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RESEARCH

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Where the Evidence and Expert Opinion Meet: A Review of Open-Water Recreational Safety Messages

**Kevin Moran, Linda Quan, Richard Franklin,
and Elizabeth Bennett**

Open water aquatic recreation is a significant cause of drowning, especially in developed countries that have easy access to aquatic environments. To simplify the plethora of safety messages promoted worldwide, 18 experts from 12 countries formed the International Task Force on Open Water Drowning Prevention (ITFDP) and published 16 generic, nonboating, open water safety messages. This paper examines the supporting evidence for the messages and makes recommendations for future research. A systematic review was undertaken of the literature published from 1990 to 2010. Task force members were asked to provide the Secretariat with organizational recommendations or the evidence base that informed their decision making. The review identified strong evidence bases for the importance of supervision and alcohol avoidance. Several messages were supported by some evidence such as lifeguards, CPR training, and life jacket use. The remaining messages had some supporting data and/or were organizational recommendations but lacked evidence demonstrating their efficacy. It identified where evidence to substantiate axiomatic wisdom is lacking and where research is needed to address gaps in our current knowledge of drowning prevention.

Keywords: drowning prevention, water safety education, safety promotion

Drowning ranks among the top three causes of death from unintentional injury in most countries around the world (Peden et al., 2008). Drowning because of aquatic recreation is a significant cause of unintentional injury, particularly in high income countries where there is easy access to aquatic environments and much recreational aquatic activity. Swimming or being in or near the water has been identified as the activity most frequently engaged in before drowning across a variety of aquatic locations (Langley, Warner, Smith, & Wright, 2000; Quan & Cummings, 2003; Smith & Brenner, 1995). Racial and cultural minorities are found to be at higher risk of drowning, making this an issue of equity as well as an issue of injury (Quan & Cummings, 2003; Smith & Brenner, 1995; Venema, Groothoff, & Bierens, 2010).

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It is believed that the vast majority of drowning incidents can be prevented and that prevention, rather than rescue or resuscitation, is the key intervention by which to reduce drowning (Rogmans & Wilson, 2006). It is hardly surprising, therefore, that many international organizations (e.g., the International Life Saving Federation, ILS, 2007), national government agencies (e.g., the Accident Compensation Corporation of New Zealand, ACC, 2005), and national nongovernment organizations (e.g., the National Drowning Prevention Alliance, 2009), and nongovernment regional/community organizations (e.g., Watersafe Auckland, 2008) have attempted to address the problem by promoting water safety through community education, policy, and environmental change. This well-intentioned safety promotion has created a plethora of water safety messages worldwide. In an attempt to promote globally acceptable, nonboating related, open water safety messages, a group of international people working in drowning prevention formed an International Task Force on Open Water Drowning Prevention (ITFDP) comprising 18 members from 12 countries. The objective of the task force was to develop drowning prevention messages for use in recreational open water settings such as lakes, rivers, and oceans based on expert consensus, best practice, and the literature.

Messages were collected from the Washington State Drowning Prevention Network, attendees at the World Drowning Congress 2007 in Portugal, and the ITFDP who further developed and then reviewed the messages. They were published as a series of consensus-based, generic international water safety messages (see link entitled *open water guidelines* on the drowning prevention website: www.seattlechildrens.org/dp). Using an iterative process that included the use of a modified Delphi technique, the Task Force prioritized 16 messages, subdivided into two subgroups—*keep yourself safe* and *keep others safe*—to address personal safety responsibilities and the role of the caregiver. Some of the messages are believed to be best practice but have not been evaluated. Indeed, some water safety messages appeared to have very little explicit basis for recommendation. Open water drowning prevention is an area that still needs a significant amount of evaluation (Quan, Liller, & Bennett, 2006). This paper aims to

- present the evidence base that informs the open water safety messages recommended by the ITFDP;
- identify areas where the research is lacking; and
- recommend future research to address identified gaps in our knowledge.

