# United States Lifeguard Standards

## An evidence-based review and report by the United States Lifeguard Standards Coalition

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American Red Cross

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Healthy Pools. Healthy Bodies.

# ACKNOWLEDGMENTS

Sincere appreciation is extended to all of the individuals who dedicated their time and expertise to the development of the first outcomes and recommendations of the United States Lifeguard Standards Coalition.

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## Abbreviations

| | |
|---|---|
| ABC | Airway, breathing, and circulation |
| AED | Automated external defibrillator |
| AHA | American Heart Association |
| ARC | American Red Cross |
| BLS | Basic life support |
| CI | Confidence interval |
| COI | Conflict of interest |
| CoSTR | Consensus on Resuscitation Science and Treatment Recommendations |
| CPR | Cardiopulmonary resuscitation |
| EMS | Emergency medical systems |
| EMT | Emergency medical technician |
| ILCOR | International Liaison Committee on Resuscitation |
| LOE | Level of evidence |
| MLF | Minimum level of fitness |
| PSS | Physical skill set |
| SABC | Suction, airway, breathing, and circulation |
| USLA | United States Lifesaving Association |
| USLSC | United States Lifeguard Standards Coalition |
| WRCT | Water rescue competency test |

# INTRODUCTION

We are pleased to present the first outcomes and recommendations of the United States Lifeguard Standards Coalition (USLSC), a project sponsored by the American Red Cross, the United States Lifesaving Association (USLA), and the YMCA of the USA. The sponsors intend for these recommendations to have a positive influence on the training of lifeguards and the practice of lifeguarding within their own organizations and, by freely sharing this research information and results, within other lifeguard training organizations as well. We have undergone this process maintaining the principle that best practice in lifeguarding should be based on the best and most scientific evidence available, and that once that evidence is identified, it should be relevant for and apply to all lifeguard training.

## The Problem

As lifeguarding has evolved, lifeguard training methods and standards have been established primarily on the basis of experience and opinion. This can be a result of trial and error (or success), or of the recommendations of people who are considered to be experts. Just as experience and expertise vary in different organizations, so do methods and standards. In the case of some standards, the organizations promoting them may not have an institutional memory regarding the reason the standards came to exist. The standards may simply have been accepted on the basis of historical adherence: “We do it that way because we have always done it that way.”

A review of the lifeguard training standards advanced by various organizations, including the American Red Cross, the USLA, the YMCA of the USA, and others, demonstrated that some practices differ within the field. The role of a lifeguard, regardless of where trained or employed, is to prevent death and injury. Using the best methods of training and standards of practice can therefore be expected to reduce the incidence of death and injury.

At the beginning of this project, it was assumed that some high quality scientific studies had been published within the scope of lifeguard training and standards that were not known to those developing lifeguard training programs. Another fundamental assumption was that by conducting a thorough review of the available scientific studies in related areas and by identifying areas of lifeguard training and standards that are lacking a scientific basis, recommendations could be made to help ensure that future training and standards are based on solid evidence. It was also assumed that in some areas where a scientific basis was lacking, “best practice” should be followed, but that best practices must first be determined.

## History of Collaboration

The American Red Cross, the USLA, and the YMCA of the USA all are nationally recognized nonprofit organizations, part of whose mission is the development and delivery of lifeguard training in a variety of environments. All three are the US members of the International Life Saving Federation (www.ilsf.org).

In 2003, the three organizations began discussing a formal collaboration. A key goal was to work together to identify best practices in areas that each organization had historically been relying primarily on consensus expert opinion. This eventually evolved into a formal letter of understanding, under which the three organizations have been working since that time.

## Establishment of the Coalition

In 2005, the three groups formally announced a plan to establish guidelines for lifeguarding and water safety. This project came to be known as the United States Lifeguard Standards Coalition (USLSC). The vision of the founders was to establish a process of inviting a wide range of experts from allied fields; identifying key issues in lifeguarding that needed review, research, and resolution; researching existing scientific evidence on those issues; recommending best practices based on the evidence when possible; and when unable to recommend best practices, recommending additional research.

Each organization appointed a chair based on demonstrated expertise in evaluating scientific research and conducting evidence-based reviews. A wide variety of groups were invited to appoint representatives, and face-to-face meetings were conducted from 2006 through 2008. The coalition benefited greatly by grants from the National Swimming Pool Foundation, as well as from extensive contributions of resources and personnel from the three sponsoring organizations and the many other organizations who provided experts.

The sponsoring organizations identified agencies relevant to field of lifeguarding to assure a sound, unbiased process with multidisciplinary expertise and broad representation, and to allow for open evaluation, critique, and consensus. Various levels of participation (e.g., participant organizations, individual participants and observing organizations) were identified and representatives were invited to participate based on specific criteria. The descriptions, roles and responsibilities assigned to each level of participation are listed below.

In addition, a Web site (www.lifeguardstandards.org) with an e-mail contact address (info@lifeguardstandards.org) was established that listed the selection criteria. Through this site, other organizations could request to participate if they believed they met the criteria. In this case, the following information was requested so that coalition members could determine eligibility: (1) contact information, (2) a description of the organization, (3) relevance of the individual or organization/representative to the project, and (4) potential or real conflicts of interest. Organizations that did not qualify at the Participant level were offered the opportunity to be involved as Observers. Members of the media also were invited to participate via this Web site.

## Participants and Responsibilities

| Sponsoring Organizations | Chairs |
| --- | --- |
| American Red Cross | David Markenson, MD<br>Chair of the American Red Cross Advisory Council on First Aid, Aquatics, Safety and Preparedness (ACFASP) |
| United States Lifesaving Association | Peter Wernicki, MD<br>Medical Advisor, United States Lifesaving Association<br>Member, International Life Saving Federation Medical Committee<br>Chair, ACFASP Aquatics Sub-Council |
| YMCA of the USA | Gerald E. DeMers, PhD<br>Chair, Kinesiology Department, California Polytechnic State University |

| **Sponsoring Organizations** | **Representatives** |
|---|---|
| American Red Cross | Roy Fielding<br>Stephen Langendorfer, PhD<br>Francesco A. Pia, PhD |
| United States Lifesaving Association | B. Chris Brewster<br>Peter Chambers, PhD, DO<br>Peter Davis |
| YMCA of the USA | Ralph L. Johnson, PhD<br>Terri Lees<br>Laura J. Slane |
| **Participant Organizations** | **Representatives** |
| American Academy of Pediatrics | Linda Quan, MD |
| American Association for Physical Activity and Recreation | Tomas A. Leclerc, MS |
| American Camp Association | Rhonda Mickelson |
| American College of Emergency Physicians | Andrew Butterfass, MD, FACEP |
| American Heart Association | William Hammill |
| American Public Health Association | Greg Finlayson |
| Boy Scouts of America | David Bell<br>Keith Christopher<br>Frank C. Reigelman |
| International Life Saving Federation | Steve Beerman, MD |
| National Intramural-Recreational Sports Association | Carrie Tupper |
| National Park Service | Philip Selleck |
| National Recreation and Park Association | Farhad Madani |
| US Coast Guard | ASTCS Clay Hill |
| USA Swimming | Sue Nelson |
| **Funding Organization** | **Representative** |
| National Swimming Pool Foundation | Tom M. Lachocki, PhD |
| **Observing Government Agencies** | **Representatives** |
| Centers for Disease Control and Prevention/National Center for Injury Prevention and Control | Julie Gilchrist, MD |
| National Institutes of Health/National Heart, Lung, and Blood Institute | George Sopko, MD |
| **Observing Organizations** | **Representatives** |
| American Heart Association | Mary Fran Hazinski |
| American Red Cross | Don Vardell |
| Canadian Lifesaving Society | Perry Smith |
| Canadian Red Cross | Michele Mercier |
| Starfish Aquatics International | Lake White |

| Supporting Organizations | Staff |
|---|---|
| American Red Cross | Jean Erdtmann<br>Pat Bonifer-Tiedt (Retired)<br>Connie Harvey<br>Lindsay Oaksmith O'Donnell |
| YMCA of the USA | Mike Espino<br>Kay Smiley<br>Kelly Fischbein (Volunteer) |

| Level of Participation | Roles and Responsibilities |
|---|---|
| **Sponsoring Organizations/Co-Chairs** | • Fulfill roles through appointment of a co-chair and additional representatives<br>• Establish process<br>• Chair the meetings<br>• Serve as editors for final products<br>• Participate in voting and evidence review |
| **Participant Organizations**<br>Not-for-profit national professional/scientific associations and governmental agencies with a vested interest in the field of lifeguarding. | • Fulfill roles through appointment of a representative<br>• Attend all meetings<br>• Participate and complete evidence reviews assigned<br>• Vote on recommendations<br>• Review final publications |
| **Individual Participants**<br>While most participants functioned as representatives of various organizations, a few recognized national and international experts in the field and individuals who possessed unique knowledge were invited to participate. | • Attend meetings related to their area of expertise<br>• Assist with evidence reviews<br>• Do not vote on recommendations<br>• Review relevant sections of final publications |
| **Observing Government Agencies**<br>While many government agencies were invited to be participating organizations, some wished to observe rather than to participate. | • Fulfill roles through appointment of representative<br>• May attend meetings at their discretion and expense<br>• May review final publications<br>• Do not vote on recommendations |
| **Observing Organizations (Nongovernment)**<br>Certain organizations with an interest in the field served as observing rather than participant organizations. The list included those who chose to observe rather than participate, those who did not meet the criteria for participant organizations, and those that had a real or perceived conflict of interest (such that serving as a participant organization would create either a real or perceived bias to the process). | • Fulfill roles through appointment of representative<br>• May attend meetings at their discretion and expense<br>• May participate in meetings after disclosing any conflicts of interest<br>• May review final publications<br>• Do not vote on recommendations |

## Scope of the Process

The following general categories were covered, with specific questions in each listed below:

*Prevention and Vigilance*

1. What evidence is there to support the effectiveness of scanning techniques in identifying patrons in need of assistance?
2. What evidence is there that has identified external factors that positively influence vigilance among lifeguards?
3. What are effective strategies to avoid inattentional blindness?
4. What visual and behavioral cues are useful for identifying high-risk patrons?
5. How long should a lifeguard be assigned to continually watch the water before interruption of duty?

*Rescue and Standards of a Lifeguard*

1. Is there evidence to support recommending a minimum age for lifeguards?
2. Is there evidence to support recommending a minimum hearing standard for lifeguards?
3. Is there evidence to support recommending a minimum vision standard for lifeguards?
4. Is there evidence to support recommending a minimum physical competence level for lifeguards to be met and maintained?
5. Is there evidence to support recommending use of equipment during aquatic rescues for lifeguards?

*Resuscitation, First Aid, and Education*

1. Are there unique aspects for establishing and maintaining upper airway management in the drowning process resuscitation?
    a. For in-water resuscitation, are there unique aspects of establishing and maintaining upper airway management and safe, effective, and feasible rescue breathing in the drowning process resuscitation?
2. Is suction safe, effective, and feasible in the drowning process resuscitation?
3. Is there any evidence that there are safe, effective, and feasible positioning, maintaining and extrication techniques in maintaining peripheral neurologic function or outcome of a cervical spinal injury?
    a. What are the relative risks and benefits of spinal injury management in the water?
4. Is oxygen safe, effective, and feasible in the drowning process resuscitation?
5. Can resuscitation skills needed for the victim of the drowning process be acquired through online learning?

## Key Components

The key components of the process met the following criteria:

- Were evidence based
- Were thorough, detailed, collaborative, and unbiased
- Were international in scope
- Involved individuals who both implemented the guidelines and worked using the guidelines
- Provided opportunity for input throughout the process

## Steps

The multistep development process was validated, using evidence-based guidelines, and included the following:

- Investigation of the history of safety and rescue protocols currently in existence
- Establishment of definitions for key terms in this field

- Definition of the scope of the process and the questions to be addressed
- Development of a hypothesis and/or scientific question for each area to be addressed
- Review of the available evidence using a validated and standardized approach. In most cases, two experts reviewed each topic, rating the level and quality of evidence using a standardized evidence evaluation process to develop a “worksheet” for each topic. The evidence reviewed included but was not limited to:
  - Population-based studies
  - Epidemiologic studies
  - Case-control studies
  - Historic research
  - Case studies
  - Large observational studies
  - Review of past research summaries
  - Extrapolations from existing data collected for other purposes
- Presentation and approval by coalition members of the evidence review summaries: each question was presented, discussed, and critiqued by the assembled experts until a consensus was reached.
- Draft consensus recommendations document developed by co-chairs
- Open comment on the draft consensus recommendations document.
- Review and revision of the draft consensus recommendations document by co-chairs in accordance with evidence-based, pertinent comments
- Participant-level review of revised draft to ensure consensus
- Publication of guidelines with evidence review
- Public distribution of final guidelines

### Conflict of Interest Statement

The USLSC considered conflict of interest (COI) of the utmost importance in maintaining the integrity of the evidence evaluation process. Every effort to resolve any real or perceived COI during the entire science review process was made. Every participant was asked to complete and update a COI disclosure form, and a COI booklet, which included all COI information for every participant, was given to all participants.

