

## Water Hazards: Underwater Breath-Holding Revisited

Drowning is a common hazard and one of the top causes of injury-related death in young people, according to statistics from the Centers for Disease Control and Prevention (CDC). An average of nine people per day in the United States succumb to unintentional drowning and nearly a third of them are under the age of 25. While schools, colleges, and universities may understand that the young population using their pools is especially vulnerable, institutions may not know that the drowning hazard threatens not only weak swimmers but strong swimmers as well.

Three years ago, UE reported in an issue of *Safety Dispatch* on drowning incidents in college pools involving swimmers engaged in breath-holding exercises designed to extend underwater swimming time. Recently, another round of "underwater breathing" cases has captured our attention as the swimmers involved were younger and were using the campus pool for recreational "fun swims." The swimmers were healthy, athletic males from 15 to 26 years old, all of whom were capable-to-strong swimmers. Each died in shallow water, many near the side of the pool.

This *Bulletin* revisits the danger of underwater breath-holding and reminds institutions that better training and improved pool regulations can prevent fatalities from shallow water blackout (SWB), a condition caused by underwater breath-holding.

### Shallow Water Blackout

Prolonged underwater breath-holding can be deadly. Decades of documented cases involving free divers, spear fishermen, Navy SEALs, and competitive swimmers demonstrate that underwater breath-holding can lead to SWB. This appears to be the fate that befell swimmers at several educational institutions.

SWB results from an insufficient amount of carbon dioxide to activate the body's natural impulse to breathe. Here's how it works: A swimmer or diver hyperventilates—that is, takes rapid and repeated deep breaths of air — thinking that doing so will increase oxygen stores so that he or she can stay underwater longer. However, instead of increasing oxygen, hyperventilation actually decreases the body's natural store of carbon dioxide.

A common misconception is that breathing is triggered by a lack of oxygen. Actually, a specific level of carbon dioxide in the blood prompts the breathing reflex. If the level of carbon dioxide is not high enough because of hyperventilation or some other reason, a swimmer or diver will not get the message that it is time to take a breath. Then, because of depleted oxygen reserves, blackout follows. A loss of consciousness underwater can trigger a series of events—inhalation of water, cardiac arrest, brain damage—that can ultimately lead to death. Deep breathing as an underwater endurance step actually *increases* the risk of drowning.

The swimmers who died at educational institutions either sought to improve their free diving (that is, diving in deep water for as long as possible without an external air supply), or they had challenged other recreational swimmers to an underwater swimming contest. While underwater breath-holding capacity may be a desirable attribute for Navy SEALs or an underwater fisherman, the specialized training needed to attain this capacity requires close supervision and should not be practiced in a recreational setting. In fact, institutions should ban prolonged underwater breath-holding altogether.

## Training Aquatics Staff

Aquatics staff, including lifeguards, pool managers, and coaches, needs to understand SWB and how it results from underwater breath-holding exercises and games. This information, however, is not readily available. The American Red Cross (ARC) and the YMCA, the primary organizations that train and certify pool lifeguards, provide only vague references to these subjects in their programs. Given that large numbers of lifeguards obtain their certification from these organizations, the lifeguards you hire may not be trained adequately to identify dangerous underwater swimming practices and prevent an SWB drowning.

Monitoring for SWB is challenging. Lifeguard training programs generally focus their surveillance and rescue techniques on weak and struggling swimmers. Because those that fall prey to SWB are typically strong and experienced swimmers trying to improve or demonstrate their underwater swimming prowess, lifeguards who do not understand SWB may not appreciate the dangers that could threaten these competent swimmers.

Another practical challenge for lifeguards is detecting a swimmer experiencing SWB. While the movies may portray drowning victims as flailing around, screaming for help, and struggling to stay afloat, the reality is usually quite different, particularly with an SWB drowning. Typically, SWB occurs underwater rather than on the water's surface where a struggling swimmer can be observed readily. Again, many training programs miss the mark, teaching scanning patterns and other drowning concepts that emphasize the pool's surface rather than its bottom. Even in crystal clear water, a swimmer at the bottom of a pool can disappear from sight due to reflections, glare, and refractions at the water's surface.

Most SWB victims are found motionless underwater and, in some cases, the victim's arms and legs may move involuntarily in a swimming-like motion as he or she loses consciousness. Often a swimmer wearing goggles, not the lifeguard, is first to notice an SWB victim's body underwater. To assist lifeguards, several institutions have installed Poseidon, a computer-aided drowning detection system. The system uses computer vision technology along with a network of cameras mounted both above and below the surface of the pool to analyze underwater activity and alert the lifeguard in seconds of a swimmer in trouble.

Even if trained on SWB, a lifeguard should not agree to supervise anyone who wants to engage in prolonged underwater swimming or be expected to do so. Submersion for even a half minute can lead to drowning, and for longer than five minutes, it generally causes death. Monitoring would require continuous supervision. A guard owes attention equally to all swimmers, so keeping special watch over a single swimmer engaged in endurance breath-holding is not appropriate. The best practice is for lifeguards at your institution's facility to restrict underwater breath-holding altogether.

Because the most popular water safety training programs do not address SWB directly and the practical realities of the SWB phenomenon create special challenges for aquatic staff, the prudent institution will consider providing supplemental training on the subject or retain an independent expert to do so.

## Managing the Aquatic Facility

Every SWB incident at an educational institution known to UE occurred in a competitive swimming pool on campus rather than a beach, lake, or other natural setting. Because pools provide a pre-determined path and distance, they are particularly attractive to swimmers setting goals for underwater swimming or challenging others to the exercise. Educational institutions can help protect swimmers from the dangers by taking steps to improve the pool facility and manage the activities of those who use it.

Institutions should review the rules and regulations governing the use of the pool and examine the facility's layout and equipment. Consider changes that would improve safety. Managers of swimming facilities may wish to consider the following tips as they advance this process:

- Prohibit underwater breath-holding—whether an endurance exercise or a competitive game—just as you prohibit diving into shallow water and other risky pool activities. Emphasize this ban above all others: The risk is that serious.
- If you see someone engaging in extended or repeated breath-holding, order the person to stop immediately. Endurance drills for underwater breath-holding are potentially dangerous and should not be undertaken in a recreational setting.

United States Lifesaving Association Safety Tips: General Information on Drowning.  
[www.usla.org/PublicInfo/safety\\_guide.asp#top](http://www.usla.org/PublicInfo/safety_guide.asp#top)

### **Sample Institutional Pool Regulations**

University of New Hampshire Department of Recreation, "Outdoor Pool Rules and Regulations" (see paragraph 12, unsafe practices). [http://campusrec.unh.edu/facilities/outdoor\\_pool\\_rules.html](http://campusrec.unh.edu/facilities/outdoor_pool_rules.html)

University of North Carolina, "Aquatics Pools Rules and Regulations" (see first paragraph, prohibited acts).  
[www.aquatics.unc.edu/Pool\\_Rules.htm](http://www.aquatics.unc.edu/Pool_Rules.htm)

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