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Emergency Oxygen Use in Aquatic and Recreation Facilities Is Overdue

Leland Yarger

Emergency oxygen means “oxygen meeting the United States Pharmacopeia (U.S.P.) specifications which, in the absence of qualified medical personnel, may be administered by properly instructed personnel for emergency resuscitation or for protection against oxygen-deficient atmosphere” (Food and Drug Administration, 1972, p. 5504). It also means

oxygen meeting the United States Pharmacopeia (U.S.P.) specifications and intended for administration by medically trained personnel and includes oxygen which is administered under the direction of a medical practitioner at elevated pressures (e.g., in a hyperbaric chamber or similar device used in the therapeutic treatment of man or animal). (Food and Drug Administration, p. 5505)

The Food and Drug Administration determined in 1996 that labeling for all oxygen equipment would bear the following statement: “WARNING: For emergency use only when administered by properly trained personnel for oxygen deficiency and resuscitation” (American Safety and Health Institute, 2007). This reflects the current labels affixed to medical oxygen cylinders. Included on the label is the statement “for all other applications by prescription only.” This helps individuals using the cylinders clearly understand the intent of emergency oxygen administration versus all other uses.

Emergency Oxygen Unit

An emergency oxygen unit is defined as a unit

containing oxygen U.S.P., a dispensing device which consists of pressure reducing equipment capable of maintaining a constant flow of at least 6 liters of oxygen per minute for a minimum of 15 minutes; content indicator (gauge); and a mask or other means of administering the oxygen to the patient. (Food and Drug Administration, 1972)

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Keep in mind that the 1972 phrase *mask or other means of administering oxygen to the patient* does not accurately reflect contemporary oxygen terminology. Today, the four most common oxygen-delivery devices are the nasal cannula, nonrebreather mask, resuscitation mask with oxygen inlet, and bag-valve and mask with oxygen-delivery line. Professional rescuers, including lifeguards, must also understand accepted flow rates for the devices as listed in Table 1.

Emergency Oxygen Use

There are many organizations that have emergency oxygen training programs and certifications. The YMCA of the USA originally set the standard of care by mandating that all their lifeguards hold current certification in emergency oxygen administration beginning January 1, 2003 (YMCA of the USA, 2001, 2003). The International Lifeguard Training Program by Ellis and Associates teaches how to use a specially designed emergency supplemental oxygen support system (Ellis and Associates, 2007). The American Red Cross (ARC) *Lifeguard Training* text recognizes that “when a lifeguard gives breaths, the air exhaled into the victim is about 16% oxygen. This may not be enough oxygen to save the victim’s life” (ARC, 2007b, p. 117). Oxygen administration is an optional portion of the ARC lifeguard program. The Starfish Aquatics Institute’s StarGuard lifeguard-training program “integrates the American Safety and Health Institutes (ASHI) curricula for emergency oxygen into the StarGuard training” (Starfish Aquatics Institute, 2006, p. v). United States Lifesaving Association (USLA) certification for “full time open water lifeguards requires training to Department of Transportation first responder standards.” The minimum equipment standards for USLA include “oxygen readily accessible at each staffed beach area, with all lifeguard personnel trained in its use” (USLA, 2005, p. 11). As noted in the ASHI *Complete Emergency Care* text, “given the potential benefit to the victim, it is reasonable for properly trained first aid providers to give emergency oxygen when it is available” (ASHI, 2007, pp. 141–142).

Table 1 Emergency Oxygen-Delivery Devices and Commonly Accepted Flow Rates

Delivery device	Flow rate, L/min
Bag-valve mask	15 or more
Resuscitation or pocket mask	10–15
Nonrebreather mask	6–15
Nasal cannula	1–6

Note. Adapted from American Red Cross (2007b).

Scuba Diving

In the Divers Alert Network (DAN) text, *Oxygen First Aid for Scuba Diving Injuries*, Dr. Peter Bennett states,

In a diving accident, there is significant data to show that delayed treatment can lead to more permanent disability. The role of delivery of emergency oxygen at the earliest possible moment—which means on the boat or on shore—is also critical in this regard. (DAN, 1997)

In addition, “providing oxygen first aid to an injured diver before the arrival of professional medical care is one of the most important measures taken when a dive injury occurs” (DAN, 2006, p. 5).

Oxygen First Aid Questioned

Professional medical groups have expressed concerns about emergency oxygen use in first-aid settings. The National First Aid Science Advisory Board in 2005 concluded that because of a lack of studies on emergency oxygen administration “there is insufficient evidence to recommend for or against the use of oxygen by the first aid provider” (ASHI, 2007). The latest emergency cardiovascular care guidelines reflect this finding (American Heart Association, 2005).