## PROCESS AND METHODOLOGY

### Evidence-Based Process

The process conducted represents the most comprehensive review of the lifeguarding literature to date. It fostered collaboration among the multiple disciplines with expertise in or supporting lifeguarding and aquatic rescue. These included not-for profit professional and technical organizations, scientific researchers, and government agencies. The process included key components and specific conflict management procedures.

Meetings of the USLSC were held in Valhalla, New York (December 2006); Charlotte, North Carolina (June 2007); San Luis Obispo, California (December 2007); and Colorado Springs, Colorado (October 2008). During these meetings, research questions were identified, volunteers from participant organizations were recruited to review the available research, the research evidence was evaluated (in most cases, two independent researchers per question), and consensus was reached on what or how the evidence answered the questions. Draft consensus recommendations were developed by the co-chairs.

The USLSC Participant Organizations then were asked to review the compiled draft and comments. A 45-day public comment period was provided, with supporting evidence and draft outcomes posted on the Internet. Concurrently, representatives of organizations that set regulations, standards, or practice guidelines in lifeguarding were invited to review the science evidence and provide comments. After the comment period, the draft consensus recommendations document was adjusted by the co-chairs for evidence-based input received that had been demonstrated to be relevant and reliable. A final review period was then provided to Participant Organizations to ensure consensus agreement on the final guidelines.

## Scientific Review and Evidence Grading

### Guideline Definitions for Evidence-Based Statements

| Statement | Definition | Implication |
|---|---|---|
| Standard | The anticipated benefits of the recommended intervention clearly exceed the harms, and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits strongly outweigh the harms. | Follow unless a clear and compelling rationale for an alternative approach is present. |
| Guideline | The anticipated benefits exceed the harms, but the quality of evidence is not as strong. In some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms. | Prudent to follow but remain alert to new information. |
| Option | Courses that may be taken when either the quality of evidence is suspect, or the level or volume of evidence is small, or carefully performed studies have shown little clear advantage to one approach over another. | Consider in decision-making. |
| No recommendation | A lack of pertinent evidence; the anticipated balance of benefits and harms is unclear. | Remain alert to new published evidence that clarifies the balance of benefit versus harm. |

**Criteria for Assigning Level of Evidence**

| LOE | Criteria |
|---|---|
| 1a | Population-based studies, randomized prospective studies |
| 1b | Large non-population-based epidemiologic studies, meta-analysis, or small randomized prospective studies |
| 2 | Prospective studies, which can include controlled, non-randomized, epidemiologic, cohort or case-control studies |
| 3a | Historic studies, which can include epidemiologic, non-randomized, cohort or case-control studies |
| 3b | Case series in which participants are compiled in serial fashion without a control group, convenience sample, epidemiologic studies, observational studies |
| 3c | Mannequin, animal studies, or mechanical model studies |
| 4 | Peer-reviewed works that include state-of-the-art articles, review articles, organizational statements or guidelines, editorials, or consensus statements |
| 5 | Non-peer-reviewed published opinions, such as textbooks, official organizational publications, guidelines and policy statements, and consensus statements |
| 6 | Common practices accepted before evidence-based guidelines or common sense |
| 1-6E | Extrapolations from evidence that is for other purposes, theoretical analyses that are relevant to the question being asked; modifier "E" applied to indicate extrapolated but ranked based on type of study |

*LOE, level of evidence.*

# EVIDENCE EVALUATIONS: THE QUESTIONS

# SCANNING TECHNIQUES

### *Question*

- What evidence is there to support the effectiveness of scanning techniques in identifying patrons in need of assistance?

### *Ancillary Questions*

- Is there a preferred path for scanning?
- What influences the effectiveness of scanning?

## Introduction

Some lifeguard training agencies advocate the use of specific scanning techniques and patterns; however, no direct research has been conducted to support these recommendations.

## Evidence Summary

A literature review identified no studies that related to lifeguard scanning techniques. Some of the gathered information relates to distractions and the ability to locate a specific target in a field of targets. Review of 26 research studies, with level of evidence (LOE) ratings of 3b, 3bE, 2E, 4E, and 5E, did not provide evidence of specific and effective scanning techniques to assist in identifying patrons in need of assistance. One study examined the actual physiology of the eye and the field of vision while scanning. This study presented theories for scanning patterns as being 100% effective if followed by the lifeguard but failed to provide specific evidence that these scanning patterns were indeed effective.

*Scanning Strategy*

People tend to develop their own scanning strategies. However, scanners tend to observe what is in front of them, spending about half of the search time on the front of the total viewing area and less time searching areas to the right and left of the visual field. Experience may enable the scanner to develop specific scanning patterns and to avoid dwelling on one target too long. Rather than using a rigid scanning pattern, experienced individuals use a flexible scanning strategy that allows them to emphasize important or difficult aspects of a display. Experienced individuals also learn to attend to critical features more efficiently than do individuals with little or no experience. Elliptic scanning may reduce the time needed to localize a target: scan path lengths are shorter than those of matrix, random or diagonal scan paths.

People are able to scan very quickly, but the faster the scan is performed, the less information is retained in memory.

*Target Detection*

Sensitivity to a stimulus and reaction times improve with practice. However, scanning may become more efficient with practice, but it does not become more effective. Regardless, practice does sharpen the observers' ability to recognize targets. Detecting a target becomes more difficult as the scanning environment increases in complexity; for example, scanning may be affected by the number of swimmers in a pool. In addition, the probability of finding a target decreases as the number of locations monitored increases.

If targets share similarities, attention is directed more toward those similarities. Eye fixation on a target is affected by the targets' similarities, so finding the target takes longer. If the population is homogenous, the search takes longer.

*Distractions*
It is possible that an increase in incidents or rule violations interrupts scanning. Increasing the number of distractions decreases search performance. Also, as the number of children in a pool increases, lifeguards tend to observe the children more than the adults.

## Consensus Recommendation
Evidence is insufficient to make a recommendation for or against specific lifeguard scanning techniques.

**Standards**
None
**Guidelines**
Lifeguard certifying agencies and supervisors should provide training programs and in-service protocols that cover the following:
- Emphasize scanning all fields within a scanning zone using maximal head movements.
- Require new lifeguards to practice scanning with supervision and feedback.
- Emphasize that when individuals within a population are similar in appearance, it takes longer to identify potential drowning incidents.
- Inform lifeguards that distractions greatly affect the scanning process.
- When training aquatic supervisors, include information regarding the benefits of supervision and frequent encouragement.

**Options**
- A plan should be in place to provide backup support when rule enforcement duties or incidents affect the ability of a lifeguard to effectively scan.
- Because scanners tend to observe what is in front of the total viewing area and less time searching areas to the right and left of the visual field, lifeguard employers should consider reducing the field of view assigned to lifeguards. This could be done by placing lifeguards closer together along a linear beach or at the corners of a pool versus along the sides.
- Since the probability of finding a target decreases as the number of patrons increases, consider increasing the lifeguard staff and dividing scanning responsibilities among them when the number of patrons rises.

**No Recommendations**

*Primary Summary Authors: Jerry DeMers and Michael C. Giles, Sr.*

# VIGILANCE

## *Question*

- What evidence is there that has identified external factors that positively influence vigilance among lifeguards?

## *Ancillary Question*

- What factors influence vigilance among lifeguards?

## Introduction

Vigilance is intimately related to two other topics of this coalition: scanning and inattentional blindness. Vigilance has been defined as "a state of readiness to detect and respond to certain specified small changes occurring at random time intervals in the environment" (Liu and Wickens, 1992). Other industries have identified external factors that influence vigilance performance. These factors include the task to be performed, the individual responsible for the vigilant observation, measures of performance, and the environment. The task could relate to duration, rest pauses, and knowledge of results. Examples of factors that relate to the individual include personality, sensitivity, motivation, and fatigue. Environmental factors that influence vigilance include noise, heat and cold, humidity, and time of day. Any one of these factors, or a combination of these factors, may confound the ability of an individual to maintain vigilance. Note that the studies cited in this summary do not necessarily examine lifeguarding.

## Evidence Summary

*Supervision and Encouragement*

Vigilance was *improved* by encouragement (one study), by supervision or the belief that monitoring was ongoing (one study), and by encouragement and modeling of good behavior (one study). One expert opinion asserted that onsite supervision and regular encouragement also improve vigilance.

*Sleep*

Three separate studies showed, respectively, that sleep loss temporarily impaired vigilance and sustained attention, sleep deprivation caused effects similar to those of alcohol intoxication, and sleep deprivation had lingering effects for a day after a full night’s sleep.

*Environmental Temperature*

Researchers found in one study that a gradual exposure to temperatures above 90° F (32° C) impaired vigilance. Another study found that the overall proportion of missed signals was 50% higher and response times were 22% longer at an ambient temperature of 81° F (27° C) than at 70° F (21° C). In a third study, pilot errors were progressively greater at temperatures above 84° F (29° C). A study by D.P. Wyon, I. Wyon, & Norin (1996) showed that performance in an environmental temperature above 79° F (26° C) negatively affected performance.

*Drug Use*

A study examining the effect of recreational drug use on vigilance found that people assigned to a vigilance task who tested positive for recreational drugs (including marijuana, cocaine, opiates, benzodiazepines, or a combination of marijuana and cocaine) were more likely to demonstrate a higher rate of false alarms than those who tested negative.

*Caffeine Consumption*

In a separate study, caffeine consumed at dosages found in commonly consumed beverages produced net beneficial mood and performance-enhancing effects in light, nondependent individuals who consumed small amounts. A second study showed that caffeine consumption improved alertness and vigilance. In a third study, consuming caffeine produced benefits in cognitive performance, even for habitual users of caffeine; in addition, those with higher daily caffeine consumption tended to perform somewhat better than those with a low consumption.

*Consumption of Sugared Beverages*

In one study examining sleep-deprived individuals, energy drinks containing sugar, but little caffeine, had a negative longitudinal impact on vigilance, with an initial boost and an ensuing decline that outweighed the benefits.

*Sleep Apnea*

In another study, the majority of sleep apnea patients demonstrated attention deficits.

*Physical Exercise*

A separate study showed that an exercise period of 40 minutes demonstrated increased vigilance.

*Duration of Scanning*

Harrell and Boisvert (2003) observed the duration of scanning by six lifeguards in three indoor swimming pools. The absolute number of child swimmers (younger than 17 years) in the pool was a significant predictor of the duration of scanning, as was representing child swimmers in terms of bits of information. Duration of scanning increased as a linear function of both numbers of children and child bits of information increased. Lifeguards appeared to simplify the task of information processing and decision-making by concentrating on children as a more at-risk group of swimmers. Duration of scanning was not significantly related to changes in the number of adult swimmers.

*Noise*

Taylor, Mellow, Dharwda, Gramopadhye, and Toler (2004) investigated the effects of noise on visual search performance. When compared with continuous noise treatment, random and intermittent noise patterns had negative effects on the ease of search task accuracy. Lavine (2002) explored concurrent eye movements and performance during a vigilance task designed to require frequent visual scanning. Effects of time and auditory stimuli were examined. With time-on-task, subjective fatigue ratings increased, dwell time (defined as the total duration of fixations on target digits) decreased, number of fixations decreased, and fixations were further from target digits in all conditions. In summary, fatigue decreased vigilance, and sound simulation disrupted scanning.

*Intervention*

Schwebel, Lindsay, and Simpson (2007) observed lifeguard attention, distraction, and scanning before and after a brief intervention. The intervention was designed to increase the lifeguard's perception of susceptibility of drowning incidents, to educate about potential severity of drowning, and to help overcome perceived barriers about scanning the pool. Lifeguards displayed better attention and scanning, and patrons displayed less risky behavior after the intervention was added. Change was maintained for the remainder of the season.

*Mental Effort*

Smit, Eling, Homan, and Coenen (2005) discovered that mental effort decreased subjective alertness and that physical effort increased subjective alertness. In a bibliographic study cited in *Applied Anthropology* (2001), extrapolated evidence from other studies was used to make recommendations to improve vigilance, specifically through alternating activities, having breaks, reducing noise, having temperatures below 86° F (30° C), and scheduling.

In summary, evidence from 17 studies (level of evidence [LOE] 1a–4), and six additional studies (LOE 5–6) documents that vigilance is improved when there was an interruption in duty, physical activity was interjected, regular contact and encouragement by supervisors was provided, and small levels of caffeine were ingested.

## Consensus Recommendation

### Standards

- Supervision and regular encouragement during each 30 minutes of watch improve vigilance; therefore, supervision of lifeguards should include regular contact and encouragement.

