



## Reasons to Warn of the Effects of Cold Water Immersion

We have become more and more aware in the rafting/canoeing industry that paddling fatalities are most frequently related to or caused by the effects of cold water immersion and not just by what we used to traditionally call "drowning." Because of this awareness we now believe that a commercial operator, guide or outfitters' **duty to warn** clients or participants of the risks related to paddlesports must include a warning of the possible effects of cold water immersion. In the legal context this is particularly important because, traditionally in rafting or paddle sports cases if the mode of death was anything other than traditional *drowning* or water aspiration (i.e.- was caused by cardiac arrest or ventricular fibrillation), we felt confident that we would have good causation style arguments against the claim or lawsuit (i.e. - the decedent perished because of cardiac issues unrelated to the inherent risk of *drowning* while rafting). Because we now believe that the effects of cold water immersion (cold shock, hyperventilation and hypothermia) are so much more commonly understood as they relate to drowning and boating fatalities, we now believe that *cold water immersion and the effects of cold water immersion are part of the inherent risk of rafting, canoeing and/or paddlesports* and that adequate warnings will or should include discussion or mention of cold water immersion.

As stated above, there is currently so much information available on the effects of cold water immersion or "cold shock" that we can not really make as much "head way" with the types of causation arguments we used to use in defending paddlesports fatalities cases. Because of this, we now believe that cold water immersion and its effects are an *inherent risk of paddlesports* and that commercial operators need to understand this issue and give specific warnings related to cold water immersion. It is currently thought or estimated that the effects of cold water are involved in virtually all kayaking, rafting and recreational boating deaths. The effect of sudden immersion in cold water ("cold water" isn't really all that cold and can be 25N C and 77N F where your normal body temp is 98.6N and shivering can set in when you are reduced to 96.5N) leads to a series of stages.

### Stages of Cold Water Immersion

The first stage is "cold shock" and occurs in the first 3-5 minutes of immersion. During cold shock, the swimmer/victim experiences involuntary gasping, hyperventilation, panic and vertigo. This is particularly dangerous if the victim's face is immersed as water aspiration occurs (leading to drowning). Hyperventilation increases the rate of breathing four to five times the normal resting level within 30-60 seconds of immersion. The hyperventilation results in a profound lowering of blood carbon dioxide levels and raising of blood PH levels which causes a huge risk of ventricular fibrillation ("cardiac arrest"), muscular tetany ("cramps") and cerebral vasoconstriction which starves the brain of oxygen causing disorientation and confusion. These effects, coupled with changes in lung mechanics caused by the pressure of the water on the abdomen and chest create an inability to breath and panic. The "cold shock" effect also occurs due to the rapid cooling of the skin triggering this cluster of heart and breathing responses. Typically the cardiac responses include an increase in heart rate of 40-50% and an increase in cardiac output of 60-100% which results in huge blood pressure increases. Bottom line is substantial strain on the heart which is especially dangerous for folks with any of the common risk factors for heart disease or hypertension.



The second stage of cold water immersion is what is thought of as “swim failure” and usually occurs 3-30 minutes into immersion in cold water. This is where the muscular tetany or cramps become pronounced and muscles and nerves are cooling quickly. Manual dexterity, hand grip strength and speed of movement can all drop by 60-80 percent. Even normally strong people can lose the strength necessary to pull themselves out of the water or to hold their heads above water. Because of the involuntary gasping associated with cold shock and because of the loss of strength to hold the head up that happens during swim failure, death can now occur by traditional water aspiration or drowning. Another threat in cold water immersion situations is the reduction in the length of time a person can hold their breath. The ability of the average person to hold their breath in water colder than 60N F is in the range of 15-25 seconds, approximately 1/3 of normal.

During the third stage of cold water immersion, usually within 30 minutes, hypothermia begins. Hypothermia will be dependant on the water temperature, clothing, body type and the person’s actions in the water. Hypothermia occurs when your body loses heat faster than it produces heat, cooling the organs in the core of the body and leading to loss of consciousness and death, with or without drowning.

During the fourth stage of cold water immersion, post immersion collapse occurs and can happen before during or even after a rescue. Even if removed from the water, if the victim swimmer has been immersed in cold water long enough they are still in danger from collapse of arterial blood pressure which leads to a heart attack. Also - if the cold blood from the swimmer/victim’s limbs is released back into the core of the body, heart problems are increased so that it is very important to keep the victim’s arms and legs out of the water during and after rescue; this “after drop” effect can cause cardiac arrest and be fatal as well.

### **Recommendations Regarding Cold Water Immersion Warnings**

Commercial operators and clubs in paddlesports should undertake to warn people of the effects of cold water immersion **and** should increase their explanations as to how to respond to cold water immersion. First - a guide or outfitter doing safety briefings should warn participants to be aware that immersion in cold water **will** lead to involuntary reflexes like gasping and panic, all of which will greatly increase the victim’s respiratory and cardiac responses. The verbal warning should notify people that this response will occur in normal healthy people **and** that folks with any of the common risk factors associated with heart disease should be especially cautious in choosing this activity. Instructions for what clients and the guides should do in the event there is a swimmer should include the facts that all efforts should be made to get folks fully out of the water as fast as possible (cold water robs the body’s heat 32 times faster than cold air...). Also consider explaining the issue that physical exercise such as swimming causes the body to lose heat at a much faster rate than remaining still in the water (because blood is pumped to the extremities where it cools rapidly and then gets returned to the core where it cools the critical organs.) It has been estimated that swimming, panicking and thrashing or treading water - as opposed to defensive huddled floating - can shorten survival time by more than 50%. As such, folks who are in cold water and not able to immediately get out are then faced with the critical choice of adopting a defensive posture in the water to conserve heat and await rescue or of attempting to swim for safety. In calmer flowing water and still water swimmers can reduce heat loss by bringing their legs up to their chest and crossing their arms and holding onto their life vest. Swimmers must assess their surroundings and must exercise judgment as to whether to swim



quickly and realistically based on where they are in the water and the likely hood of them getting to actual safety without rescue. Staying calm is critical.

Remember too that your release and waiver and acknowledgment of risk documents are one of the primary ways to satisfy your duty to warn clients of the risks associated with an activity. As such, in addition to all of the other wording that will appear in a well drafted release type document, we advise that language such as the following appear in your release. "It is possible that the raft or canoe could encounter changing water flows or waves or that loss of control of the raft or canoe could occur resulting in collision or capsizing or sinking or my being "washed" overboard; I understand that prolonged exposure to cold water can result in cold shock, hyperventilation, hypothermia, or drowning - all of which could lead to my injury or death. I understand that communication in the sea, lake and/or river terrain in which this activity occurs is always difficult and in the event of an accident, rescue and medical treatment may not be immediately available."

**Tracey Knutson, Knutson & Associates P.O. Box 1026 Girdwood, Alaska 99587  
PH 907-264-6610 Fax 907-782-2028 [www.traceyknutson.com](http://www.traceyknutson.com)**

---

See, NOLS Sea Kayaking Instructor Notebook "S.K.I.N." on Cold water Immersion.

And see, The Wilderness First Responder text by Buck Tilton.

Also: United States Search and Rescue Task Force on Cold water Survival at

And, Cold Water Immersion by John Browning at [www.wildernessconnection.com](http://www.wildernessconnection.com)