen studies examined from 2004 to present.

- The major gap in water safety policies and drowning prevention campaigns in New Zealand and internationally are those related to alcohol use in and around water, particularly in young men.

Conclusions

This study has addressed several aims of objective 4 of New Zealand's drowning prevention strategy including: the maintenance of our knowledge of risk factors; knowledge of national and international water safety research; and of existing water safety interventions, programmes and policies.

1. Introduction

Drowning has been defined as "the process of experiencing respiratory impairment from submersion/immersion in liquid"[5] and is the third leading cause of unintentional injury death in New Zealand [1]. Although the rate is reducing there is concern that New Zealand's record compares poorly with comparable counties such as Australia[1 6]. In 2005, the New Zealand *Drowning Prevention Strategy: Towards a Water Safe New Zealand 2005-2015* (DPS) [7] was launched by the Accident Compensation Corporation (ACC), to provide a framework for co-ordinating the efforts of those involved in water safety and establish a water safety culture in New Zealand. A key objective of the DPS is "to improve our water safety knowledge through research and development" (Objective 4)[7]. This objective has highlighted the need to enhance the evidence/knowledge base for water safety issues though improving our knowledge of risk factors, maintaining our knowledge of national and international water safety research and best practice, and through evaluating water safety interventions, programmes and policies[7]. This report was commissioned by the ACC to contribute to the achievement of this objective.

1.1 Objective

The main objective of this research is to undertake:

> A systematic review and "horizon scan"[1] of the scientific and "grey" literature on drowning risk factors and interventions for the period 2004 - present, together with an international comparison of water safety policies and programmes in countries similar to New Zealand.

Specific research questions corresponding to each aspect of the main objectives are outlined below:

a) Drowning Interventions and Risk Factors (2004 – present):

1. What drowning prevention interventions have been published (2004-present)?

2. What are the barriers and facilitators that determine the effectiveness of interventions?

3. What is the likely impact of, ethnicity, immigration, the environment, socioeconomic status, use of craft and behaviour patterns on the effectiveness of the interventions?

[1] Where "horizon scan" is defined as the systematic examination of likely future developments which are at the margins of current thinking and planning, and which may be used to inform the delivery of programmes and policies.

4. What are the major modifiable risk factors for unintentional[2] drowning as a result of:
    (a) non-recreational immersion incidents (including road vehicle incidents)
    (b) recreational swimming
    (c) recreational angling/net and shell fishing
    (d) recreational underwater activities?

b) International Comparison of Water Safety Policies and Programmes (2004 – present):

5. What drowning prevention interventions have been proposed/promoted internationally?

6. What water safety policies and programmes are in place in countries similar to New Zealand?

c) Horizon Scan

7. What are the likely future developments in water safety which are at the margins of current thinking and planning?

A previous review of the water safety literature carried out for ACC for the period 1990 to 2003, found that good quality studies on risk/protective factors for fatal and non-fatal drowning were limited, as were studies of effective preventive measures for drowning [8]. The present review and horizon scan of the scientific and grey literature will update the 2004 review as well as highlight any significant developments in drowning prevention research and practice.

[2] Major categories taken from the 2006 Drowning Fact sheet, Water Safety New Zealand.

2. Methods

2.1 Scientific literature search and eligibility

2.1.1 Search criteria

Search strategies to address research questions 1 to 6 were developed by a medical librarian using a keyword matrix provided by the research team for eight electronic bibliographic databases (see Appendix I). All eight databases were searched for relevant articles using the search strategies over the period February - March 2008 for articles published 2004 - present. In April 2008, the searches were re-run in Medline and Embase to capture any newly indexed entries. At the same time, hand searches of the table of contents pages were carried out in the following leading journals: Injury Prevention, International Journal of Epidemiology, Accident Analysis and Prevention, Australian and New Zealand Journal of Public Health, American Journal of Public Health for 2004 – present. This was done to check for any potential papers missed by electronically searching the databases.

2.1.2 Eligibility criteria

Eligibility criteria (see Appendix II) were developed separately for Review Question 1 (interventions) and Review Question 4 (risk factors). Eligibility criteria were also developed for Review Questions 2 and 3 (barriers/facilitators to interventions) combined and for Review Questions 5 and 6 (international comparison of water safety policies/programmes) combined. In order to assess the objectivity of the criteria, a pilot test of 50 papers was carried out independently by two members of the research team. Any disagreements over the inclusion/exclusion of studies were discussed and refinements to the eligibility criteria were made. All papers were required to have a publication date between 2004 and 2007 inclusive, were restricted to the English language and were from countries with relevance to NZ, defined as countries which have a drowning rate similar to NZ and/or are investing money in water safety research and drowning prevention initiatives. As agreed at the meeting of the Water Safety Steering Committee 7th December, 2007, these countries are Australia, Canada, the Scandinavian Countries, the UK and the USA.

2.1.3 Application of the eligibility criteria

All eligible studies/articles were assessed for inclusion in the systematic review by two independent researchers from the research team using the refined eligibility criteria. For those studies/papers

appearing to meet the eligibility criteria and those whose eligibility could not be determined from the title/abstract, the full-text articles were requested via the University of Otago library interloan system.

2.2 Scientific literature quality assessment

The development of the quality assessment tools for this review have been guided by a recent systematic review of tools for assessing quality and susceptibility to bias in observational studies. A total of 86 tools were reviewed by Sanderson et al. (2007) comprising 41 simple checklists, 12 checklists with additional summary judgements and 33 scales. These authors recommended "that tools should i) include a small number of key domains, ii) be as specific as possible (with due consideration of the particular study design and topic area), iii) be a simple checklist rather than a scale, and iv) show evidence of careful development, and of their validity and reliability"[9]. Guidance was also obtained via The STROBE Statement (Strengthening the Reporting of Observational Studies in Epidemiology) which was designed to facilitate critical appraisal and interpretation of studies [10] and a recent text on systematic reviews in health care[11].

Checklists for quality assessment were developed for each type of study design. For all study designs the checklists included: the participants, the interventions/exposure, outcomes, and main results. For randomised controlled trials and experimental designs the checklist also included factors relating to validity: randomisation (adequate, not adequate, none, not stated); allocation concealment (adequate, not adequate, not stated); blinding (single, double, triple, not stated); compliance level of participants with study protocol (adequate, not adequate, not stated); outcome follow-up (% participants - <80% inadequate, >80% adequate); intention to treat analysis carried out (yes, no); grade of evidence. For the before and after study designs the power level of the study was assessed as well as the use of concurrent control groups.

Evidence tables were compiled under the following headings: publication, design, participants, intervention/exposure, outcomes, main results, comments on validity and quality, and grade of evidence. For consistency, the eligible studies were ranked according to study design using the same criteria that were employed in the previous water safety literature review by Chalmers et al. (2004). The criteria in Table 1 were adapted from Concato et al. (2000)[12]. Evidence tables will be presented for those studies meeting criteria I, II-1 or II-2 only. For other relevant studies included in this review, summaries will be presented in the main body of the text.

Table 1: Grades of evidence adapted from Concato et al. (2000) applied to the scientific literature

I	Evidence obtained from at least one properly randomized, controlled trial.
II-1	Evidence obtained from well-designed controlled trials without randomization.
II-2	Evidence obtained from well-designed cohort or case control analytic studies, preferable from more than one centre or research group
II-3	Evidence obtained from multiple time series with or without intervention.
III	Opinions from respected authorities, based on clinical (or other relevant) experience; descriptive studies and case reports; or reports of expert committees.

2.3 Grey Literature Search and Eligibility

2.3.1. Working definition of grey literature

"Information produced on all levels of government, academics, business and industry in electronic and print formats not controlled by commercial publishing i.e. where publishing is not the primary activity of the producing body." (Luxembourg, 1997 - Expanded in New York, 2004, GreyNet – Grey Literature Network Sevice, http://www.greynet.org/greynethome.html).

2.3.2 Search criteria

A systematic search of websites containing information, or links to information, relevant to the study objectives was carried out. Eligible countries were Australia, UK, New Zealand, Scandinavia, Canada and the USA with “drowning” or “water safety” in the document/website/link title. Only websites in English were eligible. The Australian and Canadian websites were accessed during November 2007 and other countries during December 2007. Any updates since that date are not included in this study. For example, a report may have been written during a year that would make it eligible for inclusion in this review. But if it was not accessible on the web between November and December 2007 then it would not have been included.

2.3.3. Grey literature search procedure

The search procedure involved 3 stages and was hierarchical.

I. Key water safety sites were searched (e.g. water safety agencies, major injury prevention/public heath research units) for documents fitting the search criteria and all relevant documents were downloaded. Links provided on the site were followed until there were no *new* relevant sites.

II. The web was searched using the Google search engine for documents fitting the search criteria and all relevant *new* documents were downloaded. The links provided on the site were followed until there were no new relevant sites.
III. The web was searched using SCOPUS for documents fitting the search criteria and all relevant *new* documents were downloaded. The links provided on the site were followed until there are no new relevant sites.

The main aim of the grey literature search was to find information relevant to the international comparison of programs and policies, but it was also used to identify any unpublished studies relevant to questions 1 – 4.

2.3.4 Grey literature eligibility criteria

These were the same as for the scientific literature.

2.4 Horizon scan of significant developments

2.4.1 Working definition of horizon scan

An horizon scan is a scan of work underway. Its purpose is to raise awareness of ongoing work in a particular area and to highlight significant developments. It does not attempt to analyse particular strands in depth or tease out the full complexity of the issues they may raise. Some of the developments may in the future become subjects for studies in greater depth. The scan can also be used to stimulate discussions with stakeholders and the public.

2.4.2. Searching the "Horizon"

For the purposes of this review, articles or information representing a significant development in water safety found during the search of the grey literature were appraised and presented.

3. Results

3.1 Scientific literature search results

The search yielded 292 articles for potential inclusion in the review (Table 2). When duplicates were removed, the search yielded **170** abstracts/texts to review for eligibility. When the eligibility criteria for questions 1 to 4 were applied to the search results, a total of **23** scientific articles met the criteria (Table 3).

Table 2 Results of the scientific literature search of eight databases

Database	Articles Retrieved
MEDLINE	66
EMBASE	46
SPORTDISCUS	50
WEB OF KNOWLEDGE	39
WEB OF SCIENCE	22
SCOPUS	64
ERIC	1
COCHRANE LIBRARY	4
Total	292

Table 3 Eligibility results for review questions 1 - 4 for the scientific and grey literature

Review Question/s	Topic	Eligible articles scientific	Eligible articles grey
1	Drowning prevention interventions	5	0
2 & 3	Barriers/facilitators to interventions	5	7
4	Modifiable risk factors for drowning	13	2
	Totals	23	9

3.2 Grey literature search results

For the grey literature, 518 websites were visited and 1125 web documents were identified. Of the web documents, 73% were information/fact sheets or web pages, 20% were statistical or epidemiological reports, 11% were programmes, interventions or similar and 7% were policy or position statements.[3] The 428 statistical reports, epidemiological reports, programmes, interventions, policy and position statements were examined for content relevant to the international comparison of policies and programmes. During this examination, nine unpublished studies from the grey literature relating to review questions 1, 2, 3 or 4 were also identified as eligible for inclusion.

3.3 Horizon scan search results

Six documents were identified as important developments in water safety research. These were:

1. Bierens J.J.L.M (ed). Handbook on Drowning: Prevention, Rescue, Treatment. Berlin: Springer-Verlag, (2006)[5]
2. Water safety guidelines for service providers
   -from EuroSafe (2008)
3. World report on child injury prevention
   -due for release December (2008)
4. Asian and Pasifika Youth Water Safety Pilot Study
   –WaterSafety New Zealand
5. Moran, K. And Mills, C. Do Alcohol and Aquatic Mix? The Context of Youth Alcohol Consumption and Aquatic Recreation. Auckland: WaterSafe Auckland Inc. (2008).[13]
6. Moran, K. Water safety and Auckland's West Coast Fishers – Final Report 2008. Report to the Auckland Regional Council, Surf Life Saving Northern Region and Water Safe Auckland Inc. Auckland: WaterSafe Auckland(2008).[14]

[3] These groups are not mutually exclusive.

4. Discussion

Each of the review questions will be discussed in turn and evidence tables presented for those studies meeting criteria I, II-1 or II-2.

What drowning prevention interventions have been published from 2004-present?

Few methodologically sound scientific studies on drowning prevention interventions were published in the period 2004 to the present (Table 4). Only five papers met the eligibility criteria for review question 1; one systematic review with meta-analysis [2], one randomised controlled trial [15], one experimental study [16] and two before and after observational studies [17 18]. Four out of five of the interventions were education based, including home safety education (two studies), lifeguard education on surveillance techniques and poolside water safety education for parents. One study compared two different water rescue approach methods [16]. The types of outcomes were all *indirect* measures of drowning risk including self-reported water safety practices, objective measures of lifeguard and swimming patron behaviour, self-reported water safety knowledge/attitudes and the speed in seconds of a rescuer to swim to a near-drowning victim. As noted in the previous review, for serious outcomes such as fatal drowning rates, it is unlikely to be ethical or practicable to undertake randomized controlled trials of potential interventions [8].

Both the systematic review with meta-analysis and the randomised controlled trial (RCT) of home safety education were well conducted with no major problems concerning validity [2 15]. The findings of the meta-analysis of three studies [15 19 20] revealed a lack of evidence that home safety education prevented children from being left alone in the bath as reported by their parents [2 15]. Although only three studies were included in the meta-analysis, this finding persisted even when the results from any two of the studies were included. It should be noted that in all three studies, the interventions were of a general home safety nature and not limited to water safety. It is important also to acknowledge that the outcomes in the studies included in the meta-analysis were self-reported rather than objective measurements, and as such may have introduced reporting bias. However, Posner, Hawkins et al. (2004)[13] cited a study that demonstrated a fairly high degree of consistency between self-reported home safety practices and those observed directly.

