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The Issue of In-Water Rescue Breathing: A Review of the Literature

Tomas Leclerc, Juan Canabal, and Heather Leclerc

The purpose of this review of literature was, first, to examine whether the existing scientific evidence supports a recommendation for delivering rescue breaths during a swim rescue in the water and, second, to examine which lifeguarding agencies are actually training their lifeguards in rescue-breathing procedures to use while performing a swim rescue. Among the North American aquatic-agency programs examined for this review were the American Red Cross, the Young Men's Christian Association, the United States Lifesaving Association, Canadian Lifesaving Society, Starfish Aquatics Institute, and Ellis and Associates. The authors conclude that it is evident that strong support exists in favor of the practice of in-water rescue breathing among aquatic professionals and within the medical community.

Keywords: aquatic rescues, drowning resuscitation, airway management

In the past several decades, lifeguards and aquatic experts have debated one of the most difficult issues related to rescuing a nonbreathing victim from the water: whether to first retrieve the victim from the water and then provide the appropriate care needed (e.g., rescue breathing and CPR) or to initiate rescue-breathing efforts in the water whenever possible without first bringing the victim to land (or shallow water). Both medical personnel and aquatic professionals have supported the need for a quick assessment of a near-drowning victim (AMA, 1992; Modell, 1993). Many have concluded that it is essential to assess the victim's situation immediately and, when necessary, to initiate rescue breathing and/or CPR as soon as possible.

The purpose of this review of literature was, first, to examine whether the existing scientific evidence supports a recommendation for delivering rescue breaths during a swim rescue in the water and, second, to examine which lifeguarding agencies are actually training their lifeguards in rescue-breathing procedures to use during a swim rescue. Among the North American aquatic-agency programs examined for this review were the American Red Cross (ARC), the Young Men's Christian Association (YMCA), the United States Lifesaving Association (USLA), Canadian Lifesaving Society, Starfish Aquatics Institute, and Ellis and Associates.

For decades physicians and other medical personnel have attempted to understand the physiological process that occurs during a drowning event. Drowning

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is the seventh leading cause of unintentional injury deaths for all ages (Centers for Disease Control and Prevention, 2004) and remains the second leading cause of all unintentional injury deaths in children age 1–14 years (Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, 2005). Drowning has been defined as death by suffocation when submerged in the water (ARC, 1992). Most recently drowning was defined as “a process resulting in primary respiratory impairment from submersion/immersion in a liquid medium” (American Heart Association [AHA], 2005).

Nonfatal drowning (formerly called near drowning) can lead to a number of health complications. The possibility of brain damage in a nonfatal-drowning victim must always be considered (Gilbert, Puckett, & Smith, 1985). The major consequence of nonfatal drowning has been identified as hypoxemia, or insufficient oxygenation of the blood, and therefore lack of oxygen to critical tissues such as the nervous and cardiopulmonary systems (JAMA, 1992; Modell, 1968; Safar & Bircher, 1988). A primary goal of rescue and emergency treatment should be to prevent anoxic brain injury (Shaw & Briede, 1989). Gilbert et al. also identified other possible complications of nonfatal drowning, such as spasticity, hyperflexia, peripheral neuromuscular weakness, speech difficulties, and personality disturbances, all outcomes associated with damage to the central nervous system resulting from anoxia.

Patients who aspirate water might develop hemoptysis (coughing up blood from the lungs) within minutes and are at risk for developing acute respiratory distress (Harries, 1981). Shaw and Briede (1989) contended that “the goal in the management of near-drowning is to interrupt the sequence of events leading to cerebral anoxia” (p. 355).