Anecdotal Evidence

SCUBA Times magazine published an article, “Oxygen and Diving Accidents,” in which Dr. Peter Bennett wrote,

Examination of the treatment outcome of over 200 divers who called DAN for help reveals that oxygen alone has reversed major paralysis and sensory loss. Comparing equally severe cases of both decompression sickness and air embolism with oxygen, to those where oxygen was not used, has shown a much better eventual treatment outcome following early oxygen breathing. (A. Dick and P.B. Bennett, personal communications about photocopy of *Scuba Times* article from early 1980s)

What Aquatic-Rescue Practitioners Say

In *Aquatic Rescue and Safety*, by Dennis K. Graver (2004), it is recommended that “anyone with signs and symptoms of heart, lung, or brain injury will benefit from oxygen first aid” (p. 91). Graver, a scuba-diving instructor for 35 years and a medical services officer for a fire district, has seen many emergencies. Graver says

that emergency oxygen equipment is not only for professional rescuers. He goes on to say that “by investing a few hours of time and a few hundred dollars, you can qualify to administer oxygen. When you think of the value of saving lives, the cost of having oxygen at remote aquatic locations is quite small” (Graver, p. 186).

In scuba diving, the dominant emergency oxygen course is DAN’s Oxygen First Aid for Scuba Diving Injuries. Dr. Peter Bennett reflects on an incident that took place on a Pacific island training course for diving physiology and medicine for physicians (P.B. Bennett, personal communication). Dr. Bennett states,

An Arterial Gas Embolism (AGE) or near drowning occurred in front of our boat. On retrieving the unresponsive diver, I asked the physicians on board to prepare the oxygen unit. Without proper training, however, they did not know how to assemble it quickly. I had to do the job. After breathing oxygen for 15 minutes, the injured diver woke up while returning to shore. Coupled with recompression treatment in a hyperbaric chamber, the diver made a full recovery. (DAN, 1997, p. 3)

Robert Ogoreuc, an aquatics professor at Slippery Rock University, as well as an ocean lifeguard, states, “The most effective way to reverse someone that is in a hypoxic state is the application of supplemental oxygen. I have witnessed the benefits of this firsthand along with many of the students that I have trained over the years” (R. Ogoreuc, personal communication, February 4, 2008).

In August of 1999, Bob and a fellow lifeguard rescued a distressed swimmer who had entered a rip current along the Jersey shore. Once onshore the victim was pale, coughing, vomiting, and unable to speak. The lifeguards proceeded to administer oxygen. Within 15 min of emergency oxygen being administered, the victim’s color improved and he could speak in complete sentences. Care of the victim was transferred to emergency medical services (EMS) personnel, and he made a complete recovery. “I am a firm believer that oxygen is a critical component in a lifeguard training curriculum,” says Ogoreuc (personal communication, February 4, 2008).

Ken Roland, pool-operations coordinator for the City of Ft. Lauderdale, FL, states, “One of the necessities of preserving human life is the establishment of a patient airway to provide high flow oxygen for greater perfusion” (K. Roland, personal communication, February 19, 2008). Ken compared two rescues, one without oxygen and the second with oxygen:

In my experience, I resuscitated a 4-year-old girl using rescue breathing. It was a long minute and a half of puffing and shouting for her to breathe. One gasp and she expelled the contents of her stomach into my mouth. In another instance, I rescued a 10-year-old from the ocean. While swimming to the shore I did rescue breathing. Other members of the Pompano Beach Patrol arrived and we immediately inserted an oral airway and administered oxygen. She started breathing within seconds of our turning the oxygen on.

Medical Emergencies That Benefit From Emergency Oxygen

The variety of injuries and illnesses that benefit from emergency oxygen is vast. First responder texts by the ARC (2001), American Academy of Orthopedic Surgeons (2007), and National Safety Council (2008) recommend using emergency oxygen if it is available and if you are trained to use it for the conditions noted in Table 2. Table 2 is nearly exhaustive for the variety of medical emergencies that benefit from the use of emergency oxygen according to the various national training agencies.

Staff Training

Lifeguards are considered first responders and already receive CPR training for professional rescuers (CPR/PR) or health care providers; such emergency oxygen administration training is appropriate and responsible. The course length for training lifeguards in emergency oxygen is typically less than 4 hr. The ARC lifeguarding course requires at least 2 hr and 25 min for a stand-alone class. For the emergency oxygen class taught as part of an ARC lifeguard-training class the time requirement is 1 hr and 25 min. The ARC's certification in administering emergency oxygen is valid for 1 year (ARC, 2007a). The Red Cross certification validity period corresponds with the length of CPR certification validity.