One of the three studies included in the meta-analysis reported by Kendrick, Coupland et al. (2007) met the eligibility criteria for the present systematic review (i.e. Posner, Hawkins et al. 2004). In that study, caregivers of children <5years presenting to an urban pediatric emergency department for treatment of acute unintentional injuries sustained in the home were randomly allocated to a

treatment or control group [15]. Participants randomized to the intervention group received: a 2 page handout containing general information about the prevention of common household injuries to young children including drowning; comprehensive home safety counselling via a scripted verbal review of the entire handout; plus distribution and explanation of a home safety kit. The details of the handout and counselling given to participants were not reported. In relation to bath safety, the home safety kit included non-slip bathcals and a bath water thermometer. The control group received only the 2 page home safety handout. Four of the outcome questions were grouped together to form a water safety score and the results showed no significant difference between the groups. Although the internal validity of this RCT was relatively high, it is difficult to interpret the result in relation to drowning prevention as the results for each component of the water safety score were not presented separately.

In a non-randomised experimental study, the speed of rescuers swimming to near-drowning victims with a rescue tubes using preferred YMCA and American Red Cross (ARC) approach methods was compared[16]. For the YMCA approach method, the rescue tube is held with one hand so the nose of the tube is pointed in the direction that the rescuer is swimming and a single arm pull and breaststroke kick is used. For the ARC approach method, the rescue tube is held under the armpits across the chest and rescuer swims using breaststroke and front crawl. Lifeguards (n = 15) and non-lifeguards (n = 18) took part in the study and were assessed for speed on 10 different tasks using the two rescue methods. In four out of five comparisons between the ARC and YMCA methods, the YMCA method was significantly faster[16]. Furthermore there was no loss of control of the rescue tube using the YMCA method on any task compared to the ARC method where control of the rescue tube was lost between 28% and 36% of the time depending on the task. Speed of rescue is an important aspect in the survival of a drowning victim and loss of control of the rescue tube will waste precious time. Although this study was non-randomised, all participants carried out both rescue approach methods thereby minimising the potential for problems with validity due to a biased sample.

Only limited conclusions can be drawn from the two eligible 'before and after' studies due in part to a lack of control groups. In a well conducted study, Moran and Stanley (2006) provided a group of parents of 2 – 4 years old toddlers with a 10-week educational programme while their toddlers were receiving instruction in the pool. The topics covered were: the importance of adult supervision; how to supervise in the home, at the beach and when boating; the circumstances surrounding toddler drowning; and child-related cardiopulmonary resuscitation (CPR) skills. The results showed that water safety knowledge and attitudes were significantly improved in parents following

the programme compared to before the programme, but parental knowledge of toddler CPR skills were not[17].

In another before and after study, the scanning and distraction behaviours of a group of lifeguards were significantly improved after a one-hour educational meeting[18]. The educational meeting included; descriptions of risky patron behaviour and frequency of distracted lifeguards; discussion of a fatal drowning incident at another pool and revision of pool surveillance techniques. Interestingly, swimming patrons displayed significantly fewer risky behaviours post-intervention even though the intervention was directly targeted at the lifeguards. Because no control groups were used in either of these observational studies, the true magnitude of change that can be attributed to the intervention is unclear. Furthermore, the longevity of these effects could not be determined from these studies. Nonetheless, both of these studies suggest that targeted educational sessions have the potential to change attitudes, knowledge and behaviours relatively quickly.

In addition to the five primary studies described in Table 4, three review articles on different aspects of drowning prevention have also been published since 2004[21 22 23]. Although review articles are not commonly included in systematic reviews, these articles are included here to provide a more comprehensive update to the previous literature review by Chalmers et al. (2004). Salomez and Vincent (2004)[19] briefly discussed the most important strategies in drowning prevention from published recommendations. These were: adequate supervision of toddlers and infants in or close to water; swimming lessons for improving swimming ability from four years of age; avoidance of alcohol use in all individuals involved in water-based activities; fencing of private pools on all four sides and the wearing of personal flotation devices by all children and adults while performing activities that may result in falling in the water.

Schnitzer (2006)[20] presented evidence-based recommendations for the prevention of drowning in toddlers and school-age children. They reported that there was consistent, good-quality patient-oriented evidence for pool fencing as a preventive strategy - on all four sides with self-latching gates. For vigilant adult supervision and cardiopulmonary resuscitation training, they reported that there was inconsistent or limited-quality patient-oriented evidence. But the authors also state that the American Academy of Pediatrics (AAP) recommends that children under the age of four years should never be left alone or in the care of another child while in or near water and that adults should supervise children from within an arms length and refrain from distracting activities whenever children are in or around water.

Wilks et al. (2007)[23] summarised the results of three different Australian studies on drowning fatalities and proximity from the red and yellow patrol flags on beaches. For example, a study of beach drowning data was described that revealed that although no beach-related drowning incidents occurred between the red and yellow flags between 1999 and 2005, 70% (n = 54) of beach-related drowning incidents occurred less than 1 km from the flags[24]. They concluded that those swimmers who stay between the patrol flags and who find themselves in need of assistance are most likely to be successfully rescued. They further stated that the common belief that swimming in close proximity to the flags will provide the same benefits as swimming between the flags if assistance is required has been shown by Australian rescue and drowning data to be erroneous.

The Handbook on Drowning published in 2006 is a compilation of knowledge on drowning and contains documents which were the result of the various consensus meetings during the World Congress on Drowning held in 2002 and the final recommendations of the World Congress on Drowning [5]. Recommendation number 4 was that preventive strategies and collaboration are needed.

"All agencies concerned with drowning prevention – legislative bodies, consumer groups, research institutions, local authorities and designers, manufacturers and retailers – must collaborate to set up national and local prevention initiatives. These will depend on good intelligence and insightful research, and must include environmental design and equipment designs as a first route, in conjunction with education, training programs and policies which address specific groups at risk, such as children. The programs must be evaluated and the results of the evaluations must be published p 663"[5].

In section 2.8 of the Handbook on Drowning an overview of drowning prevention strategies is presented[25]. Epidemiological studies were presented as support for the following strategies: swimming pool fencing, lifesavers, resuscitation; swimming training; personal flotation devices; barriers on roads (next to waterways); small boats: design and actions after capsizing.

4.1 Summary of drowning prevention intervention studies

The previous review of the water safety literature carried out for ACC for the period 1990 to 2003, found that good quality studies on effective preventive measures for drowning were very limited [8]. The most compelling evidence at that time was for fencing of domestic swimming pools, self-regulation of commercial diving in Tasmania and legislated regulation of commercial fishing in Alaska. The present review shows that there have been few scientifically robust evaluations of

drowning prevention interventions since 2004. The strongest evidence is limited to the well-conducted meta-analysis of three studies of the effectiveness of home safety education in preventing children from being left alone in the bath. The results of this analysis show a *lack* of evidence for *general* home safety education preventing children from being left alone in the bath. However, specific and comprehensive water safety education may have yielded different findings. Furthermore, the type of participant may also have been an important factor as to the success or otherwise of the educational interventions. In the meta-analysis by Kendrick, Coupland et al. (2007) the participants were all parents attending emergency departments, well child clinics or were part of a general practice. In before and after observational studies by Moran and Stanley (2006) and Schwebel et al. (2007) the participants were lifeguards or parents of toddlers enrolled in swim classes and therefore may have been more motivated to improve their water safety knowledge and skills.

Table 4 Evidence for drowning prevention interventions 2004 – 2007 (scientific literature).

Study	**Kendrick D., Coupland C. et al (2007)**
Design	Systematic Review and meta-analysis
Participants	80 studies included
Interventions	Home safety education with or without provision of safety equipment.
Outcomes	i) Possession and use of HSE ii) Safety practices iii) Self-reported injury in children aged 0 – 19yrs *Only the following relevant meta-analysis was included in this review:* Safety practice outcome - 'Never leaving a child alone in the bath 3 studies: 2 RCTs, 1 non-RCT
Main results	**Meta-analysis** "Never leaving a child alone in the bath" Total N = 896, 381 (intervention) 384 (control) Odds Ratio 1.01 (95% CI 0.69 to 1.47). Not statistically significant Lack of evidence that home safety education prevented children being left alone in the bath
Comments on Validity	Small number of studies in meta-analysis (N=3) Combined sample size in each arm relatively small. Findings of meta-analysis are robust to the exclusion of any one study *Overall*: Well conducted systematic review and meta-analysis
Grade of Evidence	I

Study	**Posner, J. C., L. A. Hawkins, et al. (2004)**
Design	Randomised Controlled Trial
Participants	Caregivers of children <5 years presenting to an urban pediatric emergency department for treatment of acute unintentional injuries sustained in the home (N=96)
Interventions	*Intervention*: Verbal home safety counseling + home safety kit + Home safety literature handout (N=69) *Control:* Home safety literature handout (N=67)
Outcomes	Safety practice scores as assessed by a questionnaire before, and 6 to 8 weeks after the intervention. *Relevant outcome:* Water safety score comprised of 4 items
Main results	No significant difference between groups for questions related to water safety ($p<0.33$) *Follow-up:* Intervention= 71% Control = 70% Those lost to follow-up did not differ significantly with respect to group assignment or demographic factors
Comments on Validity	*Randomization:* adequate *Allocation concealment:* adequate *Blinding: single* - outcome assessors *Compliance:* adequate *Outcome Follow-up:* <80% - inadequate *Intention to treat analysis: Yes* *Overall:* Good quality RCT
Grade of Evidence	I

Study	**Leclerc, 2007**
Design	Experimental – case crossover
Participants	Certified YMCA and ARC (American Red Cross) lifeguards (N=15) Non-lifeguards who demonstrated entry level swimming skills (N=18) Both groups included males, females, college students and the community aged between 16 and 25 years but the exact make-up of the groups was not given.
Interventions	(1) **ARC rescue approach** – participants kept the rescue tube under the armpits across the chest, swimming with the head out of the water using the breaststroke and front crawl. (2) **YMCA rescue approach** – participants held the rescue tube with one hand positioned at the centre of the tube, so the nose of the tube was pointed in the direction that the participant was swimming. A single arm pull and a breaststroke kick with the head out of the water were used to swim the modified breaststroke and modified front crawl.
Outcomes	Three different events were timed by the Zink Hall poll OSM-5 Omega timing system using the two different approaches for a total of 10 trials. Event 1: Swim with rescue tube 25 yd in straight line Trial 1: ARC method front crawl Trial 2: YMCA method front crawl Event 2: Swim with rescue tube 15 yd while crossing over five lane dividers in the pool Trial 1: ARC method front crawl Trial 2: YMCA method front crawl Trial 3: ARC method breaststroke Trial 4: YMCA method breaststroke Event 3: Swim with rescue tube 15 yd around two simulated people Trial 1: ARC method front crawl Trial 2: YMCA method front crawl Trial 3: ARC method breaststroke Trial 4: YMCA method breaststroke
Main results	In four out of five comparisons between the ARC and the YMCA methods, the YMCA method was faster ($p<0.05$). No significant difference in times between lifeguards and non-lifeguards. Participants lost control of rescue tube between 28% and 36% of the time using the ARC method. No participant lost control of the rescue tube using the YMCA method.
Comments on Validity	*Randomization:* none – volunteers were used but all participants performed *both* interventions thereby minimizing problems associated with non-randomised samples. *Allocation concealment:* no *Blinding:* not stated

	Compliance: adequate *Outcome Follow-up:* 100% *Intention to treat analysis: Yes* *Overall:* Reasonable quality experimental study
Grade of Evidence	II-1

Study	**Schwebel, D. C., S. Lindsay, et al. (2007)**
Design	Before and After Observational
Participants	Lifeguards working at an outdoor swimming pool in a community centre (N=14)
Interventions	Lifeguard education: Evening meeting presented by the researchers and swimming pool managers (1 hour) -described risky patron behavior and frequency of distracted lifeguards -discussed fatal drowning incident at another pool -reviewed American Red Cross pool surveillance techniques.
Outcomes	*Lifeguard behaviours:* -looking at the pool/deck -distractions -scanning *Patron behaviours:* -running on the deck -pushing people under the water -dangerous diving -aggressive acts -jumping into water near someone else Assessed by two coders pre- and post-intervention:
Main results	Significant behavioural changes were observed not only in the lifeguards whom the intervention was aimed at, but also in swimming patrons. **Significantly reduced:** *Patron behaviours:* -running on the deck -pushing people under the water -jumping into water near someone else *Lifeguard behaviours:* -distractions **Significantly improved:** *Lifeguard behaviours:* -scanning
Comments on Validity	No concurrent control group for assessment of baseline changes over time Statistical power modest – 60% power *Overall*: Small but reasonable quality observational study
Grade of	II-3

Study	**Moran, K. and T. Stanley (2006)**
Design	Before and After Observational
Participants	Parents of 2 - 4 year old toddlers enrolled in swim school lessons (N=106)
Interventions	10 week poolside water safety educational programme
Outcomes	*Water safety knowledge and attitudes:* -importance of adult supervision -how to supervise -circumstances surrounding toddler drowning -toddler CPR skills -expectations of swimming lessons Assessed by self-report questionnaire pre- and post-intervention
Main results	**Significantly improved:** *Water safety knowledge* -importance of adult supervision -circumstances surrounding toddler drowning *Water safety attitudes:* -expectations of swimming lessons **No change:** -parental knowledge of toddler CPR skills
Comments on Validity	Non-randomised self-selected population No concurrent control group for assessment of baseline changes over time Outcome follow-up 99% - adequate *Overall:* Good quality observational study
Grade of Evidence	II-3

What are the barriers and facilitators that determine the effectiveness of interventions?

What is the likely impact of ethnicity, immigration, the environment, socioeconomic status, use of craft and behaviour patterns on the effectiveness of the interventions?

Since 2004 there have been few studies that have specifically investigated possible barriers and facilitators to drowning prevention interventions, or the impact that various modifiable and non-modifiable factors such as personal perceptions or ethnicity have on the effectiveness of drowning prevention interventions. The five studies from the scientific literature reported here are all cross-sectional by design (grade of evidence III) with two incorporating comparison groups. Two studies have examined some aspect of personal perception or belief that people have regarding water safety and swimming ability that may affect the success of swimming lessons as a drowning prevention measure[4 26]. One study examined risk taking behaviour by swimming pool patrons and surveillance habits of lifeguards[27] and another investigated compliance of backyard swimming pools with the requirements of pool fencing legislation[3]. The role of ethnicity as a possible barrier to drowning prevention interventions was studied in a group of Vietnamese-Americans[28].