The American Heart Association (AHA; 2005) indicated that the most important factors that will determine the outcome of a drowning are the duration and severity of the hypoxia. A number of authors recommended, when feasible, initiating rescue breathing for a victim while still in the water (Beyda, Modell, Lilja, & Ornato, 1989; Gilbert et al., 1985; Manolios & Mackie, 1988). Harries (1981) also contended that the “recovery of a victim depends largely upon the speed with which circulation and ventilation can be established” (p. 407). Gilbert et al. further emphasized that if a nonfatal-drowning victim is promptly rescued and resuscitated, the victim will have an improved chance of survival. Kyriacou, Arcinue, Peek, and Kraus (1994) recommended that the first and most important treatment of the drowning victim is the immediate provision of ventilation. They further concluded that prompt initiation of rescue breathing increases the victim’s chance of survival (Kyriacou et al.).

To obtain a favorable neurological outcome, nothing is more important than rescuing the submerged victim as quickly as possible (Quan, 1993). W. Richardson (personal communication, February 12, 1997) stated that if the victim is nonbreathing, mouth-to-mouth in the water might be enough to start the victim breathing again, and time is important to this endeavor to limit the potential for brain damage or complications associated with not breathing. Similarly, the American Medical Association (AMA) strongly recommended that “rescue breathing should be started as soon as possible, even before the victim is moved out of the water” (AMA, 1986, p. 2929; AMA, 1992, p. 2246).

In 1995 USLA stated that “based on the experience of professional beach lifeguards . . . there is a two minute window of enhanced opportunity for successful

recovery and resuscitation of submerged victims” (p. 72). In cases of isolated respiratory arrest, initiating artificial ventilation while still in the water might improve the chances of survival of the nonbreathing victim by more than 50% (Szpilman, 1997). Susiva and Boonrong (2005) recommended that if nonfatal drowning happens, effective immediate resuscitation is crucial for the best outcome for the victim.

Porter (1997) compared the time it took a trained sample of male and female participants to perform the ARC and YMCA procedures for the rescue and initial resuscitation of a passive nonfatal-drowning victim, at approach distances of both 12.5 yd and 22 yd. This experimental thesis study was conducted in a 25-yd swimming pool at Indiana University of Pennsylvania in 1997. The study showed that participants who performed the YMCA procedure (in-water rescue breathing) were able to start first breath to a victim in a mean time of 41.4 s. When participants performed the ARC procedure (without rescue breaths in the water) they were able to start the first breath to a victim in a mean time of 91.9 s. When delivering this first breath to a victim in the water, the sample mean time of the YMCA procedure was 50.5 s faster than that of the ARC at an approach distance of 12.5 yd and 71.8 s faster at an approach distance of 22 yd.

The 2000 *Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care* (ECC) indicated that prompt initiation of rescue breathing had a positive association with the survival of a victim (AHA, 2000). Prompt resuscitation and aggressive respiratory and cardiovascular treatment have been identified as crucial for optimal survival (Hasibeder, 2003).

The International Lifesaving Federation Medical Commission (2001) recommended the following: “Whenever possible, if a victim is found in the water, the rescuer should immediately establish whether spontaneous breathing is present and, if it is absent, initiate artificial ventilation” (p. 2). The commission also stated, however, that “when performed in deep water, this is a difficult procedure, requiring extreme fitness, swimming ability, a flotation device and prior training” (p. 3). Furthermore, opposition to deep-water rescue breathing by Golden, Tipton, and Scott (1997) was expressed when they advised, “Landing a casualty should never be delayed to enable attempts at in-water resuscitation” (p. 218).

In recent years the AHA and the ARC cofounded the National First Aid Science Advisory Board to review and evaluate the scientific literature on first aid. Their review of the scientific literature resulted in a *Consensus on Science for First Aid With Treatment Recommendations* (International Liaison Committee on Resuscitation, 2005). These recommendations were included as part of the first-aid portion of the 2005 ECC guidelines.

The National First Aid Science Advisory Board recommended in the 2005 ECC guidelines that rescue breathing should be provided even before the victim is pulled from the water if possible (AHA, 2005). The guidelines also recommended, however, that rescuers without training should not attempt to provide care in deep water (AHA, 2005). Emphasis on training for this special skill in the water was further noted by the European resuscitation guidelines of 2005. They recommended that for the treatment of drowning, if the rescuer is trained to do so, rescue breaths should be started in the water (Soar et al., 2005).

