WHY SWIMMERS DROWN

Open water drowning survival guidelines for swimmers

JOHN CONNOLLY

Editor

WHY SWIMMERS DROWN

Open water drowning survival guidelines for swimmers

John Connolly
Editor

PERIDIS
PUBLISHING

ISBN 978-0-947225-80-3

Published in Australia by

Peridis Publishing

PO Box 600

Toowoomba 4350

THE Lifesaving FOUNDATION

DROWNING RESEARCH SAVES LIVES

PERIDIS PUBLISHING

EDITORIAL NOTE

Whilst many contributors to this book are academics the book has been prepared for a wider audience and is not intended as an academic or scientific work. In addition to lifesavers the target audience includes the 'general public.' In order to allow the content to be more widely disseminated and read, the academic practice of referencing citations has not been used (these are available from the individual authors). The content, however, is based on the latest drowning prevention and rescue research and has been editorially reviewed. The appendix Book Authors contains short biographies of contributors showing their levels of expertise and lifesaving experience. If you have a specific query you may contact an individual author directly or The Lifesaving Foundation at info@lifesavingfoundation.ie and I will forward your question to the appropriate author.

John Connolly
Leading Editor

EDITORIAL TEAM

John Connolly B.Ed., MA in Ed.	(Ireland)
Professor Joost Bierens MD, PhD.	(The Netherlands)
Professor Richard Franklin PhD	(Australia)
Professor Emeritus Stephen Langendorfer PhD	(The United States of America)
Dr Shayne Baker OAM, DProf	(Australia)

CONTENTS

FOREWORD

Drowning presents our global community with a constant challenge as over 300,000 people drown each year. Despite the enormous efforts of people to prevent drowning through signage, education, media campaigns, lifeguard protected waterways, the use of lifejackets the challenge is constant and begins with young children learning how to survive an immersion in water.

The high level of research from the health and medical practitioners provides data and information that can be used to develop and improve the strategies and the response to drowning.

One of the most common message and tools that we strive to encourage from the youngest child is to teach children to swim. The ability to move through the water away from danger or to assist someone in need is as important a life skill as learning to walk.

The question put forward with this book is quite a common response from the public when they hear or read of a drowning and the report includes a statement that suggest that the person was a strong swimmer. The obvious question arises then, why do swimmers drown?

Learning to swim is a fundamental life skill to learn and like any other physical activity once learnt most people can use their swimming ability to support themselves in the water. The degree to which a person can manage an unplanned immersion in the water can be impacted by several factors such as the person's level of swim fitness, whether they are clothed, if they are familiar with the environment and the conditions or if they have a floatation device.

The researchers and practitioners contributing to this book have identified some of the specific details and insights into the various environments, conditions into why swimmers drown and more importantly some ways to minimise the risk.

On behalf of the International Lifesaving Federation, I commend this book which makes a positive contribution to further understand drowning and helps towards global drowning prevention.

Mr Graham Ford AM

President

International Lifesaving Federation

FOREWORD

I come from a fishing family. My entire youth was spent in the sea. Experience is the greatest teacher, and sometimes these lessons can come with a heavy price. Achievement for me, is not founded in medals or wins, but in moments when we become exposed to our weaknesses and grow. I have had the privilege of being part of the most exciting, most extreme, dangerous, and risky swimming experiences in the world of open water swimming.

In 2006 a team of six swimmers, took on a relay swim around the island of Ireland, without wetsuits, sometimes 20 miles offshore, in waters up to 300m deep, in a rolling ocean. There were times when we felt physically unable to swim but pushed ourselves to exceed our previous limits. The greatest advice I received in 2006 was “Never risk a bad swim”. Since then, I have swum in the Bering Strait and in the Drake Passage at Cape Horn. In 2012 I began swimming in ice, at 0° Centigrade, and went on to pioneer distance ice swimming.

Every swim is the sum of its parts. The plan needs to include not only our own safety but also the safety of our support and rescue teams. Very cold-water swimming requires support teams to have the highest level of understanding of the challenges, of the risks to swimmers, and the management of outcomes in remote locations. The ethos driven into my psyche is “if we cannot get you out of the water, you cannot get in”.

For over twenty-five years I have hosted distance cold open water swims on the southwest coast of Ireland. I bring groups of swimmers into deep water, always focusing on pushing limits in a safe environment, and promoting an understanding of the need to properly plan each swim. I have spent the last fifteen years working with survival experts, learning, so that others can swim safely.

The contributors to this book offer so much good survival information. Don’t see it as just words on paper. The gold standard is that those who read it will see a value in how to create a better plan to mitigate risk. It is about imposing your swim, safely, into different scenarios. There are multiple risks attached to today’s world of open water swimming, many attached to pressures from social media and peers. It is vital that we prepare and train within our experience levels. Vigilance is the price of safety. When we enter an open water environment there are many variables we need to manage, cold being one of the greatest challenges.

Nuala Moore

World leading extreme and ice swimmer

Holder of two Extreme Swimming Guinness World Records

INTRODUCTION

John Connolly

The subject drowning is complicated and yet simple. In common language drowning is understood as death by inhaling water. The actual medical definition of drowning, agreed by the International Life Saving Federation and the World Health Organisation in 2003, is "the process of experiencing respiratory impairment from submersion or immersion in liquid", usually water. Drowning, therefore, is simply experiencing breathing difficulty in water or another liquid and, contrary to the common understanding, you can drown and live.

Apart from dying by drowning, you can drown and survive with no physical injury, with short-term physical injury, or with long-term physical or neurological injury. Psychological injury can also accompany any of these physical survival outcomes. As a swimming teacher I often came across pupils who said that they had survived a drowning event and now had a fear of water. Survivors need not carry the extra baggage of psychological injury. Drowning survival outcomes can be greatly improved with a little simple specific information and understanding. This book contains that survival information.

I say this with confidence because I have drowned three times and survived all events unharmed. That is, I have survived three drowning events without any physical or psychological injury during my thirty plus years as a working lifeguard. Being a swimmer got me into trouble, something common, and being a knowledgeable swimmer got me out of trouble. In all three situations I was pushing my skill boundaries when I inhaled water and realised that I was drowning. I survived because I understand the drowning process and know how to overcome the associated challenges. Most drowning deaths are avoidable if swimmers follow our advice. The book also contains water safety advice because most drownings are preventable. We tell you how not to get into trouble in the first place.

Research in developed countries has established that the majority of those who die by drowning can swim. This can surprise and confuse people. In interviews I say that swimmers die by drowning because they don't know how not to drown. When asked to elaborate I say that they probably try to solve the wrong problem first. They try to leave the water first when they really need to immediately sort out their buoyancy and breathing. Sometimes a little knowledge can save your life. Here is a piece of advice that you will find repeated throughout this book – if you experience breathing difficulty in water, float on your back and, when you can, try to slowly deepen your breathing. Any pain you experience will quickly pass. Stay floating until you are breathing regularly before thinking about swimming to an exit point.

This book explains why and how swimmers get into trouble in water and what they should do to survive a drowning event. Research suggests that in life-threatening situations our minds can trawl up survival information we were exposed to sometime beforehand. Perhaps something you read in this book will save your life in a drowning situation.

Editor John Connolly: Float and deepen your breathing

John Connolly Image

CHAPTER 1

DROWNING

INTRODUCTION

John Connolly

Drowning deaths are preventable or avoidable with forethought and proper training.

The sinking of RMS Titanic, with the loss of over 1500 lives, is a famous drowning event. Research has established that the sinking could have been prevented and even having struck the iceberg the high loss of life could have been avoided. Death is preventable or avoidable in most drowning situations.

The sinking could have been prevented at the design stage had all the internal walls, called bulkheads, been installed from the hull bottom to the main deck thereby making every compartment a watertight box. However, safety came second to luxury. The middle bulkheads stopped at lower deck five to make open upper deck space for large restaurants, walk-through lounges, and a ballroom. These compartments were not watertight. The iceberg ripped holes in a small number of these open-top compartments. Water flowed over the top of bulkheads, filling more and more compartments in turn, until the ship broke in two. Computer simulations show that had all its bulkheads been fully watertight RMS Titanic could have stayed afloat for days, possibly even reaching her New York destination.

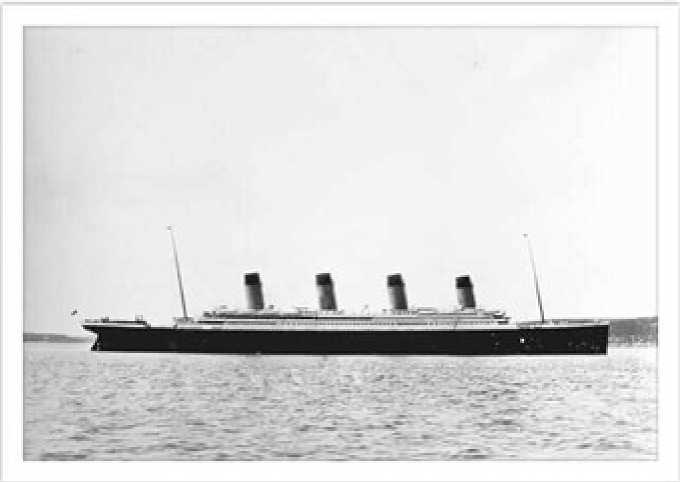
The deaths of so many could have been prevented by having sufficient lifeboats to carry everyone aboard instead of only enough for one-third of the ship's passengers and crew. The owners were certain that the ship was unsinkable. Overconfidence in themselves and an underestimation of the level of risk associated with certain water activities is a common cause of swimmers getting into trouble in water.

Despite its design failures and the shortage of lifeboats the number of deaths could still have been reduced. Most lifeboats were not full when launched even though officers knew that there were insufficient boats for all passengers and crew. More lives could have been saved had all available lifeboats been launched full to capacity.

Prior thought and training would have made a great difference to the number of lives saved. Because the ship was considered unsinkable no thought was given to what to do should it actually begin to sink. The survival time in a lifejacket in the freezing water was about 30 minutes and much less without one. The rescue ship *RMS Carpathia* arrived within two hours of the sinking. Most of those in the lifeboats lived and all of those in the ocean died.

"Control your Irish passions, Thomas. Your uncle here tells me you proposed 64 lifeboats and he had to pull your arm to get you down to 32. Now, I will remind you just as I reminded him these are my ships. And, according to our contract, I have final say on the design. I'll not have so many little boats, as you call them, cluttering up my decks and putting fear into my passengers."

J. Bruce Ismay, Director of the White Star Line to Thomas Andrews, Head Designer of RMS Titanic



Titanic at anchor in Cobh, Ireland

Fr. Browne Photo Collection

THE PATHOPHYSIOLOGY OF DROWNING

Jeroen Seesink & Joost Bierens

- ***Drowning is experiencing breathing difficulty in water or under water.***
- ***Only the terms fatal and non-fatal drowning are officially used.***
- ***The number of non-fatal drownings is many times greater than fatal drownings.***
- ***Drowning persons can only hold their breath for a short time.***
- ***Lack of oxygen causes the cardiac arrest in drowned persons.***
- ***Lack of oxygen may not cause cardiac arrest but can cause severe neurological damage.***
- ***Drowned persons should be assessed by a medical doctor.***

Definition of drowning

Drowning is defined as the process of experiencing respiratory impairment from submersion or immersion in liquid. In most cases the liquid is water. It simply means having trouble breathing. This can be the result of either a sudden or a gradual submersion (underwater) or immersion (with the face still above the water surface). In both cases we speak of drowning. It is not necessary to die to drown.

Fatal and non-fatal drowning

There are many terms that say something about drowning, such as near drowning and secondary drowning. To avoid confusion, only the terms fatal drowning and non-fatal drowning are officially used. As soon as someone accidentally or deliberately ends up in water or underwater, and there is breathing discomfort, it is a drowning incident. The absence or presence of irresistible coughing is considered important to differentiate between non drowning and drowning when there is breathing discomfort. If the drowning process is interrupted in time and the person saves him or herself, or is rescued, it will be classified as a non-fatal drowning. If the drowning person dies after a drowning incident, it is called a fatal drowning.

Prevention is preferable.

Prevention is better than cure so it is always preferable to avoid drowning. According to the World Health Organization (WHO), the recorded mortality (death) due to fatal drowning is estimated to be between 250,000 and 300,000 cases per year. The WHO's Global Report on Drowning states "the way deaths are classified means the full extent of the world's drowning problem is underrepresented – statistics currently exclude intentional drowning (for example, suicide and homicide), as well as drowning deaths resulting from flood disasters and water transport incidents."

Because most cases of drowning are not registered, the number of non-fatal drownings is many times higher than fatal drownings. Drowning is one of the leading causes of mortality among children (Figure 1.1).

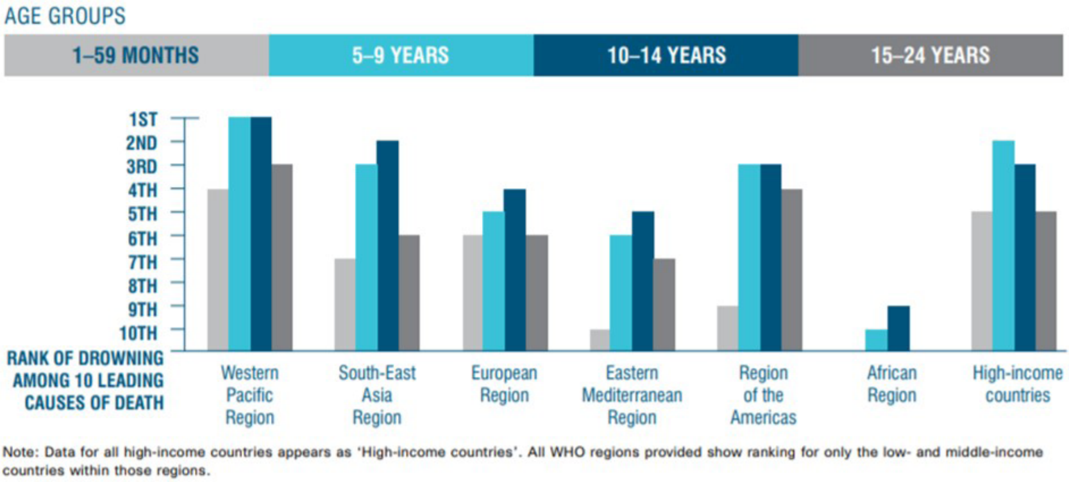


Figure 1.1.

WHO Global report on drowning: preventing a leading killer (2014). Rank of drowning among 10 leading causes of death.

Worldwide, children aged 1 to 4 years old are the age group in which most drownings occur, followed by children aged 4 to 9 years old. Many of these drowning incidents could have been prevented with measures, such as swimming lessons, supervision, life jackets, fencing along the waterfront, and raising awareness of the potential danger through local and national prevention campaigns. The effectiveness of preventive measures over the years was clearly demonstrated by drowning death trends in Victoria, Australia. (Figure 1.2).

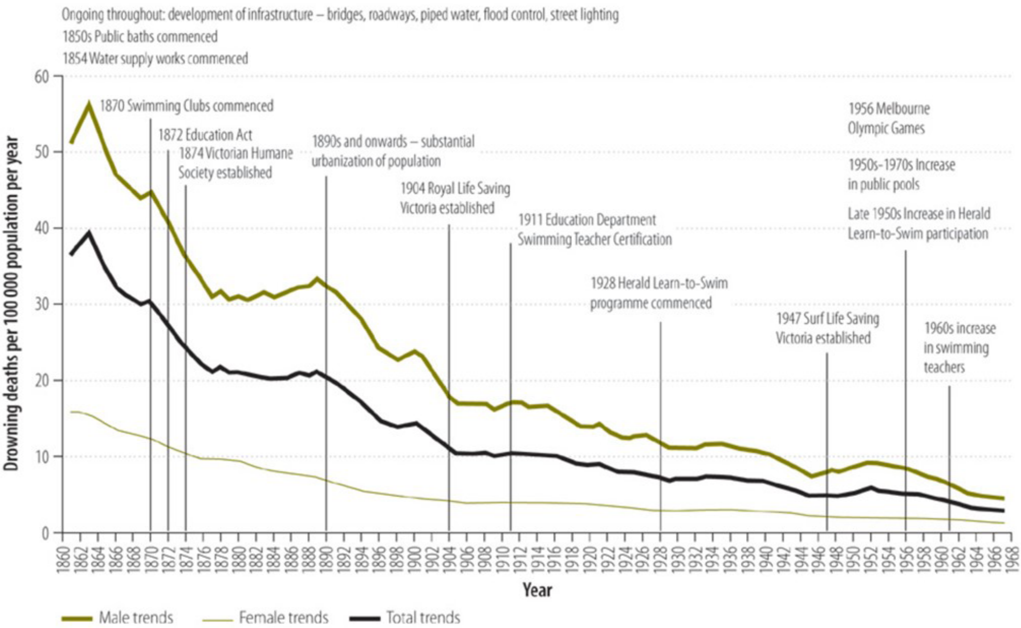


Figure 1.2.

WHO Historical factors in relation to drowning death trends, Victoria, Australia, 1869–1967.