Equipment Evaluation

The typical emergency oxygen system consists of the following items: a portable oxygen cylinder or tank, an oxygen regulator with variable flow and flowmeter, a gauge on either the oxygen tank or the regulator to read the amount of oxygen in the tank, and oxygen-delivery devices including nasal cannula, nonrebreather mask or resuscitation mask, and bag-valve and mask. Lifeguard staffs should consider using an oxygen kit that has all the necessary oxygen-delivery equipment in one container that can easily be transported to the victim during an emergency. Both hard cases and soft bags are available. The hard case might protect the oxygen cylinder more than a soft carrying bag in the event that the kit is dropped or hits a hard surface.

The following tasks are necessary to maintain the equipment:

- The oxygen tank must undergo a hydrostatic test every 5 years by a Department of Transportation-authorized facility.
- Every day of facility operation, the staff should verify that the oxygen-tank volume gauge registers as full. Because emergency oxygen delivery requires a minimum of 6 L/min for at least 15 min, using partially full cylinders is not recommended and could endanger a victim's health.

Table 2 Conditions Benefiting From Emergency Oxygen

Medical condition	Training Organization First-Responder Text		
	AAOS (2007)	ARC (2001)	NSC (2008)
Heart attack	X	X	X
Shock	X	X	X
Stroke	X	X	X
Poisoning	X	X	X
Serious head injury	X	X	X
Complications during pregnancy	X	X	X
Diabetic emergency		X	X
Abdominal injury		X	X
Internal bleeding		X	X
Anaphylaxis		X	X
Serious back injury	X	X	
Substance abuse	X	X	
Epiglottitis	X		X
Respiratory arrest and distress	X		X
Mild airway obstruction	X		X
Seizures	X		X
Closed chest injury	X		X
Scuba-related emergency	X		
Drowning	X		
Flail chest	X		
Gunshot wound	X		
Dyspnea	X		
Penetrating chest wound	X		
Fractured femur		X	
Internal bleeding		X	
Sudden illness		X	
Care for the mother after childbirth		X	
Shaken-baby syndrome			X
Childhood trauma			X
Altered mental status			X
Bronchiolitis			X
Nonbreathing newborn			X
Asthma			X
Heat-burn emergency			X
External bleeding			X
Croup			X
Smoke inhalation			X
Heat stroke			X
Emergency musculoskeletal injury			X

Note. AAOS = American Academy of Orthopaedic Surgeons; ARC = American Red Cross; NSC = National Safety Council.

- Every day the lifeguard staff should verify that the kits are all accounted for and serviceable for use.
- Any local procedures and documentation that are required must be followed.

Determining Facility Risks

On a regular basis aquatic directors should review the accident reports for their facilities to determine how many of the listed injuries or illnesses that can be treated by emergency oxygen (Table 2) have occurred during the review period. As a part of this regular review, it is useful to evaluate the length of time between accident recognition and arrival of EMS personnel at your location for each accident. It might be helpful to consider the worst-case scenario using the distance of the EMS station from your facility and determine how often EMS get a call and are not present? Is it every 12 min, every half hour, or less frequently? Consider what could happen to your injured or ill patron during this time if your staff is unable to administer oxygen for any length of time. The answers to these questions will obviously affect your need to keep your emergency oxygen kit in good repair and your staff trained in its use.

Conclusions

In this article I have summarized reasons for which emergency oxygen administration has become a contemporary standard of care for first responders despite some recognition that its value needs further scientific verification. I also have argued that professional rescuers including lifeguards, aquatic managers, athletic trainers, and aquatic coaches and educators should all be required to have emergency oxygen training and to keep their certifications current. Furthermore, I strongly recommend that facilities that already employ staff trained in first aid and CPR give serious consideration to training the staff in emergency oxygen use. I feel this is especially important for facilities that already have staff trained at CPR/PR or health-care-provider levels.

Oftentimes, “seeing is believing” for administrators deciding on oxygen use, especially when faced with initial equipment and training costs. Those of us who have seen the dramatic effect that oxygen can have on a victim swear by its use. In light of the clear lack of a body of research to either support or refute the use of emergency oxygen, practitioners of emergency oxygen use, as well as the major lifeguard-training agencies, who by default have set the standard of care, should provide input to formal publications such as *IJARE*. It will become increasingly important to help this lifesaving resource become mainstream practice at all aquatic facilities or provide the scientific evidence that it is harmful or does not provide the benefits that I have anecdotally reported. Oxygen’s enhancement of victim survival in scuba incidents is quite clear. The benefits of first responders’ use of emergency oxygen are also clear from published agency texts. In our industry, I urge all of us to train our respective aquatic staffs and keep detailed reports of emergency oxygen use. Together we can create a basis for documented care that should help save lives.

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