During this review of the literature, we discovered a study that compared the outcomes of performing immediate in-water resuscitation with those when delaying

resuscitation until the victim was brought to shore (Szpilman & Soares, 2004). The study was conducted using data analysis of nonbreathing drowning victims rescued by lifeguards in the coastal area of Rio de Janeiro, Brazil. Szpilman and Soares found that providing in-water ventilation to a nonbreathing victim resulted in a 3.15-times higher chance of recovery without enduring complications than waiting until the victim was brought to shore. Furthermore, the authors of this comparative study concluded that delaying resuscitation efforts was associated with a worse outcome for nonbreathing drowning victims. In the 1,831 cases analyzed in this study between 1972 and 1991, in-water resuscitation was associated with better likelihood of the victim's survival (Szpilman & Soares).

Acting as the governing body for underwater activities in the United Kingdom, the British Sub Aqua Club (www.bsac.org) provides training programs for divers and instructors and develops safety advice for the sport of diving, both in the United Kingdom and throughout the world. The club has adopted the 2005 European Council guidelines for resuscitation as found in the British Sub Aqua Club's *Basic Life Support Guidelines 2006*.

Other Lifeguard Training Agencies' Perspectives

In their *Aquatic Rescue Professional* textbook, Ellis and Associates (2000) illustrated procedures to begin rescue breathing in the water using a resuscitation mask. They stated the following:

Lack of air to the brain can rapidly lead to irreversible brain damage. In most cases it will take you 1 minute to remove a victim from the water. That first minute could be critical. This is why it is so important to begin rescue breathing as soon as possible, even while you are still in the water. (p. 45)

Ellis and Associates (2007), in their latest international lifeguard-training program, teach their guards how to execute a rescue with rescue breathing in the water using a resuscitation mask. Information about this procedure was not available before 2000. In this 2007 edition they declared, "While performing the rescue and moving the guest toward the extrication point, you should begin rescue breathing in the water using a resuscitation mask" (p. 66). This skill is explained and illustrated in their 2007 training manual.

In the *StarGuard* lifeguarding program by the Starfish Aquatics Institute, rescue breathing in the water is taught to lifeguards as part of their training. White (2007) concludes in their textbook, "Providing ventilation immediately, while you are still in the water, can be crucial to a successful rescue outcome—especially when you are not sure how long a drowning victim has been submerged and without oxygen" (p. 100). This skill is explained and illustrated in the 2007 *StarGuard* training manual.

The Lifesaving Society, a member and part of The Royal Lifesaving Society Canada, delivers the national lifeguard service training program to Canadians and has supported the practice of performing rescue breathing in the water. The Lifesaving Society has indicated in its training manuals that "the priority in rescue of the unconscious nonbreathing victim is to get the victim's head out of the water, the airway open and clear, ventilations assessed and maintained, and circulation

assessed and maintained” (Lifesaving Society, 1999a, p. 48, 2007a, p. 48; The Royal Lifesaving Society Canada, 1993, p. 48). Evidence in favor of this practice by the Lifesaving Society is strongly supported by their “rescue breathing carry skill” (Lifesaving Society, 1999a, p. 48, 2007a, p. 48), which trains lifeguards to provide some control of the victim’s head and airway while facilitating moving quickly to shallow water. The Canadian lifesaving manuals further explored and demonstrated various techniques for rescue breathing in both shallow and deep water (Lifesaving Society, 1999b; The Royal Lifesaving Society Canada, 1994). These skills are part of the national lifeguard service program and also explained in the latest, 2007, edition of the *Canadian Lifesaving Manual* (Lifesaving Society, 2007b). It should be noted, however, that the manual indicates that difficulties in airway management, vomiting complications, and retention of body heat are problems that could arise when attempting deep-water rescue breathing (Lifesaving Society, 2007b).