In one New Zealand study, parental perceptions of the role of toddler swimming ability and pre-school swimming lessons in drowning prevention were surveyed in a sample of 882 parents of 2 – 4 year old toddlers[4]. The toddlers were either attending early childhood centres (n=327 from 23 different centres) or were enrolled in swim schools (n=555 from 18 different swim schools). The results showed that significantly more swim school parents believed that swimming lessons were the best way to prevent toddler drowning (57% vs 47%) and that toddlers could learn to save themselves if they fell into the water (43% vs 33%). More swim school parents also believed and that it was better to develop swimming ability rather than rely on adult supervision (35% vs 30%). In New Zealand, swimming lessons for pre-school children have been publicly encouraged by some water safety organisations, however, the results of this study suggest that many parents, especially those whose children were enrolled in lessons, have an overly optimistic view of the protective role of swimming ability in toddler drowning prevention. It should be noted that the demographic makeup of the two groups of parents was not given and therefore the possibility of selection bias affecting the results of this study cannot be ruled out. Nonetheless because of the overly optimistic view of the protective role of swimming lessons of all the study participants, the authors suggest that swim schools should de-emphasise the safety aspect of toddler swimming lessons and alternatively promote the value of water familiarisation, exploration of movement and enhancement of physical skills for children[4].

The willingness of individuals to enrol in swimming classes requires them to recognise that they do not have functional skills[26]. The self-efficacy of young adults aged 18 to 35 years of age regarding their understanding of what constitutes a competent swimmer was examined via 45 interviews in a cross-sectional survey [26]. The participants were all approached in recreation centres and parks with significant water features in rural upstate South Carolina, USA with the final makeup of the sample 78% white, 22% African American and 44% female[26]. They were asked: a) do you know how to swim?; b) What is your definition of swimming?; and c) What does it mean to you when someone else says they know how to swim?[26]. The results showed that while most respondents stated that they could swim, less than half outlined swimming competencies mirroring standards adopted by leading aquatic organisations[26]. Only one third mentioned advanced skills such as knowing a formal stroke which is essential for safe participation in swimming in unguarded areas[26]. Although this study was limited in sample size and geographic range, the results suggest that learn to swim messages could go unheeded if the very people that most need to take swimming lessons actually perceive themselves as being competent swimmers[26]. The implications for practice are that advertisements for swimming programs should not simply refer to the need to be able to swim but describe the skills that will be taught[26].

Risk-taking behaviour by pool swimming patrons and the surveillance habits of lifeguards are two critical behaviours that may impact upon the effectiveness of drowning prevention measures. At an outdoor swimming pool in a Jewish Community Centre in the USA observational data were collected in three areas of the pool[27]. Five types of dangerous behaviours were assessed in patrons: a) pushing people under the water; b) dangerous diving; c) aggressive acts; d) jumping into the water near someone else; and e) running on the deck. Four lifeguard behaviours were observed and coded: a) looking at the pool; b) distractions; c) warnings delivered to patrons; d) scans of pool sections. A composite measure of all dangerous patron behaviours yielded a total of 91 dangerous patron behaviours per hour, occurring in all parts of the pool, while lifeguards issued a warning roughly only once per 14 dangerous behaviours witnessed[27]. Lifeguard scanning behaviour was strong (roughly once every 10 seconds) but they were distracted about 10 times per hour. The main limitations of this study are that it was observational and it measured drowning risk rather than actual or near-drownings[27]. Nonetheless these results suggest that swimming pool patron risk-taking can be high at public swimming pools and that lifeguards need to warn patrons more often about dangerous activities[27].

Drowning rates vary by ethnicity in New Zealand and in the USA [6 29 30] and, therefore, it may be appropriate to consider ethnic specific interventions and the potential barriers and facilitators to these. Quan et al. (2006) [28] carried out focus group interviews with 15 Vietnamese-American

teenagers (15 – 19 yrs) and 20 Vietnamese-American parents recruited through English and Vietnamese fliers. The Vietnamese interviewed reported that the Vietnamese community do not participate in water sports, are unaware of drowning risks, do not have water safety skills or use precautions and attributed cases of open-water drowning to fate. Participants had negative attitudes to life jackets, swimming pools and lessons but identified schools and Vietnamese media as a means of delivering injury-prevention messages. The authors concluded that decreasing drowning among Vietnamese-Americans requires changing knowledge, attitudes and safety practices with programs and messages in Vietnamese, as well as targeting the dominant culture[28].

Four-sided fencing of private swimming pools has been shown to significantly reduce the risk of drowning in children[31], however, the non-compliance of backyard swimming pools with the requirements of pool fencing legislation remains a barrier to the success of this intervention[3]. A cross-sectional study was carried out in New South Wales, Australia to document the approaches adopted to manage backyard swimming pool inspections and compliance in three local government areas (LGA)[3]. The aim of the study was to describe the compliance levels and identify perceived barriers to compliance in the three areas. Within the LGA governed by Council A there were around 182,000 residents, Council B 57,000 residents and 19,000 in Council C. The results showed that Council A had limited procedures in place for the management of backyard swimming pools and of the 1003 pools inspected during the study 51.4% were *not* compliant at a first inspection. However, after a second inspection in Council A 55.1% converted from a non-compliant to compliant status showing that repeat inspections may result in improved compliance. Council B had an annual inspection program and out of 863 pools with a known compliance status only 3.2% were *not* compliant. Council C had reactivated its inspection program two years previous to the study after a long lapse in activity. Out of the 464 swimming pools that were inspected, 54.3% were *not* compliant with safety requirements. The most common types of faults resulting in pool non-compliance were gates not self-closing and/or self-latching, inadequate signage, climbable objects placed too close to fences and too much space under pool fences. The two most significant barriers to enforcement of compliance with the NSW Swimming Pools Act 1992 were difficulties created by the Act and the general lack of resources for the implementation of inspection programs. There is also a common perception that inspection programs are unpopular with pool owners, however in reality almost all pool owners (N=196/205, 95.6%) who responded to a survey (N=205/1003, 20.4%) in Council A's area supported safety inspections by the council[3]. Limitations of this study include that the councils used were a convenience sample and not randomly selected, differences in pool inspection practices may have existed between pool inspectors in the three councils and the low response rate of pool owners in Council A to the survey[3].

From the grey literature search, seven studies were identified. One examined water safety supervision of young children on New Zealand beaches, and another reported on the participation of Asian peoples in aquatic recreation and the water safety knowledge, attitudes and behaviour of Asian youth in New Zealand[32 33]. Both of these studies were posted on the WaterSafe Auckland website after the cut-off date for the grey literature search. Given the relevance to this review however, both studies will be discussed here. Three of the studies were identified from the World Water Safety Conference (2007) website, two evaluating multi-media campaigns, one from New Zealand and one from Australia[34 35]. The third study, from Canada, investigated factors that would affect the ability of lifeguards to recognise a submerged victim[36]. Two further New Zealand reports were also identified. One was a survey of local authorities on the issue of compliance with, and enforcement of the Fencing of Swimming Pools Act[37], and the other was a literature review of the Fencing of Swimming Pools legislation[38].

A cross-sectional survey of 769 parents/caregivers who were in charge of young children aged 9 years or less at 18 popular Auckland, Northland and Bay of Plenty surf and flat-water beaches was undertaken between January and March 2007[33]. Child swimming abilities and parent/caregiver supervisory behaviours and perceptions of drowning risk were assessed using questionnaires and observations by research assistants on beaches. The research assistants were experienced in dealing with the public and had extensive knowledge of beach safety from surf lifesaving experience. Out of 544 observations made, one quarter of adults (24%; N=130) were not considered to be providing adequate supervision of their children for the prevailing water conditions. Of those not at the water's edge supervising their children (N=130), almost one third (30%) spent their time lying down on the beach sunbathing and more than one quarter talked to other people (28%) or used cell phones (27%). Other distractions observed among parents/caregivers not providing adequate water safety supervision were eating and drinking (11%), reading books or magazines (7%), drinking alcohol (3%) and other unspecified behaviours (29%). Most parent/caregivers estimated slight or no drowning risk for under 5's (60%) and for 5-9 years olds (82%). But twice as many males (37%) as females (18%) estimated *no* drowning risk for the older age group, suggesting a tendency for males to underestimate the risk of drowning compared to females. More males reported higher estimates of swimming ability among their 5 – 9 years olds compared to females (66% compared 50%). Only two thirds of the sample thought that parents/caregivers were the best supervisors for children and there were considerable differences according to gender and ethnicity. Significantly *more females* than males believed that the role of water safety supervisor was best filled by parents/caregivers. More Pasifika (41%) and Maori (30%) parents/caregivers than all other groups considered that lifeguards were best able to supervise their children in the water. One quarter of (27%) of Asian

parents/caregivers believed that other adults closest to their children in the water were best able to supervise their water safety. These findings provide evidence of questionable supervisory practice and misconceptions of parent/caregivers critical role in supervising children's water activity at the beach that should be considered in drowning prevention campaigns[33].

Moran (2006) reported on participation in aquatic recreation and the water safety knowledge, attitudes and behaviour of Asian youth in New Zealand. A nationwide written survey was carried out during school hours. Two hundred and six students (9.4% of the sample), aged between 15 – 19 years and enrolled in full-time study in New Zealand state or private schools, who self-identified as of Asian ethnicity, were among 2,202 students who took part in the survey. The results showed that Asian youth participated in significantly less aquatic activity (with the exception of land based fishing) as non-Asian youth. One half of Asian students had participated in land-based fishing during the previous year, making it their most popular form of aquatic recreation. Land-based fishing was the fourth most popular activity for non-Asian youth. Although the Asian youth held more positive attitudes towards water safety than their non-Asian counterparts, their water safety knowledge and skills were generally poor with one third unable to swim 25m, more than half unable to perform a rescue and almost two thirds unable to perform CPR. The authors state that a "combination of high exposure to danger and inability to cope with that danger are likely contributors to the over-representation of Asian people in rock fishing fatalities[32].

A study was carried out to determine the barriers to lifeguard recognition of submerged victims and to develop strategies to help lifeguards improve submerged victim recognition[36]. A submerged manikin simulating a small Caucasian boy was used to evaluate recognition under a variety of water facilities ranging from a 25m x 6 lane swimming pool to an aquatic leisure centre with waves, water slide. Water depths ranged from 30cm to 5m and elevated lifeguard stands from 1.8m to 3m in height were tested. The subjects were experienced staff lifeguards at each of the test facilities, although the number was not stated. The results showed that deeper water and darker pool bottom and wall colours made it more difficult to see and recognise the manikin. A common assumption has been that if the water clarity is very good, the lifeguard should be able to easily see and recognise a submerged victim. With undisturbed water conditions however, the lifeguards often found that they were unable to see the manikin on the bottom when it was only 10 metres away from their lifeguard position. Another assumption has been that lifeguarding from an elevated lifeguard stand improves recognition. The results of this study showed that elevation of lifeguards did not improve victim recognition. It was reported that the lifeguard must be less than 10 metres from the victim for calm waters and as close at 2 metres if there is turbulence. Walking patrols are

recommended rather than lifeguarding from a fixed position and the colour of pool walls and bottom should be white[36]. It should be noted that the number of tests, sample size of lifeguards and number of water facilities was not reported and could have influenced the results of this study.

In April 2007, Water Safety New Zealand launched the first phase of an 8-week public awareness campaign regarding learning to swim with television and movie theatre advertisements[34]. Market research undertaken post-campaign indicated that 41% of those surveyed recalled the advertisement. Of those that recalled the advertisement, 16% had enrolled their child in swimming lessons as a result. No details were given regarding the sample size or the demographic make-up of the surveyed participants. Because of this, it not known to what extent the sample is biased. The method of obtaining information from the participants was also not given. These limitations aside, the results suggest that a social marketing campaign to increase awareness of the importance of learning to swim and the mobilisation of caregivers and parents does result in increased swimming lesson enrolments[34]. In Australia, "Play it Safe by the Water" (PISBTW) is a multi-agency public awareness and education campaign which aims to implement an holistic water safety strategy for the state of Victoria[35]. The campaign involves advertising, public relations and multilingual communication (sixteen languages). Telephone surveys were completed by a random sample of 500 Victorians pre- and post-campaign to assess public awareness of and attitudes to water safety and related advertising. The results showed that since the inception of the PISBTW campaign the unintentional drowning rate in Victoria had decreased from 1.38 per 100,000 in 1997/1998 to 0.74 per 100,000 in 2006/2007 [35]. Survey results indicated a recall of advertising by up to 77% of respondents. The results suggest that consistent messages and branding can facilitate the uptake of holistic water safety messages.

Gulliver and Chalmers (2006) carried out a literature review for the period 1997 to 2005 to compare overseas experiences of compliance and enforcement issues of pool fencing legislation with those of New Zealand. The three cross-sectional studies identified showed that the extent of current legislation enforcement is highly variable in the Australian states of Victoria and New South Wales, possibly because of the lack of requirements for local authorities to enforce the relevant Acts. Western Australia and the Northern Territory are the only states that have a legislative requirement for pools to be registered with local councils, and for on-going pool inspections[38]. A lack of registration and on-going inspection requirements are important limitations in the legislation in the majority of states in Australia. The level of enforcement of the Fencing of Swimming Pools Act 1987 (FOSPA) in New Zealand is also highly variable[38] There is no requirement under the FOSPA for local authorities in New Zealand to undertake inspection programs. Because of this there is

potential for incomplete enforcement and compliance. Strengthening the legislation to require on-going inspection of private swimming pools may achieve higher compliance rates in New Zealand, and has been shown to do so in Australia[31]. In France, the responsibility for on-going compliance lies firmly with the pool owner – should a child drown in a pool that is found to be non-compliant, the owner could face criminal charges of death by negligence[38].

A survey of local authorities in New Zealand with a responsibility for enforcing the FOSPA was carried out in 2006[37]. The aim of the study was to identify the current status of compliance with, and enforcement of the FOSPA. Out of 73 territorial local authorities that were sent a questionnaire, 49 (67%) returned their completed questionnaire. Out of the 55,150 pools identified by local authorities: 70.5% were reported as complying with the Act without exemptions; 3.7% had exemptions; 5.4% did not comply; and 20.4% were estimated as having unknown compliance status[37]. Sixty-three percent of local authorities (n=31) reported having a program of re-inspection to ensure continued compliance. In total, 70% of respondents (n=33) reported difficulties in enforcing the Act. The most commonly reported difficulties were defining the immediate pool area, perimeter fencing and access via house doors. The six most common reasons given by pool owners for not fencing a pool were: lack of fencing options; lack of knowledge of the law; cost of fencing; presence of other unfenced water hazards on the property; owner does not agree with the law; and no pressure from the local authority to comply[37].