### Guidelines

- Because sleep deprivation decreases vigilance even after a "recovery" night of sleep, training and in-service protocols should emphasize the need for lifeguards to obtain a full night's sleep before assuming lifeguard duties.
- Lifeguard employers should screen candidates for untreated sleep apnea because these individuals have a decreased ability to maintain vigilance. This could be ascertained on applications for employment.
- Reasonable steps should be taken to protect lifeguards from high ambient temperatures. Steps might include providing sun protection for outdoor activities (e.g., sun shades, protective clothing), using air conditioning and adjusting indoor temperatures, and/or decreasing the length of shifts.
- Training relating to the use of different intervention options should be incorporated.

### Options

- Consumption of caffeinated, nonsugared drinks has been demonstrated to benefit vigilance. (Note: Negative health impacts of caffeine, if any, were not reviewed.)
- Use of recreational drugs among lifeguards should be prohibited because chronic use decreases vigilance, even when the user is not under the influence.
- Aerobic exercise can positively impact a subsequent vigilance task. Lifeguards should consider including exercise periods during their breaks as a way to subsequently improve vigilance.
- Aquatic facilities should incorporate into their operational plans the foregoing evidence-based interventions that positively influence vigilance (Standards, Guidelines, and Options above).

### No Recommendations

*Comments*

- While the option is provided that drug use should be prohibited, no recommendation could be made regarding the appropriate way to enforce or monitor employees.
- Not enough evidence exists for recommendations to be made regarding the consumption of sugared drinks and lifeguard vigilance.
- Not enough evidence supports the benefits of a meeting held mid-season (summer) to discuss the importance of the lifeguard function, the negative outcomes of error, and ways to improve performance and short term lifeguard vigilance.

*Primary Summary Authors: Greg Finlayson and Linda Quan, MD*

# INATTENTIONAL BLINDNESS

### *Question*

- What are effective strategies to avoid inattentional blindness?

## Introduction

Inattentional blindness occurs when people fail to notice stimuli appearing in front of their eyes while they are preoccupied with another visual task (Mack & Rock, 1998). Multiple studies on inattentional blindness noted that under a variety of experimental conditions, approximately 50% of the observers failed to notice an unexpected object on a critical trial even when the object was visible and in motion for least 5 seconds (Mack & Rock, 1998; Most, Simons, Scholl, & Chabri, 2000). Importantly, this unnoticed object was easily observed by subjects who were not otherwise concentrating on a prescribed task that was psychologically or physiologically demanding (Neisser & Becklen, 1975; Simons & Chabris, 1999).

Change blindness happens when either small or large visual scene changes are unnoticed by the viewer during either a visual distraction or a brief cloaking of the observed scenes or images (Hollingworth, 1999; Levin & Simons, 1997; McConkie & Currie, 1996; Rensink, O'Regan, & Clark, 1997; Simons & Levin, 1998). The literature on change blindness consistently notes that little visual detail from either natural or artificial environments is represented and retained from one scene to another (O'Regan, 1992; Rensink, 2000a; Simons & Levin, 1997). In one study, change blindness occurred even without the distraction or masking of target stimuli.

## Evidence Summary

Presently, the phenomena of inattentional blindness and change blindness have not been scientifically studied in the lifeguard environment. Hence, it is necessary to rely on experimental studies to determine if research findings on these two topics are applicable to the lifeguarding environment.

The work of Mack and Rock (1998) on inattentional blindness can be extrapolated to lifeguards' surveillance processes. These authors used crosses, dots, squares, and other geometric shapes to study the perception and recognition of unexpected visual stimuli. They found that when the subject's attention was focused elsewhere, critical target stimuli were difficult to perceive. Mack (2000) noted inattentional blindness as the failure to detect a fully observable but unexpected visual stimulus while attending to another visual task and added "There can be no conscious perception without attention."

Simons and Chabris (1999) explored whether the findings of Mack and Rock would apply to a real-world setting. In their experiment, participants were required to keep a silent mental count of the number of ball passes between members of two teams. During this experiment, a woman dressed in a gorilla suit walked into the middle of the basketball passing exercise, beat her chest for several seconds, and walked out of the scene. Only 64% of the easy task participants (sequential aerial passes) and only 45% of the hard task participants (sequential aerial and bouncing passes) noticed the unexpected event. These failures occurred even though at times the ball was in front of or obstructed by the gorilla. Subsequent researchers have replicated the work of Mack and Rock (1998) and of Simons and Chabris (1999) and noted that all participants noticed the gorilla if they were not counting league ball passes.

Individual's intuitions about the relationship between perception and cognition also were examined in various studies. The subjects in these studies greatly overestimated their ability to detect changes when they were viewing a particular scene but not focusing on it. In a later study, Levin, Simons, Daniel, Angelone, and Chabris (2002) extended their change blindness research and found that change blindness was present in a variety of naturally occurring situations.

Simons (2002) investigated the limits of change blindness and identified them: overwriting, only encoding the features of the initial object, the failure to store visual information internally rather than externally, storing but not comparing visual images, and constructing a third internal representation by superimposing elements of the first and second views. No single cause was deemed to satisfactorily account for all change blindness findings.

In summary, evidence from 63 studies with a level of evidence (LOE) of 1a through 4E, and six additional studies with a LOE of 5E, indicates that focused attention is needed to detect change, that inattentional blindness and change blindness exist, and that process and attention capacity are similar in younger compared with older adults. No specific evidence was found to demonstrate that inattentional blindness affects lifeguarding.

## Future Research

Research is needed to determine if there are strategies that can be implemented to avoid inattentional blindness.

## Consensus Recommendation

The reviewed studies were concerned primarily with verifying the existence of inattentional and change blindness and did not suggest any strategies for avoiding them. Therefore, the evidence is considered to be insufficient to recommend strategies for avoiding inattentional blindness in lifeguarding.

**Standards**
None
**Guidelines**
None
**Options**
None
**No Recommendations**
*Comments:* Agencies and employers should emphasize scanning training for the surface and underwater in environments where water clarity permits.

*Primary Summary Authors: Laura J. Slane and Francesco A. Pia, PhD*

# VISUAL AND BEHAVIORAL CUES

### *Question*

- What visual and behavioral cues are useful for identifying high-risk patrons?

### Introduction

Identification of high-risk patrons may or may not be appropriate within lifeguard training. Some current training manuals list high-risk behaviors that may require lifeguard intervention; however, scanning techniques for lifeguards need to address all patrons equally rather than identify separate groups. Epidemiologic studies have described risk factors and can provide a profile of those who are at greater risk of an aquatic accident.

### Evidence Summary

The studies reviewed indicate that some characteristics that were related to drownings, namely, gender, age, race and other sociocultural parameters. The following studies include information relating to specific behaviors and cues.

Bell and others (2001) documented the risk factors for drowning among active duty, male US Army soldiers. Most drownings occurred when no lifeguard was present, but almost two-thirds occurred in the presence of others. Drownings involving minority victims were less likely to involve alcohol but were more likely to occur in unauthorized swimming areas. Whereas most drownings did not involve violations of safety rules, over one-third of the cases involved some form of reckless behavior, particularly for those younger than 21 years.

Driscoll, Harrison, and Steenkamp (2004) reviewed the role of alcohol in drownings associated with recreational aquatic activity. They discovered that drowning appears to be the overwhelming cause of death associated with recreational aquatic activity, noting that alcohol was detected in the blood in 30% to 70% of these persons. The few relevant studies examining the degree of increased risk suggest that persons with a blood alcohol level of 0.10 g/100 mL have about 10 times the risk of death associated with recreational boating compared with those who have not been drinking.

Other studies focused primarily on population characteristics rather than on visual or behavioral cues.

In summary, evidence from 11 studies with a level of evidence (LOE) of 1a through 4) and 16 additional studies having a LOE of 4 through 5 document that risky behavior and alcohol are behavioral cues that should be given special attention regarding swimming or aquatic activities. Open-water alcohol-related drownings commonly occur in unguarded facilities and with boating. Although risky behavior was cited as a cue in studies, the actual identification of specific risky behaviors was not noted.

### Consensus Recommendation

**Standards**

- Consumption of alcohol is a visual and behavioral cue that an individual may be at greater risk of drowning. Lifeguard certifying agencies should emphasize this fact in lifeguard training.

**Guidelines**

- Individuals who are under the influence of alcohol should be discouraged or excluded from participating in aquatic activities.

**Options**

None

**No Recommendations**

*Primary Summary Authors: Michael C. Giles and Greg Finlayson*

# BREAKS (INTERRUPTIONS OF DUTY)

### *Question*

- How long should a lifeguard be assigned to continually watch the water before interruption of duty?

### *Ancillary Questions*

- Should a lifeguard be assigned to continually watch the water for more than 30 minutes without a break?
- How long of a break should a lifeguard receive between assignments to watch the water?

## Introduction

Water surveillance is a key assignment of lifeguards. Unless a situation in which a person who is in danger or distress is recognized, an effective response to prevent death or injury is impossible. By vigilantly watching those in the water, lifeguards can observe behaviors and hazards that can be stopped or modified to prevent injury and death, and can promptly respond if rescue efforts are needed.

Many factors affect an individual's ability to effectively perform lifeguarding tasks, including emotional or physical characteristics, physical surroundings, and time on task. It is well established that the ability to concentrate on a given task declines over time, and although time is a factor that can be controlled, the length of time that a lifeguard should be assigned to water surveillance has not been defined. In many settings, the watch is limited to 1 hour.

## Evidence Summary

*Duration of Watch*

Evidence from three randomized studies showed that over a 30-minute period, vigilance declines; two additional literature reviews also indicated that vigilance declines over time. The decline was linear in one study and not linear in another. In one study that lasted 2 hours, the decline was greatest in the first 30 minutes and more gradual in the next three 30-minute periods.

*Breaks*

One study indicated that a 30-minute break after a vigilance task can fully "reset" vigilance.

## Consensus Recommendation

**Standards**

None

**Guidelines**

None

**Options**

None

**No Recommendations**

*Comments*: Evidence from three high-level studies in laboratory settings and other industry standards and recommendations indicates that vigilance declines during the first 30 minutes of tasks. Whereas a shorter period of scanning duty may be better, extrapolation to the lifeguard setting is difficult because the risks of decreased vigilance over time may be offset by the unique aspects of lifeguarding duties, including risks induced by frequent changing of lifeguards. Therefore, a recommendation cannot be made for an optimal length of time for a lifeguard shift.

*Primary Summary Authors: B. Chris Brewster and Linda Quan, MD*

# AGE

## *Question*

- Is there evidence to support recommending a minimum age for lifeguards?

### Introduction

For many years, lifeguard training agencies and employers have set minimum age requirements for lifeguards. These ages have varied. No direct research to a specific age requirement has been conducted. Some have questioned different minimum age requirements as they relate to maturity, performance, and safety levels in the lifeguarding profession. Because lifeguarding has become such a specialized field, there may be a need to determine the appropriate minimum age, as well as whether lifeguards have the maturity and ability to handle the level of stress inherent in effectively performing their duties.

### Evidence Summary

A literature search was performed using the terms lifeguard maturity, mature lifeguard, age required for lifeguards, immature lifeguards, and age requirements for lifeguards. Databases searched included PubMed Central, OVID, *The Journal of the American Medical Association*, EBSCOHOST, *British Medical Journal*, IngentaConnect, and the lifeguard manuals of several agencies. Age requirements for other professions also were evaluated using the Web sites of the Department of Labor and other agencies.

Various reports, articles, and case studies regarding young adolescents have had several similar findings. A pattern of behavior, poor decision making, and perhaps poor reasoning among young adolescents have led to patron injuries, as well as a compromise to the lifeguards' safety while on the job or in the workplace.

Data on US children younger than 18 years with acute occupational disinfectant-related illnesses between 1993 and 1998 were collected from the Toxic Exposure Surveillance System and from the California Department of Pesticide Regulation (Brevard, Calvert, Blondell, & Mehler, 2003). In the latter study, the incidence of acute occupational disinfectant-related illness was higher among youths 15 to 17 years of age than among adults 25 to 44 years of age (Brevard et al., 2003). Evidence from two observational studies, whose level of evidence (LOE) ranged from 2E through 3bE, document that teenagers seem to present various levels of maturity between the ages of 15 and 17 years. Seven additional studies and resources ranging in LOE from 4E through 5 suggest that perhaps age has nothing to do with levels of performance, and that hiring lifeguards as young as 15 years of age has been accepted by some lifeguard training agencies and aquatic practitioners.

Expert opinion on age requirements for lifeguards is split. Specific scientific studies in maturity levels for lifeguarding that support age requirements are lacking. Guidelines for age requirements for many other disciplines indicate that 18 years of age is widely accepted.

Evidence suggests that as adolescent lifeguards become older, they are more likely to have the maturity to handle the stress and responsibility required to effectively perform the job. Because research directly associated with the age of lifeguards is lacking, currently we must rely on a consensus of experts (International Labor Organization, 1976; US Department of Labor, 2007).