In their 1995 open-water lifesaving program the USLA identified water rescue breathing as part of their protocol (USLA, 1995). The USLA (1995) stated, “In most cases, an initial attempt at resuscitation should be initiated in the water by opening the airway, checking for breathing, and delivering the initial breaths recommended in current CPR protocol” (p. 192). Later, in 2003, in their latest training manual, the USLA clearly indicated that lifeguards still learn in-water rescue-breathing procedures (USLA, 2003) in accordance with the International Lifesaving Federation Medical Commission recommendations of 2001 they have chosen to follow. When USLA surf lifeguards enter the water and come upon nonbreathing victims, the airway is opened, breathing is checked, and if there is no breathing, they are instructed to attempt ventilations for approximately 1 min (USLA, 2003). The USLA (2003) further emphasized the following:

If breathing is not restored after one minute of ventilation, and the swim to shore is expected to be five minutes or less, rescue the victim while ventilations are continued or stop every one or two minutes to ventilate again for approximately one minute (12 to 16 ventilations). If the rescue to shore is more than five minutes, continue ventilation one additional minute in place and check for movement or reaction to ventilations, then follow the same protocols as for a swim of five minutes or less. (p. 264)

These were part of USLA-recommended steps for victim retrieval and resuscitation for recent submersions recovered within 15 min of submersion in warm water (USLA, 2003).

In the past, the YMCA has taught rescue breathing in the water in their “On the Guard” lifeguard program (YMCA of the USA, 1986, p. 71). When their program was revised in 1994, the YMCA identified both the rescue tube and the rescue buoy as being helpful when entering the water by stating, “It serves as a flotation aid to assist you in performing the rescue and in positioning the victim for rescue breathing” (p. 76). The 1994 YMCA textbook illustrated how to carry out this skill when lifeguards performed both front and rear approaches to a passive victim. In a similar fashion, initiating the rescue-breathing procedure in the water was also demonstrated when rescuing a scuba-diving victim (YMCA of the USA, 1994).

These skills remained effective in the YMCA’s 1997 revision, and they further stated, “The YMCA conforms to the standards established by the Emergency Cardiac Care Committee of the American Medical Association, which specifies

that rescue breathing should be started as soon as possible” (YMCA of the USA, 1997, p. 86). The YMCA, as previously described, has continued to train lifeguards to perform rescue breathing in the water in the 2001 edition of their lifeguarding program (YMCA of the USA, 2001).

The ARC has taught rescue breathing in the water for a number of years (ARC, 1974). Rescue breathing in the water can be found in the 1988 American Red Cross lifeguard-training program, in which they stated, “If the victim is not breathing when contacted in deep water, rescue breathing should be started as soon as possible” (ARC, 1988, p. 47). They further emphasized “Rescue breathing can be initiated in deep water using a rescue tube, rescue buoy, rescue board, or if the victim is wearing a water-ski belt, personal flotation device (PFD), or a buoyancy compensating device” (p. 47). In the 1988 edition of their training manual how to provide deep-water rescue breathing is illustrated. If the victim could not be removed from the water or brought to the shallow end, lifeguards were instructed to bring the victim to poolside and begin rescue breathing (ARC, 1988).

In the 1990 version of the ARC lifeguarding program (ARC, 1990), the rescuer was still able to initiate rescue breathing in the water during a swimming rescue, with the addition of the technique of “shallow-water rescue breathing without equipment” (p. 126). The training manual further illustrated several ways to provide in-water rescue breathing to a victim with and without equipment in both the shallow- and deep-water ends. While in the water and when handling a victim of suspected spinal injury in shallow water, lifeguards were instructed to use the “modified jaw thrust” (ARC, 1990, p. 178) and provide rescue breathing to a victim while being assisted by another lifeguard. In addition, emergency scuba-diving procedures were included and illustrated for lifeguards to perform as part of this training. If a scuba diver was found unconscious and not breathing, lifeguards were instructed to transport the diver to the surface and begin rescue breathing as quickly as possible (ARC, 1990).