4.2 Summary of barriers and facilitators to drowning prevention interventions

The results of these studies suggest that factors such as risk-taking behaviour by swimming pool patrons, lifeguard behaviour, ethnicity and personal perceptions may mediate the effect of drowning prevention interventions. In particular, inspection programmes were shown to facilitate compliance to pool fencing requirements, but the cost of fencing, lack of fencing options and the lack of knowledge of the law were some of barriers that were identified. Parents who have children enrolled in swimming lessons were shown to have an overly optimistic view of the protective role of swimming ability in toddler drowning prevention, warranting further investigation. Multimedia marketing was shown to mobilise action by parents and caregivers to enrol their children in swimming lessons. Barriers to lifeguard recognition of submerged victims included pool wall and bottom colours, and proximity to the victim. Contrary to expectation, elevation of the lifeguard on a platform did not facilitate submerged victim recognition.

What are the major modifiable risk factors for unintentional drowning as a result of: a) non-recreational immersion incidents (including road vehicle incidents); b) recreational swimming; c) recreational angling/net and shell fishing; and d) recreational underwater activities?

In New Zealand, all drowning deaths are captured by Drownbase™. This database was developed in 1990 and contains records of all fatal drowning incidents in New Zealand since 1980 and is the official database of Water Safety New Zealand (WSNZ). In 2007, there were 43 non-recreational immersion drowning incidents representing 39% of all fatal drownings in New Zealand for that year (DrownBase™ - WSNZ). Ten of the non-recreational drowning immersions were road vehicle incidents. There were 15 deaths (14%) from recreational swimming; 9 deaths (8%) from recreational angling/net and shell fishing; and 8 (7%) deaths resulting from recreational underwater activities (DrownBase™ - WSNZ). Taken together, the statistics show that two thirds of drowning deaths in New Zealand in 2007 were associated with these four activities. It is important that these four activity groups are targeted in the research arena.

For the period 2004 to present there were no analytical studies investigating modifiable risk factors such as case-control studies that met the eligibility criteria for inclusion. There were thirteen published studies of a descriptive, retrospective analysis or cross-sectional design (grade of evidence III) that examined *potential* modifiable risk factors for unintentional drowning. These studies will be briefly described to provide a picture of the areas that have received research attention in the review period. Only results that generally relate to one of the four activity categories will be highlighted. Chalmers et al. (2004) provided a summary of the evidence from analytical studies published from 1990 to 2003 on risk factors for unintentional drowning and the relevant key findings be included as background in this section.

Alcohol Use

Alcohol adversely affects judgement and decision-making, with serious potential consequences for those operating boats, those swimming and for those responsible for supervising children[39]. The World Health Organisation states that alcohol consumption is one of the most frequently reported contributory factors associated with adolescent and adult drowning in many countries[40].
Chalmers et al. (2004) 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. Percentages

of between 21 – 79% for any involvement of alcohol and 20 – 64% for blood alcohol concentrations (BAC) of 0.1% have been reported for swimming-related drownings[8 41]. In 2004, Driscoll, Harrison and Steenkamp published a review of the role of alcohol in drowning associated with recreational aquatic activity. They presented the results of 23 main studies and suggested that drowning is the overwhelming cause of death associated with recreational aquatic activity (swimming and boating), that alcohol is detected in the blood of 30% to 70% of persons who drown in association with recreational activity, and that alcohol probably contributes to between 10% and 30% of all recreational drowning deaths[42]. They further concluded that the risk of drowning increases with increasing blood alcohol concentration.

Two retrospective analyses of drowning deaths and their association with alcohol that met the eligibility criteria for this review were published in 2004, examining data from Australia[43] and Finland[44]. Drowning deaths that occurred in Australia (excluding Queensland) from 1 July 2000 to 30 June 2001 were identified using the National Coroners Information System (N=289) and were analysed to examine the contribution of alcohol to drowning deaths in Australia[43]. The authors assumed that if the BAC of a drowning victim was ≥ 0.1g per 100ml (0.1%) then the drowning could be attributed to alcohol. Reliable blood alcohol concentrations were available for 137 (58%) of the deaths and alcohol appeared to contribute to approximately 19% of these (25% for recreational activity). This percentage falls within the range highlighted in the review by Driscoll et al (2004) mentioned above. In the Finnish study, mortality and population data from Statistics Finland were used to determine drowning mortality rates (1970 – 2000) and individual level data from death certificates were analysed and cross-linked to a nationwide post-mortem toxicology database[44]. The results showed that 9279 unintentional drowning deaths occurred between 1970 and 2000. In boating-related drowning deaths, 78% of males and 71% of females had a BAC of ≥ 50mg/dl (0.05%)while in non-boating related drowning deaths, the respective values were 75% and 67%. Overall the strongest association with alcohol was observed in fall-related drowning deaths (83% of alcohol related drowning deaths). These percentages are notably higher than the Australian estimates and those of other countries. Even when the BAC cut-off was increased from 0.05% to 0.1%, as in the Australian study, the percentage of "alcohol positive" drowning deaths dropped only slightly from 68% to 65%[44].

Form the grey literature search, two eligible reports were identified[39 45]. In 2007, the International Life Saving Federation (ILS) published the first ever World Drowning Report[39]. This report presents drowning data from 16 countries for the year 2002, obtained from the WHO Global Burden of Disease database and summary statistics from the 2005 ILS survey (which used 2003 data). The

report highlights the consumption of alcohol as a contributing factor to drowning deaths. In Canada and the United States of America for instance, over 40% of men who had drowned while boating had consumed alcohol. In an unpublished report by the New Zealand Child and Youth Mortality Committee, the circumstances surrounding drowning in those under 25 in New Zealand (1980 – 2002) was described using data from DrownBase™[45]. In New Zealand, 28% (219/767) of young adult (aged 15 – 24) drowning deaths in the period 1980 to 2002 were considered to be alcohol related. Of alcohol related drowning deaths, 98 (45%) were due to motor vehicle incidents. The most common activities prior to death when alcohol was involved were 'immersion incidents" (N=55) and "swimming" (N=35)[45].

The main limitations of studies involving drowning and alcohol are particularly well outlined by Driscoll et al.(2004)[43]. Determining the role of alcohol can be problematic as it is difficult to know whether an individual might have survived an incident if they had not been affected by alcohol. Alcohol may not necessarily have played a causal role in an incident even if it is present (eg. a car being driven by a sober person leaving the road and rolling into a river resulting in the death by drowning of an alcohol-affected person)[43]. Blood alcohol concentrations can also rise after death due to the decomposition process or fall prior to death due to normal metabolic processes. It is important, therefore, to know the time of the incident, the time the blood sample was taken and the time that the death occurred[43]. 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.

Lack of Quality Supervision

Lack of quality parental supervision is an important modifiable risk factor for drowning incidents in children[5 8 40 46]. Lack of quality supervision combined with the easy access to water in developed countries such as Australia, New Zealand, Germany and Canada heighten the risk of drowning[46]. Two descriptive studies in the scientific literature met the eligibility criteria for potential risk factors, both examining factors related to accidental immersion in children[47 48]. From the grey literature search, a retrospective analysis from the Child Death Review Unit of British Columbia was eligible[49].

Somers (2006) investigated the factors associated with bathtub drownings by retrospectively reviewing autopsy records for cases of drowning over a 20 year period (1984 – 2003) in Ontario, Canada[48]. Eighteen consecutive cases of bathtub drownings were identified with the mean age of the victims being 17 months, with most cases occurring in infants aged less than 12 months (72%).

In 16 of the 18 deaths (89%) the child had been left unsupervised for up to 20 minutes. Thirty-nine percent of the victims had been co-bathing with siblings and 17% had been using bath seats. The drowning deaths of young children (aged 0 – 5years) in Victoria, Australia over a 13 year period (1989 – 2001) were examined in a second study[47]. Cases in which the child drowned in a dam were extracted for analysis. Out of the 27 deaths, 74% were male and aged between 1 and 3 years. Constant visual supervision was absent in all cases and was found by the coroner to be the primary contributing factor in all of the deaths. Other major factors were the lack of effective barriers between the dam and the child, the child was playing outside the house, the dam was within 300 metres of where the child was playing and stage of the child's development of motor skills[47]. The authors suggest that the results support the implementation of strategies such as promotion of child safe play areas and targeted public awareness campaigns for rural and regional aquatic environments[47].

Parental attitudes, beliefs and practices with regard to bathing their children were studied in a convenience sample of caregivers presenting to the paediatric emergency department of a children's hospital from May 2002 to November 2003[50]. During the study period, 136 families representing 209 children participated in the cross-sectional study. The majority of respondents (119/136 = 87%) believed that a 6-12 month old child could *never* safely be left alone in a bathtub but 6% replied that they *could* be left for less than 1 minute and 5% had left a 6-12 month old child they were bathing alone in the tub while they left the bathroom. Sixteen percent of caregivers said that they would be more willing to leave a 6-12 month old child with an older sibling alone in the bathtub and 11% reported that they had done this in the past. Sixty-six percent of the caregivers said that they knew how to perform CPR but only 44% knew infant CPR. Out of those who reported not knowing how to perform CPR, 91% said they would take free 2 hour CPR course if offered[50]. This study indicates that the uptake of drowning prevention measures such as learning infant CPR skills and messages such as promoting constant adult supervision when bathing infants and young children could be improved.

The Child Death Review Unit of British Columbia reviewed 33 child (0 – 18 years) deaths based on available information found in the coroner's case file[49]. The years in which these deaths occurred were not stated. Out of the 33 cases, 17 involved factors relating to water safety. In 13 out of the 17 cases, lack of supervision was determined to be the critical factor.

Use of Infant Bath Seats

To investigate the possible role of infant bathtub seats in fatal and non-fatal drowning incidents in South Australia a review was conducted of the files of the Forensic Science Centre and Child

Protection Unit, Women's and Children's Hospital, Adelaide from 1988 to 2003[51]. A total of six cases of drowning occurred over the six-year period in children under two years of age. There was one fatal case and two non-fatal cases associated with bathseat use and lack of supervision and three non-fatal cases not associated with bath seats. The results of this study suggests that bath seats may be associated with a lack of supervision, however the study size is small and the supervision status of the other three cases of near-drowning was not given.

In another study, the RoSPA/RLSSA UK database of cases of children aged under two years drowning in the bath between 1989 and 2003 were examined[52]. There were six cases of babies under 2 years of age who drowned in the bath while using a bath seat. This compared with 47 children of a similar age drowning in the bath not associated with a bath seat. All the babies in bath seats and the vast majority of babies not in bath seats were unsupervised at the time[52]. The authors state that a baby drowning after being placed in a bath seat is a rare but definite cause of death but it is unclear whether it represents an increased risk of drowning compared with a baby without a seat. They further state that it is the lack of supervision that is the main risk to babies in the bath.

Risk-Taking Behaviour

Risk-taking behaviour is an important factor in unintentional injury occurrence[5]. In a New Zealand study the usual water-related behaviour and non-fatal drowning incidents in a cohort of young adults (N = 1073) was evaluated [53]. The aim of the study was to describe water-related factors such as water-confidence, exposure to risk environments, safety and risk behaviours, and examine the association between these factors and a non-fatal drowning experience. Non-fatal drowning was defined by asking participants whether, in the last three year, they had any experience on, in, or near the water when they were afraid they might drown. The results showed that sixteen percent of the cohort reported being involved in non-boating water-related activities within two hours of drinking alcohol in the year prior to being interviewed for the study. A total of 169 non-fatal drowning incidents were reported by 141 cohort members, with 36% of these incidents occurring while swimming. The largest proportion of these incidents occurred at a beach and when they were caught in a rip or knocked over by waves (reported in 16 (27%)). For males, the only explanatory factor significantly associated with being involved in a non-fatal drowning incident was exposure to risk environments. For females, the only significant factor was that those who reported a non-fatal drowning incident were significantly more likely to report boating within two hours of consuming alcohol. Two of seven diving incidents reported by cohort members occurred as a result of the diver becoming fatigued, or because they had gone too deep in their dive. The results also showed that

those young adults who were more 'confident' in the water were more likely to participate in activities in unsafe water locations such as the harbour and the open sea than those who were not so confident. 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. One of the limitations of this study was that the amount of alcohol consumed was not requested.

Adverse climatic conditions substantially increase the risk of drowning deaths[5] and although this is a not a modifiable factor, the behaviour of people during such events potentially is. Thirteen flood events from Europe and the United States resulting in 247 fatalities were analysed[54]. Approximately two-thirds of the deaths occurred through drowning and 70% involved males. Vehicle-related drowning occurred most frequently (N=81, 33% of total deaths) and mainly when people were trying to drive across flooded bridges, roads or streams. This study shows that a significant numbers of flood deaths are attributable to unnecessarily risky behaviour. In the unpublished report by the Child Death Review Unit of British Columbia it was reported that nine children out the 33 died as a result of eight motor vehicle incidents in which the vehicle became submerged in water[49]. 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.

The previous review by Chalmers et al. (2004) reported no analytical studies of risk factors for recreational underwater diving or recreational land-based fishing for the period 1990 – 2003. A recent study by McClelland (2007) retrospectively analysed diving-related fatalities for the period January 2000 to December 2006 using Water Safety New Zealand's Drownbase ™ data[55]. The circumstances of each case, the method of the accident investigation and the coroner's reports were reviewed. In total, 56 diving-related fatalities (40 scuba divers and 16 snorkellers) were identified and analysed. Of the 40 scuba divers, 50% were inexperienced (less than 2 years of experience) and only 40% were following standard safe diving practice and diving with a buddy at the time of the incident. Eleven out of the 40 scuba divers were solo diving and in 13 other cases buddy separation had occurred. Thirty percent (12 out of 40) had significant medical conditions that may have disqualified them from diving.

4.3 Summary of modifiable risk factors

Alcohol use, lack of parental supervision, use of bath seats and risk-taking behaviour or combinations of these were the *main* modifiable potential risk factors for drowning and near-

drowning identified in the studies examined from 2004 to the present. Alcohol use was shown to be factor in unintentional fatal and non-fatal drowning incidents associated with recreational swimming and non-recreational immersion. Lack of parental supervision was related to the use of bath seats and both were shown to be factor in non-recreational immersion incidents. Risk-taking behaviour was associated with recreational swimming and non-recreational immersion incidents including motor-vehicle incidents and recreational underwater diving. In the particular case of scuba diving, risk-taking behaviours such as solo diving, buddy separation and underlying medical conditions were linked to fatal drownings. Case-control studies or other studies using analytical study designs would be necessary to further elucidate the extent to which all of these factors *increase* the risk of death from drowning. It is likely that alcohol interacts with the other risk factors mentioned here and this warrants further attention. Campaigns targeting alcohol use around, in or on water have the potential to cut across activity groups.