The range of expert opinion and consensus make it difficult for aquatic professionals and lifeguard agencies to agree on maturity levels as they relate to employing lifeguards as young as 15 years old. However, expert opinion and consensus from both the US Department of Labor and the International Labor Organization indicate that the minimum working age for less-hazardous lifeguarding jobs (e.g., swimming pools, various jobs in waterpark) should be 15 years.

## Future Research

Studies are needed on individuals aged 15 to 17 years who perform lifeguarding duties in various water environments.

## Consensus Recommendation

**Standards**

None

**Guidelines**

- Individuals performing lower-stress and lower-risk lifeguarding jobs, such as pool lifeguarding and some types of waterpark guarding, should be at least15 years old.
- Individuals performing higher-stress and higher-risk lifeguarding jobs, such as open water, wave pools, etc, should be at least 16 years old.

**Options**

- Lifeguards should be 18 years old or older whenever feasible, particularly for more demanding, stressful, or risky guarding jobs (e.g., beaches, open-water lakes, high-use pools, water parks with more demanding features).

**No Recommendations**

*Primary Summary Authors: Peter Davis and Sue Nelson*

# HEARING

### *Question*

- Is there evidence to support recommending a minimum hearing standard for lifeguards?

### *Ancillary Questions*

- If so, what is the minimum requirement?
- Are hearing aids acceptable?

## Introduction

Many occupations—particularly those in which individuals must be able to perform under stressful situations, that require physical ability—have minimum standards for performing these tasks as a prerequisite for employment. Lifeguarding requires the ability to maintain attention and focus for long periods of time. Lifeguards must be able to identify potentially dangerous situations and react to them in a reasonable timeframe to ensure the safety of others. Many questions have been asked about the minimum requirements for lifeguards, including physical ability, age, hearing, and visual acuity.

## Evidence Summary

A thorough literature review and database searches for key words related to lifeguarding, hearing standards, police, firefighting, and driving requirements identified 18 sources. The studies with the highest level of evidence (LOE) examined the abilities of both hearing-impaired individuals and normal-hearing individuals to perform their jobs. Occupations that require intense communication or increased attention are better suited for normal-hearing individuals (Kramer, Kapteyn, & Houtgast, 2006; Weisel & Cinamon, 2005). In sources that involved driving standards and recommendations for other professions, impaired hearing reduces people's abilities to perform complex tasks, including operating an automobile (Wood, 2006; Ivers, Mitchel, & Cumming, 1999; F.J. Garcia Callejo,, F. Garcia Callejo, & de Paula Vernetta, 2005). Minimum hearing standards in their occupations are supported in articles by the American College of Occupational and Environmental Medicine (2002) and by the Communities and Local Government of the United Kingdom's *Medical and Occupational Evidence for Recruitment and Retention in the Fire and Rescue Service* (2004). Some studies suggested specific standards, with the consensus being a minimum hearing threshold or no more than an average of a 25-decibel loss in both ears over a range of frequencies (500, 1000, 2000, and 3000 Hz, respectively).

An assessment of specific employment applications for law enforcement, firefighting, the Federal Aviation Administration pilot's license, and lifeguarding certification provided a consensus that a minimum hearing standard should exist. Most of these applications also set minimum hearing thresholds. Only one study opposing minimum hearing thresholds concluded that although it was recognized that some type of hearing standard is needed, there still are some opportunities for hearing-impaired officers in law enforcement (Punch, Robertson, & Katt, 1996).

In summary, six studies involving case series and observations studies had an LOE of 2 through 3b, and 12 additional studies had an LOE of 4 through 5. This expert opinion and consensus, along with the fact that most applications set minimum hearing thresholds for employment, indicate the need for a minimum hearing standard for lifeguarding.

## Future Research

Further research is needed to determine if adjunctive aids are acceptable for use in a lifeguarding setting. Validation studies also are necessary to confirm that developed thresholds are comparable among all lifeguarding settings, such as pools, lakes, and open-water environments. Adoption of a formal hearing standard in lifeguarding would require additional research.

## Consensus Recommendation

There is enough evidence to recommend that there should be minimum hearing standards for lifeguarding. However, because the amount of direct research about a minimum hearing standard in lifeguarding is limited, and because the indirect studies had a lower LOE with most information presented as individual consensus, we can make a guideline decision only as opposed to a standard.

**Standards**

None

**Guidelines**

- Minimum hearing standards should be in place for individuals performing lifeguarding duties.

**Options**

- The minimum hearing threshold of lifeguards should be no more than an average of a 25-decibel loss in both ears over a range of frequencies (500, 1000, 2000, and 3000 Hz).

**No Recommendations**

*Primary Summary Author: Andrew Butterfass, MD, FACEP*

# VISION

## *Question*

- Is there evidence to support recommending a minimum vision standard for lifeguards?

## *Ancillary Questions*

- If so, what is the minimum requirement?
- Are corrective lenses/treatments acceptable?

### Introduction

Many occupations, particularly those in which individuals must be able to perform under stressful situations that require physical ability—have minimum standards for performing these tasks as a prerequisite for employment. Lifeguarding requires the ability to maintain attention and focus for long periods of time. Lifeguards must be able to identify potentially dangerous situations and react to them in a reasonable timeframe to ensure the safety of others. Many questions have been asked about the minimum requirements for lifeguards, including physical ability, age, hearing, and visual acuity.

### Evidence Summary

A literature review identified 22 relevant sources. The studies with the highest level of evidence (LOE) included a study that looked specifically at developing visual acuity standards in lifeguarding (Seiller, 1997), and another that examined the same but pertaining specifically to beach lifeguards (Tipton, Reilly, Scarpello, & McGill, 2007). In sources that involved driving standards and recommendations for other professions, impaired visual acuity reduced people’s abilities to perform complex tasks, including operating an automobile (Wood, 2006; Ivers, Mitchell, & Cumming, 1999; F.J. Garcia Callejo, F. Garcia Callejo, & de Paula Vernetta, 2005). Minimum visual acuity standards in their occupations are supported in articles by the American College of Occupational and Environmental Medicine (2002) and by the Communities and Local Government of the United Kingdom’s *Medical and Occupational Evidence for Recruitment and Retention in the Fire and Rescue Service* (2004). Some studies suggested specific standards.

An assessment of specific employment applications for law enforcement, firefighting, the Federal Aviation Administration pilot’s license, and lifeguarding certification provided a consensus that a visual acuity standard should exist. Most of these applications also set minimum visual acuity thresholds for employment, with a limited range that required minimum vision acuity of no worse than 20/40 in corrected vision in each eye. One study set an uncorrected visual acuity at 20/200. In the study by Tipton and others (2007), as long as lifeguards’ vision was corrected during scanning, they were able to reach victims even after loss of corrective lenses.

### Future Research

Further research is needed to determine if corrective devices (contact lenses and glasses) are acceptable for use in a lifeguarding setting. Preliminary studies look promising. Validation studies are necessary to confirm that developed thresholds are comparable among all lifeguarding settings, such as pools, lakes, and open-water environments. Adoption of a formal standard in lifeguarding would require additional research.

### Consensus Recommendation

There is enough evidence to recommend that there should be minimum visual acuity standards for lifeguarding (six studies of LOE 3b and 16 additional studies with an LOE between 4 and 5). However, because the amount of direct research about a minimum visual acuity standard in lifeguarding is limited, and because the indirect studies had a lower LOE with most information presented as individual consensus, we can make a guideline decision only as opposed to a standard.

**Standards**

None

**Guidelines**

- A minimum vision standard for lifeguards should be identified and instituted.

**Options**

- Each facility is encouraged to require testing of corrected and uncorrected vision and to then develop appropriate standards for their venues.

**No Recommendations**

*Primary Summary Authors: Peter Davis and Andrew Butterfass, MD, FACEP*

# PHYSICAL COMPETENCY

## *Question*

- Is there evidence to support recommending a minimum level of physical competence for lifeguards to meet and maintain?

## *Ancillary Questions*

- Is there evidence that identifies a job-related skill set for lifeguards?
- Is there evidence that suggests which fitness components are represented in the lifeguard skill set?
- What are the (evidence-based) physiologic demands of job-related skills of a lifeguard?
- Is there evidence to support recommending a minimum level of physical fitness for all lifeguards to meet and maintain regardless of venue?
- Is there evidence to support recommending different minimum levels of physical competence for different venues (e.g., open-water surf, open-water non-surf, swimming pools)?
- Is there evidence to support recommending specific laboratory protocols to test fitness relevant to the lifeguard skills set?

## Introduction

The public has a reasonable expectation that public servants, emergency responders, and those considered to be trained professional rescuers (e.g., firefighters, paramedics, emergency medical personnel, Coast Guard personnel, and military personnel) be physically able to perform rescue activities according to their level of training, regardless of the prognosis of the victim. Agencies that employ such professionals generally have physical performance requirements that must be met and maintained. It would seem intuitive that those same or similar expectations would be maintained for lifeguards, who have acquired the distinction of "professional rescuer."

Agencies that train beach/surf lifeguards recognized early that lifeguard personnel must be physically able to respond promptly and adequately to perform their duties both on land and in the water. For example, the United States Lifesaving Association adopted physical training standards in 1984. The National Park System adopted a five-item test in 1986 that was first introduced in the mid 1970s by the Gateway National Recreation Area, a National Park Service field unit in the metropolitan New York–New Jersey area. According to the National Park Service, "the test provides a rather solid indicator of one's current potential, prior to employment, to handle the physical demands of in-service training and on-the-job emergencies without either endangering oneself or endangering those who are entrusting their safekeeping to one" (Martinez 2007).

Because lifeguards are considered to be "professional rescuers," it is reasonable to expect that job skills require at least a minimum level of fitness. This always has been the case for lifeguards at beach and water fronts, who, in fact, have been expected to meet and maintain physical fitness skills and competencies.

### Evidence Summary

There is little doubt that the job responsibilities of a lifeguard require certain physical skills and that to successfully perform the job, at the very least, a minimum level of fitness is needed. To validate this assumption, we considered the general fitness and fitness standards that exist for public safety personnel and included them in the investigation of the proposed question.

First, we developed a list of physical skill competencies that lifeguards, regardless of venue, must maintain for successful job performance. Research demonstrates that lifeguards, regardless of venue, have similar skill sets that require fitness levels to be met and maintained for job success.

Consideration was given to the following issues as components of the original question regarding evidence to support recommending a minimum physical competence level for lifeguards to meet and maintain:

- The need for a minimum level of fitness
- Single-skill versus combined-skill scenarios to test for physical skill competency
- Skill competencies that are venue specific
- Physical fitness testing to address minimum levels of fitness
- Frequency of testing for physical skill competencies

The following “physical skill set” (PSS) was identified based on literature review and assessment of the skill components included in the curriculums of the major nationally recognized lifeguard certifying agencies:

- Running quickly on land then safely entering the water
- General swimming ability
- Surface diving and swimming underwater to a specific depth
- Recovering a casualty from deep water to the surface
- Towing a casualty (emphasis on kicking strength and efficiency) to a point of exit from the water
- Lifting, carrying, and or dragging a victim to a point of safety
- Handling a victim of a spinal injury
- Performing cardiopulmonary resuscitation (CPR) until emergency medical assistance arrives

Minimum fitness standards have been developed on local levels for a number of public safety professionals, including police, fire, and military personnel. These jobs demand exceptional physical performance on the job, but only sporadically and for relatively short periods of time (a description that also seems to fit the job of a lifeguard). Although in general, these jobs otherwise can be considered sedentary (i.e., not physical enough to elicit a training effect), sudden strenuous exertion can be needed at any second. Researchers agree that certain physiologic requirements are important for effective work in the public safety domain. Firefighters and police officers often are required to pass a job-related physical ability test or candidate physical activity testing before being allowed into training programs, and they must repeat the testing procedures at least annually. These testing procedures include timed tests that have been validated for specific job requirements. If the individual fails a section, he or she may be removed from duty and put into a training program until physically ready to return to the job.

Additional support for requiring an MLF for lifeguards is provided by a review of research into the physiologic demands of CPR, a critical physical skill component. Studies suggest that the number of satisfactory chest compressions administered decreases over a short period of time, and that the rescuer’s level of fitness is the key to continuing CPR without undue fatigue. Other studies show that the practice of CPR is a moderately intense activity and requires a certain level of fitness. None of the studies included involved any kind of physical demand before the subjects began administering CPR, whereas lifeguards already may have performed demanding rescue tasks, including water entry, casualty recovery, and towing and removal of the casualty before they can begin CPR. It is logical to question the quality and effectiveness of the CPR in this scenario if the lifeguard does not possess a greater than minimum level of fitness to provide CPR for an undetermined amount of time until help arrives.

Even more support for meeting and maintaining a minimum level of fitness can be found in the literature (Winett & Carpinelli, 1999) that upholds the position of the American College of Sports Medicine (ACSM) as stated in their *Recommended Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness and Flexibility in Healthy Adults* (ACSM, 1998). Research shows that aerobic exercise is necessary for cardiorespiratory fitness in certain amounts at a certain level of intensity and that improvements in muscular fitness require strength and endurance training.