Method

Several efforts were made to identify evidence basis for each of the drowning prevention messages. Before finalization of the ITFDP recommendations, a review was conducted of the scientific and “gray” literature related to the drowning prevention message topics. The initial list of messages was cross checked with supporting literature or recommendations made by credible national and international organizations such as the ILS. ITFDP members were asked to provide the rationale that informed their decision making about water safety messages. It was assumed that ITFDP members, due to their expertise, experience, organization links, and work, would be able to provide details of relevant literature that might not appear via the

systematic search of peer reviewed databases. In addition, Task Force members participated in developing a layperson-oriented rationale underlying each drowning prevention message. The rationales were couched in user-friendly rather than academic/scientific language and were designed to focus the recipient's attention on critical factors associated with the message (full copy of the rationale is available under a link entitled *Open Water Guidelines and Rationale* from: www.seattlechildrens.org/dp).

After the messages were finalized, a systematic search was undertaken of the following data bases: EMB Reviews (Cochrane Database of systematic reviews), EMBASE 1990–2009, ERIC 1990–2009, Medline 1990–2009, PsychInfo1990–2009, Safety Lit 1990–2009, and Sport Discus 1990–2009. Searches were limited to English language publications and a list of water-related activities was used to focus the search on nonboating related aquatic recreation. These terms included angling, aquatic, beach, body surf, dive, fishing, recreation, surf, and swim. These activities were searched in conjunction with injury-related terms and outcomes including drown, drowning, near-drowning, submersion immersion, water-related injury, and spinal cord injury.

We present each of the messages with an extract of the rationale developed by the task force. We then examine the evidence gathered during the review process, summarize the evidence basis for each prevention message, and make recommendations for future research.

Results

Learn Swimming and Water Safety Skills (Message 1: Keep Yourself Safe, Message 1: Keep Others Safe)

What the Experts Said.

“Being able to swim reduces the chance of a serious incident, but does not guarantee safety.”

“Water safety is more than just having swimming skills. It is also having the confidence, knowledge, skills, and attitudes to be safe in and around water.”

“Help and encourage others, especially children and teens, to learn swimming and water safety survival skills.”

What the Research Evidence Says. The protective role of swimming skill in the prevention of drowning is not clearly defined. Swimming has long been advocated as a way of promoting water safety and reducing drowning risk (e.g., Swimming and Water Safety Position Statement, ILS, 2007). A systematic, large-scale review of childhood and youth drowning noted that even though some studies (for example, Asher, Rivara, Felix, Vance, & Dunne, 1995; Erbaugh, 1986) had shown that swimming lessons improved the ability to dive, swim underwater, breathe correctly, and tread water, no study had examined the more important question of whether swimming lessons actually prevented drowning and near-drowning (Harbourview Injury Prevention and Research Centre, 2001). Connor, Langley, and Cryer (2007)

note that research on learning to swim as a means of drowning prevention “has been sparse and equivocal and the protective effect, if any, may be age-related” (p.43).

Recent studies have, however, provided some evidence of the value of swimming skills in preventing drowning. A case-control study in the U.S. found a positive association between swimming skill and drowning prevention in children less than five years of age (Brenner et al., 2009). The study found that those who died were less likely to have had formal lessons compared with matched controls (3% vs. 26%, respectively), although it should be noted that the estimates were imprecise. The results were less compelling in older children, those 5–19 years of age. A case-control study of swim instruction in rural China found a protective effect on drowning among children aged 1–4 years (Yang, Nong, Li, Feng, & Lo, 2007). Prevention programs in rural villages in Bangladesh have found that teaching swimming to children over the age of five years helps to prevent drowning (Linnan et al., 2007; Rahman et al., 2009).

It has been suggested that the protective effect of being able to swim might be offset by the increased exposure to aquatic risk inherent in utilizing that skill (Baker, O’Neil, Ginsburg, & Li, 1992; Barss, 1995; Smith, 1995) or could lead to overconfidence or to swimming in hazardous places (Baker et al., 1992; Brenner, Saluja, & Smith, 2003), yet little documented evidence exists to confirm this relationship. The contention by Baker et al. (1992) and Brenner et al. (2003) that swimming proficiency, and thus confidence in water, is a precursor for some individuals to engage in high-risk behavior has not been demonstrated. In a study of over 2000 New Zealand youth, Moran (2006) found no significant association between greater self-reported swimming proficiency and increased risk-taking behavior when swimming or when participating in other aquatic activities.

The underestimation of risk and overestimation of skill to cope with that risk appears well founded, particularly in males, whose underestimation of drowning risk and overestimation of swimming skill to cope with that risk offers strong explanatory evidence as to why more males drown than females (Bennett, Quan, & Williams, 2002; Gulliver & Begg, 2005; Howland, Hingson, Mangione, Bell, & Bak, 1996; McCool, Ameratunga, Moran, & Robinson, 2009; Orłowski, 1987, 1988).