It's all about oxygen

The different cells in the body together form the various tissues and each tissue has its own function. This allows us, for example, to move, ensures that the heart can pump blood, and makes us aware of the world around us. These processes use oxygen and are very efficient, producing water and carbon dioxide in addition to energy. After the oxygen has been used by the cells, carbon dioxide is produced, circulated into the lungs, and exhaled. Any excess water is excreted by the kidneys. Without oxygen, the body can release energy in other ways for a short period of time. This is very inefficient and results in the release of various harmful substances. Consequently, without oxygen, the human body cannot survive for long. In essence, every cause of death can be traced back to the failure of the body to provide oxygen to the various tissues and thus keep the body's cells alive. This can happen quickly, such as in cardiac arrest where suddenly there is no more oxygen circulating through the blood. Cancer, on the other hand, is much slower as the body is gradually depleted by a tumour with uninhibited cell division that demands more and more oxygen and energy, which eventually leads to exhaustion and oxygen deficiency in the other tissues.

Drowning by submersion

When someone suddenly falls into water, and ends up underwater, a variety of events occur in the body. Often the first reaction, presuming that someone is conscious, is an attempt to hold their breath. In very cold water there can be an immediate gasp reflex where the person uncontrollably inhales water. When it is not possible to return to the surface quickly, most people will panic. Although it can be very difficult to stop, panic is an unhelpful reflex that uses up extra oxygen and energy, and breathing is not possible underwater. Any remaining oxygen in the blood will be used up quickly and carbon dioxide will accumulate in the blood, resulting in an increasingly stronger respiratory stimulus to breathe. Usually within a minute the breathing stimulus will eventually become so strong that an uncontrollable gasp for breath will arise. That moment is called the "breath-hold breakpoint". The drowning person will ingest water, choke, and soon lose consciousness. Subsequently, the respiratory stimulus will disappear and cardiac arrest will occur due to the lack of oxygen. Thus, in the case of submersion, acute oxygen deficiency is the main challenge and first aid should focus on making oxygen available to the tissues of the drowning person's body as soon as possible. Treatment is further explained in chapter 12.

Drowning by immersion

If someone ends up in water, without the face being submerged, the airway will not be blocked by the water. Acute shortage of oxygen is not the primary problem for such a drowning victim. The body temperature will decrease due to various factors, such as the lower water temperature, the insulating characteristics of the clothes worn, and the anatomy (size and shape) of the body. Children and thin individuals cool down fastest. Initially, when temperature starts to drop, the body enters an action mode in which it actively tries to survive by increasing the heart rate, the respiration rate, and a higher blood pressure. The drowning person starts to shiver and thereby consumes a lot of energy, expending a lot of calories in an attempt to prevent a further temperature drop. If the immersion is not interrupted, and the person is not removed from the water, shivering and vital signs will fall short and the body will continue to cool down further. The heart rate, respiration rate, and blood pressure start to decrease further and further. The level of consciousness will drop and muscles will become stiffer and eventually cramp up. This reduced consciousness, exhaustion, and inability to swim and stay on top of the water will cause the immersed person to disappear underwater and die. How long this process takes depends on the circumstances. When someone falls into ice-cold water, this process will be much faster than in relatively warm water.

Human body reflexes in cases of drowning

Humans are land animals. In the event of a drowning incident, various reflexes can occur in the body. In someone who suddenly ends up in cold water, the water has a strong stimulating effect on the skin. This response causes a high heart rate and blood pressure, but also uncontrollable hyperventilation and gasping, which is called the cold shock. Taking an uncontrollable breath when the face is underwater will also lead to water inhalation which will not help the situation. An opposite response is the “diving response” that occurs in water of all temperatures. This reflex is mainly seen in children and marine mammals and much less in adults, although evidence is moderate. Due to the water on the skin, an energy and oxygen-saving reflex occurs, in which, among other things, a lowered heart rate and reduced respiratory stimulus ensures that the body can survive longer underwater with oxygen “on board” in lungs, blood and cells. It is the contradiction between the simultaneous occurrence of the above stimulating and calming reflexes that appears to be associated with the occurrence of arrhythmias. This may explain the fact that arrhythmias are relatively more common in swimmers.

Another reflex that can be protective during drowning is laryngeal spasm. The “laryngeal spasm” has not been extensively studied, but it is believed that the vocal cords contract when cold water is encountered by inhaling water as an initial immersion gasp or after the breath-hold breakpoint. Due to this reflex the water will not flow to the lungs but into the stomach. When a drowning person is rescued quickly, this can prevent damage to the lungs. However, the vocal cord spasm eventually relaxes due to lack of oxygen and, if there is a respiratory stimulus, water will still be inhaled into the lungs.

In some extreme situations, hypothermia can have a protective effect. Although hypothermia is almost always harmful and must be prevented, in exceptional cases it can actually be protective for the body. This only applies to a situation in which the body becomes deeply hypothermic quickly, especially before an oxygen deficiency occurs. An explanation is that hypothermia slows cell metabolism and therefore less oxygen and energy is consumed. For example, the oxygen demand of brain cells is about 5% less with every degree Celsius that the temperature of brain tissue decreases. If this occurs immediately after a drowning person submerges underwater, it will limit the damage caused due to oxygen deficiency because there will be less oxygen required.

Damage by water

Any water entering the lungs will cause damage, whether it is fresh water or salt water. The lungs are a fragile organ. Airways continue to branch and reduce in size to the level of the alveoli which are prone to damage. A person has about 300 million alveoli, which lie together like small bunches of grapes. Expanding all these alveoli would cover an area of about 50-100m^2, which equals about half the ground surface of a tennis court. The walls of these small alveoli are extremely thin, half a micrometer, corresponding to a 16 times narrower diameter than that of a red blood cell. The large surface area and thin walls of the alveoli allow a good gas exchange between blood and air within the alveoli. Inhaled oxygen is absorbed from air into the blood and replaced by carbon dioxide which is then exhaled. To prevent the walls of alveoli from sticking together and closing, they are covered in a kind of lubricating oil, called surfactant.

Without this lubricant, alveoli collapse and can only be blown open again with great force. Inflating a balloon takes a lot of effort in the beginning but becomes easier later after repeated inflations. Similarly, it is difficult to reinflate collapsed alveoli outside of hospital without specialist equipment. Once water enters the lungs, the fragile alveoli will be damaged and it becomes more difficult for the essential gas exchange of oxygen to take place. Water can also render the surfactant ineffective, which further complicates the gas exchange. The white or pink foam seen in the mouths of drowned persons is a mix of surfactant and water and a sign of damaged alveoli. After rescuing a drowned individual, the explained damage by the water can cause resuscitation problems. Drowned persons, who have evidently inhaled water in their lungs and who are short of breath, should always be assessed by medical doctors or advanced care providers. If the lungs are seriously affected, a rescued drowned person will need to be ventilated for a long time in an intensive care unit in a hospital. If the water entering the lungs was polluted by bacteria, pneumonia often occurs in the days after a rescue. Because a lot of water initially enters the stomach instead of the lungs, due to choking in combination with the vocal cord spasm, drowned people will often vomit. Care should be taken to prevent vomit entering the lungs as this is an additional cause of pneumonia.

Summary

In summary, drowning means experiencing respiratory impairment due to immersion or submersion in liquid. This can be done by sudden submersion in which an acute oxygen shortage occurs or by prolonged cooling with the head above water (immersion). Both mechanisms require a specific approach to rescue and first aid afterwards. This will be discussed further in Chapter 12.

CHAPTER 2
SWIMMING

INTRODUCTION

John Connolly

Learning to swim is not a vaccination against death by drowning.

When a boy I loved climbing and was good at it. I would accept climbing challenges from the boys in my community. Success boosted my ego and group status. One sunny day, at a local beach, I accepted a challenge to climb to the top of a 10-metre-high storm wall. The climb was easy. I sat on top of the wall looking down and around at what was happening on the beach. My attention was drawn to four young men trying to play soccer with a light beach ball. It was their using a totally unsuitable ball that attracted my attention to them. There was an offshore breeze and a gust of wind blew the light ball out into the ocean.

All four young men ran into the ocean after the ball. When they were at waist depth three of them stopped wading and one began swimming after the ball. I watched him and saw that the ball was being blown outwards faster than he could swim after it. I thought that he would soon realise this and turn back but he did not stop. A lifeguard began swimming after him. As the lifeguard closed on him I thought that the young man would now stop and turn back but he did not. Instead, the young man submerged. The lifeguard surface dived and somehow found the youth underwater. As he was towed back to the beach I noticed that the young man did not move. In shallow water his friends took him from the lifeguard and carried him onto the beach. Resuscitation was started by first aiders and a doctor summoned. After a short time, the young man's body was covered with a towel and a policeman stood guard until the body was removed.

Four young men had played soccer, one could swim and he was dead, three were non-swimmers who went home to tell of the tragedy. I realised that the young man had died because he could swim. Had he been a non-swimmer he too would have gone home with his friends and they would only have lost a beach ball and not a life. I also realised that the lifeguard had only been able to reach him because he was a powerful swimmer.

Being a swimmer can save your life, and possibly the lives of others, but it can also cost you your life or that of your child. Research suggests that parents exercise lower levels of supervision around water of children who can swim than of non-swimmer children, wrongly believing that as swimmers they are safe from drowning.

Being able to swim is not a vaccination against drowning nor is wearing a wetsuit. Non-swimmer children should wear a tight-fitting lifejacket while bathing recreationally.

Enjoy a beach safely

Clonea Strand, Co. Waterford, Ireland

Photo from John Connolly

WHAT IS SWIMMING?

Stephen J. Langendorfer

- ***The capability to swim is a learned behaviour.***
- ***There is no generally accepted definition of what it means to 'be able to swim'.***
- ***The ability to float is an essential survival skill.***
- ***The capacity to propel oneself through water in a chosen direction is crucial to survival.***
- ***Being able to control ones breathing in water is critical.***

A swimming history briefly described

Humans have been interacting with bodies of water since long before recorded history. Consuming fresh water is essential to sustain human life and historically it normally involved interacting with bodies of fresh water in the form of watering holes, ponds, lakes, or rivers. These same bodies of water provided other sustenance in the form of fish, crustaceans, waterfowl, and other aquatic creatures plus any terrestrial wildlife that was attracted to the water source. The ability to co-exist and survive around bodies of water obviously required some minimal capability to enter and exit from this fluid medium as well as probably to move through and under the water in some circumstances. Evidence exists documenting acts of swimming in cave drawings in France and on the walls of ancient tombs in Egypt and other locations in the Middle East (Image 2.1). Virtually every culture in the past two millennia has recorded the role water played in those cultures and how members of the culture interacted with water. Cultures that existed on islands or were adjacent to marine environments demonstrated extensive interaction with water including being in, on, or under the water in often amazing ways. The free divers of the Pacific and Southeast Asia developed the capability of reaching great depths by holding their breaths for extended periods of time. This activity in turn altered their anatomy and physiology in profound ways. The vast Pacific Ocean was settled by peoples who learned how to build boats and traverse long ocean distances and survive all manner of aquatic challenges. Thor Heyerdahl famously demonstrated with his craft, Kon Tiki, one example of how such long voyages could have occurred in antiquity. Of course, the ability to build boats eventually enabled humans to recognize and travel to all six of the habitable continents.

What does it mean to swim?

Everyone seems to know intuitively what swimming is, but no one seems to have been able to operationally define swimming satisfactorily. Adopting a widely accepted working definition of what it means "to swim" is extraordinarily critical to being able to understand and discuss drowning. The American Heritage Dictionary defined swim as "to propel oneself through water by bodily movements" and "to swim across a body of water." The Webster's New Twentieth Century Dictionary (2nd ed.) offered an incredible 16 different definitions of swim. Its primary definition was "to float; to be supported on water or other fluid; as any substance will swim whose specific gravity is less than that of the liquid in which it is immersed." Like the American Heritage definition, Webster's also said swim was "to move through water by means of the motions of the hands, feet, fins, etc." Interestingly, Webster also offered a qualitative element to one definition, "to glide along with a smooth motion, as with swimming." In addition, it proposed swim as the capacity "to pass over or across by swimming; to move on, in, or over a body of water" or "to cause to swim or float as in to swim an animal across a body of water." Using these definitions, we can identify two important capacities associated with swimming:

1. the capacity to float (also known as buoyancy) or to stay up in the water; and
2. a capacity to propel one's body through or across a body of water in some manner.

Three other implied capacities associated with any act of swimming are:

3. being able to voluntarily enter the water;
4. the ability to control one's breathing while in the water and performing a variety of tasks;
5. the capacity to exit the body of water at some point in time.

The failure to control one or more of these capacities while around or in the water may lead to a drowning episode. Over the past several decades, one's overall demonstrable capability related to swimming and other aquatic activities is sometimes referred to as water competence. Please refer to the section in Chapter 10 in which we discuss in detail the construct of water competence and its many elements as they apply specifically to drowning prevention. Contemporary agencies that offer aquatic or water safety programs to teach persons to swim interestingly tend to focus primarily on skills that emphasize the definitions described earlier that relate to "moving through the water," especially with the goal of being able to "glide along with a smooth motion." Instead of promoting the drowning prevention capacities associated with entering or exiting the water, controlling breathing, floating, or changing position in the water, agency swim lessons have led most laypersons to think of the mastery of formal strokes (e.g., front crawl, breaststroke) as the primary criterion that marks a person as "able to swim."

Swimming not to drown

It is certain that one critical means to reduce the likelihood of drowning is “to learn how to swim.” There is a growing body of evidence supporting this fact in modern society. Almost every country on earth in modern times has societies or organizations which provide formal lessons to help individuals, most notably but not exclusively children, to learn to swim. It is interesting to note that each aquatic agency around the globe has different curricula and unique methods for promoting the acquisition of swimming skills. No single learn-to-swim curriculum has been demonstrated to be the best or at least to be better than others. It is obvious that persons still can learn to swim regardless of the curriculum, progressions, and teaching methodology. It certainly is even possible to learn to swim with no formal instruction at all. In English-speaking countries, an unfortunate but near universal phrase often applied to the outcome of swim lessons is the “ability to swim.” I take issue with the term, “ability,” which is equivalent to an inborn or longstanding trait such as eye colour, reaction time, or balance. Obviously, the capacity to swim is an acquired or learned behaviour that is in fact constantly modified as a person’s characteristics such as body size or fitness level change or as aquatic tasks are altered or as the water environment differs. This contextual understanding that swimming is not a personal characteristic or possession, but rather should be thought of as a dynamical system of a person performing aquatic tasks in some type of water environment gives us insights into why acquiring the capacity to swim does not always prevent one from drowning. This phenomenon of how and why swimmers may drown is discussed in detail in the next article/section.

WHY SWIMMERS ARE VULNERABLE TO DYING BY DROWNING

Stephen J. Langendorfer

- ***Learning to swim does not automatically prevent either non-fatal or fatal drowning.***
- ***Drowning as well as swimming result from complex interaction of factors.***
- ***Pool swimmers may have trouble swimming in open water situations.***
- ***Swimmers often underestimate the danger associated with certain water environments.***
- ***Swimmers may overestimate their swimming skill and experience.***

Introduction

Death by drowning is an all-too-common, complicated, and yet mostly preventable event. Perhaps one of the most tragic and puzzling comments heard following a fatal drowning is that the victim was "a swimmer" or even "a strong swimmer." I wrote in the first section of this chapter that it is well known that skillfulness in swimming is one of the most common active injury prevention strategies. The data are clear: those who have learned to swim are less likely to die by drowning. Unfortunately, drowning does happen to those who have demonstrated a capability to swim, even with an above average or strong level of swimming skill. Internationally recognized researcher and a practitioner lifeguard, Dr Kevin Moran, interestingly claimed "I have never rescued a non-swimmer at the beach."

The primary aim of this section is to discuss the ironic situations concerning why and how persons, especially those labelled as "swimmers,' die by drowning. Understanding the relationship between drowning and swimming skill requires considering some underlying assumptions about how one acquires the capacity to swim. It has become an accepted assumption that swimming is a capacity that one possesses, either a capacity they have inherited or a skill they have acquired experientially.

Image 2.1.

British Museum Image of Assyrian men swimming

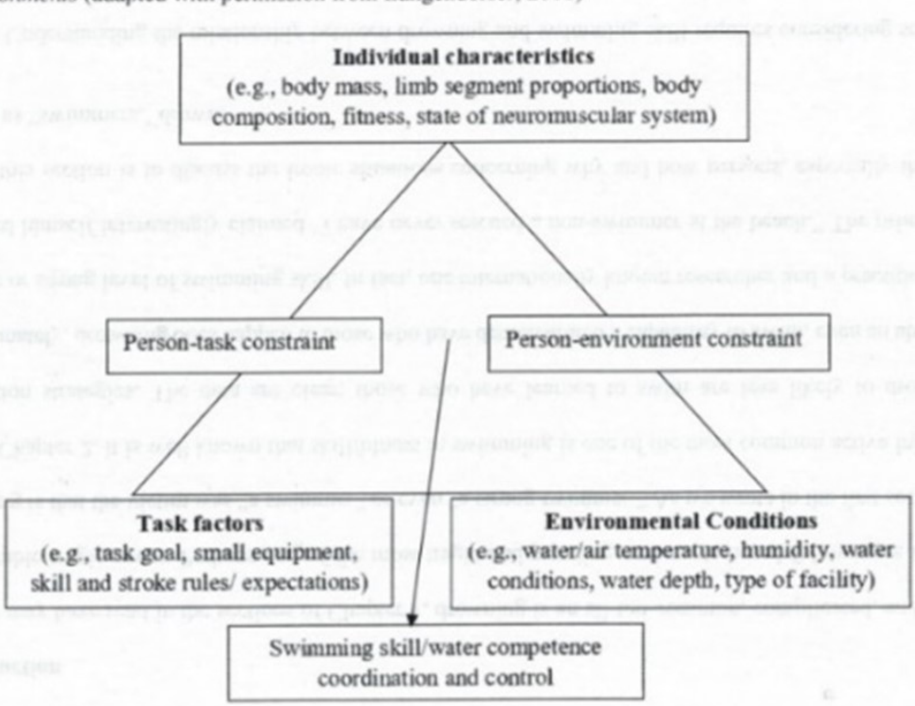
From this simplistic perspective, one’s capacity to swim follows one around like their eye colour, balance, or reaction time from one situation to another. The problem with that perspective is that as a possession one therefore should be able to swim anywhere at any time and swimmers should never die by drowning. Of course, that implicit assumption is false. One can only swim when they are in a fluid (usually water) and when they are conscious and capable of intending to swim.