4.4 Summary of International Water Safety Policies and Programs

The results from the grey literature search relevant to the above two questions are shown in Tables 5, 6, 7 and 8 and in a more detailed format in Appendices III to VII. Since 2004, the Australian Water Safety Council has been carrying out annual audits of Australian water safety programs. The latest audit was used to provide all of the input for Australia [56]. For the other countries, the information was often sourced from more than one grey literature document and therefore, for ease of reading the providers of the program, intervention or strategy are shown in Appendix III rather than in the references. In New Zealand, it should be noted that there is a program database on the New Zealand Injury Prevention Strategy website (http://db.nzips.govt.nz/index.htm) that contains national and local injury prevention and safety initiatives. A Drowning/Near-Drowning Prevention (Water Safety) Stocktake was carried out in New Zealand in 2004 by the Injury Prevention Research Centre at the University of Auckland [57]. But Australia appears to be the only country out of those examined that is undertaking regular planned audits of Water Safety Programs.

Limitations

Tables 5 - 8 include those policies, programs and strategies that are ongoing but the list may not be complete, for several reasons. Only websites with English content were used and this is one likely reason for the apparent dearth of water safety programs and policies revealed in the search of Scandinavian sites. Not all water safety policies, interventions or programs for every country are necessarily put on the web and some websites may not have been up to date at the time of the

search. The results provide a general overview of the main international water safety initiatives but they are not likely to provide an exhaustive list. Appendices III - VII provide more detail of the policies and programs shown in Tables 5-7.

Overall, it is clear that New Zealand and Australia are the two most active countries with regard to water safety initiatives of the countries included in this comparison. Both New Zealand and Australia have national injury prevention strategies, drowning prevention strategies (New Zealand)/water safety plans (Australia) and pool fencing legislation. Both countries offer educational swimming programs for infants and children or as part of the school curriculum, lifesaving training programs and training courses for teachers of aquatic skills. Public awareness campaigns such as "Keep Watch" and "Kids Alive – Do the Five Program" in Australia and "Under Five Water Wise" in New Zealand have targeted parents with children aged less than five years in an attempt to reduce water related incidents. "Beach education" outreach programs in NZ and "Telstra Beach to Bush Surf Safety Programs" and "Surf Education" programs in Australia have introduced children aged 5 to 14 years to beach and surf safety using practical and theoretical based approaches.

In New Zealand, there are also ethnic-specific strategies (Maori Water Safety Campaign and the Pacific Peoples Water Safety Strategy) reflecting an overrepresentation of Maori in drowning statistics[7], environment-specific educational drowning prevention initiatives such as ACC RiverSafe and ACC PoolSafe, and activity-specific educational programs such as SailSafe. Australia has a community awareness program for Culturally and Linguistically Diverse Communities (CALD) across Australia where consultation is held prior to a water safety program commencing, to determine water-related issues that are of concern in each of the major ethnic communities. FarmSafe Australia is also actively involved in promotional and educational activity regarding child (water) safety on farms, and Surfing Australia carries out safe surfing promotional activity and educational courses. Australia has legislation restricting blood alcohol concentrations for recreational boat operators that is supported with random breath testing in four states: South Australia, Queensland, Western Australia and Victoria[58]. The paper reporting this legislation was identified in the scientific literature search and not the grey literature. It appears that the search strategy used in this review, with its focus on "drowning" and "drowning prevention" failed to pick up relevant information concerning water safety and boating, in particular alcohol restricting legislation.

For the period 2000 – 2002, Canada, the U.S.A. and Australia had the same age-standardised death rate from drowning at 1.4 per 100, 000 population (Connor et al. 2007), yet these countries differ vastly in their level of dedication to water safety initiatives, at least at the national level. There is currently a *proposed* Injury Prevention Strategy for Canada (2005) and Safe Kids Canada recently released a position statement in May 2007 regarding the need for safer (4-sided) pool fencing as this is not required in most states in Canada. The Lifesaving Society of Canada has an Injury Control Strategy and offers lifesaving programs very similar to those found in New Zealand and Australia. However, few national water safety community awareness/marketing campaigns or educational initiatives are carried out in Canada. The Swim to Survive™ Program aims to teach children in schools the essentials for survival in water and an unexpected fall into deep water, and the Water Smart™ Campaign delivers personal lifesaving educational messages to target groups: parents of children 2-4 years and male adults 18-49 years. The results of this search have shown that the U.S.A. puts little effort into water safety, at least at a national level. However, the story could well be different if statewide water safety initiatives were examined. Of major note with regard to the U.S.A. is the new Pool and Spa Safety Act (2007) that takes effect on December 19, 2008. This federal law requires all pools and spas to be equipped with anti-entrapment devices or systems that comply with a performance standard.

The search of water safety policies and programs in the United Kingdom (UK) revealed a National Water Safety Forum in the UK with six advisory groups relating to: 1) Beach Safety; 2) Inland Water Safety; 3) Sea Safety; 4) Swimming Pool Safety; 5)Water Sports Safety and 6) Water Safety at Home. The role of the Forum is to be the natural body in which organisations involved in water safety will participate in order to have a strong voice with Government on water safety issues. The Forum is primarily concerned with preventive action and water safety education rather than search and rescue. It advises and comments on legislation but is not directly involved in regulatory or enforcement activity. The Irish Water Safety Association is a statutory body of 12 members and has the role of educating people in water safety best practices. Aquatics is a component of the Physical Education Strand of the Primary School Curriculum in Ireland and the Irish Water Safety Association has developed a course that incorporates all aspects of the Aquatics Strand – called PAWS (Primary Aquatics Water Safety). This programme was specially tailored for primary school pupils and is exclusive to schools.

EuroSafe is the European Association for Injury Prevention and Safety Promotion. The mission statement of EuroSafe is to reduce both intentional and unintentional fatal and non-fatal injuries through increased coordination and strategies that combine and build upon existing strengths and

capacities. The European Child Safety Alliance (ECSA) is a program of EuroSafe with the mission to advance child injury prevention throughout Europe by enhancing the quality of children's lives through the power of reason, solidarity and compassion. The "Be Water Wise" campaign is a drowning prevention and water safety campaign of the ECSA. The campaign was first launched in 2003 with the support of Johnson and Johnson. In 2005 to 2007, support was received from the European Commission to extend water safety promotion with the participation of Austria, Belgium, Denmark, Estonia, France, Iceland, Israel, Germany, Greece, Italy, Malta, the Netherlands, Northern Ireland, Norway, Poland, Portugal, Scotland, Spain, Sweden, Switzerland and the United Kingdom. The key campaign messages are to: Actively supervise all young children; Teach your children how to swim; Everyone must wear a personal flotation device (lifejacket) when boating or fishing; Get trained in CPR (Cardio-Pulmonary Resuscitation); Use pools that are fenced with locking gates and Teach children never to swim alone. The ECSA also has an Action Plan for Child Safety (i.e. a policy document identifying drowning as one of nine priority safety areas relevant to children and adolescents). On July 14, 2008 the ECSA, EuroSafe launched a new resource entitled "Protecting children and youth in water recreation: safety guidelines for service providers". This is outlined in the horizon scan in section 4.4 of this review.

In the International Life Saving Federation (ILS) World Drowning Report it is stated that prevention programs should encompass strategies to address the need of high-risk target groups and focus on: 1) Environmental modification - removing hazards or creating barriers; 2) Protecting those at risk (children under 5 years, men aged 18 – 49 years) by promoting change in risk taking and supervision, and promoting swim and lifesaving skills development; and 3) Training the general community in water safety and resuscitation [39]. The ILS further proposes that messages should focus on behaviour change; that messages for parents of young children should focus on their responsibility to minimize and restrict water hazards and closely supervise their children when they are near water – "Stay within arms' reach"; and messages for men should focus on communicating the need for abstaining from alcohol when swimming and boating, the need to wear lifejackets when boating and the need to learn boating safety rules[39]. New Zealand and Australia are promoting all of these messages, with one exception. Given the accumulating evidence highlighting the involvement of alcohol in adolescent and adult drowning (section 4.2 of this review and horizon scan results reported in section 5), the major gap in water safety policies and drowning prevention campaigns in the all of the countries examined are those related to alcohol use in and around water, particularly in young men. More analytical research on the relationship between alcohol and drowning is necessary to assist in the understanding of this issue. Also needed are evaluations of

the effect of national legislation restricting alcohol use in aquatic environments on fatal and non-fatal drowning statistics.

Table 5 Summary of national injury prevention and water safety strategies

	New Zealand	Australia	Canada	United Kingdom	Scandinavia	U.S.A
Injury Prevention Strategies	•New Zealand Injury Prevention Strategy 2003	•National Injury Prevention and Safety Promotion Plan 2004 - 2014	•(Proposal)Ending Canada's Invisible Epidemic: A Strategy for Injury Prevention 2005	•Action Plan for Child Safety 2007 •Child Safety Good Practice Guide		
Water Safety National Strategies/ Plans/Forums/ Councils	•Drowning Prevention Strategy: Towards a Water Safe New Zealand 2005 - 2015 •Drowning Prevention Council •Pacific Peoples Water Safety Strategy 2008	•National Water Safety Plan 2004 - 2007 •National Marine Safety Strategy 1998	•Lifesaving Society's Injury Control Strategy 2004	•National Water Safety Forum (UK) •Irish Water Safety Association		

Table 6 Summary of national water safety legislation/policies/position statements

	New Zealand	Australia	Canada	United Kingdom	Scandinavia	U.S.A
Legislation/ Standards/ Policies/ Position Statements	•Fencing of Swimming Pools Act 1987 •The Safety Barriers and Fences around Swimming Pools, Spas and Hot Tubs Standard (NZS 8500:2006) •Water Safety Signage Standard NZS 8690:2003 •ACC PoolSafe Quality Management Scheme •Pool Alone Policy	•Pool Fencing Legislation 1991 •Australian standards AS1226.1 (1993) and AS1926.2 (1995) developed to ensure compliance with pool fencing requirements. •Maximum blood alcohol concentrations for recreational boat operators in four states		•International Lifesaving Federation Position Statements		•Pool and Spa Safety Act 2007 •Policy Statement: Prevention of Drowning in Infants, Children and Adolescents •Swimming Pool Barrier Guidelines

Table 7 Summary of national water safety community and marketing campaigns

	New Zealand	Australia	Canada	United Kingdom	Scandinavia	U.S.A
Community Awareness/ Guides/ Marketing Campaigns and Programs	•Maori Water Safety Campaign •Swim for Life™ Campaign •Integrated Aquatic Program (IAP) •Stay on Top Campaigns (PFD, communications equipment) •Pool Safety – Your Pool Your Responsibility •ACC PoolSafe •Safe Summer Campaigns •Under Five Water Wise	•Keep Watch (Child Safety on Farms) •Telstra Beach to Bush Surf Safety Program •Work with Culturally and Linguistically Diverse (CALD) communities across Australia •Pool fencing for preventing children from drowning •Aquatic and Recreational Signage Style Guide	•Water Smart Campaign	•Guidelines for safe and recreational water environments: Volume 1: Coastal and Fresh Waters •Guidelines for safe and recreational water environments: Volume 2: Swimming Pools and Similar Environments •Be Water Wise Campaign •Get Safe for Summer Campaign •Government Garden Pond Safety Campaign		•Safekids U.S.A. Kids Don't Float Campaign •Beach Safety Week

Table 8 Summary of national water safety educational campaigns and training courses

	New Zealand	Australia	Canada	United Kingdom	Scandinavia	U.S.A
Educational/ Training Courses	•ACC RiverSafe Junior •ACC RiverSafe Senior •Be WaterWise Programmes •Beach Education •BoatSafe •Recreational boating courses •Integrated Aquatic Program (IAP) •In at the Deep End •Royal Lifesaving Society Education •Safe Boating – an essential guide •Safe Fishing •SailSafe •SwimStart •WaterSense •WaterSmart	•Australasian-Oceania Swimming Professional Convention •AUSTSWIM teacher of swimming and water safety (TSW) •Royal Lifesaving Society Australia Education •Safe Surfing Australia •Spring-into-Summer Seminar Series •Surf Education •Swim and Survive •Swim TOUR:National Seminar Series	•Swim for Life™ •Canadian Lifesaving Education •Swim to Survive™	•Primary Aquatic Water Safety (PAWS)		

5. Horizon Scan Findings

The horizon scan revealed some important publications that should be highlighted and these are outlined below. Two New Zealand studies by Kevin Moran from WaterSafe Auckland came to light and are presented below along with a New Zealand pilot study of a targeted ethnic-specific program.

Bierens J.J.L.M (ed). *Handbook on Drowning: Prevention, Rescue, Treatment*. Berlin: Springer-Verlag, 2006[5]

In 2006, the Handbook on Drowning edited by J.J.L.M. Bierens was published. This book provides a compilation of the results of the World Congress on Drowning held in Amsterdam, in the Netherlands in June 2002. It covers most areas related to drowning including: epidemiology, prevention, rescue, resuscitation, hospital treatment and investigation of drowning incidents, and includes the definition of drowning agreed upon during the congress. That is, "Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid"[5].

The final recommendations on the issues of drowning prevention, rescue and treatment made at the World Congress are also published in the 2006 handbook. These are:

1. A new, more appropriate, world-wide uniform definition of drowning must be adopted.
2. There is a great need of adequate and reliable international registrations of drowning incidents.
3. More data must be collected and knowledge gained about drowning in low-income countries and societies.
4. Preventive strategies and collaboration are needed.
5. All individuals, and particularly police officers and fire fighters, must learn to swim.
6. Rescue techniques must be investigated.
7. Basic resuscitation skills must be learned by all volunteer and professional rescuers as well as lay persons who frequent aquatic areas or supervise other in water environment.
8. Uniform glossary of definitions and a uniform reporting of drowning resuscitation must be developed and used.
9. Hospital treatment of the severe drowning victim must be concentrated.