In summary, studies support the value of swimming lessons to prevent drowning in young children. To date, the evidence is weak and further research on the preventive effect of swimming ability on drowning is required for older children and adults.

Swim in Areas With Lifeguards (Message 6: Keep Yourself Safe, Message 2: Keep Others Safe)

What the Experts Said.

“Lifeguards help protect you. Lifeguards are trained to promote safe behavior around the water to prevent drowning. They watch for and help those in distress, providing rescue and medical assistance to those in need. Before entering the water at a beach with lifeguards, ask lifeguards for safety advice”

What the Research Evidence Says. Lifeguard rescue and resuscitation data worldwide provide compelling evidence for the desirability of swimming under

lifeguard supervision. In the U.S., the United States Lifesaving Association (USLA) estimates the chance that a person will die of drowning while attending a beach protected by USLA affiliated lifeguards is 1 in 18 million visits (USLA, 2009). From 2005 to 2009, five times more drowning fatalities were reported at unguarded sites compared with guarded sites (103 vs. 17 drowning fatalities per annum, respectively; USLA, 2009). Four pre/post case studies in a lifeguard effectiveness report published by the Centers for Disease Control saw a decrease in fatal drowning at sites after getting lifeguards (Branche & Stewart, 2001).

Another indicator of the efficacy of lifeguard supervision is the number of successful resuscitations performed. Lifeguards successfully resuscitated 67% of 171 victims in incidents in Queensland from 1973 to 1992 (Fenner, Harrison, Williamson, & Williamson, 1995). Similarly, a survival rate of 62% of 262 resuscitation incidents was reported nationally in a 10-year Australian study from 1973 to 1983 (Maniolas & Mackie, 1988). In both of these studies, most victims had been swimming outside patrolled areas before rescue (55% and 71%, respectively). More than half of 157 beach drowning deaths from 2005 to 2007 occurred outside normal patrolling times, whether outside normal patrolling season or at a time of day before or after a lifeguard/lifesaving service is on active duty (Surf Life Saving Australia, 2007). These studies can only suggest lifeguard effectiveness because they did not identify how many swimmers were at risk in patrolled versus nonpatrolled areas. Without studying a comparison/control group, such as sites with and without lifeguards, a study cannot appropriately draw any inferences about associations or causality (Grimes & Schulz, 2002).

In summary, evidence for the effectiveness of lifeguards as a primary prevention is lacking. In particular, evidence of the role of lifeguards in open water environments other than beaches, such as lakes and rivers, is lacking. Further research is required to formally evaluate this intervention (Peden et al., 2008).

Always Swim With Others (Message 2: Keep Yourself Safe)

What the Experts Said.

“Many drowning deaths involve people swimming alone. When you swim with someone else, it is more likely that one of you can help the other and call or signal for help.”

What the Research Evidence Says. Evidence to support the safety benefits of swimming with others is surprisingly sparse. Some research suggests that at-risk behaviors are common in those who swim alone (Smith & Brenner, 1995; Schootman, Fuortes, Zwerling, Albanese, & Watson, 1993). Morgan, Ozanne-Smith, and Triggs (2009) reported that most beachgoers preferred to be close to others when in the water, with more females than males stating this preference (females 81%, males 62%). Males in this study were more likely to visit the beach alone and also be more likely to be far from others in the water. Schootman et al. (1993) found that 15% ($n = 338$) of junior high and high school students had *often* or *always* swum alone. In a national survey of New Zealand youth, Moran (2006a) found that almost half of respondents had swum alone ($n = 1,026$; 47%) or undertaken other aquatic activity ($n = 867$; 42%) alone in the previous year. More males than

females were likely to have swum alone (males 51%; females 42%). The study also reported unsafe attitudes toward swimming alone with one third of youth ($n = 714$; 32%) disagreeing that swimming alone was always risky, and four in every ten students ($n = 865$; 39%) disagreeing that crossing a river alone was dangerous. One study noted that since most adolescents and young adults were swimming with a buddy or witnessed when they drowned, further research is required to determine if the frequently promoted message to always “swim with a buddy” does anything to reduce the risk of drowning (Quan & Cummings, 2003). By encouraging risk taking activity and providing peer pressure, one or several buddies may actually increase drowning risk. Furthermore, the rescue skills of a buddy have not been described nor identified.