Swimming as a dynamic system

A very different way to understand one’s swimming capability arises from accepting that swimming is the result of interactions among a person’s personal characteristics and the intention to perform aquatic tasks while one is in an aquatic environment (Figure 1).

Figure 1

Swimming as a dynamic system comprised of indvidual characteristics, task demands, and aquatic environments (adapted with permission from Langendorfer, 2011)



Any change in one or more of these elements portrayed in the triangle changes the relationships among the three elements and thereby changes one’s capacity to swim (or not to be able to swim). For example, if a person suffers an orthopaedic injury, their swimming capacity is altered and likely diminished. If a person is unconscious, they likewise cannot engage in any goal-oriented aquatic tasks.

This is the reason that the best lifejackets are designed to hold the face and head of an unconscious or incapacitated person out of the water and have a hood to reduce the inhalation of water. Many aquatic environments (e.g., large surf, rip currents, white water rapids, cascades or waterfalls, extremely cold water) preclude successfully swimming in them regardless of the personal characteristics of a swimmer.

In each of these situations, the interaction of one or more of the elements diminishes or prevents one from successfully swimming. In other words, interactions (called "constraints") among the three elements of the dynamic swimming system that allow one to swim can also create a non-swimming (a.k.a., drowning) situation.

Text Image 2.2

Safely learning to swim with Mum in open water. John Connolly image

Swim versus drown

As I have described earlier, the risk of drowning as well as the probability of being competent in different water environments can be viewed as a situational probability associated with how the three elements (i.e., individual characteristics, task demands, water environment) interact with each other (Figure 2.1). The "constraints model" illustrated in Figure 2.1 offers a simple graphic illustration of how one may demonstrate a capacity to swim (either as simple floating or as transporting oneself through the water) and at the same time how drownings may likewise occur. Simplistically we can describe "swimming" to occur when an individual's personal characteristics interact with certain aquatic task demands in conducive aquatic environments.

The process of learning to swim can be envisioned to occur when a person experiences specific person-task and person-environment constraints sufficiently to feel comfortable repeating them. It also can explain why a person who has learned to swim in a pool setting may have great difficulty in open water situations. A person who has experienced specific aquatic tasks (e.g., mainly swimming on the front) may not transfer the capacity to perform other aquatic skills (e.g., swimming on the back) successfully.

In similar situations, a person could find herself in a drowning situation despite being observed to be a swimmer or even a strong swimmer in other situations. Another documented reason for drowning in those who may be labelled as swimmers or strong swimmers is a result of the failure of the person to accurately perceive the risks associated with certain aquatic tasks and especially aquatic environments in relation to their individual characteristics or their person-task or person-environment constraints. The literature repeatedly has demonstrated that such a mismatch between a person's perception of the aquatic task and environment and his or her actual capabilities occurs most frequently among young males, ages 15-25 years. Such a case of over-estimating one's capabilities, while simultaneously under-estimating the hazards and risks of the tasks and environments, may be a leading cause of drowning. It is most likely also the reason why young children under the age of 5 years have such a high rate of drowning due to their less well-developed capacity to self-evaluate their skills as well as to recognize the existence of risks.

In the end, the relationship between learning to swim and the prevention of drowning is at best a paradoxical one. Certainly, research evidence exists to demonstrate that young children who have had swim lessons are less likely to drown than similar-aged children who have not had lessons. At the same time, it is apparent that the simple metric of being "able to swim" does not inoculate a person from drowning.

Part of this paradox lies in our failure heretofore to adequately define what is means to be able to swim as well as our inability to appreciate the dynamical relationships among a person's individual characteristics, their experience with a wide range of aquatic tasks, and the risks associated with different aquatic environments.

CHAPTER 3
HOW SWIMMERS GET INTO TROUBLE

INTRODUCTION

John Connolly

Experience of swimming in one type of water does not transfer fully to a different water type.

For several years I led a team of lifeguards working on an Atlantic surf beach. At the end of the third year, I undertook a deep analysis of all rescues performed. I was surprised to discover that while the great majority of those visiting the beach were local, the majority of those rescued lived in neighbouring inland counties. My deep analysis of reports and discussion with lifeguard team members established that many of those rescued were inland river swimmers who lacked a proper understanding of wave and tide dynamics.

My research exposed gaps in our own swimming experience. Whilst we trained in what we called rivers and had provided lifeguard cover for charity river swims all were in estuarial waters, where fresh river water meets salty ocean water, and were tidal. The water flow in inland sections of rivers is one directional, moving from source to ocean, but in the estuarial sections of rivers the direction of the water force changes as tides ebb and flood. Consequently, concerned that our lifeguards might undertake a river rescue when off-duty, we introduced inland river and lake training sessions. These proved to be popular in our lifeguard training programme. We learned that a strong swimmer, swimming with the river flow, can move faster towards a casualty than someone running along an uneven riverbank and that swimming diagonally facing into the river current moved a swimmer sideways towards the riverbank. We also learned that lake water can feel colder than ocean water; often has particulates suspended in it making it horrible to swallow; and that exiting still water through deep mud is very difficult and exhausting. It provided salt-water surf lifeguards with real experience of still and moving fresh water should they come across a drowning person away from a beach.

Inland people know that if there are storms in the mountains there will be an increase in water flow, water force, and river levels for a short time afterwards. They know to stay out of rivers following heavy rain. Some inland people appeared to have a false assumption about oceans that tidal waters flood and ebb at a uniform rate. There is often little movement during the last two hours of an ebbing tide and the first two hours of a flooding tide and a full half flow of all water occurring during the middle two tidal hours.

Inland swimmers can also lack experience with waves leading to an underestimation of the strength of waves with children having an inability to recover if tumbled around by a large wave resulting in a drowning event.

You can be an excellent river swimmer and a novice surf swimmer, or an experienced surf swimmer and a novice lake swimmer. Swimming expertise in one water type does not transfer automatically or fully to other water types.

Image 3.1

Read information notices

Image 3.2

Avoid difficult exit locations

THE TROUBLE WITH SWIMMERS

Shayne Baker

- ***Poor judgment can cause people to drown.***
- ***Over estimating ones swimming ability can be a fatal misjudgement.***
- ***Assess the conditions before entering the water.***
- ***Swimming should be a regular activity to maintain competency.***

The different aquatic environments described in the introduction can create a range of conditions that can challenge most swimmers and while swimming is widely recognised for the health benefits in building endurance, muscle strength and cardiovascular fitness different, environments present different strategies in the water. For example, a strong and regular swimmer will achieve a much lower resting heat rate (approximately 45 beats per minute or lower) than most people due to the cardiovascular fitness that they achieve. The application of the fundamental skills of swimming are certainly transferable, though there is a need for people to think before they act in and around natural waterways.

The recreational pursuits and interests of people getting into swimming is as varied as some of the styles and strokes that are displayed when we sit and watch the procession of swimmers enjoying their passion. The achievement and development of swimming ability and fitness does not protect us from one of the most dangerous factors – ourselves.

For many summers spent on the Gold Coast as a voluntary beach lifeguard I would often be approached by many visitors from overseas as well as regional or rural areas of Australia to ask me if it would be safe for them to swim across a tidal estuary, without any knowledge of the water movement at the time. Based on my experience and a high number of rescues of people with similar approaches my tendency is to focus the attention on the individual and what I would refer to as their ‘swim fitness competency’. Leading questions such as “how often do you swim?”, or “how many kilometres are week would you swim?” would at least prompt the person to think about the task and then we could discuss some options.

The purpose in this approach is that as an island nation many Australians do learn to swim, from a young age which means that once someone has mastered a swimming stroke or two at a young age that they are now considered a ‘good’ swimmer. However, when we learn to walk we tend to practice it every day as an important life skill and our competence grows with time, whereas with swimming if we are not regularly swimming we are not as strong in our capability to maintain our body position and move through the water.

Swimming fitness and competence does require regular time spent in the water and if we don't then we might be able to demonstrate the mechanical motion of swimming, but we will not be as effective as we could if we swam on a regular basis.

What is enough swimming?

The obvious question then is to understand what level of swimming we would need to do to be considered swim fit. It is a question that is difficult to answer as a person could regularly swim a specific distance in a pool, across a bay or a stretch of open water in a lake or dam at a decent pace. Is this enough? It would be better than not swimming regularly or even doing a hard swim workout occasionally and then not maintaining a regular program.

If we use a 50metre pool as the standard for improving stamina then we could consider some of the strategies below at least twice a week to improve swimming fitness and competence.

Table 3.1
Swimming Workout Strategies

Application	Impact	Benefit
Concentrate on swim technique	Reduces resistance, save energy and increase speed	It enables you to swim faster and more efficiently
Set realistic goals to achieve	Need to be achievable to help you get where you want to be.	The achievement of goals provides motivation.
Regular sessions are the key	Becomes a habit like other lifestyle activities.	It builds consistency and fitness.
Use a program to build capacity	Provide you with a day, time and tasks.	You will gain strength and fitness.
Use drills to enhance stroke	Focus on stroke improvement, not your preferred stroke.	It complements swim technique and fitness development
Track your time and distance	Achieve increased distance in reduced time.	Realise a high level of fitness and capacity
Use specialised equipment to increase strength	Increase your strength and power.	Focus on specific physical areas to improve.

The likelihood of the average member of the public engaging in the level of swimming activity highlighted is not high and serves to remind us of the effort that makes a strong swimmer. The logic is clearly indicating that entering the water should be undertaken with some degree of caution.

Then there is the added complexity for somebody experiencing new challenges from entering the water encountering strong currents, cold water or even swimming with clothes on due to an unplanned immersion.

At times when we learn of a drowning in an area that we know well we might ask ourselves why would somebody drown there or why would they enter the water there as it is a known risk? Some of the main influences that result in people drowning is that in some instances despite their own swimming competence when confronted with a new aquatic environment for the first time we may not cope or in some aquatic situations we might have trouble getting out of the water. Then there is the situation when some people enter the water under the influence of alcohol or through a sense of altruism towards rescuing family members, friends or even pets. A good fit swimmer might be great at achieving target lengths in a pool or bettering their own times over a set distance, but how do we manage when it is not the usual location or we need to respond to a friend or family member in difficulty in the water?

Text Image 3.3

Swimmers can take risks having false confidence in their ability to swim out of trouble.

Image from John Connolly

THE FIRST TIME PROBLEM IN COLD OPEN WATER

John Connolly

- ***Many swimmers only swim in warm water and are unprepared for a cold-water immersion.***
- ***Most people have difficulty dealing with more than two new experiences at one time.***
- ***Too many new experiences together can result in the self-destructive behaviour of panic.***
- ***Enter cold water slowly and feet first if possible.***
- ***Practice swimming in street clothing in a safe learning location.***

In developed countries most swimmers are taught to swim in warm swimming pools. Many people only swim recreationally in pools at home and in warm open water locations on holiday. The First Time Problem theory proposes that some swimmers who die by drowning are pool or warm water only swimmers who are overwhelmed by the number of new experiences they must deal with following an unexpected cold-water immersion. Research suggests that inexperienced open-water swimmers are prone to overestimating the distance they can swim because they are unaware of the impact of cold on muscle performance. If clothed they are further restricted by wet clothing so the distance they can actually swim in cold open water can be about a quarter of that regularly swum in a warm pool.

- **Talk:** *Reassure the person and tell them know where to go.*
- **Reach**: *If close enough use something to reach out to the person, this might be a stick or an oar.*
- **Throw:** *This could include throwing a rope that you can pull them back in or a flotation device they can use to stay afloat.*
- **Wade:** *This involves getting into the water but going no further than you can stand and throw a rope or a flotation device and talk to the person.*
- **Row:** *If available using a surfboard, boat, canoe, or other to go out and rescue a person.*
- **Swim:** *This involves swimming to the person. This increases your risk of drowning and you should be careful as the person may pull you under in panic if you get too close.*
- **Tow:** *This is a last resort and involves swimming and bringing the person back to shore.*

Open water drowning realities

Open water drowning realities Inexperienced open water swimmers are vulnerable to death by drowning at outdoor locations. There are many differences between swimming in a warm indoor pool and in a cold open water location. These include cold water entry shock, waves, clothing, currents, surf, and difficulty exiting the water. Psychological research has established that most individuals have difficulty dealing with more than two new variables to their normal routine at one time. The more variables there are the greater the danger of confusion which in drowning situations often means the difference between surviving or dying. If a swimmer has consumed alcohol beforehand it adds an extra layer of complication to a swimmer's confusion and survival chances.

A competent pool swimmer might comfortably deal with many of the above differences were they to occur singly, gradually, and sequentially. It is the immediate need to deal with many of them together, while struggling to remain buoyant and breathe, that overwhelms them. This situation can lead to panic.

Panic

Panic has been described as a self-destructive behaviour without good judgement or reasoning. In a panic a swimmer may focus on one survival strategy which may or may not succeed. It could be to swim as fast as possible to the nearest perceived exit point without any consideration of distance. An important physical change to human vision occurs in life threatening situations caused by the release of survival hormones. Objects that are very close or very far are blurred and the width of vision narrows into what is called tunnel vision. Disorientation can also be caused by an imbalance of fluid in the inner ear following a sudden change from land to water temperature. Military practice has established that with specific training and experiences a tendency to panic can be greatly reduced. It is possible to safely provide practice and training in open water emergency experiences and skills. Learning to float in cold water is a valuable experience.

Cold

It is generally known that entering cold water can be uncomfortable, even painful. Many swimmers avoid it thereby denying themselves the prior experience needed to successfully handle an unexpected cold-water entry. When humans eat ice cream quickly it results in sharp pain in the head and centre of the chest. They wait for it to pass without thinking that they are having a heart attack. They don't panic and next time remember to eat ice cream slowly. Entering cold water slowly is recommended either sitting down and dangling legs into the water or walking slowly out into shallow water and sitting down before swimming into deep water.

A slow entry allows time for the cold shock response to pass with the swimmer's face and chest out of the water, something denied in an unexpected fall into deep water. A fast entry into cold water produces a gasp reflex where a swimmer inhales water. Pinching the nose and covering the mouth with a hand prevents this inhalation of cold water and a consequent choking sensation.

Clothing

Swimming in clothing is often discouraged or forbidden in swimming pools for hygiene reasons. A swimmer may never have swum in street clothing and footwear before falling into open water. Wet clothing restricts arm and leg movements which can result in a mistaken decision to undress. Clothing has air trapped inside it which provides buoyancy initially and some protection from the cold. Sports footwear is usually buoyant helping to keep legs on top of the water. Swimmers need to modify their swimming strokes when wearing clothing (Image 3.4). They can safely practice swimming in clothing in pools thereby removing an important new experience from drowning situations. Sometimes, in open water, it is easier and possibly better to swim backstroke keeping the arms underwater.

Image 3.4

Swimming in clothing.

John Connolly Image

Eyes and hair

Most pool swimming is done wearing eye goggles and swim hats which are missing in drowning situations. Swimming without goggles can be difficult, especially in wind spray situations. Experiments in pools show that swimmers stop frequently to wipe their eyes, dropping their legs and treading water to do so (Image 3.5). Treading water demands effort and oxygen when both need to be reduced. Swimming backstroke helps avoid this situation. Wet hair can be blown into the eyes, again reduced when swimming backstroke.

Image 3.5

Eyes closed and raised body position when swimming without goggles in a pool.

John Connolly image

Night time

Image 3.6

River at night.

John Connolly image

Many accidental drownings occur at night or in low light situations. The initial disorientation is increased at night when there can be an absence of normal daytime reference points (Image 3.6). This is compounded if the swimmer has been drinking alcohol. Swimming in darkened swimming pools is usually forbidden but blindfold swimming exercises can help swimmers learn how to cope with disorientation caused by a loss of vision.

Summary

Swimmers need to understand what happens to the human body in a cold-water immersion situation and that their immediate survival needs are to remain buoyant on top of the water and to slow down and deepen the fast shallow drowning breathing. Floating on the back in the beginning, looking for and holding on to some buoyant object, not removing clothing, and if deciding to swim to safety to strongly consider doing so using a hands-in-the-water backstroke are recommended.

THE EXITING OPEN WATER PROBLEM

John Connolly

- ***Some swimmers are unable to climb out or leave the water at the end of a swim.***
- ***It is a mistake to swim while experiencing breathing problems.***
- ***Cold water immersion can result in a loss of grip strength in a swimmer's hands.***
- ***On a lifeguarded beach floating and waiting to be rescued is an effective survival strategy.***
- ***A longer swim to a shallow exit point can be better than a shorter swim to a high exit point.***

Drowning research points to many deaths occurring close to land and perceived safety. It also strongly suggests that the majority of those who die by drowning in developed countries have some swimming ability. Together this research raises the question "Why could they not save themselves by swimming the short distance to safety and leave the water?" Some eyewitness accounts state that the drowning person could not exit the water and succumbed to fatigue or injury. Let me make it clear that any person who can remove themselves from the water immediately, that is within seconds, should do so. This paper considers situations when leaving the water immediately is not possible.