Research conducted at the Cooper Institute for Aerobic Research (2006) supports the importance of requiring minimum levels of fitness for public safety personnel. Others agree that for physically demanding jobs, physical fitness programs should be part of the daily schedule. Identifying the necessary physical skills set can justify and be used in training plans/programs for maintaining the MLF related to the specific skill set.

Ample support was found for requiring minimum physical skill competences in the identified skill sets. Research conducted at the Cooper Institute identifies the following components related, at least in part, to the PSS for lifeguards:

- Sprints—anaerobic power
- Lifting and carrying—muscular strength, muscular endurance, anaerobic power
- Dragging and pulling—muscular strength, muscular endurance, anaerobic power
- Use of force for longer than 2 minutes—aerobic power, muscular strength, muscular endurance

Consensus among research articles and relevant agencies on the question of venue-specific minimum physical skills competencies indicates that surf rescue of a casualty puts greater physical demands on the rescuer than does pool rescue (except for extrication and performance of CPR, which are similar and land-based in both environments). Research and consensus both support physical fitness and PSS that should be met and maintained for beach lifeguards, although further research may be needed to differentiate between surf and non-surf venues.

There is no research on any aspects of PSS specifically for pool lifeguards (except for studies on the physiologic demands of performing CPR), but important information can be drawn from general fitness studies and studies conducted with beach lifeguards.

According to the ASCM (1998), “A significant reduction in cardio-respiratory fitness occurs within 2 weeks of stopping intense training with participants returning to pre-training levels of aerobic fitness after 10 weeks to 8 months.”

The ACSM recommends muscular strength training two to three times per week, performing a minimum of one set of 8 to 12 repetitions per muscle group. In studies involving maintenance of strength gain, it appears that as long as the training intensity remains the same, participants can maintain strength gains for up to 12 weeks with as little as one lifting session every 2 to 4 weeks.

**Evidence Summary for Ancillary Questions:**

*Evidence Summary that Identifies a Job-Related Skill Set for Lifeguards*

Evidence from five studies `(level of evidence [LOE] 3b) supports the following skill set required of surf and/or non-surf open-water lifeguards: towing a casualty, paddling with a casualty, swimming in the sea, swimming under water, lifting and dragging a casualty, and beach running. In addition, expert opinion and consensus from 10 LOE 5 documents/agency training programs identify the following skill set for lifeguards: swimming; rescuing a victim; swimming underwater; towing a victim; lifting, dragging, and carrying a victim; and administering CPR.

*Evidence Summary that Suggests which Fitness Components Are Represented in the Lifeguard Skill Set*

Evidence from four LOE 3b studies, two LOE 3c studies, one LOE 5 study, seven LOE 3bE studies, and one LOE 4E study supports the following fitness components represented in the skills set of lifeguards and other public safety professionals (e.g., police, fire, military personnel) for job performance:

- Aerobic capacity
- Anaerobic power
- Muscular strength and endurance (especially lifting)
- Body composition

*Evidence Summary of (Evidence-Based) Physiologic Demands of Job-Related Skills of a Lifeguard*
Evidence from two LOE 3b studies, seven LOE 3c studies, and three LOE 3bE studies supports that the physiologic demands of activities within the lifeguard skill set (performing compressions for CPR) require moderate-to high intensity aerobic capacity and that lifting and dragging require anaerobic power.

Based on the "Principle of Specificity," the ACSM states, "Cross-over of training effects between one mode of endurance activity and another is limited. The most effective way to train for a particular activity is to practice that activity regularly" ( 2001, p. 489).

*Evidence Summary to Support Recommending a Minimum Level of Physical Fitness for All Lifeguards to Meet and Maintain Regardless of Venue*
Evidence from three LOE 3b, nine LOE 3c studies, and two LOE 4E studies supports the need for minimum levels of fitness based on the PSS identified for lifeguards. In addition, expert opinion and consensus among three LOE 4 and nine LOE 5 documents support this summary.

*Evidence Summary to Support Recommending Different Minimum Levels of Physical Competence for Different Venues (e.g., Open-Water Surf, Open-Water Non-Surf, and Swimming Pool)*
Evidence from four LOE 3b studies and two LOE 4 studies supports the need for specific tests for physical skill competence of open-water surf and non-surf lifeguards. In addition, expert opinion and consensus among five LOE 5 documents support the evidence.

*Evidence Summary to Support Recommending Specific Laboratory Protocols to Test Fitness Relevant to the Lifeguard Skill Set:*
Evidence from two LOE 3b studies and five additional LOE 3bE studies supports the use and reliability of laboratory fitness tests to predict job performance. Additional expert opinion and consensus documents (two LOE 4, two LOE 5, one LOE 4E) also support this evidence.

## Consensus Recommendation

### Standards

- Aquatic managers should ensure that all employed lifeguards meet the minimum level of fitness required for the lifeguard PSS. This should be assessed by requiring successful completion of a timed venue-specific water rescue competency test (WRCT), which includes, but is not limited to, the following:
  - Safely entering the water from a lifeguard station/elevated stand
  - Performing a rapid approach to the victim
  - Descending to the deepest part of the venue (not to exceed 20 feet)
  - Retrieving the victim (an adult submersible manikin or equivalent)
  - Returning the victim to safety
  - Safely removing the victim (with the help of other staff if based on the specific venue emergency action plan) to a position of safe access for emergency medical services
  - Performing CPR for a period of 9 minutes (average US response time) or the documented response time of the venue, whichever is less.
  - Performing the components of the WRCT, as described earlier, in a continuous non-interrupted sequence.

### Guidelines

- Aquatic managers should test all employed lifeguards at least once every 10 to 12 weeks to ensure maintenance of the PSS and fitness.
- Aquatic managers should provide for, or require, adequate specific exercise by employed lifeguards to ensure the maintenance of the minimum level of fitness required by the PSS. This should be in the form of in-service training or exercise programming.

**Guidelines (continued)**

- Open-water venues and other more challenging lifeguarding environments may require testing of additional required skills, which could include long distance running and/or swimming, multiple-victim rescues, navigating large surf, cold water exposure, rescue board paddling, and rowing.

**Options**

- Laboratory fitness testing may be used for fitness screening of applicants but does not substitute for the pre-employment WRCT/fitness test.

**No Recommendations**

*Primary Summary Authors: Terri Lees and Roy Fielding*

# USE OF EQUIPMENT

### *Question*

- Is there evidence to support recommending use of equipment during aquatic rescues for lifeguards?

### *Ancillary Question*

- Are there methods of performance using standard rescue equipment that are more efficient than others?

## Introduction

The long history of lifesaving has included both the use and lack of use of lifesaving equipment. However, little research has been done to recommend what type of equipment would constitute best practice. Over the years, the pioneers of modern lifeguarding developed workable equipment. Most contemporary lifeguarding entities recommend the use of some type of flotation device when conducting a rescue to reduce the risk to both the rescuer and the victim. Currently, lifeguards have a variety of equipment—most of which was designed originally for beachfront environments—that have made the rescue of victims (distressed, passive, submerged, or active) safer, faster, and more efficient.

## Evidence Summary

No relevant evidence was identified in a search (of nine databases) using the terms *lifeguard equipment, lifesaving equipment, water rescue equipment*, and *guard equipment*.

Information was gathered by evaluating the equipment used by the most widely recognized lifeguard training agencies. In addition, lifeguard training manuals were reviewed for statements or research justifying use of the equipment.

Results showed consensus among the vast majority of lifesaving organizations that efficacy of in-water rescue (surf, nonsurf open water, or pool environments) is increased by the use of equipment when appropriate training has been conducted by a qualified instructor for lifeguard candidates. Because this recommendation is widely published in textbooks and training materials, it is supported by an LOE of 5.

In short, there is a consensus of expert opinion supporting the use of equipment for in-water rescue. There is not enough evidence to recommend which equipment should be used specifically or to distinguish between equipment designed for a specific purpose.

## Consensus Recommendation

**Standards**

None

**Guidelines**

None

**Options**

- It is recommended that appropriate equipment be used for in-water rescue, provided that the rescuer has received proper training specific to its use.

**No Recommendations**

*Primary Summary Authors: Terri Lees, Rhonda Mickelson, and Peter Davis*

# AIRWAY

## *Question*

- Are there unique aspects of establishing and maintaining the upper airway during the process of resuscitation after drowning?

## *Ancillary Question*

- Are there unique aspects of establishing and maintaining upper airway management for in-water resuscitation?

## Introduction

Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid. Drowning outcomes are classified as death, morbidity, or no morbidity. The "drowning process" is the continuum that begins when the victim's airway lies below the surface of the liquid, usually water, at which time the victim voluntarily attempts to hold his or her breath. This may be followed by an involuntary period of laryngospasm secondary to the presence of an irritant (i.e., not air) in the oropharynx or larynx. This begins a cascade of hypoxia that most often results in the victim actively aspirating liquid and swallowing larger amounts of liquid into the gastrointestinal system. If there is no rescue and/or reverse of this cascade, the hypoxia increases and multisystem failure ensues.

If the drowning process is stopped or reversed, the hypoxic changes can be reversed. However, hypoxic changes can continue despite rescue and resuscitation if reoxygenation is impaired. This can occur when there is no effective circulation or if oxygen cannot reach lung tissue because of upper airway obstruction or aspiration damage to the lower airway. Maintaining an open airway to allow oxygen to reach some effective lung tissue and minimizing the aspiration obstruction of the airway improve resuscitation outcomes.

The degree to which airway management problems impact resuscitation and outcomes after rescue from the drowning process is unclear. It also is unclear whether the use of techniques to reduce regurgitation and subsequent aspiration of gastric fluids improves resuscitation outcomes. There are many reports of various techniques for upper airway management in the prehospital setting after rescue from the drowning process, which may imply that upper airway management after rescue from the drowning process is an important issue.

Although there has been considerable debate and controversy about the techniques of upper airway management during and after rescue from the drowning process, there is little documentation of the upper airway challenges themselves.

## Evidence Summary

The speed of relieving hypoxia during the drowning process has the greatest influence on outcome, and ensuring that a victim is brought to land should not delay attempts at in-water resuscitation (Orlowski & Spzilman, 2001; Golden, Tipton, & Scott, 1997).

In a report of 36 nonfatal drownings at Miami Beach from January 1967 through December 1969, submersion victims were treated at the scene with suctioning the oronasopharynx, establishing an airway, and assisting or controlling ventilation by personnel of the specially trained Fire Rescue Squad of Miami Beach. Treatment recommendations made, based on expert opinion, included the following (Hasan, Avery, Fabian, & Sackner, 1971):

- An airway should be established and artificial ventilation begun immediately.
- Postural drainage and oronasal suction should be instituted whenever possible.

- If the patient is unconscious upon arrival, tracheal intubation should be performed immediately and then a nasogastric tube inserted to aspirate the stomach, but only after a cuffed tracheal tube is in place. This will prevent aspiration of stomach contents.

In reports of prehospital care of 162 immersion resuscitation victims in Australia from 1973 to 1983, vomiting and regurgitation occurred in 86% of those who required cardiopulmonary resuscitation (CPR), in 68% of those who required expired-air resuscitation, and in 50% of those with spontaneous respiration; obtaining and maintaining a clear airway was difficult in 54 of the victims (Manolios & Mackie, 1988).

According to Pearn (1985), "The unconscious (but breathing) victim must be nursed and transported in the coma position, for the airway is particularly likely to be blocked secondarily by regurgitation of large amounts of water and of stomach contents. Often the first sign of successful CPR is a convulsive abdominal diaphragmatic heave with a flood of vomitus or swallowed water."

The International Life Saving Federation Medical Committee (1994) issued the following statement: "This combination of hypoxia and a full stomach is the cause of the regurgitation that is very familiar to lifeguards and is an almost inevitable accompaniment of near drowning."

The victim's position during rescue is a determinant of vomiting during the rescue or transport. More than 80% of resuscitation of drowning process victims results in vomiting (Szpilman, 2002). Szpilman and Handley (2006), consistent with the Basic Life Support Working Group on the International Liaison Committee on Resuscitation (ILCOR, 2006), recommend the following:

- The victim should be in as near a true lateral position as possible with the head dependent to allow free drainage of fluids.
- The position should be stable.
- Any pressure on the chest that impairs breathing should be avoided.
- It should be possible to turn the victim onto the side and return to the back easily and safely, having particular regard to the possibility of cervical spinal injury.
- Good observation of, and access to, the airway should be possible.
- The position itself should not give rise to any injury to the victim.

From January 1995 to December 2000, in a retrospective selected group of waterfront resuscitation drowning victims in Brazil, in-water resuscitation provided the victim a 4.4 times better chance of survival (Szpilman, 2006).

In summary, evidence from nine retrospective observational case series and case review studies with the highest LOE of 3b, and 11 peer review consensus papers (LOE 4), supports that upper airway management is a significant challenge in drowning process resuscitation. Early rescue breathing and airway management, including in-water resuscitation, improves outcomes in drowning process resuscitation when performed by trained rescuers in open-water settings.