In summary, evidence for the protective role of a swimming companion is lacking; further research on the circumstances surrounding drowning incidents where the victim was alone versus accompanied is required.

Obey All Safety Signs and Warning Flags (Message 3: Keep Yourself Safe, Message 8: Keep Others Safe)

What the Experts Said.

“Signs and flags inform you about water dangers or show you where it is safer to swim. Signs can have important information about topics such as tide times and heights, underwater hazards, currents, waves and other water hazards.”

What the Research Evidence Says. While the value of safety signage appears axiomatic, evidence to support its effectiveness is lacking. Studies have suggested that swimming between the flags at patrolled surf beaches reduces the risk of drowning (Sherker, Brander, Finch, & Hatfield, 2008). Studies have reported low levels of compliance with safety signage among different age groups—youth (Moran, 2006), young adults (Gulliver & Begg, 2005), and adult beachgoers (McCool, Moran, Ameratunga, & Robinson, 2008; Sherker, Williamson, Hatfield, Brander, & Hayden, 2010) as well as at different water settings, including surf, rivers, and lakes (Bennett et al., 1998). Moran (2006a) found that many male youth reported having swum in prohibited areas (50%), swum outside patrol flags (61%), and ignored warning signs and safety directions (39%). A study of the effect of “no diving” signs on 526 American students reported poor recall of the sign and limited effect on student perception of the danger it portrayed (Goldhaber & Deturck, 1988). Such evidence suggests the strong need for further safety education to increase the number of people swimming in patrolled areas (for example, Fenner et al., 1995; Franklin, Peden, Rubin, & Scarr, 2008). A successful way to increase compliance has been reported but involved active interaction over multiple years. Fishers at remote coastal settings became cognizant and appreciative of safety warning signs and public rescue equipment following a targeted drowning prevention campaign (Moran, 2011).

In summary, evidence does not support the usefulness of signage alone. Further study is required to determine the following: the value of signage as a preventive intervention; the most effective nature and placement of signage, especially in

societies with extensive cultural and linguistic diversity; and behavioral interventions based on why recreational water users intentionally or unintentionally ignore warning signs in aquatic settings.

Use Life Jackets (Message 5: Keep Yourself Safe, Message 5: Keep Others Safe)

What the Experts Said.

“Life jackets, also called personal flotation devices or PFDs, save lives. Life jackets can be used for swimming, wading and other water activities. Life jackets help you to be seen, making it easier to find and rescue you.”

What the Research Evidence Says. Approved life jackets have been shown to be effective in reducing drowning deaths associated with boating activities (Cummings, Mueller, & Quan, in press; United States Coast Guard, 2003). Life jacket use has been promoted for children or weak swimmers recreating in and/or near water. Community based campaigns have led to the availability of life jacket loaner stations, which have been reported to save lives (Bennett & Bernthal, 2001). No study to date has been conducted on the efficacy of life jacket use for nonboating activities such as wading or swimming.

Life jacket use is a compliance issue too. American and New Zealand teens, especially males, are either unaware of or resistant to life jacket use (Bennett, Quan, & Williams, 2002; Bennett et al., 1998; Moran, 2006; Quan, Bennett, & Williams, 2002). Quan and colleagues (1998) suggested that an understanding of user/nonuser attitudes may help in structuring safety messages specifically targeted at this high-risk group.

Promotional efforts have led to increased use among land-based fishers at high risk fishing sites (Moran, 2011), i.e., fewer fishers reported *never* wearing a buoyancy aid (2010, 35%; 2006a, 72%) and more reported wearing them *sometimes* (2010, 35%; 2006a, 23%) or *often* (2010, 31%; 2006a, 4%). High mortality rates and low levels of life jacket use have also recently been reported in land-based fishers in Australia (Crosariol, Vasica, & Franklin, 2010; Thompson, 2010).

Further research is required to determine the effectiveness of life jacket use in aquatic recreational activity such as while swimming or playing in the water (Quan, Liller, & Bennett, 2006). Evidence of successful promotion of life jacket use and subsequent reduction in drowning is also required.

Avoid Alcohol Use (Message 4: Keep Yourself Safe)

What the Experts Said.

“Alcohol is a key factor in many drowning deaths. It impairs coordination, judgment and swimming ability.”