In drowning situations swimmers need to focus first on their immediate survival needs. These are to stay on top of the water and to consciously slow down and deepen the fast shallow breathing associated with drowning. If these cannot be achieved there will most likely be a strong impulse felt to swim as fast as possible to the nearest exit place. Doubling a swimming speed involves a fourfold expenditure of oxygen at the very time when the person's lungs are unable to supply it. This can quickly result in sudden total swim failure where a swimmer's muscles cramp due to a lack of oxygen. If not wearing a buoyancy jacket or holding onto a buoyant object a swimmer in this condition will submerge.

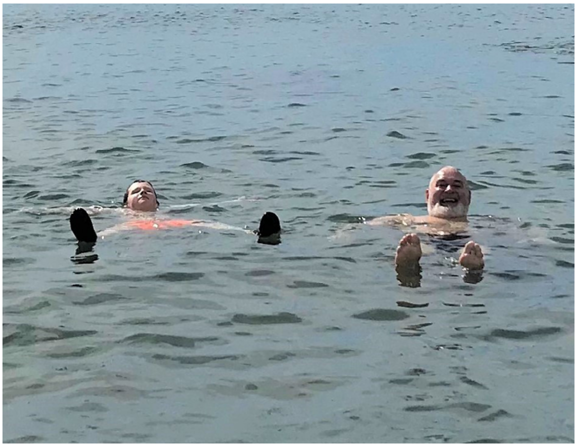


Image 3.7

Float and deepen breathing

John Connolly Image

Loss of grip

Immersion in cold water quickly results in a loss of feeling and control of fingers followed by a loss of grip strength. A swimmer loses the ability to grab hold of things, such as buoyancy aids or ladders, or having managed to hold onto something buoyant they lose it if pulled away by waves or some other water force. The longer they are immersed the weaker their physical condition becomes, even if not injured, leading to a reduced ability to pull oneself up out of the water unaided. This condition of physical fragility continues to be a problem in the treatment of rescued persons. In making themselves buoyant, waiting to adjust to the cold, and slowing down their breathing swimmers give themselves time to think about getting out of the water. Swimming the longer distance to an exit place with a low gradient and where help is likely to be available, such as a sandy beach, may be a better survival option than swimming a shorter distance to a lonely high exit place.

Rivers

Rivers consist of freshwater and flow downhill which is how they obtain their energy. River water is less buoyant than salty water. A river flow is usually strongest in the middle. A person falling into a river from the riverbank can be swept quickly out into the main centre current. On surfacing they should try to immediately grab hold of some close fixed object to stay at the riverbank. Potential rescuers will have little time to act before the faller is pulled too far out to catch a thrown rescue aid. An out and back sculling arm action, on the back, with slow leg kicks may be required to stay buoyant in freshwater whereas floating alone may do so in salty water. The swimmer should look around for a floating object they can use to keep themselves buoyant. Remembering the previously mentioned loss of grip strength they should try to attach themselves to the buoyant object in a way that does not require them gripping it strongly. I refer you to chapter 5 (Rivers).

Mature rivers can meander from side to side with faster deeper water at outside bends and slower shallower water at inside bends. Outside bends may have undercut riverbanks which will collapse if climbed up on. When the surface flow of water hits the outside bank it corkscrews, submerging and bringing anything floating down with it to the riverbed, before surfacing again. In slow moving water swimming back to the bank may be relatively easy whereas in fast water it may be necessary to swim at an angle into the current. This seems counter intuitive but swimming sideways into the current can result in the strong flow moving the swimmer towards the riverbank. Swim slowly or scull through weeds to avoid becoming untangled in them.

Rivers flowing through urban areas tend to have high man-made sides (Image 3.8). Sometimes the location of steps and ladders are highlighted by painting the background a bright colour or by having the area specially lit. Boat slips are often lit up at night. In fast flowing water swimming or floating near a bridge carries a danger of being trapped against a support pillar and swimmers should scull feet first giving themselves the option of pushing away with their feet.

Image 3.8

Steep manmade sides with difficult to see ladder, invisible at night

John Connolly Image

Beaches

Common causes of drowning on beaches are rip currents, wave action, and offshore winds blowing inflatables out to sea (Image 3.9). A distinction needs to be made between lifeguarded and unguarded beaches.

Image 3.9

Arrow points to rip current

John Connolly Image

On a lifeguarded beach all a swimmer usually needs do to stay alive is to accomplish the immediate survival needs of staying buoyant and slowing down breathing, with the addition of waving one hand for help. The lifeguards will come and rescue swimmers in distress. Staying buoyant in a rip current is often accomplished by floating on the back. The current does not pull swimmers under but rather it brings them out into deep water. In big surf staying on top of the water can be achieved by tucking up the knees and holding breath if possible – turning into a ball which may be rolled around but will return to the surface where a hand can be waved when a new fast breath is taken. Persons in an inflatable being blown outwards should stay in it and wave for help. If the inflatable overturns swimmers should hold on to it if possible and await rescue by the lifeguards.

On a beach without lifeguards staying buoyant, slowing down breathing, and waving for help all apply but if rescuers come they may not have rescue training and certainly will not have the rescue equipment provided to lifeguards. Turning oneself into a ball may result in the waves pushing the swimmer into shallow water. Holding breath, deliberately sinking down to the bottom, and pushing off upwards towards the beach (bobbing) also works. If a rip current brings a swimmer out close to the wave break (where waves start to form surf) swimming further out to calmer waters beyond the surf may be an option where it is possible to float and rest. On a small beach swimming sideways to the edge may make it possible to exit the water onto rocks.

ALCOHOL AND DROWNING

Hannah Calverley

- ***Alcohol is a contributory factor in many drownings.***
- ***Alcohol consumption reduces reaction time, decision making, co-ordination and vision.***
- ***Do not enter water after drinking alcohol.***
- ***Alcohol consumption can cause poor judgement and risk assessment.***
- ***Alcohol consumption can result in overconfidence in a person's swimming ability.***

Alcohol as a risk factor for drowning

Alcohol contributes to many drownings all over the world. This is particularly the case with adolescents and young adults. When drowning deaths are investigated, the individuals' recent consumption of alcohol is often identified as having contributed towards their death. It is estimated that alcohol is a factor in 10% - 30% of all drowning deaths globally but this is considered an underestimation as the reporting and recording of drowning deaths varies worldwide.

Entering water

Drinking alcohol and ENTERING WATER (for example to swim) is dangerous regardless of the setting, be that a swimming pool, river, lake, or an ocean. Alongside the changeable conditions of the water, you will also have to cope with the effects of alcohol on how you think and move. Alcohol can influence and enhance the risk of other factors associated with drowning, such as poor swimming ability, time spent in cold water, and ability to exit the water. This increases your risk of drowning.

In water

Examples of how alcohol can affect you in water include, but are not limited to:

- A slowing of your reaction time and decision making can affect how long you stay in the water and how quickly you react to changing and dangerous situations.
- Reduced coordination and vision can affect your swimming ability and cause confusion as to where and how to exit the water.
- Over confidence and an incorrect perception of various abilities can lead you to feel more competent in the water and take more risks, such as swimming out further and jumping into water from a height.

On water

It is also dangerous to consume alcohol while ON WATER, for example while driving a boat, a jet ski, or as a passenger. When operating watercraft, there can be rules and regulations about alcohol use, just like driving a car, so it is important to be familiar with these. Passengers are the driver's responsibility and, therefore, it is vital that drivers stay alert and in control. While a passenger on watercraft, it is important to resist drinking alcohol and to stay alert. An activity could include entering the water intentionally (for example by jumping) or accidentally (for example by falling). In either case, alcohol will increase the risk of drowning.

Around water

Another important point to note is that while alcohol is dangerous to consume when participating in activities IN or ON water (such as swimming and boating), there are also dangers associated with consuming alcohol AROUND water (Image 3.10).

Information from drownings in some countries, such as the United Kingdom, show that alcohol is a factor in drowning deaths involving people who never intended to be in the water, but who unintentionally entered the water anyway.

Image 3.10

RLSS UK Image

An example of this is an individual walking alone next to a river after a night out, losing their balance, and falling into the water. Another is a group of people standing on rocks drinking and fishing, and who get swept into the ocean by a wave.

In such cases, the effects of alcohol (for example reduced muscle control, over confidence in abilities, reduced perceptions of the environment) significantly increases the danger and contributes to those people drowning. It is necessary to understand such risks, and to take appropriate action to avoid becoming another person whose alcohol consumption contributed to their drowning death.

Some young people have indicated that they feel it is safe to transfer their understanding of drink driving laws and safety strategies to settings where they are drinking in, on, and around water. They feel that having a 'designated driver/supervisor' makes consuming alcohol in an aquatic setting safe, and they only consume enough alcohol to keep them at or below the legal drink driving limit.

Despite the apparent appropriateness of these precautions, there are dangers associated with transferring techniques for 'safe' alcohol use in one context to one involving water, due to variations in the environments.

First, the use of a 'designated driver/supervisor' in an aquatic setting does not stop alcohol consumers from taking part in the risky activity, thereby making them susceptible to the effects of alcohol in water outlined previously.

This strategy is also dependent on the 'designated driver/supervisor' being competent in supervising, swimming, and rescues, and consequently places everyone involved at risk of drowning.

Transferring this 'designated driver/supervisor' strategy from drink driving scenarios to drinking and swimming scenarios should be avoided. Second, there is currently no consensus on the amount of alcohol that impacts aquatic abilities. Alcohol affects people differently and this varies in different circumstances. Research showed individuals with an alcohol level below the drink driving limit in many countries i.e., 0.05% blood alcohol concentration (0.05g of alcohol in every 100ml of blood) had a noticeable reduction in their diving abilities and perceptions, which in turn would put them at an increased risk of drowning. Therefore, applying and transferring drink driving laws and practices to aquatic settings is extremely risky.

Summary

It is important to recognise the dangers associated with drinking alcohol in, on, or around water and to make informed decisions about your actions. Advice from the Royal Life Saving Society UK (and other organisations) is to avoid consuming alcohol if you plan to participate in aquatic activities and once you have had a drink you should stay away from water (Image 3.11). Plan a route home from a night out that does not involve walking near water (for example a river) and look out for friends and family making sure they are also aware of the dangers of combining alcohol and aquatic activities.

Image 3.11

Royal Life Saving Western Australia Image

Finally, it is vital to never consume alcohol when supervising people who are in, on or around water, such as children, aiming to always remain alert and aware of their actions. Following these recommendations can reduce the numbers of drownings caused by alcohol. Don't drink and drown.

ALTRUISM

Richard Franklin & John Pearn

As the water gently laps the shore there is a scream for help. I turn and see my son in trouble. Without thinking I run down the beach and into the water, racing towards my son, I need to get to him, rescue him, keep him safe. There is nothing else except me, the water, and my son. My arms thrash the water as my legs kick like a World Cup Football player. I don't notice the rip that pushes me further away from my son. I push harder because he needs my help. It has been years, probably a decade since I have swum this hard. I was a good swimmer at school, winning a few ribbons and knew that back then I could swim a couple of kilometres no bother and still have enough in me for a return trip. But it was not my 17-year-old body that I was using to rescue my son. Now in my 30's there was a little fat on the belly, but hey I was still fit, running a couple of times a week maybe not as fast as I used to nor as often, work you know. Getting closer now I can see him still yelling. As I near I see a person with a board scoop him up. Relieved I take a breath and slip below the water. I am so tired; my arms are so heavy. I sink and the silence is eerie. Goodbye my son, good luck.

While this story is made up it represents the common altruist scenario of a loved one, often a father, who jumps to the rescue and does not survive (Image 3.12).

TRAGEDY AT HOLIDAY SPOT

HERO DAD DROWNS SAVING SON AND PALS

A BRAVE dad drowned yesterday after jumping into the sea to save a group of teenage boys.

TURN TO PAGE 5

He's washed out to sea after jumping in to help teens

Image 3.12

Newspaper headline

A little prior thought and some preparation and this could have been prevented from happening. What goes into a successful rescue? Luck, training, preparation skill, availability of life saving devices, a few moments contemplating what to do. All these things.

Altruism is a funny thing; we laud it by giving people medals and conducting ceremonies for putting their life on the line for others. Under the banner of altruism there are three categories: duty, where a person has a feeling of obligation; supererogation, where a person goes beyond duty (this would be the case for someone who is duty bound such as a lifeguard however does more than what is required); and the third, altruism, involves an action that embodies a personal risk. It is this last category that is of particular importance to the altruism of rescues.

There are four basic elements that make up altruism, a concept of duty or obligation to another, a person in need of help, the concept of a successful outcome, and finally, the courage to act. Most altruistic acts are performed as a Good Samaritan, a person who acts out of kindness and not for reward. Often there is a link between the person undertaking the rescue and the person needing to be rescued, usually a relative or friend. However, in a small number of incidences bystanders act altruistically that another might be saved.

In the context of bystander's refsponse to drowning, we have identified an aquatic-victim-instead-of rescuer (AVIR) syndrome where the Good Samaritan Bystander attempts a rescue and does not survive, whereas the person needing rescuing does survive. This heart-breaking scenario can be prevented if people are prepared. This preparation includes: 'downtime' prior training in rescue and resuscitation skills, rescue knowledge, adequate fitness for the situation, and a moment of time to assess the situation, weighing up the options and choosing a path that leads to all being saved. We advocate scenario training as a component of all first aid and rescue courses. This would include checking the surrounding area for something that floats and getting this to the person in trouble.

The drowning chain of survival (Image 3.13) has also been proposed as a way of helping people understand what to do in an emergency and specifically the four 'Rs' of 'recognise, respond, rescue, and revive'. These mnemonics are valuable in helping people remember what to do in an emergency.

Image 3.13

The Drowning Chain of Survival

It should also be noted that altruism and rescue does not relate only to humans. The newspaper and professional literature is replete with stories of pet owners coming to the rescue of their animal and attempting to save them from drowning. Unfortunately, many such reports also contain incidents where the owner has died in the rescue attempt.

BYSTANDER RESCUE

Jonathon Webber

- ***Sometimes a drowning person survives, and a would-be rescuer dies.***
- ***Rescuers should only enter the water with some form of flotation.***
- ***The 4Rs of aquatic rescue are: Recognise, Respond, Rescue, Revive.***
- ***The recommended rescue sequence is: Talk-Reach-Throw-Wade-Row-Tow.***
- ***Emotional support should be offered to the rescuer and drowning person.***

Since time immemorial, humans, who do not possess innate swimming ability, have been getting into difficulty in the water. In these situations, a redeeming feature of humanity that endures today is the altruistic desire of those who can swim to help another person in distress. Sadly, the person in trouble survives the event in some cases, and the would-be rescuer dies. This phenomenon has been described as *Aquatic Victim-Instead-of-Rescuer Syndrome*.

In some countries, bystanders and even emergency services personnel are directed not to enter the water to rescue someone drowning but to wait for specialist help to arrive. It is unlikely that a parent will stand at the water's edge and watch their child drown. We need to instruct people on what they should do, not what they shouldn't do if they see someone drowning. In doing so, we can maximise the drowning person's chance of survival and minimise the risk of attempting rescue to bystanders. Therefore, it is the purpose of this section to look at why swimmers sometimes drown while attempting rescue and provide guidance on what they can do to make this activity safer.

Surviving a drowning incident can have more to do with an individual's ability to float than it does their ability to swim. Otherwise, why would swimmers drown? While getting the person out of the water is the strategic goal, providing flotation to interrupt the drowning process is the immediate priority or tactical goal. This concept of interrupting the drowning process and "buying time", rather than focusing on getting the person out of the water is something that even professional rescuers have, in some cases, yet to fully comprehend. It is even more relevant for lay-rescuers, though, who may not have the physical capacity, skills, or equipment to safely get the drowning person back to shore.

Image 3.14 (a)

Image 3.14 (b)

The Drowning Chain of Survival refers to a series of steps that when enacted,attempts to reduce mortality associated with drowning and aquatic rescue.

Hence, the Drowning Chain of Survival's central and arguably most important link after prevention, in line with this, is "Provide flotation - To prevent submersion" (Images 3.14 a & b). Unless unconscious, removing the drowning person from the water becomes a secondary issue.

Providing flotation buys valuable time to plan the rescue effort. It is of equal importance to the drowning person's chance of survival as it is to the rescuers. This leads us to the main reason why altruistic rescuers sometimes drown; **f**ailure to enter the water with some form of flotation. Although entering the water is the most dangerous form of bystander rescue, and other methods such as shouting to encourage the person to make their own way to safety, throwing a rope or flotation device, reaching with a pole or branch from land or shallow water, or rescuing from a craft or boat are the safest, the inevitable consequence if these approaches fail, is to enter the water. As taught by various water safety agencies, a useful reminder of these steps is *Talk-Reach-Throw-Wade-Row-Tow* (Image 3.15).