Both outcome data and expert opinion support the concept that there are unique aspects of establishing and maintaining an upper airway during the drowning process resuscitation, and that early rescue breathing, including in-water resuscitation is safe, effective, and feasible for trained rescuers in open-water settings. It is extrapolated that this also would be a positive factor for drowning process resuscitation outcomes in pool settings.

The drowning process creates a unique and challenging problem in upper airway management for victims, rescuers, and those providing resuscitation and medical care. Resolving any upper airway obstruction may be the most important step in reversing the hypoxic cascade, often complicated by regurgitation and vomiting, either spontaneously or as a result of triggers in the rescue, resuscitation, and transportation process.

The evidence available suggests the following:

- Prevention of unintended immersion, aspiration, and drowning is most important.
- Most drowning process victims have upper airway management problems.
- Aspiration leads to acute and chronic complications in medical management of drowning.
- Reversing aspiration and subsequent hypoxia may have a significant impact on outcome.
- Early rescue breathing is a priority in reversing the hypoxic cascade and may prevent cardiac arrest.
- It is safe and effective to provide rescue breathing in shallow water. It may be helpful to provide rescue breathing in deep water if the conditions are safe; a single, trained rescuer is supported by a flotation device; or there are two or more trained rescuers.

Reasonable assumptions include the following:

- Upper airway management is more challenging in the prehospital setting.
- Preventing aspiration is helpful in improving outcomes and reducing the need for airway management.
- The upper airway management in an un-intubated unconscious victim may require the full-time attention of one rescuer.
- During resuscitation, the drowning process victim may benefit from airway drainage positioning and minimizing patient movements to reduce vomiting, regurgitation, and the consequent risk of aspiration.
- Distractions, such as suspecting a spinal injury when the probability is very low, decreases focus on higher priorities.

Airway management awareness and skills should be standard in prehospital and hospital protocols for drowning process rescue and resuscitation in open-water, surf, and pool submersions. In addition, early rescue breathing, including in-water rescue breathing, is recommended as a standard in shallow water in all cases and in deep calm water with trained rescuers with flotation support. In all drowning process resuscitation, upper airway management control and early rescue breathing is the highest priority.

## Future Research

The degree of challenge in airway management and its impact on outcome is not known. It would be reasonable to create a point or line scale of the degree of difficulty for airway management in drowning resuscitation, such as the following:

*Airway Management Difficulty Score*
0 = No difficulty
1 = Manual techniques for one occasion
2 = Manual techniques for multiple times at intervals
3 = Manual techniques continually
4 = Mechanical or structural techniques for <5 minutes
5 = Mechanical or structural techniques continually

Prospectively designed research is needed on the application of early expired-air resuscitation on the outcome of the drowning hypoxic cascade victim.

A need also exists for further research on the impact of in-water resuscitation for the rescuer(s).

## Consensus Recommendation

### Standards

- Airway management awareness and skills must be included in prehospital and hospital protocols for drowning process rescue and resuscitation in open-water, surf, and pool submersions.
- Prevention of aspiration is beneficial.
- In all drowning process resuscitation, upper airway management control and early rescue breathing is the highest priority.

### Standards (continued)

- In basic life support for drowning resuscitation:
  - Earliest possible airway management and ventilation may be lifesaving in drowning resuscitation.
  - Early rescue breathing, including in-water resuscitation, is recommended under the following appropriate circumstances: shallow water, a trained rescuer with a flotation aid in deep calm water, or two or more trained rescuers.
  - Positioning, drainage and airway-clearing skills should be provided to all lifeguards and aquatic rescue responders.
  - Lifeguards should be trained to minimize vomiting and regurgitation.
- In advanced life support for drowning resuscitation:
  - Airway management control and rescue breathing (with assistance as necessary) is the highest priority in drowning resuscitation.
  - Nasogastric suction should be considered to reduce regurgitation and enhance respiratory function.

### Guidelines

- Education of rescuers and resuscitation personnel who may respond to drowning patients should emphasize the challenges of airway management in drowning resuscitation.
- In-water resuscitation should not be attempted in deep water by a single rescuer without flotation support. In this case, the priority should be rescue to shore.
- Procedures or issues that distract rescuers and resuscitation personnel from the lifesaving attention to airway management (e.g., focusing on spinal injury in situations where it is not likely) should be identified and minimized in drowning resuscitation.
- For unconscious or recovering victims, or during transport of drowning victims:
  - The victim should be in as near a true lateral position as possible with the head dependent to allow free drainage of fluids.
  - The position should be stable.
  - Any pressure on the chest that impairs breathing should be avoided.
  - It should be possible to turn the victim onto the side and return to the back easily and safely, having particular regard to the possibility of cervical spinal injury.
  - Good observation of, and access to, the airway should be possible.
  - The position itself should not lead to any injury of the victim.

### Options

None

### No Recommendations

*Primary Summary Author: Steve Beerman, MD*

# SUCTION

### *Question*

- Is suction safe, effective, and feasible in the drowning process resuscitation?

## Introduction

Several methods to remove water, debris, and vomitus from the upper respiratory system (oropharynx) have been introduced, debated, and included in drowning process resuscitation protocols over time. In the drowning process resuscitation, upper abdominal thrusts pose a greater risk of precipitating gastroesophageal regurgitation and subsequent aspiration. Upper abdominal thrusts do not expel sufficient water from the airway or lungs to assist in resuscitation. In addition, upper abdominal thrusts may delay and complicate the start of effective cardiopulmonary resuscitation (CPR). Postural drainage before first ventilation and other means of removing fluid and vomitus also have been debated in recent decades.

But what about suction? Suction is used regularly in prehospital emergency medicine by paramedics and physicians to maintain airways in trauma patients. Should lifeguards be using suction in the field, too? We explored whether suction should be recommended during resuscitation of drowning victims, that is, whether it is safe and effective and can be used successfully.

## Evidence Summary

Identifying information on suctioning is difficult because there is a little scientific literature on early resuscitation measures by lifeguards, and literature on suctioning of submersion victims is extremely scarce. Because of this lack of specific evidence, we examined literature on submersion victims and resuscitation with any mention of suctioning in the articles on resuscitation or submersion incidents.

The literature generally refers to suctioning in a neutral or positive manner as a common and standard protocol in emergency medicine and airway management. The theoretical basis for suctioning a submersion patient would be to assist in establishing the airway by removing either aspirated fluid (or vomitus) from the airway or lungs, or debris that is blocking the airway.

*Safety*

There is no evidence indicating that suction is unsafe to use on drowning victims during early resuscitation efforts or any part of the rescue and resuscitation process when obstruction is present.

*Effectiveness*

The effectiveness of suction in submersion victims has not been well studied.

*Removing Aspirated Fluid from the Lungs.* There is a general consensus that little, if any, fluid can be expelled from the lungs by drainage techniques, including suctioning, abdominal thrusts, or postural drainage; this is because after just a few minutes of submersion, water is absorbed into the circulation (Harries, 1986; Mills-Senn, 2000; Braun & Krishel, [*Advanced Cardiac Life Support Guidelines*] 1997; DeNicola, Falk, Swanson, Gayle, & Kissoon, 1997; Modell, 1966). According to the latest American Heart Association (AHA) guidelines (2005), there is “no need to clear the airway of aspirated water, because only a modest amount of water is aspirated by the majority of drowning victims and is rapidly absorbed into the central circulation, so it does not act as an obstruction in the trachea.”

*Removal of Vomitus/Debris from the Airway or Lungs.* In some patients, the airway is blocked by vomitus or particulate matter, making resuscitation difficult (Manolios, 1988). In these cases, although techniques vary, the vomitus or debris should be removed if it interferes with airway management (AHA, 2005; Auerbach, 2007; Orlowski & Szpilman, 2001; Ornato, 1986; Cahill, 1968). Although some lifeguards are trained and equipped to suction airways (due to additional training such as in emergency medical technician [EMT] instruction, in certain lifeguarding courses, or through site-specific training), no specific studies on the use of suction by lifeguards was found. It is stated clearly in the literature that in prehospital rescue efforts, suction is an option for removal of vomitus and debris blocking the airway.

*Feasibility*
The feasibility of suction at the drowning process resuscitation scene has not been well studied.

*Timing of Start of Resuscitation in Relation to Suction or Fluid Draining from the Airway.* There is general consensus that resuscitation should begin before attempting to remove fluids from the airway or lungs (Ibsen & Koch, 2002; Orlowski & Szpilman, 2001). According to Orlowski and Szpilman (2001), victims can even be “oxygenated and ventilated effectively through copious pulmonary edema fluid. The first priorities are adequate oxygenation and ventilation.”

It is clear, based on this evidence, that the protocol for resuscitation should remain ABC (airway, breathing, circulation), not SABC (suction, airway, breathing, circulation).

## Consensus Recommendation

Evidence is insufficient to indicate whether existing suction techniques are safe or unsafe for submersion and drowning victims if used in any aquatic environment. Evidence from 11 review articles and guidelines, ranging from a level of evidence (LOE) 4 to LOE 5, indicate that when suction is performed by prehospital personnel on submersion victims that have regurgitated or vomited or that have an airway blockage, the airway can be better controlled. However, this evidence does not specify the effectiveness of suction as used by lifeguards. In addition there is evidence that routine suctioning would delay ventilation and thus oxygenation and even in the setting of copious secretions is not needed for effective ventilation. Thus, routine suctioning is not warranted.

There is consensus that for submersion and drowning victims who vomit or regurgitate during the drowning process resuscitation, suction may be used to clear the upper airway (oropharynx) (Orlowski & Szpilman, 2001; Quan, 1993; Carli, Hapnes, & Pasqualucci, 1992; Ornato, 1986; Cahill, 1968; Auerbach, 2007; Minkler, Limmer, Mistovich, & Krost, 2007; AHA, 2005). In addition, there is consensus that if ventilation is prevented by blockage of the upper airway with vomitus or debris, clearing these obstructions with suction and manual techniques is necessary. Due to the absence of specific evidence on the use of suction by lifeguards and the absence of evidence on the efficacy of existing suction devices in the aquatic environment, training lifeguards in manual and powered suction devices can only be considered an option.

**Standards**
None
**Guidelines**
- The routine use of oropharyngeal suctioning in the drowning process resuscitation is not recommended.
- In a submersion victim, when the oropharynx is blocked by vomitus or debris that is preventing ventilation, these obstructions should be removed via suctioning and manual removal techniques.

**Options**
- Training lifeguards on manual and powered suctioning equipment should be considered.

**No Recommendations**

*Primary Summary Authors: Farhad Madani and Peter Chambers, PhD, DO*

# CERVICAL SPINE INJURY

### *Question*

- Is there any evidence that there are safe, effective, and feasible positioning, maintaining and extrication techniques in maintaining peripheral neurologic function and outcome of a cervical spinal injury?

### *Ancillary Questions*

- What are the risks of cervical spinal injury in the submersion victim?
- What is the evidence that lifeguards can accurately (with high sensitivity and specificity) identify victims who have a spinal injury?
- What is the evidence that motion restriction can improve outcome after cervical spinal injury in the drowning victim?

## Introduction

The risk of cervical spinal injury in general trauma victims has been clearly documented. Information from such experience with trauma victims is included in this review as extrapolated evidence regarding recognition of spinal injury and motion restriction in suspected spinal injury, with citation of the limitations.

The joint evaluation by the American Heart Association (AHA) and the American Red Cross (2005) of evidence in first-aid procedures included evaluation of peer-reviewed research regarding drowning victims with potential spinal injury and recognition and immobilization of victims with potential spinal injury. The review of evidence regarding motion included the following topics:

- Risk of injury to the cervical spine and the need for immobilization
- Whether injury to the cervical spine can be identified by first-aid rescuers
- Immobilization by first-aid rescuers when injury to the cervical spine is suspected
- Airway management when injury to the cervical spine is suspected

The *2005 American Red Cross and American Heart Association Guidelines for First Aid* (2005) and other literature relevant to identifying the risk, recognition, and motion restriction for drowning victims published since 2005 also were included in this review. To identify information regarding the sensitivity and specificity of emergency medical system (EMS) protocols to select patients for spinal motion restriction or immobilization (i.e., the identification of patients at greatest risk of spinal injury), we included peer-reviewed evidence from the trauma literature.

## Evidence Summary

*Risk*

For the three publications that provided key information regarding the risk of cervical spinal injury among drowning victims, the level of evidence (LOE) was 3a, 3b, or lower.

Chang, Tominaga, Wong, Weldon, & Kaan (2006) reported a retrospective analysis (LOE 3b) spanning 1993 to 1997 of 100 patients admitted to three university hospitals in Hawaii after they sustained a water sports–related cervical spinal injury. Water-related accidents occurred predominantly in non-residents, and nearly all (96%) occurred at beaches with moderate to severe shore breaks. Only 8% of the cervical spinal injuries were thought to result from a dive.