“Alcohol may also give a false impression of your ability to cope with the risks and make you overconfident about your ability to get out of trouble.”

What the Research Evidence Says. Abundant evidence supports a key role that alcohol consumption plays in increasing the likelihood of drowning and drowning deaths during aquatic activities (Driscoll, Harrison, & Steenkamp, 2004, 2003; Howland & Hingson, 1988; Orłowski, 1987, 1988; Smith & Brenner, 1995). One Australian study found that alcohol contributed to approximately 30% of nonboating related drowning deaths associated with recreational aquatic activity (Diplock & Jamrozik, 2006).

Alcohol achieves its lethality in multiple ways. Bell et al. (2001) found that alcohol use was associated with a ten-fold increase in reckless behavior such as violation of safety rules and swimming in an unauthorized area, particularly by those less than 21 years of age. In addition, it affects balance, swimming coordination, heat retention, and cardiac response to immersion. Moreover, the effect is dose related; the risk of death increased as the blood alcohol level increased (Smith & Kraus, 1988).

Howland et al. (1996) reported significant gender differences in alcohol-related aquatic activity and other associated risky behaviors such as swimming alone after alcohol use (males 15%, females 4%) and swimming at night (males 38%, females 32%). Several studies have reported unsafe attitudes toward mixing alcohol with aquatic recreation among young adults (Gulliver & Begg, 2005) and male youth (Moran, 2006). For example, a study of 21-year-old young adults from Dunedin found that one-fifth of males had consumed alcohol before aquatic activity (Gulliver & Begg, 2005). Similarly, Moran (2006a) found one quarter of 16–19-year-old males had mixed alcohol with swimming ($n = 512$; 24%); more alcohol use among males during swimming activity (males 26%, females 19%), and more males also had observed friends drinking alcohol during aquatic activity (males 33%, females 24%).

While alcohol use is a risk factor in drowning deaths, it is unclear what effect decreasing alcohol use during aquatic activities would have on fatal drowning. Cummings and Quan (1999) noted that decreasing drowning death rates in open water were associated with a decreasing rate of positive blood alcohol detection in western Washington State. Studies are needed that assess the impact of alcohol availability and control on open water, nonboating activity.

Provide Close, Constant Supervision (Messages 3 and 4: Keep Others Safe)

What the Experts Said.

“Most childhood drowning deaths occurs (sic) when there is a lapse in supervision. Good supervision starts with good planning before you arrive at a water site. Once at the site, it requires that you be dedicated to the job, capable, and able to respond.”

“Set water safety rules and be sure that caregivers in charge of your children are safety conscious and capable of providing proper supervision around water.”

What the Research Evidence Says. Supervision has been defined as encompassing three critical dimensions: attention, proximity, and continuity (Saluja et al., 2004).

For water, rescue skills need to be considered a fourth dimension. Observational studies of victims at beaches suggest that nonswimming adults out of their depth in water are generally unable to struggle on the surface for more than one minute, whereas infants and young children can submerge in as little as 20 s (Pia, 1971). Furthermore, drowning victims are rarely able to call for help or attract attention when in distress (Pia, 1971). Continuous surveillance and immediate reaction is thus critical to the prevention of drowning in open water.

Evidence exists to indicate that childhood drowning is strongly associated with lack of adequate supervision (Ahmed, Rahman, & van Ginneken, 1999; Brenner, 2003; Bugeja & Franklin, 2005; Cody, Quraishi, Dastur, & Mickalide, 2004; Fang et al., 2007; Landen, Bauer, & Kohn, 2003; Quan, Gore, Wentz, Allen, & Novack, 1989; Rahman et al., 2009). In Australia, a New South Wales study on drowning in children aged 5 years and below found that supervision was a factor in all but two cases of drowning in bodies of natural water, with around half of all children being without any adult supervision (New South Wales Water Safety Taskforce, 2002).