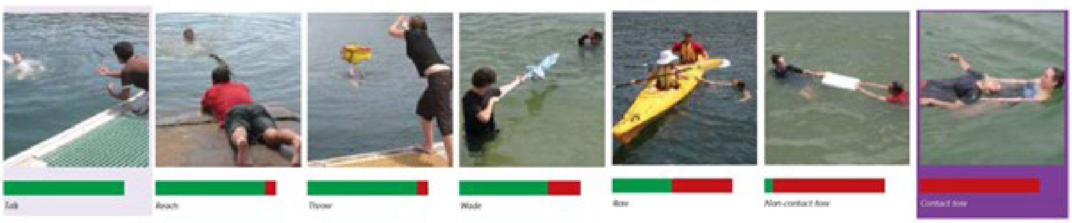


Image 3.15

Talk-Reach-Throw-Wade-Row-Tow is a series of steps for effecting a bystander rescue. The risk to the rescuer is shown in red and gets progressively higher with each step.

Image credit: Royal Life Saving Society Australia.

The 4Rs of Aquatic Rescue is a reaction mnemonic designed as a cognitive aid for lay-rescuers to refer to during an emergency and community education programmes (Image 3.16).

Exhaustion, inability to cope when in difficulty, injury, and overestimation of ability and underestimation of risk, are all reasons that swimmers attempting rescue have drowned.

Most of these hazards can be overcome by performing a dynamic risk assessment throughout the rescue process, and most importantly, taking some form of flotation. The 4Rs takes a holistic view by providing advice at each stage of the rescue process, with inbuilt safety reassessments at multiple points.

Image 3.16

The 4Rs of Aquatic Rescue outlines the steps to be taken by the public if they see a person in trouble in the water.

Image credit: Drowning Prevention Auckland, New Zealand.

The steps of the 4Rs are:

Recognise

- Notice someone in trouble.
- Check for danger.
- Act quickly.

Respond

- Provide flotation.
- Send for help (call your local emergency number).
- Reassess safety of people and the scene.

Rescue

- Think safe.
- Rescue from land or craft is safest.
- Rescue in water; non-contact is safest.
- Take flotation if entering the water.

Revive

- Provide care.
- If the person is not breathing normally, start CPR.
- If breathing, put the person in the recovery position.
- Stay with the person until help arrives

While commercially available buoyancy aids such as rescue tubes, rescue cans, auto-inflating devices, and life-rings are ideal, this equipment will not always be available. To ensure the rescuer does not enter the water without some form of flotation, improvised devices should be used. Examples include empty soft drink bottles, surfboards, bodyboards, soccer or rugby balls, and cooler-box lids, in addition to wearing a lifejacket and using swim fins. The rationale for this is clear; if the would-be rescuer gets into difficulty, they have something to keep them afloat.

Rescuers should never swim make direct physical contact with a drowning person. When close to the drowning person, but not too close to be grabbed, they should assess their own situation (e.g., are they exhausted already) and the drowning person's. Any person drowning can grab hold of a rescuer. In these situations, the flotation device can be used as a physical barrier to prevent a drowning person from attempting to use the rescuer as a source of buoyancy. In some cases, it can also keep both people afloat while waiting for help to arrive. Rescuers may have to decide to keep a buoyancy aid for themselves and abandon the rescue attempt to preserve their own life. There is no shame in doing this.

Other bystanders also have a pivotal role to play. As drowning incidents often occur in moving bodies of water, the point at which the drowning person entered the water may not be where they and the rescuer are now. At least one bystander should be tasked with monitoring the positions of the drowning person and rescuer. Additional bystanders should direct emergency services to the scene, provide regular updates to the agency coordinating the rescue, and locate first aid/resuscitation equipment if available. If no other bystanders are available, a lone rescuer must call for help first (activate the emergency services) and then stop and reassess whether it is safe to proceed with a rescue attempt that involves entering the water.

Finally, following a bystander rescue, emotional support must be offered to all those involved, especially in the case of a fatality, a person not found, or an unsuccessful resuscitation. The psychological impact on lay and professional rescuers can be profound. Engaging with local authorities and water safety agencies may also be appropriate if the location has been the scene of other drowning incidents. Subject to an aquatic risk audit, the site may be considered suitable for installing barriers, signage, public rescue equipment, remote monitoring, or a combination thereof.

In conclusion, we must ensure that the spirit of human altruism in aquatic emergencies is not extinguished. If it is, many more lives will be lost to drowning. We applaud those who have bravely risked their lives attempting to rescue known and unknown individuals.

CHAPTER 4
BEACH HAZARDS

INTRODUCTION

John Connolly

I am responsible for my own safety

I was a working lifeguard for over 30 years. I was a professional pool lifeguard and a volunteer surf beach lifeguard. I have rescued over 100 persons from drowning. A question sometimes discussed by lifeguards is why so many people fail to thank lifeguards for saving their lives? We surmised that many were embarrassed at having to be rescued and just wanted to escape from the rescue location as fast as possible. I've seen rescued swimmers grab up their belongings, throw them into a car, and drive away in wet swimwear. One other thing we found to be common was a failure by those rescued to take personal responsibility for their getting into trouble. They would blame the waves, the wind, the tide, the rip current, other bathers, and even the lifeguards, for not protecting them from themselves. It is a survival fact that I am responsible for my own safety and for the lives of those in my care and you are responsible for your own safety.

'Go to a lifeguarded bathing location' is a great piece of advice but it is important for all to understand that there is no such place as a truly safe beach. Safety is a relative concept depending on a person's age, swimming ability, beach experience, health, level of alcohol in the body, and other factors such as the state of the tide and wind. Lifeguards working a beach make it safer than a non-lifeguarded beach but I repeat, not safe. Parents can sometimes, possibly often, rely wholly on lifeguards to protect them and their children. On a lifeguarded beach safety is a shared responsibility – between parents and lifeguards – with parents having prime responsibility.

Lifeguards are not babysitters. Lifeguards are human and therefore there are good ones and bad ones, careful ones and careless ones, well-trained ones, and poorly trained ones. Parents should assess the work of the lifeguards on their beach. You may think that you are not qualified to do this but you can easily determine if a lifeguard is watching bathers or lazing about. If a location is new to you, look for bathing notices and read them. Take the time to check out what situations you can expect to find on a beach. Tides and weather can be checked before leaving home. If you don't understand the impacts of weather and tides on beaches you can do an internet search and will find many good explanatory documents and videos.

BEACHES

Shayne Baker

The benefits of swimming are well documented, and we know that there are many swimming lessons, swimming clubs, and competitions that occur throughout the world. Transferring the purest form of swimming skills from the relative safety of the calm, clear waters of the local swimming centre to the beach environment does require a swimmer to develop their knowledge and skills about the beach and the hazards that may impact on enjoying a swim in the open ocean. The unique characteristics of the beach are not controlled by people and it is important that as we move from the relative safety of a swimming pool that we learn to manage some of these characteristics. Readers will learn about the nature of the ocean and its currents, waves, and tides and more importantly how to avoid becoming a drowning statistic.

Image 4.1

Beach safety poster

Reproduced with permission from SOBRASA (Brazil)

OCEAN TIDES

Rui Seabra

- ***Different water basins around the world have different tidal conditions.***
- ***Water levels rise and fall at different hourly rates.***
- ***Swimmers should not assume that tidal changes at a holiday location are the same as at home.***
- ***Flooding and ebbing tides change the depth profiles of beaches.***
- ***The deeper the water the closer to shore waves will break.***
- ***Rip currents tend to occur during ebbing tides.***

Tides are a common feature of the world's oceans and can be a source of danger to swimmers if poorly understood. Tides are set in motion by the ever-changing relative positions of the Earth, Moon and Sun, and Earth's rotation - these alone, interacting together, are the "engine" that drives tidal actions. Everything about the orbits matters, including alignment, distance, inclination and even shape. Still, this only directly accounts for a waist-high tidal range, at most (Image 4.3).

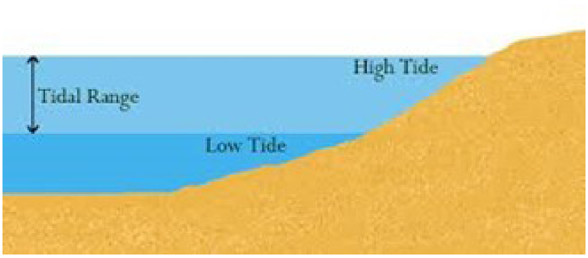


Image 4.3

Tidal range

Wikipedia Image

It is other factors such as the amplification of successive tides over eons of time and the interaction with the seafloor and coastal geometry that account for most of the differences in timing and range that can be found in tides around the globe.

It is important to note that tides are in fact waves, with a much longer wavelength than the wind-driven waves that break on a beach. As the tidal wave approaches shore water depth rises and the tide is said to be "flooding". After peak high tide is reached, the wave moves away and water depth lowers as the tidal wave begins to recede and we have an "ebbing" tide. Then the cycle repeats itself.

The sun generates a daily tide. The lunar influence is twice as strong as the Sun's and generates twice-daily tides. Since each oceanic basin has specific characteristics, these two influences are felt with different intensities on any given shore. Tides, therefore, can be semi-diurnal (two low tides each day; most common), diurnal (one low tide each day; least common) or mixed (a blend of the two). Tides rise and fall faster on shores with semi-diurnal or double tides than on shores with diurnal or single tides, taking a little over 6 hours - instead of 12 - to go from low tide to high tide.

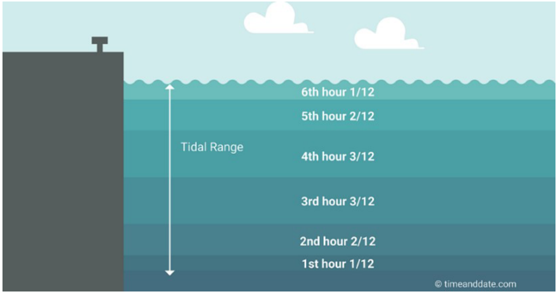


Image 4.4

Tidal Rule of Twelfths

Time and date.com image

The water level does not rise and fall at constant rates. Instead, 1 hour before to 1 hour after peak high tide the rate of change slows, stops, and restarts falling towards peak low tide. Likewise, 1 hour before to 1 hour after peak low tide the rate also slows, stops, and restarts flooding towards peak high tide. During the second hour to the fifth hours of a 6-hour tide period the rate of change gradually increases with the maximum tidal water movement at mid tide (Image 4.4).

Tidal regimes vary considerably around the world's coastlines and differences in tidal range can be striking, from about 30 cm (1 foot) or less in mid-ocean islands such as Tahiti, to over 15 m (50 feet) in the Bay of Fundy (Canada). Lastly, on any given shore, tide amplitudes also change over time. Typically, tidal ranges are greatest during full and new moons (called "spring tides") compared to quarter moons ("neap tides"). At mid latitudes, the amplitude of spring tides may also change considerably throughout the year, with the greatest tides typically occurring during summer ("king tides"). We are now ready to discuss the role of tides on a swimmer's safety.

First and foremost, tides are only a relevant safety factor where a tidal range is substantial. Where the tidal range is less than 1 m (3 feet), weather and swell can easily render tides unnoticeable and of less importance to swimmers. Everywhere else (and more so the greater the tidal range) tides generate two important safety risks: a constant changing of beach shape and profile, and the triggering of currents. Although the vertical gradient swimmers encounter when getting in or out of the water in sandy beaches is greatly dependent on how exposed to swell that beach is (sheltered locations are flatter), it will tend to be steeper during high tide and shallower during low tide.

Steeper profiles tend to make waves break closer to the shore, the shore-break more intense, and exiting the water more difficult. Individuals with reduced mobility should avoid swimming during high tide in wave-exposed, steep locations. Shallower gradients, on the other hand, cause waves to break further offshore and are associated with stronger rip currents - one of the leading killers of swimmers.

Rip currents occur mainly around the ebbing low tide and are typically absent during the flooding high tide. Therefore, when conditions are optimal for the formation of rip currents swimmers should avoid the low tide, or at least be aware of that heightened risk and be knowledgeable about how to deal with it. Close to rock formations changing tides can reveal, or cover up, rocks and other potential hazards. These can be especially dangerous, and while risky behaviours such as rock diving are discouraged in any situation, swimmers should at the very least ensure that the underwater environment at the time of the activity (not the day before, not earlier in the day) is properly assessed. Swimming into coastal caves is also extremely dangerous as swimmers risk becoming trapped by the incoming tide.

As tides change water rushes in and out of the shore. It is a crude oversimplification to think that this generates currents that carry swimmers into and away from the beach, respectively. The direction of tide-driven currents is highly dependent on the shape of the beach and the seafloor, and it is not uncommon for currents to form in counterintuitive directions. Contrastingly, in most open-ocean beaches, without extreme tidal ranges, tidal currents tend to be marginal. Thus, local knowledge is extremely important, and swimmers should always ask lifeguards for advice. This is even more crucial in or close to estuaries, as the water outflow can severely distort tidal patterns and lead to extreme and unpredictable currents during the ebbing of the tide that may carry swimmers offshore. In any case, in most locations tide-induced currents tend to be strongest during mid tide, when the rate of change of the water level is greatest, and along shallow, constricted sections of the beach (e.g., close to headlands or breakwaters).

Finally, tides are different than most other hazards in that they are neither static nor unpredictable. Instead, they change rhythmically and with predictable patterns. Thus, all it takes for swimmers to minimize the safety risks posed by tide-related hazards is to be knowledgeable of their presence and dynamics, and to always check the tide chart before they are out swimming. And never forget to familiarize with the tide patterns when traveling to a new destination, as those may not look like anything you are used to.

WAVES

Jasmin C. Lawes

- ***Waves are primarily caused by the wind blowing across the water's surface.***
- ***It is important that swimmers learn to identify different wave types and understand their characteristics.***
- ***It is easy to lose awareness of where you are in surf and what is happening around you.***
- ***Swim at a lifeguarded beach and stay between the red and yellow flags.***
- ***Stop, look, and plan before you enter the water, especially in a surf zone.***

What are waves?

"Waves are created by energy passing through water, causing it to move in a circular motion. However, water does not actually travel in waves. Waves transmit energy, not water, across the ocean and if not obstructed by anything, they have the potential to travel across an entire ocean basin."

US National Ocean Service (https://oceanservice.noaa.gov/facts/wavesinocean.html)

Waves are dynamic, powerful, and everchanging, and are one of the most enjoyable features of the oceans. Their rhythmic motions can hypnotise and relax, with much enjoyment to be found by simply watching waves gently roll in, or as they crash and roar during a big swell. Waves can be surfed, jumped over, or dived under. However, for the unfamiliar, they can also be hazardous. Different conditions affect waves, and it is important to understand how waves work, what types of waves may be present when you visit the ocean, and how you can interact with them safely to reduce the potential for injury.

How Do Waves Form?

Waves form into regular patterns of larger and smaller waves. The larger waves in the pattern are called sets and the smaller waves referred to as the lull. The time between each wave crest is called the wave period and is measured in seconds. While it is opposing forces that cause the sea surface to oscillate and create a wave, the dominant phenomenon behind wave development is wind.

Wind strength, direction, and duration (or fetch) all impact on what state a wave is in when it reaches a coast at the 'surf zone'.

Wind Strength**:** The swell gets bigger as the wind gets stronger.

Wind Direction: Wind is needed to propel the waves towards a beach to create surf zones. Beaches can be protected by sandbars, headlands, or reefs, which can stop or inhibit waves from reaching the shoreline.

Wind Duration or Fetch: The distance the wind has been blowing over the sea surface. The longer the fetch, the bigger and cleaner the surf will be once the wave reaches the surf zone.

The Surf Zone: As waters get shallower near the coast, waves slow down as they lose energy through contact with the sea floor. This causes waves to change shape and get higher and steeper until the slope of the crest cannot support itself and it breaks, creating the surf. Surf is where water and air are mixed together and is less supportive for a swimmer than water alone.

There are three types of breaking waves each with their own key characteristics. On any beach in the surf zone, there will commonly be a combination of these three types of waves.

Types of Waves

Image 4.5

Plunging or Dumping wave

Image credit https://beachsafe.org.au/surf-safety

Plunging or dumping waves (Image 4.5) occur when the sea floor is steep or there is a sudden change in depth due to features such as sandbars or reefs. These waves can also create a hollow tube when they break, which surfers call the 'barrel' or 'tube'. The wave crest is steeper than a spilling or rolling wave, as it becomes vertical, then curls over and drops onto the trough of the wave, seemingly 'dumping' its energy at once in a relatively violent impact. Plunging or dumping waves are particularly dangerous as they can pick people up and drop them onto shallow sandbanks or reefs with great force.

Spilling or rolling waves (Image 4.6) are gentler waves that are produced by interactions with a gently sloping sea floor. As the wave approaches the shore, it releases its energy more slowly, causing the crest to gradually spill forward onto the wave face itself until it is all white water. Spilling waves are slower and take more time to break than any other wave. Spilling or rolling waves are commonly found at locations with flatter shorelines. These are generally safer types of waves.

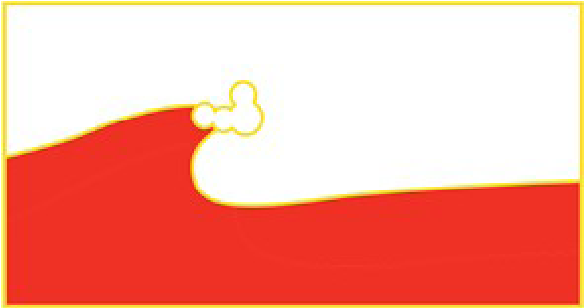


Image 4.6

Spilling wave

Image credit https://beachsafe.org.au/surf-safety

Surging waves (Image 4.7) are produced when swells with longer wave periods arrive at coastal locations that have steeper profiles. The base of the wave moves fast and does not allow the crest to evolve. As a result, surging waves may never actually break as they approach the water's edge since the water is very deep. They are commonly observed around rock platforms and beaches with steep shorelines.