In 1995, the ARC lifeguarding program recommended that rescuers no longer begin an assessment or application of rescue breathing to a nonfatal drowning victim while in the water. Despite that change in procedure, the following statement (ARC, 1995) can be found in the textbook: “Time is critical in life-threatening emergencies. Unless the brain gets oxygen within minutes of when breathing stops, brain damage or death will occur” (p. 54).

After in-water rescue breathing was eliminated from the ARC 1995 lifeguard-training program, it appears that it also has remained out of their 2001 and 2006 revisions. Reference to their previous rescue-breathing practices during the use of a rescue board could not be found in the newly revised 2007 lifeguarding manual (ARC, 2007).

Review Summary

We reviewed and studied research articles, several medical databases, one experimental study, and lifeguard-training manuals covering a 39-year period between 1968 and 2007. From our examination of the literature, it is evident that strong support exists in favor of the practice of in-water rescue breathing among aquatic professionals and within the medical community. We found one article, however, opposing the in-water rescue-breathing practice, in addition to a few lifeguarding

agencies who cautioned about the difficulties of performing deep-water rescue breathing.

The evidence regarding rescue procedures involving initiating rescue breathing in the water among the North American lifeguard agencies was obtained directly from their respective lifeguard-training manuals. In most cases, when reading the in-water rescue-breathing procedures in these lifeguard-training manuals, we identified no direct citations either at the ends of chapters or at the ends of the books that linked their procedure to scientific evidence supporting the action. Table 1 provides a listing of the lifeguard-training agencies reviewed, with information regarding the presence of citations, as well as each agency's decision regarding acceptance of the 2005 ECC guidelines.

All lifeguard agencies we reviewed for this article train their lifeguards in the use of in-water rescue breathing except for the ARC, which eliminated training their candidates in this practice in 1995. According to the Health and Safety Numbered Notice 127 released by the ARC in 1994 as a rationale for this change in practice, "Most pool drownings occur within a few feet of safety at the poolside and commonly are children who can easily be removed from the water by a single lifeguard" (p. 6). In response to the ARC statement, Porter (1997) noted that "lifeguards cannot assume that all drowning victims are going to be children within a few yards of the pool[side]" (p. 42).

Table 1 Citation Practices and Recognition of the American Heart Association's Guidelines for Emergency Cardiovascular Care (ECC) of Major Lifeguard-Training Agencies

Agency and year	Citations to references (research-based or otherwise)	Acceptance of ECC 2005 guidelines
StarGuard (White, 2007)	No citations	Program follows the 2005 ECC guidelines.
Young Men's Christian Association (2001)	No citations	2001 revision follows the 2000 ECC guidelines.
United States Life Saving Association (2003)	Citations to 3 references: The 2001 International Life-saving Federation Medical Commission (2001), the Brazil study (Szpilman & Soares, 2004), and the 2000 ECC guidelines (American Heart Association, 2000)	2003 revision follows the 2000 ECC guidelines.
American Red Cross (2007)	No citations	2007 revision follows the 2005 ECC guidelines.
Lifesaving Society (2007b)	No citations	2007 revision follows the 2005 ECC guidelines.
Ellis and Associates (2007)	No citations	2007 revision follows the 2005 ECC guidelines.

The ARC (1994) rationalized the omission of in-water rescue breathing by writing, "Rescue breathing requires slow ventilation and observation of the chest rising to check the adequacy of ventilation which cannot be sufficiently done in the water" (p. 6). When reviewing the methods and techniques using equipment for rescue breathing from other agencies, we discovered that positioning the tube under the unconscious victim's back allows lifeguards to watch for the victim's chest to rise while breathing into the valve of the resuscitation mask. The ARC (1994) also stated in the Safety Numbered Notice 127 that "our future lifeguards will be entering deep water only with equipment (rescue tube). Both hands are required to handle the tube and the victim; therefore, opening the airway in the water using the head/tilt chin lift is impractical" (p. 6). We acknowledge that perhaps these could be valid concerns, and we wondered what studies referenced or conducted by the ARC supported each of these statements. Unfortunately, no studies that support these statements were released by the ARC in their Health and Safety Released Notice of 1994.