Parents may be overly optimistic about their children's swimming skill and ability to look after their own safety (Moran & Stanley, 2006a, 2006b). They may also be overconfident in their own skill and that of their children to cope with the risk associated with swimming at beaches (Blitvich, Petrass, & Finch, 2008; Moran, 2009, 2010a; Petrass, 2009). In a focus group study of Vietnamese immigrants, parents defined supervision of children as "watching," but parents and teenagers agreed that supervision is unnecessary if a child is old enough to be home alone, knows how to swim, and that children can "take care of each other" (Quan, Crispin, Bennett, & Gomez, 2006). Some abrogation of parental responsibility when children are in the water has also been reported (Cody et al., 2004; Moran, 2009, 2010a). In a study of 769 caregivers on New Zealand beaches, Moran (2009) found that more than one quarter (29%) failed to provide appropriate supervision for their under 5-year-olds at the beach. Almost half (46%) of caregivers did not provide close supervision for their 5–9-year-olds. Although there were no significant differences between males and female self-reported supervision, male caregivers were more likely to rate their 5–9-year-olds as good swimmers and less likely to estimate a high risk of drowning for that age group.

In terms of the role of lifeguards in child supervision, one in five caregivers (20%) believed that the lifeguard is the main person responsible for the child's safety in the water (Cody et al., 2004). Moran (2009) found that more males than females thought that either lifeguards (males 28%, females 19%) or other adults close to their children in the water (males 13%, females 8%) were best able to supervise their children's water activity at the beach. Harrell (1995, 2006a) suggests that lifeguards are less inclined to pay attention to groups of children in the belief that there is safety in numbers and that they are less inclined to scan where adult caregivers are near.

In summary, ample evidence exists to support the critical role of close and constant supervision of children's aquatic activity, further work is required on the explicit nature of supervision in the aquatic environment. Most recent studies have focused on parental supervision at beaches but further research is required to investigate supervision in other open water environments. In addition, evaluations of current interventions (such as parent education, regulations, and legislation) are required so that strategies to improve supervision practices can be best implemented.

Know Weather and Water Conditions (Message 7: Keep Yourself Safe)

What the Experts Said.

“Cold water, weather, tides, surf, currents, and other factors can have a major impact on open water safety.”

“River currents are hard to see and they vary, even in the same location.”

What the Research Evidence Says. Exacerbating environmental hazards including waves, rip currents, tides, river currents, cold water, and wind-chill-inducing winds are commonplace at many popular recreational sites in temperate climates. Such conditions may heighten the risk of drowning by adding the debilitating effects of hypothermia and “wave splash” to the downward spiral of respiratory failure that is drowning (Golden & Tipton, 2002). Rip currents have been universally recognized as the main water hazard at surf beaches (Fenner et al., 1995; Hartmann, 2006; Klein, Santana, Diehl, & Menezes, 2003; Scott, Russell, Masselink, Wooler, & Short, 2007; Short, 2007). Rip currents have been associated with 89% of rescues in Australia (Short & Hogan, 1994). Contrary to popular belief, large wave height was not a significant risk factor in New Zealand with most rescues (82%) taking place in surf < 1.5 m in height (SLSNZ, 2008).

Evidence supporting the value of “knowing the water” rests in studies that have found that tourists and new migrants are at greater risk of drowning when recreating in unfamiliar waters. For example, in Denmark (visitors rate of drowning is three times higher than Danes) and with U.S. (13.1% overseas vs. 7.1% in U.S. of injury deaths) and Finish travelers (15.6% abroad vs. 7.1% at home of injury deaths), there is a higher rate of drowning in those unfamiliar with the conditions (Guse, Cortes, Hargarten, & Hennes, 2007; Lindberg & Steensberg, 2000; Lunetta, 2010). This may be due to the consequence of increased exposure to risk through participation in aquatic recreation such as swimming, snorkeling, and diving. A set of 29 recommendations for water safety and drowning prevention for travelers to be promoted by travel-medicine professionals has been developed (Cortes, Hargarten, & Hennes, 2006). One recommendation advises travelers to be attentive to signs posting surf and weather conditions as well as other potential hazards such as murky water and hidden underwater objects.

Relatively little is known about how knowledge of water and weather conditions impact on drowning prevention in other settings such as rivers and lakes. In focus groups held to describe their attitudes and behaviors around recreational water activities, Vietnamese-American parents noted that Washington State lakes and rivers differ, being colder and faster than the shallow, warm waters in Vietnam (Quan, Crispin et al., 2006).

In summary, no evidence informs the need for knowing the water and how laypersons would use that information. Further research is required to determine how knowledge of water and weather conditions might impact the frequency of drowning incidents.

Learn Safe Ways of Assisting Others (Rescue, First Aid, and CPR; Messages 6 and 7: Keep Others Safe)

What the Experts Said.

“Learn safe rescue skills to avoid placing yourself in danger.”