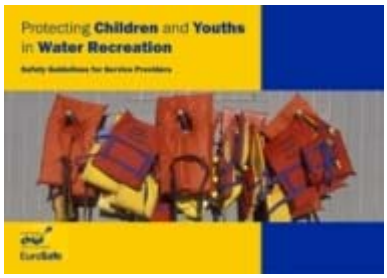
10. Treatment of the patient with brain injury resulting from cardiopulmonary arrest attributable to drowning must be based on scientific evidence. Due to the absence of interventional outcome studies in human drowning victims, current therapeutic strategies must be extrapolated from studies of humans or animals having similar forms of acute brain injury.

11. Wearing of appropriate and insulating life jackets must be promoted.

12. The balance between safety and profitability or recreational diving must remain critically observed.

13. Safety of diving fishermen needs more attention.

Water safety guidelines for service providers - EuroSafe



On July 14, 2008 the European Child Safety Alliance, EuroSafe launched a new resource entitled "Protecting children and youth in water recreation: safety guidelines for service providers." in co-operation with the Commissioner of Consumers, Meglena Kuneva, and Chair of the Internal Market and Consumers Protection Committee, Arlene McCarthy. This water safety resource is specifically tailored towards people working in the water recreation and tourism sectors to assist them in offering safe water related activities and services for children and families throughout Europe.

Commissioner Kuneva with Chair Arlene McCarthy

Developed with the support of the European Commission and in collaboration with professional water recreation associations and injury prevention experts across Europe, these guidelines provide informative facts on injuries and hazards, and outline specific safety recommendations for 13 common water settings and sports in order to encourage safe water related activities for children 0 - 18 years of age. The intent of the guidelines is to support those working in the water recreation industry throughout the European Union – whether as hotel managers, rental providers or tour operators – to fulfill their responsibilities for safe services. Implementation of the guideline recommendations will enhance good safety practices that will help to save children's lives.

(From http://www.eurosafe.eu.com/)

World report on child injury prevention

WHO and UNICEF are collaborating on the development of a *World Report on child injury prevention*. The document, like the *World report on violence and health* and the *World Report on road traffic injury prevention*, will be an important advocacy tool as well as a science-based report on what is known about child and adolescent injuries and how these injuries might be prevented.

The report will cover the following topics and is due for release 10th December, 2008:

- Child injuries in context
- Road traffic injuries
- Burns and scalds
- **Drowning and non-fatal drowning**
- Falls
- Poisoning

(From: http://www.who.int/violence_injury_prevention/child/injury/world_report/en/)

Asian and Pasifika Youth Water Safety Pilot Study

WaterSafe Auckland in association with ACC has initiated a pilot study in which 312 Year 9 and 10 students of mixed ethnicities developed core practical water safety skills while meeting specific ethnic needs. The students participated in four practical and four theoretical lessons during term one and all completed a questionnaire pre- and post-test. Results showed a 68% improvement in water confidence as a result of wearing a life jacke, and 80% of Asian and 67% of Pasifika students reported an improvement in personal water safety knowledge.

(From http://www.watersafe.org.nz/)

Moran, K. And Mills, C. (2008) Do Alcohol and Aquatic Mix? The Context of Youth Alcohol Consumption and Aquatic Recreation. Auckland: WaterSafe Auckland Inc[13].

This was a New Zealand research project that examined the context in which youth alcohol consumption and aquatic recreation occurs. Focus group sessions were used: 1) To ascertain the personal experiences and observations of youth with regards to the use of alcohol, in, on and around water; 2) To examine the contexts, both social and situational, in which alcohol consumption and aquatic activity occurred; 3) To identify at risk behaviours and make recommendations to promote safe practice among youth around water and when engaged in aquatic recreation. Twenty-one participants (8 males and 13 females) took part ranging in age from 15 to 17. From the results, the following recommendations were made:

To WaterSafe Auckland and injury prevention and other water safety organisations:

1. Highlight the dangers of mixing alcohol consumption and aquatic activity amongst youth and make it a key priority area for action.
2. Investigate possible education campaigns, especially those focused on young adult males that promote self safety rather than reliance on others.
3. Educate parents about correct supervisory behaviour where alcohol is involved, and the importance of parents promoting safe youth behaviours around water.

To local territorial authorities:

4. Investigate procedures in place around alcohol free public events.
5. Investigate current risk management practices implemented at public events near water.
6. Investigate potential safer alternatives for underage youth during the New Year period celebrations.

To Alcohol Healthwatch and other alcohol advisory groups:

7. Advocate for stronger monitoring and safety policies at public events, especially alcohol free events and events near water.
8. Advocate for stronger enforcement of legal purchase age identification.

Moran, K. (2008). Water safety and Auckland's West Coast Fishers – Final Report 2008. Report to the Auckland Regional Council, Surf Life Saving Northern Region and Water Safe Auckland Inc. Auckland: WaterSafe Auckland[14].

The Auckland Regional Council (ARC), WaterSafe Auckland Inc (WAI) and Surf Life Saving Northern Region (SLNR) jointly conducted the final year of a 3-year project that built on the rock fishing safety campaign entitled West Coast Fishing Safety initiated in the summer of 2006 and developed in 2007. This report followed on from two previous ones [59 60]. The aims of the final report were: 1) to continue on-site rock fishing safety education promotion in 2006-07; 2) to determine the effect of the project on Auckland's west coast fishers' safety practices and beliefs and; 3) to make recommendations for future rock fishing safety promotion[14]. A cross-sectional study of 235 fishers at high risk locations on Auckland's West Coast was undertaken at the end of the summer safety campaign in April 2008. A written questionnaire was used to obtain information regarding whether the fishers had taken part in the 2006/07 campaign by ARC, WAI and SLNR, if they were aware of the follow-up 2008 fishing safety promotion, and their opinions on recently installed safety signage and the possible placement of angel rings (flotation aids) at high risk sites. Two thirds (65%) of fishers had seen the new on-site safety signage and of these, 79% considered them to be highly successful/successful. More than half (57%) considered the installation of angel rings at high risk sites to be essential. Over the course of the campaign, fewer fishers reported never wearing a life jacket (2006, 72% / 2008, 52%) and more reported wearing them often (2006, 4% / 2008, 22%). However, more than half of fishers (53%) reported *never* wearing any life jackets or flotation aids. Almost half (44%) of fishers in 2008 reported *sometimes* or *often* consuming alcohol while fishing. The rock fishing community was shown to be predominately male (86% - 92%) with almost half of the respondents of Asian origin (455 – 49%), transient in their participation in rock fishing and 25% of fishers were of recent residency. The author suggests that any of the above factors may make the task of changing risky attitudes and behaviour challenging [14]. From the results of the study, nine detailed recommendations are made.

6. Conclusions and Recommendations

This review has updated and contributed to the evidence and knowledge base that is expected to be central to the effective targeting of available resources and the development of innovative ways to prevent drowning in New Zealand [7]. Several aims of objective 4 of New Zealand's Drowning Prevention Strategy have been addressed including the maintenance of our knowledge of risk factors, national and international water safety research, and of existing water safety interventions, programmes and policies. Summaries applicable to each review question are presented at the end of each section of this review.

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. This review has shown that this knowledge gap 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. However, alcohol use, lack of parental supervision, use of bath seats and risk taking behaviour were the main modifiable potential risk factors for drowning in the four activity areas identified in this review. Chalmers et al. (2004) also stated that scientifically robust evaluations of existing interventions such as swimming lessons and potential interventions such as those proposed for reducing alcohol use in association with swimming were needed. Once again this need has not changed since the last review.

Ten recommendations were made by Chalmers et al. (2004) based on a synthesis of their review. Six of those ten recommendations were beyond the scope of this review. Out of the remaining four recommendations, three have been addressed since 2004. These were Recommendations 1, 2 and 6. *Recommendation 1* was that swimming and diving (including pool activities), boating and fishing should be given first priority in the development of a national strategy for the prevention of drowning, near drowning and other water-related injury. These activities have been since been identified in the Drowning Prevention Strategy as priority areas for action [7]. *Recommendation 2* was that research be undertaken to confirm the role of gender, age, alcohol consumption and reckless behaviour as factors in swimming-related drowning, near-drowning and other injury. Non-modifiable risk factors such as age and gender were not included in this review but alcohol consumption and reckless behaviour were two modifiable potential risk factors for drowning that have attracted research attention in the last few years. The present review (section 4.2) highlighted one New Zealand study on usual water-related behaviour (safety and risk behaviours) and the association with a near-drowning experience [53]. There has been one review of alcohol and drowning[42], two retrospective analyses of drowning deaths and their association with alcohol[43 44],

and one study examining the context in which youth alcohol consumption and aquatic recreation occurs [13] since 2004. *Recommendation 6* was to undertake an evaluation of current levels of enforcement and compliance in New Zealand, to identify barriers to compliance, and compare findings with the findings of previous evaluations[8]. Two investigations of barriers to compliance and enforcement of pool fencing have been carried out in Australia and New Zealand. In those studies, inspection programs were shown to facilitate compliance to pool fencing legislation[29], while the cost of fencing, lack of fencing options and the lack of knowledge of the law were some of barriers that were identified[35].

The remaining recommendation from the previous review, as identified below (*Recommendation 1*) should continue as a target area for research activities and several further recommendations are made from the present review:

Recommendations

A clear protective effect of learning to swim on the risk of drowning has not yet been demonstrated[6].

> ***Recommendation 1*:** Research be undertaken to investigate the effect of swimming ability on the risk of drowning and near-drowning, and to assess the contention that improved swimming ability may raise the risk of adverse outcomes [8].

The World Health Organisation states that alcohol consumption is one of the most frequently reported contributory factors associated with adolescent and adult drowning in many countries [40]. In New Zealand 28% (219/767) of young adult drowning deaths (aged 15 – 24) between 1980 and 2002 were considered to be alcohol related[45]. Water safety initiatives concerning alcohol use around aquatic areas are lacking both in New Zealand, and internationally.

> ***Recommendation 2*:** That research be undertaken to examine the contexts, attitudes and behaviour towards alcohol use by demographic groups in aquatic environments in New Zealand.

> ***Recommendation 3*:** That research be undertaken to investigate the effect of alcohol consumption on the risk of drowning/near-drowning and the relationship of alcohol consumption to other risk factors such as parental supervision and risk taking behavior.

***Recommendation 4*:** That an international comparison be undertaken of the adoption of alcohol restricting legislation and campaigns relating to water safety in countries other than New Zealand and a review of the impacts of such interventions.

***Recommendation 5*:** Development of a program and/or campaign related to alcohol use around, in and on the water, particularly in the target demographic of male youth aged 15 – 24 years.

The Australian Water Safety Council are undertaking annual audits of their national, statewide and local water safety programs to provide an index of programs, services and resources [56]. Such an audit in New Zealand would be helpful in informing future programs and would assist in making a coordinated approach to water safety and water safety research.

***Recommendation 6*:** That annual audits be undertaken of water safety programs, campaigns and policies in place in New Zealand to aid in making a coordinated approach to water safety.

Two studies in this review have highlighted in different ways the misconception held my many parents/caregivers that swimming lessons or people *other than* parents/caregivers provide better protection for their children near water than supervision from parents/caregivers [4 33]. Around 52 Parents Centres in New Zealand are the primary providers of antenatal education and childbirth support in New Zealand (www.parentscentre.org.nz/). Water safety education is not currently a major feature of any of the ante- or post-natal courses offered by the parent centres, and as such, is an under-utilized resource.

Recommendation 8: That research be undertaken to identify possible barriers and facilitators to parental/caregiver supervision of babies and children around water.

***Recommendation 9*:** The development and pilot evaluation of a short targeted education program for new parents surrounding supervision of babies and children around water as part of antenatal classes.

Although there were limitations with the study, the finding suggesting that recognition of a submerged manikin is improved when swimming pool bottoms are coloured white (as opposed to

darker colours) and when lifeguards perform walking patrols (as opposed to sitting on elevated stands) [36] is an area worth pursuing.

> ***Recommendation 10*:** That well-designed experimental research be undertaken to assess barriers to lifeguard recognition of submerged "victims" including pool bottom colour and position and movement of the lifeguard.

APPENDIX I Scientific Literature Review Search Strategies

MEDLINE
Advanced Search, using MeSH

1 exp Accident Prevention/ (26189)
2 Primary Prevention/ (6641)
3 Exp Risk/ (345410)
4 Public Health/ (19244)
5 Health Education/ (15453)
6 Risk-Taking/ (8300)
7 Health Promotion/ (20791)
8 Health Knowledge, Attitudes, Practice/ (30319)
9 Immersion/ae [Adverse Effects] (143)
10 Exp Drowning/
11 1or 2 or 3 or 4 or 5 or 6 or 7 or 8 (439978)
12 9 or 10 (873)
13 11 and 12
14 Limit 13 to (English language and humans and yr="2004-2008")

BASIC Search (natural language)

15 prevention of drowning and near-drowning (Including related terms) (285)
16 limit 15 to (English language and humans and yr+"2004-2008") (104)
17 14 or 16

EMBASE

Ovid Syntax Search

1. risk/ (16683)
2. Accident prevention/ (3967)
3. Primary Prevention/ (8448)
4. risk factor/ (182726)
5. Risk Reduction/ (17938)
6. Risk Management/ (8619)
7. high risk behaviour/ (1348)
8. Risk Assessment (144435)
9. High Risk Population/ (36544)
10. 'danger, risk, safety and related phenomena"/ (16)
11. health promotion (19541)
12. exp DROWNING / (1078)
13. IMMERSION/ (1349)
14. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 (372659)
15. 12 or 13 (2398)
16. 14 and 15 (289)
17. limit 16 to (human and English language and yr="2004-2008") (128)

BASIC Search (natural language)

18. prevention of drowning or near-drowning [61] (56)

19. limit 18 to (human and English language and yr=”2004-2008”) (16)
20. 17 or 19 (136)

SPORTDISCUS

1. DE “DROWNING” or DE “DROWNING—Prevention” (566)

2. drowning or “near drowning” (715)

3. DE “AQUATIC sports – Safety measures” or DE “AQUATIC sports injuries” or DE “BOATING injuries” or DE “CANOEING accidents” or DE “DIVING accidents” or DE “DIVING injuries” or DE “SCUBA diving injuries” or DE “SCUBA diving accidents” or DE “YACHTING accidents’ or DE “YACHTING injuries” (400)