The ARC (1994) further stated, "It is impractical for a single lifeguard to assemble a breathing device while supporting a victim in deep water and then to attempt to breathe for the victim. In fact, it delays proper care" (p. 6). In an experimental study Porter (1997) noted the following:

A pocket mask with the valve attached can be carried during a rescue in a modified case worn on a belt or around the rescuer's waist (as it was in this study). Angling the valve 90 degrees on a Laerdal pocket mask allows the rescuer to provide rescue breathing in deep or shallow water with relative ease. (p. 43)

Based on Porter's (1997) study, we realized the importance of a lifeguard's entering the water with a resuscitation mask. We made further observations on equipment use and noted that the YMCA rescue tube provides a place for the pocket mask that could be fully assembled and ready for use in the water by the lifeguard.

In 1995 the ARC declared, "Once a person submerges and breathing stops, brain cells are damaged within a few minutes. To reduce the possibility of brain damage, you must quickly be able to recognize that a person needs help and provide that help promptly" (p. 54). Their 1995 text classified a series of lack-of-oxygen timed intervals in which they indicated that 4–6 min after breathing stops brain damage is possible, after 6–10 min brain damage is likely to occur, and after over 10 min without oxygen irreversible brain damage is certain (ARC, 1995).

The elimination of rescue breathing in the water by the ARC lifeguard program appears to represent a clear deviation from their own past practices and statements, as well as the previous American Medical Association resuscitation recommendations (AMA, 1986, p. 2929; AMA, 1992, p. 2246) and the recent 2005 AHA guidelines for emergency cardiovascular care that support in-water rescue breathing.

As a result of the findings of this literature review, we offer the following recommendations:

- Lifeguard agencies should have a process for citing evidence-based research practices and reliable experimental studies and referencing them in their training manuals. One positive example is the recently formed U.S. Lifeguarding Standards Coalition project in which the ARC, YMCA, and USLA, with funding support from the National Swimming Pool Foundation, are conducting rigorous scientific reviews of important questions related to lifeguarding practices.

- Lifeguard agencies should provide accurate citations in their training manuals that connect their procedures with existing scientific evidence supporting those practices.
- Scuba-diving agencies should examine and analyze their current and past practices regarding in-water rescue-breathing procedures to be in compliance with the 2005 ECC guidelines.
- All lifeguarding agencies, including the ARC, should standardize the in-water rescue-breathing procedures in their lifeguard-training programs to reduce confusion and emphasize the strong support for this procedure.

To conclude, understanding the possible consequences for an individual when his or her brain is deprived of oxygen for a long period of time, we concur with most expert opinions found throughout the literature that breathing must be restored as soon as possible. We have identified the need for more rigorous scientific research to be conducted on this technique when performed in both shallow and deep water. We could not find any experimental or scientific studies conducted specifically by any of the lifeguard agencies that support the methods and practices they have implemented for in-water rescue breathing.

We discovered that most lifeguard-training programs employ traditional practices handed down over generations. Aquatic practitioners are owed explanations of why lifeguard-training agencies have not been held to higher standards, especially related to these agencies' failing to release the evidence-based research that led them to implement methods for practitioners to follow. Either scientific studies have not been conducted by lifeguard agencies or they have been conducted but are not available to the public.

We found it interesting that Langendorfer's (2007) first *IJARE* editorial stated,

For whatever reason, too often we "aquatic people" indeed have failed to either conduct our own research or to integrate research from related fields such as psychology, pedagogy, or kinesiology. We instead have primarily relied on *tradition*: Too often we have followed practices handed down generation after generation without ever even performing a logical analysis to see if these practices make sense. (p. 2)

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