“Early CPR (also called cardiopulmonary resuscitation) greatly increases the chances of survival from drowning.”

What the Research Evidence Says. Many fatal drowning incidents occur in the presence of others and usually when the victim is close to the water’s edge (Nixon, Pearn, Wilkey, & Corcoran, 1986). Very little data identify what rescue skills work best or are performed best by nonexpert rescuers. A recent case series from the Netherlands highlights the anecdotal nature of rescue data (Venema et al., 2010). Of the 289 rescues reported from 1999 to 2004, 343 victims and 503 rescuers were involved, and 109 victims were resuscitated by bystanders. The study also noted that rescues often occurred in dangerous circumstances including multiple victims (26%), cold or icy water (87%), deep water (95%), and swimming to the victims (70%). In Canada, 78% of attempted rescues were conducted by untrained bystanders (Royal Life Saving Society Canada, 2004). Similarly, friends had been the rescuer in one third (33%) of the 810 self-reported, life-threatening submersion experiences reported in a national survey of New Zealand youth (Moran, 2010b). Similarly, a U.S. survey of 1,000 adults (> 18 years) found almost half (48%) reported a life-threatening submersion experience. Of these, 48% had been rescued by family or friends (American Red Cross, 2009).

Studies have reported on the number of drowning fatalities where the victim was attempting rescue, sometimes called “double drownings” (Orlowski, 1987; Smith & Brenner, 1995) or aquatic victim-instead-of-rescuer (AVIR) syndrome (Pearn & Franklin, 2010). A large population based study reported that in 2–3% of drowning fatalities cases, the would-be rescuer had been overcome by the drowning person (Centres for Disease Control and Prevention, CDC, 1986). In an Australia study, from 2002 to 2007, 88 would-be rescuers were predominantly males (91%), whose fatal drowning occurred at beaches (37%) and rivers (22%; Franklin & Pearn, 2011). Many victims had needlessly drowned because bystander unfamiliarity with the simple skill of throwing a lifeline or lifebuoy (Pearn & Franklin, 2009). Both studies support the need for bystanders to be cognizant of safe noncontact rescue techniques.

A lack of rescue ability has also been reported among 21-year-old young New Zealand adults, most of whom ($n = 486$; 52%) had not received any lifesaving training (Gulliver & Begg, 2005). Moran (2006) reported that more than one-third ($n = 762$; 35%) of high school students self-reported having no rescue ability. Similar findings in other studies have prompted recommendations that all school children should be taught basic water rescue skills (Smith & Brenner, 1995; CDC, 1986). Further research is required to determine whether the protective value of lifesaving skills is real and whether it reduces or exacerbates risk, especially among males who may be overconfident about their ability (Moran, 2006).

A solid body of evidence supports the experts' contention that CPR skills are critical in the drowning prevention chain. Survival from out-of-hospital cardiac arrest is primarily dependent on the rapid initiation of bystander cardiopulmonary resuscitation (Marchant et al., 2008; Venema et al., 2010) and the early arrival of medical assistance (Kyriacou, Arcinue, Peek, & Kraus, 1994; Youn, Choi, Yim, & Park, 2009). Bystander CPR, combined with rapid activation of emergency medical services, has been estimated to increase survival rates from sudden cardiac arrest two to threefold (Eisenburger & Safar, 1999). Not surprisingly, CPR has long been advocated as an important community skill (American Academy of Pediatrics, 2010a, 2010b; Brenner, 2003; European Resuscitation Council, 2000; Smith & Brenner, 1995; Wintemute, Kraus, Teret, & Wright, 1987; Yang et al., 2007).

Bystander CPR skills are not widely possessed in the community or possibly widely used when needed. Some research has indicated a lack of CPR knowledge among youth (Lester, Donnelly, Weston, & Morgan, 1996; Lester, Weston, Donnelly, Assar, & Morgan, 1994; Moran, 2006; Parnell, Pearson, Galletly, & Larsen, 2006) and among the general population (Gagliardi, Neighbors, Spears, Byrd, & Snarr, 1994; Larsen, Pearson, & Galletly, 2004; Liu & Clark, 2009; Liller, Kent, Arcari, & Mc Dermott, 1993).

While ample evidence exists to support the widespread learning of bystander CPR, further work is required to determine how best to promote CPR as well as other emergency lifesaving skills.