A 10-year medical chart review (LOE 3b) of 143 children admitted to an urban tertiary pediatric facility after submersion revealed that only seven of the children (4.9%) had traumatic injuries, all of which were cervical spinal injuries (Hwang, Shofer, Durbin, & Baren, 2003). All seven cervical spinal injuries occurred in pools, and six of these resulted from diving.

A retrospective review (LOE 3b) of 2244 submersion victims in the state of Washington identified victims from records of 32 acute care hospitals, the EMS agencies, and the medical examiners' offices (Watson, Cummings, Quan, Bratton, & Weiss, 2001). The most common sites of submersion were open bodies of water (65%) and swimming pools (18%). The overall incidence of cervical spinal injury was low, occurring in only 11 (0.49%) of the victims. Victims were classified into one of three presubmersion activity risk categories: high-impact/high-risk, low-impact/low-risk, and not in the water (or activity not specified). Diving, water skiing, surfing, assault, and operating motorized vehicles were identified as high-impact/high-risk activities. All submersion victims with cervical spinal injuries were among the 471 victims (21%) who were engaged in high-impact/high-risk activities. No cervical spinal injuries occurred in the submersion victims who were reportedly engaged in low-risk/low-impact activities, such as swimming, bathing, wading, fishing, and scuba diving. Note that this review by Watson et al. (2001) was included in the 2005 AHA–American Red Cross first aid evidence evaluation.

*Recognition*

In the review just cited (Watson et al., 2001), clinical presentation data were available for those 1304 submersion victims who received medical care. In this subgroup, only five victims, none of whom was alert at the scene, had cervical spinal injury, and all were engaged in high-risk activities and had evidence of serious injury. Conversely, no cervical spinal injuries were documented in submersion victims who were engaged in low-risk/low-impact activities and had no signs of serious injury.

While not exclusive to aquatics injures, a 4-year prospective study in Michigan (LOE 2E) evaluated the accuracy of an EMS protocol to select patients for spinal immobilization (Domeier, Frederiksen, & Welch, 2005). The EMS and hospital records of 13,357 eligible trauma patients for whom complete data were available were examined. The protocol recommended spinal immobilization for any patient who incurred an injury via a mechanism with the potential for spinal injury *and* any of the following: altered mental status, evidence of intoxication, neurologic deficit, suspected extremity fracture, or cervical or thoraco-lumbar pain or thoraco-lumbar tenderness. The assessment was positive in 61% of the patients (8132/13,357) and negative in 39% (5225/13,357). Of those with a positive assessment 7% (594) were not immobilized; 10 of these had a spinal injury but none had a spinal cord injury. Of the patients with a negative assessment, 37 did have a spinal injury and more than half of these (14/37) were immobilized by EMS personnel despite the negative assessment. The spinal injury assessment protocol in the hands of EMS personnel had a sensitivity for detecting spinal cord injury of 91% (confidence interval [CI]: 88.3–93.8%) and a specificity of 40% (CI: 39.2–40.9%).

In two additional prospective studies, the statewide use of an EMS protocol for spinal immobilization in Maine was evaluated (LOE 2E) (Burton, Harmon, Dunn, & Bradshaw, 2005; Burton, Dunn, Harmon, Hermanson, & Bradshaw, 2006). EMS providers were instructed to immobilize patients who had an injury incurred via a mechanism with the potential for spinal injury *and* one of the following: patient unreliability (caused by intoxication, altered level of consciousness, or an excited or uncooperative patient), presence of a distracting injury (defined as an injury that produces clinically apparent pain that would distract the victim from recognizing spinal pain or tenderness), abnormal motor or sensory neurologic examination, or spinal tenderness or pain.

In the first 12-month prospective evaluation of the Maine EMS Spine Assessment Protocol, 2220 patients were evaluated, with a decision to immobilize 1301 (58.6%) (Burton et al., 2005). Only seven (0.3%) of the total number of patients had a spinal injury and all were immobilized. This yielded a sensitivity of 100% for detecting spinal injury but a specificity of only 0.5% (i.e., only 0.5% of those who were immobilized had a spinal injury). Only three (1.3%) of the patients in this sample had aquatic injuries.

In the second prospective study of the Maine EMS Spine Assessment Protocol, EMS encounter data were compared with data from the statewide hospital database (Burton et al., 2006). In this phase of evaluation, 31,885 patients were evaluated, with a decision to immobilize 12,998 (41%). Of the total patients, only 154 (0.5%) had a spinal injury; 20 of these patients were transported without spinal immobilization. The protocol had a sensitivity of 87% (i.e., 87% of those with spinal injury were detected using the protocol) and a negative predictive value of 99.9% (i.e., this protocol would result in immobilization of 999/1000 trauma patients with a spinal injury). The positive predictive value was 0.1% (i.e., only one of 1000 trauma patients immobilized according to the protocol had a spinal injury).

These recognition studies have several limitations. None included a significant number of victims with aquatic spinal injuries, and the specificity and sensitivity of assessments were established with EMS personnel rather than with lifeguards. As previously noted, these studies represent extrapolated evidence related to the recognition of submersion victims with spinal injury.

*Motion Restriction*
If a submersion victim is thought to be at high risk of a spinal injury based on presubmersion activity or physical findings at the scene, what methods(s) should be used to restrict motion at the scene and during transport (if necessary)?

A Cochrane analysis reported no randomized controlled trials of the effectiveness of spinal immobilization for patients with spinal injury (Kwan, Bunn, & Roberts, 2001). We identified only one case–control series that compared outcome of acute blunt traumatic spinal or spinal cord injuries in patients who did or did not receive out-of-hospital spinal immobilization (Hauswald , Ong, Tandberg, & Omar, 1998). The study included a retrospective chart review of patients from two systems. Because it focuses on the effect of prehospital spinal immobilization on outcome of spinal injury, the reviewers determined that this study is directly applicable to the submersion victim (LOE 3a).

In this 5-year retrospective chart review, the neurologic outcome was evaluated for all patients with blunt traumatic spinal or spinal cord injuries who were admitted to the inpatient service or emergency department of two university hospitals (the University of New Mexico [Albuquerque, NM] and the University of Malaya [Kuala Lumpur, Malaysia]) from 1988 to 1993. All 334 patients transported to the New Mexico hospital and none of the 120 patients transported to the Malaya hospital were immobilized. Patients were similar in age and level of injury. The Malaysian patients were more likely to have a male gender and more likely to be injured in a fall rather than in a motor-vehicle crash. This is important because ejection from a motor vehicle was the most common cause of disability in the sample. Twenty-one percent of the New Mexico patients (70/334) and 11% of the Malaysian patients (13/120) were ultimately classified as having disabling injuries. A multivariate logistic regression documented a two-fold higher likelihood of disabling injury in the New Mexico hospital despite spinal immobilization. The level of neurologic deficit was the only independent predictor of bad outcome (disabling injury). The authors propose that the initial impact applies the injurious force to the spinal cord; and they theorize that subsequent immobilization either provides an immeasurable benefit or may actually increase the risk of secondary injury by delaying resuscitation or worsening tissue hypoxia by compromising airway or ventilation. They contend that the risk of unstable injuries is small and that the risk of neurologic deterioration is exaggerated.

This study is limited because it excluded victims who died at the scene or during transport, and it did not control for the severity of nonspinal injuries or for the quality of care. Although the resources and clinical capabilities were stated to be similar at the two hospitals, no supporting data were provided. Because the outcome was much worse in the group of patients in New Mexico and these patients had the greater severity of injury, it may be that the difference in injury severity overwhelmed any difference resulting from immobilization.

*National First Aid Science Advisory Board Consensus Recommendation*
We support the following statements, based on those of the American Heart Association and the American Red Cross (2005 Guidelines).

Drowning victims are unlikely to have a spinal injury unless they have a history of high-impact/high-risk activity (e.g., diving, water skiing, assault, use of a motorized vehicle, or location on a beach with moderate to severe shore breaks) *and* clinical signs of injury or obvious neurologic deficit (LOE 3b) (Watson et al., 2001; Chang et al., 2006; Hwang et al., 2003). Conversely, drowning victims with a history of high-impact/high-risk activity *and* victim unreliability (including intoxication) or obvious signs of injury are those at higher risk of spinal injury, and these can be reliably identified for spinal motion restriction and immobilization (LOE 2E) (Domeier, Frederiksen, & Welch, 2005; Burton et al., 2005, 2006). Although some of this evidence is extrapolated from protocols used by EMS systems, the consensus is that they are relevant to the aquatic setting. Although a single case-control study did not demonstrate the effectiveness of prehospital immobilization for patients with spinal injury (Hauswald, 1998), in the absence of a prospective controlled trial, the consensus opinion is to recommend spinal motion restriction and immobilization for selected submersion victims.

The National First Aid Science Advisory Board developed the following guidelines:

- Drowning victims should be removed from the water and resuscitated by the fastest means available.
- Spinal motion restriction and immobilization during transport should be used only for victims whose injury was incurred via a high-impact/high-risk activity (e.g., diving, water skiing, surfing, and assault, use of a motorized vehicle or being on beaches with moderate to severe shore breaks) and who have signs of unreliability or injury. Signs of victim unreliability or injury include intoxication, altered level of consciousness, an excited an uncooperative patient, presence of a distracting injury, abnormal motor or sensory neurologic signs, or spinal tenderness or pain. In these situations, the lifeguard should manually restrict cervical and thoracic spinal movement at the scene and should immobilize the victim on a spine board after resuscitation.
- For victims of the drowning process, time is of the essence. The lifeguard must establish airway and ventilation (and, if necessary, perfusion) in the shortest amount of time possible. If effective airway and ventilation cannot be provided in the water, even the victim with possible cervical spinal injury should be rapidly removed from the water.
- If the victim is at risk of cervical spinal injury, the lifeguard should use manual spinal motion restriction during initial assessment, provided such restriction does not prevent establishing a patent airway and effective ventilation.

## Future Research
These recommendations presume that lifeguards will be able to apply the reported EMS protocols to identify indicators for spinal immobilization. Further study is needed to support this assumption. In addition, studies are needed to document the consistency and effectiveness of manual spine restriction and immobilization during transport.

## Consensus Recommendation
**Standards**

None

**Guidelines**

- If resuscitation is required and cannot be effectively provided in the water, drowning victims should be removed from the water and resuscitated by the fastest means available. Spinal motion restriction and immobilization during transport should be used only for victims whose injuries were incurred via a high-impact/high-risk activity (e.g., diving, water skiing, surfing, and assault, use of a motorized vehicle or being on beaches with moderate to severe shore breaks) and who have signs of unreliability or injury.

**Guidelines (continued)**

- The lifeguard should manually restrict cervical and thoracic spinal movement at the scene and should immobilize the victim on a spine board after resuscitation.
- If effective airway and ventilation cannot be provided in the water, even the victim with possible cervical spinal injury should be rapidly removed from the water.
- If the victim is at risk of cervical spinal injury, the lifeguard should use manual spinal motion restriction during initial assessment, provided such restriction does not prevent establishing a patent airway and effective ventilation.

**Options**

None

**No Recommendations**

*Primary Summary Authors: Mary Fran Hazinski and Bill Hammill*

# OXYGEN

### *Question*

- Is oxygen safe, effective, and feasible in the drowning process resuscitation?

## Introduction

During the drowning process, the priority is to establish an airway and ventilate the patient. Although it is intuitive from a physiologic standpoint that oxygen is necessary in the inspired air, what is not known is (1) whether supplemental oxygen is required, and (2) whether giving supplemental oxygen would produce any detrimental effects during the drowning process resuscitation. Despite this lack of research evidence some experts have written that drowning victims may need a higher concentration of oxygen than the 16% to 21% normally given during rescue breathing or when using the bag-valve-mask resuscitator (BVM) without supplemental oxygen.

In 2005, members of the National First Aid Science Advisory Board examined the medical science literature to determine the feasibility and safety of recommending supplemental oxygen in first aid. They were unable to find any studies that evaluated emergency oxygen administration by first aid providers. As a result, their treatment recommendations state, “There is insufficient evidence to recommend for or against the use of oxygen by the first aid provider.”

Health care providers and emergency responders routinely administer supplemental oxygen to ill or injured patients. Although some first aid providers use supplemental oxygen, there are no research studies demonstrating benefit or absence of harm.

## Evidence Summary

Evidence and physiologic mechanisms support that during the drowning process, resuscitation victims require physiologic levels of oxygen; however, no research studies support a need for supplemental oxygen in the drowning process resuscitation to achieve normal oxygen levels in the victim. There are published studies which have shown that using exhaled air (16% oxygen) or room air (21% oxygen) for resuscitation achieves physiologically normal blood oxygen levels in the patient. These studies, however, addressed many types of resuscitation patients, and none exclusively who were victims of the drowning process.

In addition, studies using supplemental oxygen in resuscitation have shown that the patients achieve supra-physiologic blood oxygen levels. These and others studies have shown that these supra-physiologic blood oxygen levels are associated with poorer neurologic outcome. Whereas these research studies did show a detrimental outcome with supplemental oxygen use in resuscitation, they used either prolonged oxygen administration or studied non-drowning process victims.