4. DE “AQUATIC sports” or DE “BOATS & boating” or DE “CANOES & canoeing” or DE “FISHING” or DE “SWIMMERS” or DE “SWIMMING” or DE “SURF fishing” or DE “SURF skiing” or DE “SURFING” or DE “SCUBA diving” or DE “DIVING” or DE “KAYAKING” or DE “SEA kayaking” or DE “YACHTING” (51718)

5. DE “SAFETY” or DE “PREVENTION” (27607)

6. S1 or S2 (715)

7. S4 or S3 (51867)

8. S7 and S5 (1607)

9. S8 or S6 (2238)

10. Limit S9 to Year published from: 2004-2008; English Abstract Available; Language: English (259)

WEB OF KNOWLEDGE

Topic=(DROWNING OR DROWNINGS OR DROWNING OR DROWNINGS) AND
Topic=(PREVENTION OR SAFETY OR ACCIDENTPREVENTION OR PUBLICHEALTH OR HEALTHPROMOTION OR RISKBEHAVIORS OR RISKBEHAVIOUR OR RISKBEHAVIOURS OR RISKTAKING)
Timespan=Latest 5 years.
Refined by: Languages=(ENGLISH)

WEB OF SCIENCE

# 6	**79**	#5 OR #4 *Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=2004-2008*
# 5	**1**	#3 AND #1 *Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=2004-2008*
# 4	**78**	#2 AND #1 *Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=2004-2008*
# 3	**22**	Topic=("aquatic sport*") OR Topic=("water sport*") *Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=2004-2008*
# 2	**>100,000**	Topic=(safety) OR Topic=(prevention) OR Topic=("accident prevention") OR Topic=("public safety") OR Topic=("risk behavior*") OR Topic=("risk behaviour*") OR Topic=("safety campaign*") OR Topic=("health education") OR Topic=("safety education") OR Topic=("education program*") *Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=2004-2008*
# 1	**540**	Topic=(drowning) OR Topic=(near drowning) *Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=2004-2008*

SCOPUS

(TITLE-ABS-KEY(**drowning** OR **near drowning**)
AND TITLE-ABS-KEY(**prevention** OR **safety** OR **risk**))
AND PUBYEAR AFT **2003**
AND (LIMIT-TO(DOCTYPE, "**ar**")
OR LIMIT-TO(DOCTYPE, "**re**")
OR LIMIT-TO(DOCTYPE, "**cp**")) = 288

ERIC

#7 (drowning or "near drowning") or ((("Accident-Prevention" in DE) or (("Safety-" in DE) or ("Safety-Education" in DE))) and ("Aquatic-Sports" in DE))(19 records)
#6 (("Accident-Prevention" in DE) or (("Safety-" in DE) or ("Safety-Education" in DE))) and ("Aquatic-Sports" in DE)(2 records)
#5 ("Accident-Prevention" in DE) or (("Safety-" in DE) or ("Safety-Education" in DE))(617 records)
#4 drowning or "near drowning"(18 records)
#3 "Accident-Prevention" in DE(106 records)
#2 ("Safety-" in DE) or ("Safety-Education" in DE)(568 records)
#1 "Aquatic-Sports" in DE(41 records)

COCHRANE LIBRARY OF SYSTEMATIC REVIEWS

#1 MESH descriptor **Drowning** explode Trees 1 and 3 9
#2 (drowning) 61
#3 #1 OR #2 (from 2004 – 2008) 29

APPENDIX II Eligibility Criteria

Eligibility - Review Question 1

What drowning prevention interventions have been published (2004-present)?

Inclusion criteria (Review Question 1)

- Publication date (or report date) between 2004[4] and 2007 inclusive

- Language = English (includes substantial abstracts only in English)

- *Types of Participants*

  Study samples drawn from the general population from countries with relevance to NZ, defined as countries which have a drowning rate similar to NZ and/or are investing money in water safety research and drowning prevention initiatives.[5] These countries are Australia, Canada, Scandinavian Countries, the UK and the USA.

- *Type of Interventions/Exposures*

  Any form of primary or secondary drowning prevention strategy
  Any form of primary or secondary injury prevention strategy that includes drowning as an outcome measure

- *Types of Outcome Measures (any from the list below or any other relevant outcome)*

  Drowning rates
  Near-drowning rates/hospitalisation rates
  Risk of drowning calculation

  Water safety behaviour change

[4] To include any late publication for 2004 not included in the previous review.
[5] As agreed at the meeting of the steering committee 7th December 2007, Australia. Canada, Scandinavian Countries, the UK and the USA (specially named for the grey literature search but also to provide the focus of the scientific literature search)

Water safety knowledge

- *Study Designs (any from the list below)*

Systematic reviews

Meta-analysis including one or more eligible studies

Randomised controlled trials

Non-randomised controlled trials

Before and after studies

Cohort studies

Case-control studies

Cross-sectional studies comparing groups

Retrospective analysis comparing groups

Exclusion criteria (Review Question 1)

- Published before 2004
- Non- English article
- Country not relevant to NZ
- Study not relevant to the review question
- Published only as an abstract, letter, comment or editorial
- Case studies, case series, descriptive studies
- Any studies, papers or articles promoting, discussing or presenting drowning preventions strategies or technologies not meeting the above inclusion criteria in study design, will be excluded from this review question but considered for inclusion in review question 2.

Post hoc note: risk assessment/management, standards for risk assessment, hazards identification, knowledge transfer. These topics were not covered/mentioned by ACC in the original RFP or in IPRU's subsequent project plan.

Eligibility - Review Questions 2 & 3

What are the barriers and facilitators that determine the effectiveness of interventions?

What is the likely impact of, ethnicity, immigration, the environment, socioeconomic status, use of craft and behaviour patterns on the effectiveness of the interventions?

Inclusion criteria (Review Questions 2 & 3)

- Publication date (or report date) between 2004[6] and 2007 inclusive

- Language = English (includes substantial abstracts only in English)

- Studies/papers from countries with relevance to NZ, defined as countries which have a drowning rate similar to NZ and/or are investing money in water safety research and drowning prevention initiatives.[7] These countries are Australia, Canada, Scandinavian Countries, the UK and the USA.

- Studies/papers with relevance to the above review questions reporting a study, analysing data, reviewing studies or data or including substantial discussion of barriers or facilitators to drowning prevention interventions including ethnicity, immigration, environment, socioeconomic status, craft use and behaviour patterns.

Exclusion criteria (Review Questions 2 & 3)

- Published before 2004
- Non- English article
- Country not relevant to NZ
- Study not relevant to the review question
- Published only as an abstract, letter, comment or editorial
- Case studies

[6] To include any late publication for 2004 not included in the previous review.

[7] As agreed at the meeting of the steering committee 7th December 2007, Australia. Canada, Scandinavian Countries, the UK and the USA (specially named for the grey literature search but also to provide the focus of the scientific literature search)

Eligibility - Review Question 4

What are the major modifiable risk factors for unintentional[8] drowning as a result of

(a) non-recreational immersion incidents (including road vehicle incidents)

(b) recreational swimming

(c) recreational angling/net and shell fishing

(d) recreational underwater activities?

Inclusion criteria (Review Question 4)

- Publication date (or report date) between 2004[9] and 2007 inclusive

- Language = English (includes substantial abstracts only in English)

- *Types of Participants*

  Study samples drawn from the general population from countries with relevance to NZ, defined as countries which have a drowning rate similar to NZ and/or are investing money in water safety research and drowning prevention initiatives.[10] These countries are Australia, Canada, Scandinavian Countries, the UK and the USA.

- *Type of Interventions/Exposures*

  Any relevant and **modifiable** drowning risk or protective factors

- *Types of Outcome Measures (any from the list below or any other relevant outcomes)*

  Drowning numbers/rates

  Near-drowning rates/hospitalisation rates

  Risk of drowning calculation

  Water safety behaviour change

[8] Major categories taken from the 2006 Drowning Fact sheet, Water Safety New Zealand.

[9] To include any late publication for 2004 not included in the previous review.

[10] As agreed at the meeting of the steering committee 7th December 2007, Australia. Canada, Scandinavian Countries, the UK and the USA (specially named for the grey literature search but also to provide the focus of the scientific literature search)

Water safety knowledge

- *Study Designs (any from the list below)*

Systematic reviews

Meta-analysis including one or more eligible studies

Randomised controlled trials

Non-randomised controlled trials

Before and after studies

Cohort studies

Case-control studies

Potential risk factor study designs also included

Cross-sectional studies comparing groups

Retrospective analysis comparing groups

Large case series (>10 cases) with statistical analysis

Exclusion criteria (Review Question 4)

- Published before 2004
- Non- English article
- Country not relevant to NZ
- Study not relevant to the review question
- Published only as an abstract, letter, comment or editorial
- Case studies

Eligibility - Review Questions 5 & 6

What drowning prevention interventions have been proposed/promoted internationally?

What water safety policies and programmes are in place in countries similar to New Zealand?

Inclusion criteria (Review Questions 5 & 6)

- Publication date between 2004[11] and 2007 inclusive

- Language = English (includes substantial abstracts only in English)

- Studies/papers from countries with relevance to NZ, defined as countries which have a drowning rate similar to NZ and/or are investing money in water safety research and drowning prevention initiatives.[12] These countries are Australia, Canada, Scandinavian Countries, the UK and the USA.

- Studies/papers with relevance to the above review questions **reporting**, **reviewing**, **analysing** data or **including** substantial discussion of national or international water safety or drowning prevention policies and programmes or best practice guidelines for data collection/data items for national drowning databases.

Exclusion criteria (Review Questions 5 & 6)

- Published before 2004
- Non- English article
- Country not relevant to NZ
- Study not relevant to a review question
- Published only as an abstract, letter, comment, editorial or case study

[11] To include any late publication for 2004 not included in the previous review.
[12] As agreed at the meeting of the steering committee 7th December 2007, Australia. Canada, Scandinavian Countries, the UK and the USA (specially named for the grey literature search but also to provide the focus of the scientific literature search)

APPENDIX III Australian National Water Safety Policies and Programs

Program/Policy	Type/Info	Program Start Date	Provider
Aquatic and Recreational Signage Style Guide	Publication	2003	Surf Life Saving Australia and Royal Life Saving Australia (RLSSA)
Australasian-Oceania Swimming Professional Convention	Education: International and national lecturers present on various professional development topics for teachers of swimming and water safety.	1994	Australian Swimming Coaches and Teachers Association (ASCTA)
AUSTSWIM teacher of swimming and water safety (TSW)	Education: Core program plus 1. Teacher of Adults 2. Teacher of people with disability 3. Teacher of infant aquatics 4. Teacher of competitive strokes	1979	AUSTSWIM: The Australian Council for the Teaching of Swimming and Water Safety
Child safety on farms	Promotion and Education: Targeting farmers, farm managers, farm families. Elimination of water hazards, fenced safe play areas on farms as a support to supervision.	2002	Farmsafe Australia
Guidelines for Safe Pool Operation	Legislation/Standard	1991 in Victoria 1994 nationwide	RLSSA/LSV
Pool Fencing for preventing children from drowning	Prevention Activity	1985	RLSSA
1991 Pool Fencing Legislation. Australian Standards AS1226.1 (1993) AS1926.2 (1995),	Policy: requires that all owners of swimming pools for houses, flats and home units install and maintain a pool fence.	1991	Australian Government
Maximum blood alcohol concentration	Maximum blood alcohol concentrations		Australian Government

legislation for recreational boat operators.	(generally 0.05%) for recreational boat operators that is supported with random breath testing in four states; South Australia, Queensland, Western Australia and Victoria		
Keep Watch	Education/public awareness: Targets parents of 0 – 4 year old to supervise, restrict access to water (fencing), familiarize children to water, learn resuscitation.	1992	RLSSA
Kids Alive – Do the Five Program	Five point message promoted through a website: • Fence the pool • Shut the Gate • Teach your kids to swim, it's great • Supervise: Watch your mate • Learn how to resuscitate		Sponsored by safety gate hardware company D7D Technologies
Bronze and Rescue Awards	Education: Made up of rescue strands; Dry wade rescue, Wade rescue, Accompanied rescue, and bronze strands: Bronze Start, Bronze Medallion, and Bronze Cross. Main program is the bronze medallion for children >14 years.	1894 onwards	RLSSA
Infant Aquatics Water Familiarisation Program	Education for children 6 months to 4 years	2001 onwards	RLSSA
Junior Lifeguard Club	Education- swimming skills, community education, fitness, leadership, teamwork, competition, lifesaving knowledge	1996 onwards	RLSSA
Grey medallion	Water safety and lifesaving skills		RLSSA

	program for the over 55's		
Safe Surfing Australia	Education, prevention activity: Five level certificate course for anyone wanting to learn to ride a surfboard	2003 onwards	Surfing Australia Inc
Spring-into-Summer Swim Seminar Series	Educational seminars	2005 onwards (run during October and November)	Swim Australia
Surf Education	Education: Ages 5 – 14 years Surf safety, survival and awareness, water safety	1994 onwards	Surf Lifesaving Australia
Swim and Survive	Education: Swimming and water safety program for 5 to 14 year, six strands – Entries and exits, sculling and body orientation, movement and swimming strikes, survival and PFD skills, underwater skills, rescue skills.	1982 onwards	RLSSA
Swim TOUR: National Learn-to-Swim Seminar Tour	Education: Professional development for swim school teachers and managers	2001 onwards	Swim Australia
Telstra Beach to Bush Surf Safety Program	Community awareness: Ages 5 – 14 yrs Introduction to surf lifesaving, classroom based for school student in rural communities.	2001 onwards	SLSA
Work with Culturally and Linguistically Diverse (CALD) communities across Australia	Community Awareness: Community consultation is held prior to a program commencing to determine what water safety issues are a concern in each of the communities and what steps can be taken to help address these	2005 onwards	RLSSA

	concerns.		
National Water Safety Plan 2004 - 2007	Goal: Providing a coordinated and cooperative approach to Water Safety throughout Australia	2004	Australian Water Safety Council
National Injury Prevention and Safety Promotion Plan: 2004 - 2014	Goal: Achieve a positive safety culture and create safe environments	July 2005	National Public Health Partnership (NPHP)
National Marine Safety Strategy: A strategy for small commercial and recreational vessels in Australia	Main objective: To establish and sustain a harmonised national system which has as it's principle aim the protection of life in Australian waters	1998	National Marine Safety Committee