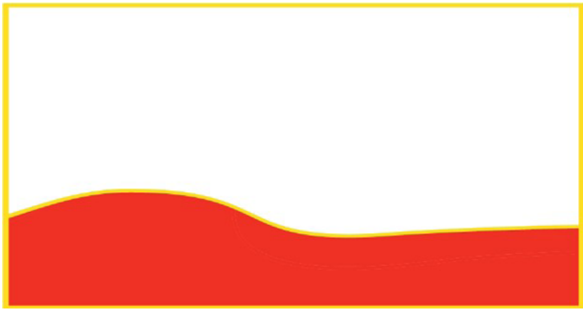


Image 4.7

Surging wave

Image credit https://beachsafe.org.au/surf-safety

Surging waves are dangerous because they can appear suddenly and knock people over before dragging them back into deeper water. They are of particular danger to persons fishing at deep water locations.

What things can go wrong when recreating in waves or in a surf zone?

Coastal environments, in particular beaches, provide access to "blue spaces", which are increasing linked to human wellbeing.

Swimming or wading in waves and recreating in a surf zone clearly has multiple health benefits, but it is important to acknowledge that as a dynamic recreational arena, the beach and its surf zones can also be hazardous and change from day to day. Similarly, it is easy to lose situational awareness (knowing where you are and what is happening around you) in surf. Situational awareness is about understanding and being mindful of our surroundings. Since the surf zone is constantly changing it is prudent to regularly monitor conditions and check where the swell may have taken you in relation to the shore.

Swimmers are situated in and under the water and when life threatening incidents occur, assistance can be some distance away. This means that they need to know how to survive the early stages of a drowning event. A small mistake or pushing your physical limits too far can have severe consequences, causing injury and even the loss of life.

The types of injuries that occur in and around waves and the surf zone are generally referred to as surf zone injuries (SZIs). Surf beaches attract a variety of recreational activities, including wading, swimming, bodyboarding, and surfing. However, surf beaches also have many associated hazards (including powerful wave conditions and rip currents), and since waves are the best arena for surf craft, the risk of collision and impact injury also increases.

Common SZIs include a wide range of spinal injuries, sprains and strains, fractures, dislocations, lacerations (commonly caused on impact with a surfboard or the ocean floor) and drowning events – both fatal and non-fatal. The risk of these injuries is thought to increase when shore breaking plunging and dumping waves are combined with steep beach shorelines, and at high energy beaches with dynamic morphologies (i.e., moving sandbars).

Another hazard strongly linked with wave energy is the rip current. It is important to understand that the water brought onto the shore by waves must return to the sea, and most commonly does so via currents (Image 4.8).

This means that surf zones are often bordered by channel rips, whose strength are directly related to the power of the waves, i.e., the bigger and stronger the waves, the faster and more powerful the rip current may be.

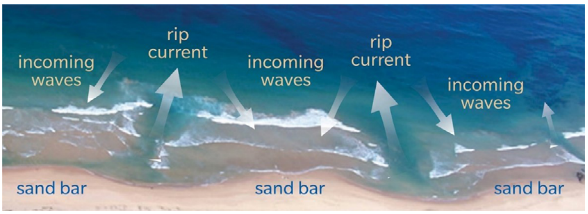


Image 4.8

Arrows indicate direction of energy in surf zones and adjacent rip currents.

Picture credit: https://beachsafe.org.au/surf-safety

Image 4.9

Lifeguards on Duty red and yellow flag

SLS GB image

How to swim safely in and around waves and the surf zone

Hazards are present in all environments, with waves and the surf zone being no exception. Even so, here are things to consider before entering the water to reduce the risk of SZIs.

1. **Swim at a patrolled location.** Where possible, swim at a location patrolled by lifeguards or a lifesaving service. Patrolled areas are usually between the red and yellow flags (Image 4.9).

2. **Talk to a lifeguard about current conditions.** Lifeguards are trained in water safety and are highly skilled first responders. Every day they identify hazards (i.e., rip currents, sandbanks, marine life) and have a good understanding of locale, site-specific conditions.

3. **Know your limits.** If the waves are too big and you are not confident of your ability, it is okay to stay on shore and enjoy the beauty of the waves from the beach.

4. **Never swim alone.** Always swim with a buddy and at a beach patrolled by a lifeguard service. If you must swim alone, inform lifeguards where you plan to swim and what time you plan to return to shore.

5. **STOP, LOOK, PLAN, before you jump into the water**. Always spend some time on shore to stop and check for rip currents and observe the pattern and intensity of the breaking waves. Look to identify the number of waves in a set and the average time of the lull in-between sets. Where possible, plan to time your entrance into the surf zone to minimise impact of an incoming set of waves, and where possible swim at a patrolled location in the designated area. Also locate clear markers on land (e.g., a lifeguard tower or an environmental feature such as a big tree or rock) to help situate yourself if needed when in the water.

6. **Look for the safest areas to enter and exit the water.** It is always easier to enter the water than to get out. Plan your exit strategy in advance to avoid getting trapped in the impact zone or being washed against dangerous rocks. Think about what your options are, and what you would do in case this occurs.

Image 4.10

Black and white chequered craft area flag (No swimming)

SLS GB image

7. **Share the waves.** Conflicts can arise when surf craft users (Image 4.10) and swimmers (especially body surfers) chase the best waves. Flagged areas identify areas safe for swimmers and prohibit surf craft can reduce these conflicts. It is important to be respectful and remember that bigger waves mean stronger forces. Surfboards can cause significant SZIs when collisions occur between surfers and swimmers recreating in the waves.

8. **If you get caught in the waves.** Stay calm. Seek help by raising your arm and calling out. Remember that energy in surf zone is heading back to the beach, so try to use this energy to get you back to shore. It may be easier to dive under waves and harness the natural, rolling power of the waves to help you rather than to try and swim through them or jump over them. If you tire you can hold your knees (roll into a ball) and hold your breath. When you surface take a quick breath and roll up again until rescued, or as the waves push you ashore.

9. **If you see someone in distress who may need rescuing, don't rush in!** If you find yourself in a situation where you may be a bystander rescuer, carefully assess the situation and do not compromise your own safety. Take a moment to STOP, LOOK and PLAN what you should do. Depending on the situation you could:

- Call for help
- Seek assistance from others, such as surfers.
- Avoid a contact rescue where possible – try a 'non-contact' rescue if you can and throw them something that floats and give them calm instructions how to get back to safety
- If you must enter the water, always take a flotation device with you (e.g., boogieboard, angel ring, esky lid)
- Learn how to provide CPR and understand the difference between resuscitating drowned and cardiac casualties.
- Supervise children on, in and around water. Always have the ability to remove all children from the water simultaneously or you will have to decide who you will leave to save themselves.
- Keep facing waves and keep young children within arm's reach.
- Where possible, swim between the red and yellow flags and understand the meaning of the other flags.

SURF ZONE CURRENTS

William Koon & Robert Brander

- ***The way water moves near a shore is complex, dynamic, and changes with place and time.***
- ***From where waves first break to the shoreline is called the surf zone.***
- ***A rip current can quickly carry a swimmer offshore but does not pull them under the water.***
- ***If caught in a rip current, float, and signal for help in the first instance.***

Many of the world's coastlines, be they ocean, sea, or lake, are characterised by beaches that have become recreational destinations for millions of people each year. The combination of variable geology, morphology and wave climates along these beaches creates a myriad of coastal processes that are beautiful, chaotic, and potentially dangerous. The way that water moves near the shore is complex and dynamic, it changes with place and time and is regulated by several different factors. A beach with small gentle waves one day can transform into a place of raging surf and powerful currents the next. This water movement is most active in the surf zone – the region that extends from where waves first start to break to the shoreline – where people like to swim. Understanding a few basics about surf zone currents can help you identify a hazardous situation, make a safer decision about where to swim (or not) and know what to do if you find yourself caught in a current.

Moving water in the surf zone is a response to nature's quest for balance: as water moves towards the shore with incoming breaking waves, it eventually must return offshore. It is also important to understand that as waves break, the water level rises. Along most beaches, the intensity of wave breaking varies over space and time and water will always begin to flow from regions where there is more wave breaking (higher water levels) to regions where there is less wave breaking (lower water levels). This simple phenomenon is what creates a variety of surf zone currents that ultimately help return water back offshore: i) bed return flow; ii) longshore currents; and iii) rip currents.

Bed return flow

The white water you see when waves break moves water towards the shoreline and tends to occur in the upper half of the water column. Along most beaches, this onshore flow is balanced by a gentle offshore return flow of water in the lower half of the water column.

While many scientists have referred to this current as an 'undertow', this term is potentially misleading as it implies that the water is pulling you 'under', which is not true. A much better term to describe this current is 'bed return flow' as it occurs close to the bottom bed. Bed return flow occurs everywhere along beaches and is particularly common on gently sloping, or flat beaches, or across sand bars. This current is not fast and does not generally represent a hazard to swimmers or bathers.

Longshore currents

When waves approach a beach at an angle to the shoreline, water from the breaking waves rushes up the shoreline at an angle and returns straight back down due to gravity. Over time, this shift in water movement combines to form a longshore current moving along the beach in the direction that the waves are coming from. If the waves are approaching the beach from the south, the longshore current will move to the north. Longshore currents can flow quite quickly and occur along the shoreline or be confined to a deeper channel between the shoreline and an offshore sand bar. While they are not necessarily dangerous to swimmers because they move parallel to the beach (not away from it), long shore currents can take you a long way away from where you entered the water. Longshore currents will flow along the beach until they reach a physical boundary, such as a headland, jetty, or groyne, where they are deflected offshore as a rip current.

Rip currents

Rip currents, or rips, are concentrated flows of water that extend from the shoreline, through the surf zone past the breaking waves. They form on any beach with waves breaking across a wide area. Rips can be powerful enough to take a swimmer out of their depth and move them quickly away from shore. Importantly, a rip current is not an 'undertow'; it will not pull a swimmer underwater. There are different types of rips with defining behaviours, some are permanent while others flow intermittently depending on wave and tide conditions. Rips have different parts where water moves faster or slower and operate in different fashions (Image 4.11).

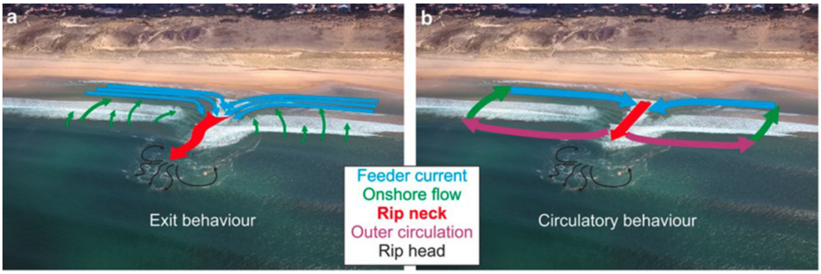


Image 4.11

A) Traditional view of rip current with "exit flow";

(B) rip current with "circulatory flow". In both panels, colours indicate the main structural components of the rip current system

(Photo Y. Lavigne and graphics courtesy of Bruno Castelle).

A continuously growing body of scientific research has helped us understand more about rip currents and it is well established that they are the primary hazard at beaches where they occur. Rip currents are the leading cause of ocean rescues and are responsible for hundreds of fatal and non-fatal drowning events worldwide each year, including swimmers of all abilities and experience.

Anyone who swims at a beach must be aware of rips. While swimming in an area supervised by trained lifeguards is always the safest option, swimmer safety is still largely in the hands of the individual. Beachgoers should understand what rips are and learn to identify them to avoid swimming into one. Rip identification can be difficult even to trained eyes, but all rip currents have visual clues. Rips are easier to spot from a higher vantage point, such as from a headland, beach berm, or a sand dune. The higher you are, the easier it is to spot rips and wearing polarized sunglasses also helps.

Many rips flow through deeper channels and, as less waves break in deeper water and deeper water is always darker, will present as dark gaps between areas of breaking waves (Image 4.12).

Image 4.12

A Rip current characterised by a dark gap between white water at Coalcliff Beach, New South Wales, Australia.

Photo by Rob Brander.

These channelised rips can occur along beaches but are also common next to physical boundaries such as headlands, groynes, and jetties, where they can often be permanent features (Image 4.13).

Image 4.13
Boundary rip current characterised by dark green "deeper" looking water next to the rocks. Fingal Head, New South Wales, Australia.

Photo by Rob Brander.

One of the problems with these rips is that many swimmers mistake these seemingly calmer areas of water as safe places to swim. If you see a dark gap heading offshore on a surf beach, a good piece of safety advice to remember is "*White is nice, green is mean*!" (Images 4.12 & 4.13)

Image 4.14
Rips defined by suspended sediment at Dias Beach near Cape of Good Hope, South Africa.

Photo by William Koon

Rip flow can also carry suspended sand as visible plumes that are most obvious just seaward of the surf zone as the rip slows down and dissipates (Image 4.14). The interaction between strong offshore rip current flow and incoming waves can also change the surface texture of the water, creating choppy, turbulent water, often with streaks of foam, in the rip compared to surrounding water where the rip is not flowing (Images 4.15 & 4.16).

Image 4.15

Turbulent and foamy rip current at Coogee Beach in Sydney, New South Wales, Australia.

Photo by Rob Brander.

Image 4.16

Choppy, textured surface of a powerful rip current at Huntington State Beach, California, USA.

Photo taken from Surf Watch V Rescue Boat by William Koon.

Channelised rips that have remained in the same place for a long period of time can also erode small embayments along the beach, which provides another visual clue to look for.

Image 4.17

Textured water surface indicate a rip current flowing offshore near Stanwell Park, New South Wales, Australia.

Photo by Rob Brander

It's good practice to always think about and look out for rips and other hazards before swimming at a beach. You don't cross a road without looking both ways and should always spend a few minutes checking for signs of rip currents before entering the water. (Image 4.17)

If you unintentionally end up in a rip, recognizing the situation early is crucial. Most people don't realise they are in a rip until they notice they are moving quickly offshore away from the beach. It is important to always make sure your feet are firmly on the bottom. If you can still stand and touch the bottom, walk sideways out of the rip and back into shallower water. If you lose your footing, the rip will simply take you for a ride. If this happens to you, there are several options on what to do next.

Float first. People drown because they submerge underwater. Floating keeps you on top of the water giving you time to think about your situation while conserving energy. There is no need to panic once you understand that rips do not pull you under the water. Often people will attempt to swim straight back to the beach against the rip current flow. In most cases, this will just tire you out and won't get you anywhere. Save your energy and think about what you can do next.

Keep floating, signal for help. Research has shown that rip flow is often circular and will often flow offshore and then around back into the shallow water of a sand bar, where you may be able to stand up (Image 4.11A). However, this does not happen 100% of the time and surf zone exits (where the rips flow offshore beyond the breaking waves) do occur (Image 4.11B). Image 4.18 shows the results from an experiment with GPS devices attached to volunteers floating in rip currents.

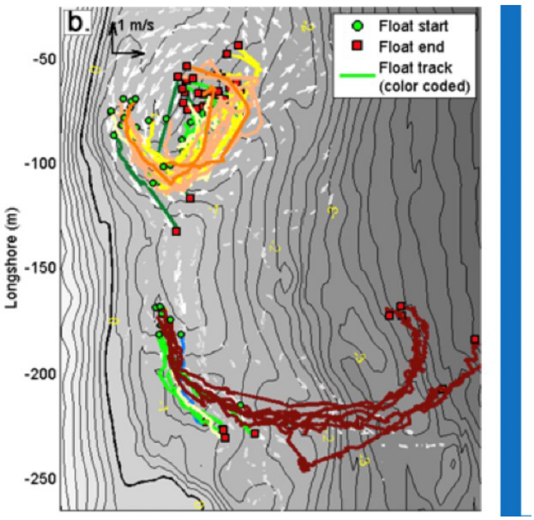


Image 4.18

Results from GPS rip current swimmer research.

Courtesy of Jak McCarroll.

All the volunteers in the top channelised rip were carried back into shallow water where they could stand up, while those in the bottom rip (a boundary rip flowing out against a rock reef) were taken much further offshore. For anyone caught in a rip, continuing to float, conserving energy, and trying to attract the attention of someone who can help, like a lifeguard or surfer, is always the best option.

Swim to escape. If you are caught in a rip and are a good ocean swimmer with knowledge of rips, you may be able to swim out of the rip. Rip flows are generally narrow so swimming to the side of a rip may get you out. In many cases, this means swimming towards the white water of breaking waves, which indicates shallower water where you may be able to stand up. However, rips can flow offshore at different angles and choosing the right direction to swim is not always easy. You may end up swimming against the rip flow. If you feel like you are not making progress, float, re-assess, then decide to either try swimming in a new direction, or continue floating to conserve your energy while signalling for help.

In reality, there is no single rip current escape strategy that will always work for every person caught in a rip current. There are too many variables including the complexity of rip current flow and human behaviour. Instead, the best advice is to understand what rips are, learn how to identify and avoid them, and if caught, stay calm, float, and signal for help if you need it.

It is crucial for any ocean swimmer to learn rip current safety, summarised in the four points below. Familiarize yourself with what rips are, what they look like, and what you should do at the beach to keep yourself safe.

Understand what rips are, and what they are not.

- o Rips are strong currents of water that flow from the beach, through the waves, out to sea.
- o Rips can move fast and can carry even the best swimmer into deeper water.
- o Rips are not "undertows"; they will not pull you down under the water.