Enter Shallow and Unknown Water Feet First (Message 8: Keep Yourself Safe)

What the Experts Said.

“Serious lifelong injuries occur every year due to diving headfirst and striking the bottom. Jumping from heights even into deep water may cause serious injury.”

“If you wish to dive, learn how to do it safely.”

What the Research Evidence Says.

Spinal cord injury (SCI) is often the consequence of recreational diving, the act of entering the water head first during recreational activity and hitting an object (Blanksby, Wearne, Elliott, & Blitvich, 1997). Diving has been identified as the most frequent sporting activity related to SCI (Hartung, Goebert, Taniguchi, & Okamoto, 1990; Katoh, Shingu, Ikata, & Iwatsubo, 1996; Schmitt & Gerner, 2001). While the numbers of hospital admissions are relatively few, the financial cost to society of SCI is high given that those most frequently affected are healthy young persons under twenty-five years of age (DeVivo & Sekar, 1997).

Risk factors contributing to recreational diving injury have been well reported, with males aged 15–29 years, especially when consuming alcohol (Aito, D'Andrea, & Werhagen, 2005; Blitvich, Mc Elroy, Blanksby, & Douglas, 1999; Herman & Sonntag, 1991; Mennen, 1981). In open water settings, entering the water from a pier or dock, diving headfirst, not having checked water depth, and being unfamiliar with location have also been identified as risk factors (Branche, Sniezek, Sattin, & Mirkin, 1991).

Further work is required on unsafe water safety attitudes and behaviors that underpin unsafe diving. Moran (2008) found that among adolescent youth, gender differences in risky behaviors and unsafe attitudes were pronounced, whereas the influence of socioeconomic status and ethnic background were less evident. For example, more females than males reported “never diving headfirst into water of unknown depth” (females 75%, males 59%). Further in-depth qualitative analysis of youth diving beliefs and practices, especially the diving habits of young males in social settings, might be a logical next step toward enhanced understanding of the vexed issue of diving-related SCI among youth.

In summary, further work is also required on how best to enter different bodies of water (such as rivers, lakes, and beaches) and how best to promote and teach safe entries, especially among high risks groups such as males and male youth.

Conclusion

Our review of the literature shows drowning and/or survey data and organizational recommendations for the recommended messages but evidence based research is lacking for most of the recommended open water messages. Evidence based messages were “learn to swim” and “avoid use of alcohol.” Several messages had suggestive data. Supporting data for “swim where there are lifeguards” were from studies showing lifeguard effect on behaviors and a case series of well-documented rescues. The data supporting the “efficacy of life jackets in preventing open water drowning” was limited to boating but no other activity. “Knowing CPR” has been shown to be effective in preventing drowning in pools. “Signage” shows some efficacy when combined with a more comprehensive drowning prevention campaign. The remaining messages were based on drowning risk factors, organizational recommendations, or small scale studies. To date, most open water drowning prevention strategies have not undergone rigorous evaluation.

Current drowning prevention messages are often based on axioms that are strongly influenced by evaluation of drowning data, anecdotal experience, recommendations of experts and expert organizations, and resources but are often missing the critical link: evidence. This paper set out to corroborate the opinions of experts in drowning prevention, reviewing contemporary research findings that applied to a set of recommended open water safety messages (see Table 1). In doing so, it achieved three purposes. First, it has provided evidence for the messages; second, it has identified where evidence is lacking and where we need to tread with caution in our advocacy; third, it has identified needed future research so that scientifically credible interventions can be promoted widely.

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Table 1 Final Messages in Order of Priority in Two Categories

Keep Yourself Safe	Keep Others Safe
1. Learn swimming and water safety survival skills.	1. Help and encourage others, especially children, to learn swimming and water safety survival skills.
2. Always swim with others.	2. Swim in areas with lifeguards.
3. Obey all safety signs and warning flags.	3. Set water safety rules.
4. Never go in the water after drinking alcohol.	4. Always provide close and constant attention to children you are supervising in or near water.
5. Know how and when to use a life jacket.	5. Know how and when to use a life jacket, especially for children and weak swimmers.
6. Swim in areas with lifeguards.	6. Learn first aid and CPR.
7. Know the weather and water conditions before getting in the water.	7. Learn safe ways of rescuing others without putting yourself in danger.
8. Always enter shallow and unknown water feet first.	8. Obey all safety signs and warning flags.

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