APPENDIX IV Canadian National Water Safety Policies and Programs

Swim to Survive™ Program	Educational: Teaching children in schools the essentials needed to survive an unexpected fall into deep water	2005	Lifesaving society of Canada
Canadian life saving Education	Educational: • Canadian Swim Patrol Program - Pre-Bronze Awards • Bronze Medal Awards • National Lifeguard Service® (NLS) Awards • Instructor Training • Examiner Training		Lifesaving society of Canada
Swim for Life™	Educational : • Personal self rescue skills to survive an incident • Water Smart® choices to reduce risks • Lifesaving skills to rescue others		Lifesaving society Canada
Water Smart™ campaign	Community Awareness/Educational: Delivers personal lifesaving education messages – target groups; parents of children 2-4 years and male adults 18-49 years of age		Lifesaving society Canada
Ending Canada's invisible epidemic: A Strategy for Injury Prevention 2005 (proposal)	Proposed Mission: To make Canada healthier through coordinated pan-Canadian strategies to reduce the frequency and severity of injuries and to improve health outcomes for those affected by injury.	2005	Prepared by SmartRisk and consultation partners

Lifesaving Society's Injury Control Strategy	Recommendations: 1. Water Smart Communities provide access to lifesaving education and training 2. All aquatic recreational facilities use National Lifeguard Service (NLS) trained lifeguards 3. Education curriculum mandates that every student receives Swim to Survive™ training	2004	Lifesaving society Canada
Position Statement: Pool Drowning and the Need for Safer Pool Fencing	Recommendations are made for safer fencing laws requiring a minimum 1.2 m high four-side fencing.	May 25, 2007	Safe Kids Canada

APPENDIX V New Zealand National Water Safety Policies and Programs

Program	Type/Info	Program Duration	Provider
Swim for Life ™	Learn to swim campaign: Initiative designed to get all New Zealand children to swim 200m by the age of 12 to prevent drowning and associated injury.	Term 1 of 2008	Water Safety New Zealand (WSNZ)
ACC RiverSafe Junior	Educational – NZ school curriculum year 7 and 8 students		WSNZ and ACC
ACC RiverSafe Senior	Educational – NZ school curriculum year 9 and 10 students		WSNZ and ACC
Be WaterWise Programmes	Educational – NZ school curriculum -primary school students • Safer play with Water (Early childhood) • Be safe near water (Years 1 & 2) • Think before you act (Years 5 & 6) • Make safe decisions (Years 7 & 8)		WSNZ
Beach Education	Educational: Outreach program for school children year 0 to 8. Uses a practical and theoretical based approach to teach children how to enjoy the beach environment safely and to introduce them to Surf Life Saving.		Surf Life Saving New Zealand
Recreational Boating Courses	Educational/Training; More than 40 core and specialty courses		Coastguard Boating Education
BoatSafe	Educational: Initiative aimed at reducing the number of water related injuries in and around boating activities.		WSNZ
In at the Deep End	Educational:		WaterSafe Auckland Inc

	Year 7 and 8 classroom and practical education to develop aquatic safety skills		
Integrated Aquatic Programme (IAP)	'Roadmap' for teachers so teachers can select the appropriate curriculum based program provided by the key safety stakeholders	Launched Feb 21 2006	WaterSafe Auckland, Surf Life Saving New Zealand, Swimming New Zealand, Coastguard Boating Eduation, New Zealand Waterwise, Yachting New Zealand
Stay on Top Campaign -PFD	Educational: Website		Maritime Safety New Zealand
Stay on Top Campaign -with communications equipment	Educational/Community Awareness: Television advertisements	October 2007	Maritime Safety New Zealand
Kayak Safety - Stay bright on top	Education re: visibility in water while kayaking		Maritime Safety New Zealand
Maori Water Safety Campaign	Short and long-term strategy developed. Kia Maanu, Kia Ora! Stay Afloat, Stay Alive! • Development of Maori Water Safety teachers education kit • Development and promotion of website • Radio adverts containing key water safety messages promoted by Maori role models • Development of printed material targeting specific groups within Maori communities • Development of regional water safety programmes throughout New Zealand in association with iwi.	Commenced June 2003	WSNZ
New Settler Safety Forum	Education to refugee adults in interactive workshops	Two full day workshops every second year and a one day refresher in	Communities Living Injury Free

		the intervening years	
ACC PoolSafe	PoolSafe initiatives include educational resources, public awareness campaigns and a Quality Management Scheme for public pools.		Water Safety New Zealand
Pool Safety – Your Pool Your Responsibility	Campaign targeting Auckland pool and spa owners and parents of young children to reduce drownings in home pools and spas		WaterSafe Auckland, ACC
ACC PoolSafe Quality Management Scheme	Independent assessment of pools management and operation in accordance with industry standards	Launched October 2001	ACC, Water Safety New Zealand, New Zealand Recreational Association
Pool Alone Policy	Policy: Children under 8 must be ACTIVELY SUPERVISED by a CAREGIVER 16 or over. ACTIVELY SUPERVISED means: Watching your child at all times and be able to provide immediate assistance.	Launched October 2003	ACC, Water Safety New Zealand, New Zealand Recreational Association
Fencing of Swimming Pools Act 1987, Building Act 2004 and NZ Standard 8500:2006	This Fencing of Swimming Pools Act requires domestic swimming pools, including spa pools, to be fenced to certain specifications. The Standard provides clear guidance for the design and construction of safety barriers to restrict young children's access to swimming pools. It sets out the layers of protective barriers such as fences, retaining walls and doors which will help to keep children safe.		New Zealand Government
The Safety Barriers and Fences around Swimming Pools,	A new standard for pool fencing in New Zealand came into force in 2007	2007	Standard New Zealand

Spas and Hot Tubs Standard (NZS 8500:2006)	replacing conflicting requirements of the Fencing of Swimming Pools Act and the Building Act. The Safety Barriers and Fences around Swimming Pools, Spas and Hot Tubs (NZS 8500:2006) standard requires that for new pools, all doors opening into a pool area will need to have self-closers that can close the door from any open position. The quality standard for building fences has also been made more specific.		
Water Safety Signage Standard NZS 8690:2003	This standard provides a consistent basis for the development and use of water safety signage within New Zealand that aims to reduce the risk of drownings and injuries.		
Royal lifesaving Society Awards	Bronze star, Bronze medallion, Bronze cross, Advanced lifesaving strand, Distinction		Royal Lifesaving Society
Safe Summer Campaigns	Community campaign – radio, print media, bus sides, boat ramps, billboards		WaterSafe Auckland Inc
SailSafe	Education: Yachting awareness and water safety programme for use in primary and intermediate schools.		Yachting New Zealand
Swim School Water Safety project	Water Safety messages to parents and toddlers at swim lessons		WaterSafe Auckland
SwimStart	Trains school teachers in methods for teaching swimming and personal survival		Swimming New Zealand

Under Five Water Wise	Education, public awareness campaigns, swimming teacher qualifications for swim schools aimed at reducing water related incidents in children under 5 years of age.		Water Safety New Zealand
Waka Ama guidelines	Code of safe practice for Waka Ama (outrigger) paddlers and clubs to implement in accordance with the local conditions within which they operate.		Maritime New Zealand in association with Nga Kaihoe O Aotearoa
WaterSense	Educational: Classroom and practical based aquatic program designed to deliver four key water safety messages to Years 1 and 2.		WaterSafe Auckland Inc
WaterSafe guidelines for schools	Policy guidelines for primary and intermediate principles and teachers promoting safe practices around water within the school and classroom environments		WaterSafe Auckland Inc
Water Smart	Introduces water safety knowledge and skills		Royal Lifesaving Society
Waterwise	Education – practical course in sailing skills – years 5 - 9		WaterSafe Auckland Inc
Whanau Nui Lessons	Free swim lessons in the Counties-Manukau region		Counties Manukau Injury Free, WaterSafe Auckland Inc, Leisure Services MCC
Regional Water Safety Strategy	Designed to lead and develop regional specific water safety education initiatives		Water Safety New Zealand
Drowning Prevention Strategy: Towards a Water Safe New Zealand 2005 - 2015	Purpose: To provide a framework to guide the efforts of the water safety sector towards a water safe New Zealand, free from drowning.	Commenced 2005	Development led by ACC
Drowning Prevention Council	The Council is focused on water safety,	2008	Made up of a number of government agencies,

	providing leadership to the advisory committees working on the Drowning Prevention Strategy, and ensuring its goals are met.		non-government organisations, community organisations and research centres involved in water safety.
New Zealand Injury Prevention Strategy	Purpose: To establish a framework for the injury prevention activities of government agencies, local government, non-government organisations, communities and individuals.	June 2003	Development led by ACC
Pacific Peoples Water Safety Strategy	Goals: focus on raising awareness through engagement with media and networks including churches and community roadshows.	Launched September 2008	Water Safety New Zealand

APPENDIX VI United Kingdom National Water Safety Policies and Programs

Action Plan for Child Safety	Policy document – drowning identified as one of nine safety areas relevant to children and adolescents Objectives 1. Child safety profiles and report cards based on a set of indicators 2. Good practice guide for child safety highlighting evidence strategies proven to reduce child and adolescent injury 3. Child safety action plan development and mentoring process to facilitate country partners in national plan development.	November 2007	European Child Safety Alliance
Child Safety Good Practice Guide	*Guidelines* for evidence-based good practice in child injury prevention and safety promotion in terms of engineering, enforcement and education	June 2006	European Child Safety Alliance Eurosafe
Guidelines for safe and recreational water environments. Volume 2: Swimming pools and Similar Environments	Review and assessment of health hazards associated with swimming pools and similar. Describes prevention and management options	2006	World Health Organisation
Guidelines for safe recreational water environments. Volume 1: Coastal and Fresh Waters	Review and assessment of health hazards encountered during recreational use of coastal and freshwater	2006	World Health Organisation

	environments. Describes prevention and management options		
Irish Water Safety Association	A statutory body of 12 members established to promote water safety in Ireland. Their role is to educate people in water safety best practices. They develop public awareness campaigns to promote necessary attitudes, rescue skills and behaviour to prevent drownings and water related accidents.	1999	Statutory Water Safety Body for Ireland, financed by Government, local authorities, fund-raising and sponsorship
International Lifesaving Federation	*Position statements*: • Lifesaver and Lifeguard colour scheme • Swimming and Water Safety education • Youth • Aquatic disasters • Use of lifesaving terms on retail items • Use of international certificates for employment issues • Ethics in research involving human subjects • International standards for beach safety and information flags	Released at regular intervals	International Lifesaving Federation
R U a Dummy2?	Resources for understanding risk taking behavior and water safety: Aimed at 12 – 16 years olds		Royal Society for the Prevention of Accidents (RoSPA)
Don't Go In!	Free resource on raising water safety awareness. The interactive CD-ROM is aimed at 7-11 year olds, and aims to encourage children to enjoy our river environment in a sensible and safe manner.		The Environment Agency, supported by RoSPA and Cambridgeshire Police Constabulary
Be Water Wise	• Actively supervise all	Updated in 2007	EuroSafe

Campaign	young children • Teach your children how to swim • Everyone must wear a personal floatation device (lifejacket) when boating or fishing • Get trained in CPR • Use pools that are fenced with locking gates • Teach children never to swim alone		
Get Safe for Summer Campaign	To raise awareness for the summer months that swimming in natural outdoor environments such as the sea, rivers, lakes and canals is quite different from swimming in an indoor swimming pool. It focuses on the importance of learning to swim and of water safety skills.		Amateur Swimming Association (ASA)
Government Garden Pond Safety Campaign	RoSPA acted in partnership with the Department of Trade to raise awareness of the danger of garden ponds. To do this they helped with research and distributed garden safety leaflets and pond safety flyers through garden centres, DIY stores and GP's surgeries nationwide, in addition raising the profile of the issue throughout the UK.		Royal Society for the Prevention of Accidents
National Water Safety Forum (UK)	Terms of Reference: The role of the Forum is to be the natural body in which organisations involved in water safety will participate in order to have a strong voice with Government on water safety issues. The		

	Forum is primarily concerned with preventative action and water safety education rather than search and rescue. It advises and comments on legislation but is not directly involved in regulatory or enforcement activity.		
Primary Aquatics Water Safety (PAWS)	A component part of the physical education strand of the primary school curriculum in Ireland. Aspects covered in the PAWS Programme range from Water Safety Knowledge to Survival Skills to basic Rescue Skills.		Irish Water Safety

APPENDIX VII U.S.A. National Water Safety Policies and Programs

Guidelines for Entrapment Hazards: Making Pool and Spas Safer	*Guidelines* Intended for use in building, maintaining and upgrading public and private pools and spas	March 2005	U.S. Product Safety Commission, Washington D.C.
Pool and Spa Safety Act 2007	• Federal law requires all pools & spas to be equipped with anti-entrapment devices or systems that comply with the ASME/ANSI A112.19.8, 2007, performance standard. The act requires such pools and spas with a single blockable suction outlet system (main drain) to modify the system to prevent entrapment. • Establish a national drowning prevention education program to inform the public about ways to prevent drowning and entrapment in swimming pools and spas	Passed by congress December 2007. Goes into effect Dec 19, 2008	U.S.A. Government
Policy Statement: Prevention of Drowning in Infants, Children and Adolescents	Recommendations for pediatricians as educators and advocates	2003	Committee in Injury, Violence and Poison Prevention
Swimming Pool Barrier Guidelines	*Guidelines:* Intended for use by owners, purchasers and builders of residential pools, spas and hot tubs		U.S. Product Safety Commission, Washington D.C.
Kids don't Float Campaign	Kids Don't Float provides lifejackets for boaters and swimmers on loaner boards near docks and other open water access sites, as well as an educational component	Launched in 38 locations nationwide 2008	Safekids USA

	for kids ages 8-14 in local schools.		
Beach Safety Week	Each year, as summer begins, the United States Lifesaving Association sponsors National Beach Safety Week in an effort to remind beachgoers to use caution in the aquatic environment. National Beach Safety Week begins the Monday before Memorial Day (which is the last Monday in May) and ends seven (7) days later on Memorial Day. The USLA National Public Education committee is responsible for coordinating National Beach Safety Week through direct efforts and through the eight USLA regions. These regions are responsible for efforts within their area.		United States Lifesaving Association

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