Although administering oxygen to patients is a basic skill provided by licensed or certified health care and prehospital personnel, the reviewers found no studies that evaluated emergency oxygen administration by lifeguards. Many studies included oxygen administration as a treatment modality, but all identified studies were confounded by the heterogeneity of subject disease states and conditions, diverse equipment needs, and multiple adjunctive treatments. These variables prevent extrapolation of the results of any of the reviewed studies to oxygen administration by lifeguards in the drowning process.

Although there are no studies on supplemental oxygen use by lifeguards in the drowning process resuscitation, there are published expert opinions and professional organization policy statements and guidelines that advocate the use of supplemental oxygen in the drowning process resuscitation by lifeguards.

A recent comprehensive review of drowning process resuscitation by Layton and Modell in 2009 stated, “As soon as more extensively trained individuals and equipment are available, other therapeutic modalities should be considered. Ventilation with a bag-valve-mask device using 100% oxygen should be initiated as soon as available." However, this statement was not based on referenced research studies but is the expert opinions of the authors who conducted the literature review. The article then goes on to state that "Oxygen (100%) should be administered en route until oxyhemoglobin analysis by pulse oximetry demonstrates that it can be reduced safely with maintenance of hemoglobin/oxygen saturations in the mid 90s to high 90s." Lastly, the article points out that in-hospital care should attempt to keep oxygen levels as low as possible and below 50% to prevent the negative effects of supplemental oxygen. The authors conclude that the evidence indicates that there can be detrimental effects from using supplemental oxygen. However, their expert opinion is that the possible negative effects do not outweigh the value of providing supplemental oxygen in drowning process resuscitation until blood oxygen levels can be assessed.

The literature on resuscitation and rational conjecture supports that the priority needs in the drowning process resuscitation are establishing an airway and providing ventilation. In addition, other resuscitation studies and rational conjecture support that physiologic oxygen can be obtained in the victim with either expired air via a mask-to-mouth approach or via ambient air using a bag valve mask-to-mouth approach. However, there are expert opinions supporting the need for lifeguards to provide supplemental oxygen in the drowning process resuscitation.

## Future Research

Further research is needed to definitively determine if supplemental oxygen is safe, effective, and feasible for use during the drowning process resuscitation.

## Consensus Recommendation

**Standards**

None

**Guidelines**

None

**Options**

- The use of supplemental oxygen by lifeguards for the drowning process resuscitation can be considered as an option but the provision of supplemental oxygen should never delay resuscitation including opening the airway, ventilation and compressions as needed.

**No Recommendations**

*Comment:* Scuba diving is a special circumstance for which oxygen during resuscitation may be helpful; this circumstance was not studied in this review.

*Primary Summary Authors: Ralph Johnson and Farhad Madani*

# ONLINE LEARNING

### *Question*

- Can basic life support (BLS) skills and selected lifeguard skills (e.g., vigilance, scanning) and knowledge (e.g., professional expectations, content knowledge) needed for adequate lifeguard performance be acquired as effectively through online learning as by traditional face-to-face instructional techniques?

## Introduction

Distance learning media and technologies continue to expand rapidly. Entire curricula at both the undergraduate and graduate levels are being delivered and diplomas earned completely online (i.e., Web-*based* learning). Alternatively, several areas of professional training (e.g., firefighting) currently use a variety of *blended* instructional approaches (i.e., Web-*assisted*) to teach knowledge and skills. The effectiveness of many contemporary Web-based and Web-assisted approaches has been studied extensively over the last decade. The most recent studies document that the use of well-designed Web-assisted instructional components offers the potential for expanding the breadth and depth of learning available in a wide range of fields and disciplines, possibly including resuscitation and lifeguarding skills and water safety knowledge.

Selected resuscitation skills that may be learned online include rescue breathing in or out of the water, single-rescuer cardiopulmonary resuscitation (CPR), dual-rescuer CPR, use of an automated external defibrillator (AED), use of a bag-valve-mask resuscitator (BVM), oxygen administration, suction, or intubation. Certain lifeguarding skills, such as vigilance and scanning skills, which require extensive practice, currently are acquired only on the job after certification; however, they, too, might be acquired and practiced extensively using online learning. Various educational techniques may not have the same efficacy for every skill.

The concept of "online learning" is represented by a variety and range of techniques. Several companies offer "accredited" online training for CPR, AED, and BLS. Some of these fully Web-based programs require viewing a presentation followed by completing a computer-graded test. Other programs, fitting the definition of blended online learning, require face-to-face interaction with an instructor after completing the online portion.

If the primary role of an instructor is evaluation, then the "acquisition" (i.e., initial learning and practice) of a skill online can be separated from testing off-line. Blended learning schemes for resuscitation skills may or may not include the use of a mannequin in video-assisted self instruction. Current Web technology also can support real-time interactive voice and visual communication between a participant and an instructor, with various applications available via Webcam or at a remote education center.

It also must be considered whether selected resuscitation and lifeguarding skills can be learned effectively via self-instruction guided by a video presentation. Additional considerations include whether a mannequin is an essential component of the learning process and at what stage, if any, direct or remote interaction with an instructor is needed for training, feedback, and/or evaluation.

Because candidates are reportedly less willing to spend time earning their lifeguard certifications, the total length (i.e., face-to-face contact time) of lifeguard courses has decreased by up to 50% over the last 27 years in some programs. The degree of change in the competencies of lifeguards—resulting from decreases in course length and the number and types of skills taught—is unknown.

This review focuses on some of the existing evidence about Web-assisted learning related to knowledge and skills in a variety of academic domains and then extrapolates the evidence to its potential use in BLS and lifeguard training courses.

## Evidence Summary

Primary information related to the question of acquisition of resuscitation skills was obtained from a review on BLS instructional methods of CoSTR (2005) and from their accompanying worksheets. Limited Web searches were conducted using terms such as *online CPR*. The primary source for the expanded review for all lifeguard skills and knowledge was a report funded by the Andrew Mellon Foundation (2006), which is a meta-analysis of existing literature on Web-based instruction (LOE 1bE) and a 3-year experimental study using technology to teach a basic communication course (LOE 2E).

*CoSTR Studies*
*Educational Methods.* It was determined that conventional CPR training results in poor acquisition and retention of skills. Evidence for and against several resuscitation training methods was reviewed. (Apart from the CoSTR review, anecdotal evidence suggests that contemporary lifeguards, in fact, may possess poorer fitness and swimming skills, as well as lifeguard content knowledge.)

*Effective BLS Instructional Methods*. Consensus on Science. Nineteen randomized mannequin studies and one extrapolated study showed considerable variability in acquisition and retention of BLS skills when different instructional formats were used (video instruction, computer-assisted instruction, and traditional instruction). Four randomized studies using mannequins indicated that one video instruction program (a self-instructed synchronous watch-while-you-practice program) achieved better skill acquisition and retention than did programs with other educational formats. One randomized study of adult learners using mannequins showed that a brief video self-instruction program produced CPR skills performance equivalent to or better than traditional training.

*Effective BLS Instructional Methods*. Treatment Recommendation. Instruction methods should not be limited to traditional techniques: newer training methods (e.g., watch-while-you-practice video programs) may be more effective. Training programs should be evaluated to verify that they enable effective skills acquisition and retention.

Studies are inconsistent with regard to which instructional technique is more effective than another. Most of the currently available evidence was included in the CoSTR review. Articles published since the CoSTR results (Lynch et al., 2005) are unlikely to change the treatment recommendation given above.

Note that existing studies are not definitive or comprehensive. Regardless, the CoSTR recommendations are pertinent to the question of online learning. Presumably any instructional technique, including specific online programs, could be acceptable if it included recommended evaluation criteria and resulted in most participants meeting the criteria. Any program without acceptable evaluation criteria or with poor success rates would be suspect.

*Other Studies*
The results of the extensive meta-analysis and the subsequent experimental study covering six university semesters concurred that there were no significant differences in academic performance between Web-assisted and face-to-face instructional techniques.

In the meta-analysis, studies since 2002 demonstrated an increased likelihood of significantly greater performance increments associated with Web-assisted instruction than with face-to-face instruction. The authors inferred that the improvement in online technology and access plus student familiarity with and wider use of technology accounted for the recent differences.

*Extrapolation to Lifeguard Training*
Because of perceived unwillingness of prospective lifeguard candidates to enroll in lengthy courses, most

courses do not provide sufficient in-class time for acquiring a higher level skill and knowledge or for practicing key observational skills (i.e., scanning, victim identification), which have been identified as critical lifeguarding skills.

Web-assisted technology could provide the opportunity to promote acquisition of lifeguard observational skills without adding to face-to-face course time. Online modules not only could provide criterion-referenced drill and practice opportunities, but also could assess student competence while simultaneously collecting and gathering data for establishing baseline lifeguard competencies in various knowledge and skills.

Other course content (knowledge domain) plus assessing mastery of that content (e.g., via online knowledge quizzes and tests) could be provided effectively online without adding face-to-face time to courses. Online knowledge testing can be organized as formative (sometimes called "drill and practice") evaluation in which candidates can repeatedly take tests or quizzes (with questions drawn randomly from a large pool or bank of questions) until the candidate reaches a desired level of mastery. Further, online discussion boards can actually enhance the amount of active learning time (ALT) in which learners are engaged as opposed to more passive time spent in traditional classroom lecture-based instruction. Online instructional components would have the option of being provided before, during, and/or after the face-to-face portions of a lifeguard training course.

Standardizing the mode of instructional delivery for selected lifeguard course content by using online methodology could enhance the degree of acquisition of course content and ensure more uniform lifeguard knowledge and skills.

*Alternative Hypotheses*

Six alternative hypotheses, adapted from CoSTR worksheets, have been derived from the original resuscitation question:

1. No differences exist in effectiveness of BLS and lifeguard skill acquisition, practice, and 6-month retention between traditional face-to-face and online instructional methods.
2. Traditional instructional methods (face-to-face lecture/demonstration/practice) are more effective in BLS and lifeguard skill acquisition, practice, and 6-month retention than all online instructional methods.
3. Interactive computer instructional methods are more effective in BLS and lifeguarding skill acquisition, practice, and 6-month retention than traditional face-to-face and other online methods.
4. Video self-instruction methods are more effective in BLS and selected lifeguarding skill acquisition, practice, and 6-month retention than traditional face-to-face or other online instructional methods.
5. A passing score from a written BLS and lifeguarding test adequately reflects competence in performing BLS and lifeguarding skills.
6. Other BLS or lifeguarding tests can be developed to validly, reliably, and objectively assess BLS and lifeguarding skills.

*Limitations and Caveats*

- Adequate and reliable access to Web-based resources is critical for student learning and satisfaction, which is related to motivation.
- Pilot testing of all online resources is important to discover potential problems.
- Reaction to online learning, especially by nontraditional candidates and those with less skill with online and electronic media, may be more negative initially but should become positive with time and experience.
- Not all content is appropriate for online learning (e.g., acquiring and improving performance skills, such as swimming strokes and rescue techniques).

Blended, or web-assisted, approaches appear to be appropriate for complex and skill-based learning such as lifeguard training. Studies that identified the efficacy of online instruction in BLS, CPR, and AED resuscitation skills were reported in the CoSTR 2005 review. In contrast, no direct studies were reported regarding the efficacy of acquisition of other non-resuscitation lifeguarding skills using online instructional methods. The above summary is extrapolated from studies of other knowledge content and disciplines. At least one proprietary lifeguard agency already is using online training, but to date no published research has described or documented the success or failure of those efforts.

## Future Research

Replicated experimental studies comparing face-to-face and online (Web-based) teaching of specific lifeguard skills and knowledge (e.g., scanning, victim identification, resuscitation skills, content knowledge) are needed either before *or* as an integral part of actively introducing online elements into lifeguard training. Subsequent and systematic research is required to determine the degree of blended, or web-assisted, content that results in optimal learning. Experimentation is essential to create an optimal balance between face-to-face and online learning and assessment. Determination of objective criteria is needed for evaluating the effectiveness of (online) learning programs for resuscitation skills for lifeguards. Research should be instituted to develop objective criteria for evaluating the effectiveness of (online) learning programs for resuscitation skills for lifeguards.

## Consensus Recommendation

*Note:* Any recommendation regarding online learning made after 2008 will need to be re-examined annually since online technology continues to evolve rapidly.

**Standards**

None

**Guidelines**

None

**Options**

- Provide online training for selected BLS and lifeguarding skills and content knowledge that have been shown to be effectively learned using an on-line format with documented, objective assessment of lifeguard candidates.

**No Recommendations**

*Primary Summary Authors: David Bell and Stephen Langendorfer, PhD*

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Listed below are the key references used for the review of sciences with consensus and the recommendations for each question addressed. The full evidence review including process, article evaluations and grading can be found in the accompanying document USLSC Evidence Worksheets.

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