Questions to be addressed:

What are safe and unsafe methods of breath-holding underwater?

Answer:

Man has been going underwater since humans have roamed the earth. Sometimes they successfully returned to the surface and exited the water and sometimes they did not. Today we are enjoying a diverse array of water sports where many families spend their recreational free time in and around the water. But the main concern still is, when they go underwater will they return safely to the surface and exit. Without some type of breathing source man must hold his breath underwater so as not to inhale a liquid that is much denser than the air we need for respiration. Breathing in this liquid can cause serious illness and even death.

Whenever we submerge underwater, by definition we are drowning and in a state of apnea. The 2002 World Congress on Drowning defined drowning as follows: “Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid. Drowning outcomes are classified as death, morbidity and no morbidity.” Apnea is the “temporary absence or cessation of breathing”. So when we submerge we will experience respiratory impairment because we cannot or should not inhale thus in a state of apnea. Millions of us go underwater and we live, a very good thing, yes we are in a state of drowning but with no morbidity or medical problems associated with it.

In recent years the aquatics world has had much discussion regarding the dangers of breath-holding and a person being submerged underwater. So we have a basic question; “Is it safe to hold your breath underwater?” The problem is the answer can be both YES and/or NO. The first thing we need to do is to look at the different types of controlled underwater experiences there are and which could be considered safer and which may have more risk associated with them. Please remember it is never safe to go in the water without someone else with you-- period. If you are attempting any type of submersion activity your buddy needs to be ready to assist if needed and have the ability to assist.

Risk associated with different types of controlled underwater breath-holding experiences
A. Just going underwater for a short period of time, less than a minute. Generally safe.
B. Going underwater to stay under for an extended period of time, longer than a minute, without any type of prior hyperventilation. Generally safe.
C. Going underwater to stay under for an extended period of time, greater than a minute, with prior hyperventilation (generally more than two deep breaths in fast repetition). Generally unsafe.
D. Hypoxic Training for competitive swimmers – is a training technique where either the swimmer does not take a breath swimming during a certain distance or limits the number of breaths. There is no evidence that this type of training produces lower swimming times but has shown to be a contributing cause to some competitive swimmer’s deaths. Dan McCarthy 5/1/2012 with USA Swimming: “Hypoxic training raises the level of carbon-dioxide in the bloodstream, increasing feelings of discomfort. While hypoxic training is constantly being investigated by organizations like the U.S. military, at this time writing research regarding the hypothesized beneficial physiological adaptations has been inconclusive.” Can be unsafe and not proven to be effective.
E. Training at altitude, which has a lower partial pressure of oxygen, has been a technique used by many athletes to increase the transport system in the body for getting oxygen to the muscles. Generally safe and effective.
F. SCUBA diving is another aquatic activity in which we are underwater, but we are carrying a limited amount of breathing gas with us. The number one rule taught in most diver education courses is to “breathe all the time and never hold your breath”. The problem the scuba diver faces is that the compressed gas he has inspired will expand upon accent. If the diver does not exhale the expanding gas can then cause serious damage in the lungs. So if the diver runs out of the breathing gas while underwater they are taught to attempt to inhale and then exhale as if in normal respiration. This allows the expanding gas to be released and the pressure in the lungs not to become dangerous. Holding ones breathe and ascending from depth is extremely dangerous.

The world of breath-hold diving has exploded in the media in the last 10 years possibly because of the nature of this extreme sport. Breath-hold diving is also referred to apnea diving and free diving. In the arena of competition, types of breath-hold dives and techniques used in breath-hold diving have expanded over time. It is important to note that the world of competitive breath-hold diving is comprised of a fairly small number of individuals (1027 members on the AIDA (Association Internationale pour le Développement de l’Apnée) International community website) around the world that train in various ways to go deeper or stay underwater longer than most individuals can comprehend. Current records have individuals staying underwater for more than 11 minutes and descending and returning from more than 214 meters (702 feet) in depth. The general swimming public needs to understand that these are extreme sport activities and that some of those highly trained individuals have died attempting these activities even with safety personnel present.

One of the more controversial techniques that a number of the breath-hold divers use is called “lung packing” or “glossopharyngeal inhalation”. The first references of using this technique are attributed to Robert Croft, a US Navy Diver in the 1960s. Lung Packing is a method for breathing additional air into the lungs, beyond what can be inhaled in a single breath. The following is a description of Lung Packing from the website www.aonea-total.com

“Although not usually used in recreation free diving as it's time consuming and difficult to do through a snorkel, it is done by the majority of competitive free divers Because it can be easy to black out while packing or pack stretching, do
it while seated and away from hard objects!