1. Learn to, and practice, spotting rip currents from the beach. Ask a lifeguard to help you spot rips.

   Although not all rips will show all these signs, here are a few clues to look for:

   - o Foamy, choppy, discoloured, or sandy looking water flowing out to sea.
   - o A narrow, darker gap between areas of breaking waves and whitewater that extends offshore.

2. Stop and watch the water first.
    - Just like you look both ways before you cross a street, whenever you get to the beach, you should spend a few minutes and look for rips and other hazards before you get in the water. Decide on where to swim only after you have assessed the area.
3. If caught in a rip, know your options to stay safe
    - Avoid swimming in a rip if possible: always swim in an area supervised by trained lifeguards and identify hazards before you get in the water.

If you are in a rip:

- Float first, stay calm, and consider your options. Don't fight the current.
- Try standing up; if you can stand up, walk back to shore.
- If you are at a beach with lifeguards, or see surfers, call out and wave for help.
- If no one is near and you are able, swim sideways towards the breaking waves.
- If you are too tired to swim: stay calm, conserve your energy and focus on staying afloat.

POOL FITNESS AND OCEAN COMPETENCY

Melinda Jackson

- ***Swimming in an ocean requires a different skill set to that of pool swimming.***
- ***Salty ocean water has better buoyancy than fresh pool water.***
- ***Fitness is only one of many survival factors in an ocean.***
- ***Take the time to check on ocean conditions before entering the water.***
- ***Wear bright coloured clothing.***

Why do proficient, fit pool swimmers get into trouble when swimming in the ocean? Swimming is swimming, right? Regrettably, this is not the case and is a common misconception! Swimming in the ocean requires a unique and different skill set to that of pool swimming. Unlike a pool setting, the beach and ocean are highly dynamic environments with constantly changing conditions that require not only physical swimming fitness but a strong knowledge of the impact of the environment, an awareness of what is happening and survival strategies to deal with these changes.

Our purpose is to highlight the differences swimmers encounter when swimming in the ocean compared to that of swimming in a pool. It is important to note that the focus is on the transition to ocean swimming rather than open water swimming in other aquatic environments or for competitive purposes. Key considerations pool swimmers must make when first moving into ocean swimming are detailed along with recommendations to swimmers, coaches, and group leaders should consider ensuring the safety of themselves, or those in their care, and minimising the risk of drowning.

Salty disturbed water

Coaches and their athletes spend countless hours perfecting their swim stroke to maximise performance. Swimmers will tell you they can freestyle their way effortlessly up and down a pool indefinitely. Even casual swimmers will boast of their prowess in pools and their ability to safely enjoy the confines of the local aquatic centre. But in the ocean, a swimmers stoke is interrupted. Salt water has a different buoyancy factor than fresh or chlorinated water and is on average 2.5 percent heavier than fresh water. This results in swimmers being more buoyant and sitting higher in the ocean than in the pool. People who understand this will quickly make the link that floating is easier in a calm ocean than in a pool. Floating is one of the most important drowning prevention survival skills.

The predominantly horizontal position of the swimmer as they breathe to the left or right in a set rhythm is disturbed in the ocean. Breathing now takes more energy as the swimmer lifts their head higher to avoid swallowing water in the wind effected choppy water or the breaking waves. The black line no longer guides swimmers and they must lift their head 'water polo style' to orientate themselves and spot key landmarks. This in turn affects their body positioning and requires both an increase and a different type of fitness. There is less 'grip' in the white water of broken waves changing the effectiveness of the catch in a swimmer's stroke; the rhythm of stroke is interrupted as swimmers dive under waves; and breath holding and disorientation impact on physical and mental fitness. Pool swimming fitness does not automatically translate into ocean swimming fitness. There are factors to consider. Swimmers can easily lose their situational awareness in surf, not knowing where they are exactly in relation to land.

Environment first

Swimming in the ocean can be both exciting and dangerous. Safety and drowning prevention depend not just on how well someone can swim but also on their understanding of the ocean environment and their ability to minimise risk factors. One's ability to swim is but one component of surviving in the ocean and the previous paragraphs highlighted the inherent changes in swimming style that must be accommodated. But what of the environmental physical changes. The known depth, black line, even tiled bottom, standard water temperature and close edge all disappear in the ocean. The wind blows: surf craft enter swimming zones; marine creatures float or swim there; the water temperature alters with currents; rip currents develop; rain brings debris; water colour varies across the globe, the ground is uneven and covered in mud, rocks, sand, silt, seaweed, or shells. The once controlled environment of the calm aquatic centre is now an exposed uncontrolled environment that is both wonderful and scary at the same time. In a pool, swimmers get to focus on swimming, in the ocean they must focus firstly on the environment and then their swimming. Fitness is no longer the most important factor in drowning prevention – competency, knowledge and understanding of the environment take precedence, supported by an ability to swim.

For your consideration

Below is a list of considerations for athletes, coaches, and leaders to reduce risk, minimise drowning and assist fit pool swimmers become competent ocean swimmers. They require differing levels of practice time and skill; can be implemented as individual skill sessions or combined into lessons; and importantly can be applied around the world to all ocean conditions.

- Speak to the locals. Lifeguards, lifesavers, fishermen, sporting groups, regular coffee groups, information centres. They will be easy to identify and often love to have a chat about their local area.
- Research the weather and ocean conditions. Download a weather/surf/beach app, read the local newspaper, watch the evening news.
- Take time before entering the ocean. Observe the conditions, identify key landmarks, and make a plan.
- Complete an ocean swimming or aquatic rescue course.
- Read the signs. Beaches often have information and warning signs erected by governments, councils, lifesaving organisations or community groups. Once read, make sure you follow them.
- Respect the environment. Do not overestimate your ability and underestimate the power of the ocean. • Understand the conditions. Learn how to identify and minimise risk in rips, currents, wave zones etc. • Learn some common signals. There are universal actions, those specific to lifesaving associations or you could make some up within your group.
- Encourage swimmers to dress appropriately. The image of the beach goer in the media is often one of those on holiday. The commercially advertised swimwear is boardshorts and bikinis. Clothing worn in the pool should be worn in the ocean.
- Swim during daylight. Swimming during dark times limits visibility for yourself and rescuers.
- Always enter the water with a buddy. Let someone know where you are going, how long you plan on being in the water and what type of activity you are doing.
- Wear a brightly coloured cap making it easy to see you from the beach.
- Understand basic first aid. Know what to do you if get a cramp, stung by a jellyfish, or are affected by cold water.
- Remain where you can stand. At least until you gain more confidence. Don’t go too far or deep, too quickly.

- Make sure there is full supervision of all swimmers in the water.
- Practice swimming without goggles.
- Swim close to shore. Check for rip currents before swimming parallel to the beach.
- Travel with the currents, not against them. Float and wave for help if in trouble.
- In waves dive deep under waves and grab the sand. If in difficulty in surf hold your knees and your breath turning yourself into a human ball. Breathe when you can. Waves push balls onto beaches.
- Stay calm.
- Gradually attempt more challenging conditions only after mastering basic skills.

If in trouble

- Float
- Wave to attract attention.
- Minimise heat loss but stay calm and still.

This is by no means an exhaustive list of conditions to consider and recommendations to follow. Our aim is to highlight that swimmers who are fit in the pool, are not necessarily fit for the ocean. Competence underpinned by swimming ability and environmental knowledge as well as survival skill training, combine to reduce the risk of drowning in an ocean environment. Whatever your preference, enjoy swimming, be safe and look after each other.

Image 4.19

Be easy to see

Image from Nuala Moore

CHAPTER 5
RIVERS AND CANALS

INTRODUCTION

John Connolly

Be prepared for something to go wrong

For a number of years I was a scout leader and later a water safety advisor to scouting in Ireland. Many readers will be aware of the scouting motto “Be prepared”. This message is very appropriate to all who recreate near water and on water. To be prepared for a safe visit to a river or canal you should ask yourself what could go wrong and how you might deal with the situation if it happened. Psychological research supports the claim that just thinking about such situations has a major positive impact when things start to go wrong.

An important message is that it is not sufficient to have safety and rescue equipment available, it must be ready for immediate use. The images 5.1(a) & 5.1(b) show rescue ring buoys that are not ready for immediate use due to the rope being knotted around the pole. Some years ago, my colleagues and I timed how fast we could throw a ring buoy into water while standing next to a buoy in a box resting on an untangled rope or with the rope wrapped around the buoy. The throw time in over 100 different buoy throws was around 30 seconds. Consider a bystander in a drowning situation who must think what to do - to locate a rescue buoy, run to it, prepare it for throwing, bring it to the water’s edge, and then throw it. We were calm, practiced, and did not have a drowning person in need of rescue during our research but in most attempts the water moved the target object outside of the rope length before we could execute a throw. Knowing this was possible, once a rope was coiled, we would sometimes run along the riverbank towards the target before throwing the buoy. We were practiced rescuers adapting our actions based on previous experiences. Rescue reports completed by police and fire service officers stated that the most likely action in a real rescue situation was a bystander throwing a buoy with an uncoiled rope into the water in response to seeing a casualty being moved away quickly. If you see a rescue aid with a knotted or tangled rope please take the time to open it up and make it ready for a rescuer. Doing so may save a life.

Being prepared also applies to lifejackets or more precisely to the wearing of one and not sitting on it believing that there will be time to put it on should a craft begin to sink.

The advice 'Wear a Lifejacket' means exactly that – wear it fastened to your body. Children need to wear a lifejacket appropriate to their age and size. Putting an adult lifejacket on a child risks the child falling out of it in water should an emergency situation arise.

Image 5.1 (a)

Tangled ropes on rescue ring buoys

John Connolly Images

Image 5.1 (b)

RIVERS AND CANALS

José Palacios-Aguilar, Santiago Cervantes-López, Roberto Barcala-Furelos

- ***River water flows fastest in the centre.***
- ***Novice river swimmers may underestimate the force of the water.***
- ***Avoid enter rivers unnecessary and swim only in designated bathing areas.***
- ***In rapids float face up, feet first.***
- ***Don't try to remove clothing unless necessary.***
- ***If dragged underwater hold your breath and strongly push up from the bottom.***

Image 5.2

Natural current of water, of variable flow.

Photo ownership: Palacios-Aguilar

Image 5.3

Rivers are sometimes areas of public bathing.

Photo ownership: Palacios-Aguilar

General River Hazards

A river is a natural current of water, of variable flow, that flows permanently ending in another river, in a lake, or in the sea (Image 5.2).

Rivers are sometimes areas of public bathing (Image 5.3), but, unfortunately, there are many cases of people who die by drowning in them, since they usually do not have lifeguard services and safety measures, except in certain authorized areas sometimes called river beaches.

The most prominent risks associated with rivers are:

- **Current**, which due to its strength, orientation and abrupt changes create a danger that is difficult to avoid (Image 5.4). Sometimes, due to irregularities in the bottom (obstacles and holes), with a large volume of water, the current rotates at high speed (eddies) and causes a serious risk of being trapped.

- **Structure**, with various parts that can become direct hazards, such as edges with vegetation, curves in the route, obstacles with rocks, variable dept with sudden changes, stony bottoms, fine or coarse sand, mud, branches, algae, etc. (Image 5.5).

Image 5.4

The current of the river creates a danger difficult to avoid due to its force, orientation and sudden changes.

Photo ownership: Palacios-Aguilar

Image 5.5

The structure of the river can offer direct dangers (vegetation, curves, rocks, sudden changes in depth, muddy bottoms, branches, algae).

Photo ownership: Palacios-Aguilar

- **Water temperature**, usually cold or very cold, which has an added danger factor, even more influential than room temperature and which can cause a serious risk of falling into hypothermia.

Image 5.6

The turbidity of the water is another risk in rivers.

Photo ownership: Palacios-Aguilar

Image 5.7

Pollution in rivers is another associated risk.

Photo ownership: Palacios-Aguilar

Other risks that can sometimes be added to the above are:

- **Turbidity**, when the water loses transparency due to suspended particles caused by the current itself or external factors (Image 5.6).

- **Pollution,** caused by spills with all kinds of pollutants (fertilizers, pesticides, plastics, toilet waste, bacteria, parasites, nitrates, phosphates and even radioactive substances) (Image 5.7).

Currents

The water in rivers does not always move at the same speed. The water in contact with the bottom and banks of a river tends to slow down because of friction. The fastest flow of water in any river is in the centre, just below the surface and the furthest from the shore.

The main problem with currents is the general ignorance people have about the force of the water. Unfortunately, they are often only aware of this great danger when they experience being uncontrollably dragged by it. In many places, accidents happen when someone tries to cross a river or stream in flood, on foot or in vehicles, just because they believe that they can save distance and time to get somewhere. What must be done first of all is to look and think about what it is like and how strong it might be. You should avoid entering rivers or floods if it is not strictly necessary. You should never attempt to enter water to rescue animals or people who have fallen in unless you have rescue training and buoyant equipment.

Self-rescue

When someone falls into a stream or river it is strongly advised that they follow this advice:

1. Remain calm and do not allow yourself to be dominated by panic, to achieve better decision-making and to save physical wear (less oxygen will be consumed).

2. In areas of rapids with obstacles, float in a defensive position, face up, as horizontal as possible, feet first (downstream) (Image 5.8) and never lower your feet if the current is strong (Image 5.9).

Image 5.8

In areas of rapids with obstacles, float in a defensive position, face up, as horizontal as possible, feet first (downstream).

Photo ownership: Santiago Cervantes-López

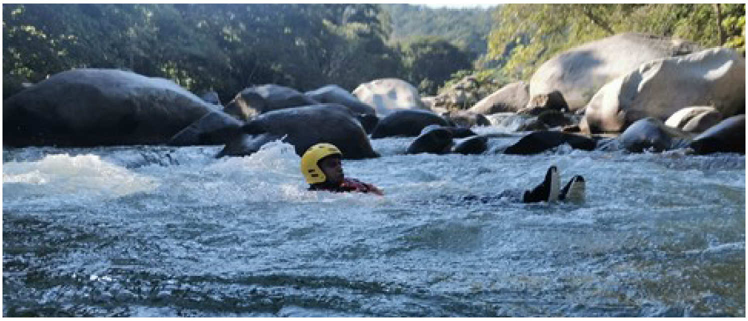


Image 5.9

Never lower your feet if the current is strong.

Photo ownership: Santiago Cervantes-López

3. Never swim against the current.
4. Make diagonal or transverse movements to approach the shore where you can hold on to a branch or something firm.
5. Use a swimming technique with your head always out of the water and your strokes (arms movements) shorter and more powerful.

If clothing is worn when falling into a stream, it will be necessary to decide whether or not to remove it, depending on its size and weight. Some clothing can provide buoyancy but others can cause the body to submerge even more.

However, thick clothing can also protect the body if bashed against rocks. Removing clothing in fast moving water is dangerous as there is a real possibility of becoming tangled up in the clothing and thereby losing use of arms or legs. Therefore, unless it is thought really necessary clothing should not be removed. Modern footwear often floats and can protect the feet.

When it is the case of being trapped in a large volume of rotating water (whirlpool), it is necessary to try to apply a great impulse so as not to be dragged under (Image 5.10).

Image 5.10

In a large volume of rotating water (whirlpool), it is necessary to try to apply a great impulse so as not to be dragged under.

Photo ownership: José Palacios-Aguilar

If the current is so strong that it inevitably drags, once again it is preferable not to panic, let yourself be carried down to the bottom where you can exit the strong current with an energetic and explosive impulse in the direction of the current itself.

In situations where the flow of water falls over an obstruction (dam) and generates a flow of current upstream, a swimmer should allow himself to submerge holding his breath and be taken downstream close to the bottom until it is calculated that the flow of water has reduced. He can then push off the bottom to the surface and swimming towards the riverbank.

Rescue

If you want to help someone who has fallen into a stream, the priority is to apply the decisional sequence for rescues in the water, summarized in the words SER: Safety, Experience and Resources (Table 5.1).

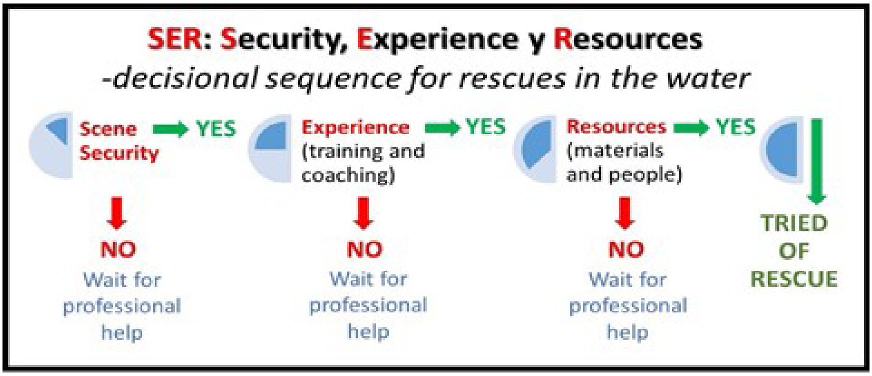


Table 5.1

Decisional sequence for rescues in the water, summarized in the words SER.

Photo Ownership: Roberto Barcala-Furelos / José Palacios-Aguilar

If the final decision is to attempt a rescue, the advice to avoid risks are:

1. Avoid entering the water.
2. The rescue must be carried out with the participation of more than one person, achieving effective teamwork. It is especially useful to put observers upstream, who can provide very valuable information.
3. It is preferable to overtake on the ground the person in the water and wait for him/her downstream.
4. Use some specific current rescue material (such as a rescue throw bag) (Images 5.11 - 5.12) or improvised material (rope with drum or similar), thrown from the riverbank.