Once a complete breath has been taken, the diver closes his epiglottis. He then sucks air into his cheeks by lowering his gullet/tongue and siphoning air in through pursed lips. This is no different than sucking water through a straw. The lips are then sealed, trapping the air in the mouth. The tongue is then raised, progressively flattening itself along the palate, starting at the tip and moving backwards. The tongue is now working like a piston, compressing the air and forcing it down the throat, past a now opened epiglottis and into the lungs. When the mouthful of air is "packed" into the lungs, the epiglottis can be locked and the process repeated.”

There have been some medical studies done regarding glossopharyngeal inhalation and trained breath-hold divers. A study by S. Chung, et al. “Glossopharyngeal insufflation causes lung injury in trained breath-hold divers” concluded that barotrauma, pressure related injury, was observed in breath-hold divers who increased their lung volumes by glossopharyngeal insufflation. The long-term effects of this barotrauma are uncertain and longitudinal studies are required to assess cumulative lung damage.”

Information regarding breath-hold diving can be found on the AIDA Internationals: The World Federation for breath-hold diving website: [http://www.aidainternational.org/](http://www.aidainternational.org/). Below are current types of apnea diving that are recognized by the AIDA and records.

- **Constant Weight Apnea.** The athlete has to dive to the depth following a guide line that he or she is not allowed to actively use during the dive. The 'Constant Weight' refers to the fact that the athlete is not allowed to drop any diving weights during the dive. Both bi-fins or a mono-fin may be used during this competition. Current Records: Men’s 128 meters (420 feet)  Women’s 101 meters (331 feet)

- **Constant Weight Apnea Without Fins** has identical rules as Constant Weight, except swimming aids such as fins are not allowed. This discipline is the youngest within competitive free-diving and has been recognized by AIDA since 2003. Current Records: Men’s 101 meters (331 feet)  Women’s 69 meters (226 feet)
• Free Immersion Apnea is a discipline in which the athlete uses a vertical guide rope to pull him or herself down to depth and back to the surface. The athlete is not allowed to release weights during the dive. It is known for its ease compared to the Constant Weight disciplines. Current Records: Men’s 121 meters (397 feet) Women’s 91 meters (299 feet)

• Variable Weight Apnea is a discipline that uses a weighted sled for descent. Athletes return to the surface by pulling themselves up along a line or swimming while using their fins. Current Records: Men’s 145 meters (476 feet) Women’s 127 meters (417 feet)

• No-Limits Apnea is a discipline that allows the athlete to use any means of breath-hold diving to depth and return to the surface using a guideline to measure the distance. Most divers use a weighted sled to dive down and use an inflatable bag to return to the surface. Current Records: Men’s 214 meters (702 feet) Women’s 160 meters (525 feet)

• Dynamic Apnea without fins is a discipline where the diver aims to achieve the longest horizontal distance possible without the use of fins or other propulsion equipment. Current Records: Men’s 225 meters (738 feet) Women’s 182 meters (594 feet)

• Dynamic Apnea with fins is a discipline where the diver aims to achieve the longest horizontal distance possible with the use of fins or a mono-fin. Records: Men’s 281 meters (922 feet) Women’s 234 meters (768 feet)

• Static Apnea is where the diver attempts to hold their breath for the longest possible time either on or beneath the surface of the water with both their mouth and nose submerged at a minimum. Current Records: Men’s 11 minutes 35 seconds Women’s 9 minutes 02 seconds

The following are the opinions and recommended policies from the American Red Cross Scientific Advisor Council for
aquatic facility operators regarding submersion and breath-holding activities in an aquatic facility.

1. The lifeguard needs to be aware and monitor patrons that go underwater.
2. A patron cannot swim more than 25 yards underwater on a single breath. If a patron does the lifeguard is directed to stop them and explain our policies and the reasons behind them.
3. If a patron is static for more than 5 seconds underwater the lifeguard is to enter the water and bring the patron up. If the patron was attempting breath holding activities the lifeguard will explain the facility policies.
4. If the lifeguard observes a patron trying to hyperventilate before submerging the lifeguard is to stop the patron from submerging and explain the policy.
5. Rules and regulation signage will contain language prohibiting extended breath-holding activities.

References:

ARC SAC

1. Voluntary Hyperventilation Preceding Underwater Swimming

Other References