Many factors will influence a rescue, such as the speed and volume of water, the size and weight of the person to be rescued (a child is not the same as an obese adult), the clothes they are wearing, and the environmental circumstances of the river (rocks, branches, water temperature, etc.).

Water temperature and hypothermia

Without adequate thermal protection, the body can lose heat 25 times faster in water than in air at similar temperatures. This can increase up to 10 times when there is movement in the water or swimming. The effects of cold on the human body become a serious risk, since they reduce flexibility, strength, and resistance. It has been calculated that strength can decrease 3% for every degree C (1.8F) drop in muscle temperature.

Image 5.11

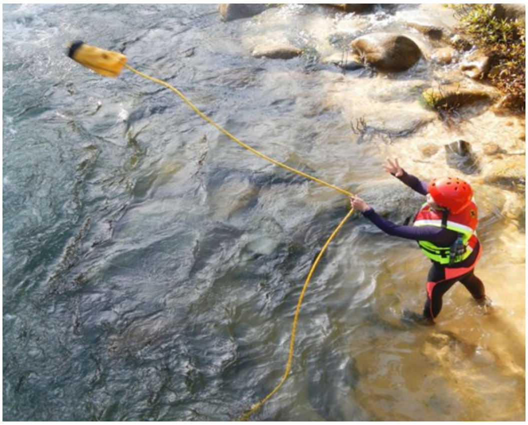


Image 5.12

If a rescue is carried out in rivers with current it is best to use some specific current rescue material (rescue bag).

Photo's ownership: Santiago Cervantes-López

With a muscle temperature of 27 ° C (80.6F), fatigue comes sooner, which would occur in approximately 20 minutes of immersion in water at 12 ° C (53.6F). Furthermore, hypothermia complicates the management of any injury and can negatively affect subsequent recovery.

Hypothermia has different degrees and its evolution will depend on the person's ability to delay cooling. In general, hypothermia occurs with an internal temperature below 35 ° C (95F) and presents different degrees of intensity as the body cools. The main problem occurs at an internal temperature of 22 ° C (71.6F) which can lead to spontaneous ventricular fibrillation. In the first degree of hypothermia the symptoms are chills and a feeling of cold, leading to a lack of motor control and uncontrollable tremors.

Later comes a loss of coordination, difficulty speaking, and pale skin. As hypothermia becomes more severe, the person stops shaking, their mental state is dulled, and they can show little interested in their survival. In these cases, if the treatment is not immediate, the person will lose consciousness.

Treatment for hypothermia should be as follows:

1. Away from exposure to cold and shelter as quickly as possible and in a good shelter.
2. Remove wet clothing and wrap the affected person in dry warm clothing, also covering the head.
3. Check vital signs. If not breathing begin basic CPR.
4. Avoid active rewarming techniques, do not massage extremities (they can cause the circulatory system to mobilize cold blood from vital organs, worsening the person's condition).
5. Avoid rough handling of the person (it can cause an alteration in the heart's electrical system, triggering a lethal rhythm or a stop).
6. Do not allow the person to waste energy.
7. Maintain comfort in the person, provide calm and security.
8. Provide heat in two possible ways: through direct body-to-body contact (without rubbing) or other external sources of controlled heat (hot water bottles, hot packs), without causing rapid heating.
9. Carry out the transfer in adequate conditions to a hospital.

Rapids & Wild Water Activities

Rapids are rivers that are distinguished by a large volume of water in the current and that travel faster down steeper slopes. It is also common for the nature of the bed and margins to vary, with a greater presence of large rocks and vegetation (Image 5.13).

Image 5.13

The rapids have a greater presence of large rocks.

Photo ownership: Santiago Cervantes-López

There is an international scale that classifies rivers in order to standardize the technical difficulty and the level of skill necessary to navigate it successfully. This scale is the result of sport and recreational activities but does not necessarily reflect how easy or difficult it is to perform a rescue. For this reason, it should be remembered that both professional members of rescue teams, athletes and people looking for fun, have been trapped and drowned in rivers.

In the rapids there are frequent activities that carry risks that must be counteracted with sufficient preventive measures related to three fundamental aspects:

1. Personal protective equipment: helmet, rescue vest, suitable footwear and suitable clothing according to the environmental conditions, especially the temperature of the water and the environment
2. Mastery of specific techniques in wild and fast waters.
3. Organization of sufficient security measures: you must have professionals who are experts in the activity to be carried out in fast or wild waters. In no case can this type of risky activities be carried out alone or with amateurs. Safety supplies include ropes, carabiners, a knife, pulleys, tubular straps, rescue tubes and a fully equipped spine board with a collar, fastening straps and head immobilizers.

Image 5.14

Artificial canals are very common in many cities.

Photo ownership: José Palacios-Aguilar

General Canal Hazards

A canal is a narrow stream of water, of natural or artificial origin. They are relatively easy to recognize since they do not have the breadth or the great volume of water of lakes or rivers, and their waters are not as fast. Artificial canals are very common in many cities (Image 5.14).

Artificial canals can be of 3 types: navigable, aqueducts and energy. Waterways are often used to transport people and goods in boats, within cities or as a connection between different natural water bodies (rivers, lakes).

Image 5.15

Canal used to carry water for irrigation.

Photo ownership: José Palacios-Aguilar

Aqueducts are used to carry water to specific places, generally human populations that require water for consumption or for irrigation (Image 5.15). Power channels are built to generate hydraulic power, which in turn generates electrical power.

In channels the volume of water in the stream, the slope of the channel, the nature of the channel bed and margins, and the speed of the water should always be considered.

Pollution is the most serious problem of any canal (Image 5.15), especially for those found in cities since polluted waters spread diseases to living beings. In the navigable channels, the boats become in some cases the most important danger.

Channels can be contaminated mainly by factors such as the following:

- Chemicals and biological agents in and around water.
- Algae that produce toxins or microorganisms.
- Household waste, such as sewage.

Chemicals can come from a variety of sources, both household and industrial, and often cause skin and eye infections. Agricultural and rural areas carry their own pollutants.

Security measures:

- The most effective measure is a permanent and effective hygiene.
- Wounds must be covered.
- It is necessary to thoroughly decontaminate hands, face and personal equipment, especially before eating, drinking or smoking.
- You have to shower and wash very well.
- Personal equipment must also be decontaminated, always before next use, or before meal breaks.

It is necessary to be aware of a variety of indicators and symptoms that can appear after a bath or accidental fall into a gutter, such as:

- Dermatitis.
- Eye irritation.
- Stomach flu.
- Muscle and joint pain.
- Pneumonia.
- Hepatic injury.
- Neurological conditions.

If any of these symptoms appear, you should go to a health centre as soon as possible.

Image 5.16

Pollution is the most serious problem of any canal.

Photo ownership: José Palacios-Aguilar

CHAPTER 6
LAKES AND RESERVOIRS

INTRODUCTION

John Connolly

Take the time to check things out

"If only I had done…" is a common regret of parents and carers who have lost a child not just to drowning but from any cause. Every aspect of the event and what happened beforehand is examined in close detail in an effort to find out how it could have been prevented. If the parents are lucky it will not descend into a blame situation. A sad fact is that following the death of a child three out of five marriages or relationships break up.

As the father of five children, I know the pressure that can be placed on parents by their children to allow them to enter the water as soon as they arrive at their water recreation place. Parents are busy setting up their equipment and letting the children into the water can be tempting but must be resisted. If you are recreating at a location well known to you it will be possible to make a quick safety assessment but if you are at a new location you will need to take the time to make a careful safety assessment. This is especially true of holiday locations. Children can be allowed play out of the water while the parents make a safety assessment. This will include reading any safety signs and notice boards.

Image 6.1

Take the time to check it out

Lifesaving Foundation Image

Persons used to swimming at ocean beaches will find it very different swimming at freshwater locations. Instead of a gradual increase in depth there is often a deep entry and instead of sand underfoot there will be mud which children may immediately dislike or fear. Lake water often contains plant particulates in suspension and if swallowed can cause vomiting.

Freshwater is less buoyant than salt water and a swimmer's body will be lower in the water which can interfere with his or her normal breathing action. Freshwater can feel colder than ocean water and will not have shallow pools where very young children can play and their bodies will gradually adjust to the lower temperature.

They will go from having an out of water body temperature of 37.5 degrees Centigrade into 10-to-12-degree lake temperature a difference of around 25 degrees. Supervisors should enter the water before the children and make themselves comfortable there before allowing the children to enter as it may be necessary to help them out quickly. It is always better to take the extra time needed to check out the conditions at a location before entering water than to regret doing so for decades after a tragedy.

LAKES AND RESERVOIRS

Richard Franklin & Amy Peden

- ***A wide range of hazards and activities occur at lakes and reservoirs.***
- ***There can be a lot of variability in water depth, conditions, and hazards depending on season and climate factors.***
- ***Water temperature is often colder than expected.***
- ***Alcohol consumption is a major risk factor related to drowning at lakes and reservoirs.***
- ***Wearing a lifejacket is a good safety strategy.***

Here are several strategies you can use to help keep yourself and those in your care safe when on, in, or around lakes and reservoirs.

These include:

- *being aware of the weather,*
- *being aware of the hazards in and around the water body,*
- *wearing lifejackets (especially on boats or watercraft, children or for weak or non-swimmers),*
- *establishing behaviour rules,*
- *closely supervise children,*
- *learning CPR,*
- *not drinking alcohol in, on, or around water,*
- *staying hydrated and being sun safe,*
- *observing safety signage,*
- *talking to the locals,*
- *having a rescue plan,*
- *knowing your own strengths and limitations.*

Box 6.1

Lake and Reservoir Safety Strategies

Establishing rules and following them are important for keeping yourself and those in your care safe. These rules may include:

- *where you can enter the water and swim,*
- *entering feet first,*
- *no diving, or diving in a set location,*
- *having a buddy with you,*
- *no drinking alcohol,*
- *ensuring you have a plan if something goes wrong,*
- *establishing who is in charge and how that position of responsibility might change,*
- *wearing a life jacket,*
- *what to do when the weather changes,*
- *not using pool toys to keep you safe, etc.*

Box 6.2

Rules for keeping people safe in Lakes and Reservoirs.

GENERAL HAZARDS

A wide range of hazards can be found in and around lakes and reservoirs that need to be taken into consideration to ensure the safety of those visiting these locations. For our purposes here, we use the term lakes and reservoirs interchangeably, noting that reservoirs, while often forming lakes, may also have a dam or be dammed at one end. We will discuss dams in more detail in section 6.3.

Boating and using watercraft on lakes requires the same safety as those on any waterway. These include:

- *Ensuring that they have the correct safety equipment especially lifejackets that are accessible for the passengers and that there are enough life jackets for each person.*
- *Having the right size lifejacket for each person is also important so if you have children in your care, making sure their lifejackets are fitted appropriately is essential.*
- *Checking that lifejackets are in working order and if they are inflatable they have been serviced.*
- *Ensuring that lifejackets are not just on and loosely open but are secured, especially for children, and non / poor swimmers. It is difficult to secure a lifejacket when immersed in water.*
- *Fire extinguishers should be carried and close to hand. Even on water, many people can be burnt mainly due to the fuel carried on the boat.*
- *Emergency Position Indicating Radio Beacon (EPIRB) or emergency beacons are also a valuable safety device, allow you to signal for help if you get into trouble. You can also get personal locator beacons that you can wear.*
- *A phone / radio so you can call for help is important.*
- *You may also have flares in your safety kit for signalling for help as well as a chart, compass, drinking water.*
- *The boat might should include an anchor, rope, oars, and bailing equipment.*
- *Making sure your equipment is in working order before you leave is an important step in the trip.*
- *Develop an operating procedure that you leave with others on land which includes information on when you are going, where you are going and when to expect you back, so they can call for help if you do not return on time. The earlier a search starts the more likely it is that you will be found.*
- *Check the weather regularly.*

Box 6.3

Safety tips for boating and watercraft on lake and reservoirs.

Image 6.2

Alpine Lake

Stephen Walker on Unsplash

Lakes often look peaceful and tranquil (Image 6.2) but it is what is under the water that can impact on safety. Lakes are used for a wide range of activities such as fishing, boating, swimming, and paddling, and each activity has its own risks that need to be considered. Another key issue is water temperature. The water in a lake or reservoir is often considerably colder than expected, which can cause cold shock upon entry. The temperature of lakes can vary greatly depending on season, depth, geographic location, time of day or position within the lake, and where entry into the water occurs. This occurs when the temperature of the water is less than 15 ^{o}C (59 ^{o}F). Cold shock can cause involuntary inhalation which, if under the water at the time, can result in drowning. Cold shock can also cause heart attacks, hyperventilation, and neuromuscular incapacitation, which impacts on your ability to use your muscles effectively. Neuromuscular incapacitation is challenging if you need to ‘pull’ yourself out of the water as often you may not have the strength to do so.

Another significant issue is alcohol or more specially the consumption of alcohol on, in, and near water, to increased risk of injury or death. Alcohol is a depressive drug and a vasodilator which widens blood vessels, usually under the skin, leading to increased blood flow which speeds the cooling of your body when in water. Being under the influence of alcohol can impair your judgement, can reduce your inhibitions resulting in you performing riskier activities than normal, can reduce your muscle coordination, impair your reaction times and, should you need rescuing and resuscitation, may reduce the effectiveness of cardiopulmonary resuscitation (CPR) on your unconscious body.

Lakes vary greatly in size. Some lakes you can see from one bank to the other, with others being large enough to have their own weather systems. There are lakes that appear and disappear depending on the season or amount of rainfall and others that freeze entirely, or partially, over. No matter what the type of lake you need to understand the impact of weather on the conditions, especially if you are going boating or using watercraft. Changes in weather can be rapid around lakes.

If there are signs of thunder and lightning you should leave the water immediately, move away from open areas, avoid trees that are tall and isolated, and metal objects.

It is also recommended that you wait at least 30 minutes after the storm has passed before going back into or on the water.

Hazards in lakes are common and can range from objects you can see above the water such as trees, to hidden objects such as submerged rocks, weed, glass, and rubbish (e.g., shopping trolleys, cars, fences, etc.). Always check the conditions before entering the water slowly. Enter feet first (preferably wearing footwear). Do not dive or jump into water if you have not checked the depth or what is under the surface immediately beforehand. Some lakes have designated swimming areas, however, with most lakes there is mixed usage (i.e., swimming and power boating for example). Each person is responsible for their own safety and the safety of those in their care, even in lifeguarded areas. There is also a general responsibility not to put others at risk through reckless activity. If you are swimming try to do so in areas where boats or watercraft are unlikely to go. If you are in charge of a vessel, stay away from areas where people are swimming.

Water quality is another safety issue at lakes which can vary by season or weather conditions. In times of heavy or steady rainfall, water can enter the lake bringing pollution or contaminated water with it. Stagnant water should be avoided, as should water with algae or other visible contaminants especially sewage (a common source of contamination after heavy rain). However, it is not always possible to see contamination. Many diseases are spread via water. These include cholera or cryptosporidium (spread by human faeces) or leptospirosis (spread by animals) or giardia (spread by human faeces, however often in water already). Check for warning notices or ask the locals about the water quality and be careful in water that is regularly used by animals.

The supervision of children around water is important and changes as a child grows and learns more skills. Children under the age of five years and non-swimmers should be within arm's reach, having all your attention, all the time they are in the water. As a child grows or learn swimming skills you can move further away but be ready to help quickly if they get into trouble. Also, if possible you should check out your swimming skills in a pool prior to going to a lake so you know what your skill and fitness levels are. Often we remember what we could do when we were younger and this may no longer apply especially in open water.

Water skiing is a common activity on lakes and reservoirs and brings with it great enjoyment albeit with its own set of risks. Owners and operators of a boat or personal watercraft (PWC) have a safety obligation (often legal) to ensure that the boat is safe to use. This may include being registered, used safely (i.e., following the rules of the lake and the water safety rules generally) and has all the required safety equipment for passengers, crew, and skiers.

You should not have a person skiing behind a boat unless there is a spotter (this person should be responsible and it is recommended that they be over the age of 13 years), they need to ensure there are no dangers to the skier, be able to relay message from the skier to the boat operator, including letting them know if the skier falls off or if there is a vessel behind them. Lifejackets should be worn by the skier and the type should be appropriate for the conditions and the wearer.

Summary

In summary lakes and reservoirs can be enjoyable places to swim and recreate, however these environments have a number of hazards that you should look out for. Knowing your own skill levels and ensuring the safety of children is critical to having a safe and enjoyable day. Alcohol and water do not mix, as such if you are going to swim and drink ensure that you do not drink alcohol prior to swimming and if you have been drinking, do not re-enter the water.

DAMS

Richard Franklin & Amy Peden

- ***Dams vary in size.***
- ***There is a need to be careful of water quality and dam edges.***
- ***Dams can be difficult to get out of and may require different techniques.***
- ***Fenced safe play areas for children can prevent them from accessing the dam.***

Image 6.3

Small farm dam

Image from Amy Peden

Image 6.4

Large dam walled at one end,

Sharon Moy on Unsplash

Dams are usually manmade aquatic locations and can be smaller than a lake (they vary significantly in size). Some may be dammed at one end and let water out to supply the surrounding area, while some may be dug into the ground (Image 6.3 & Image 6.4). Dams are similar to lakes with respect to some of the hazards which may be present including water temperature, submerged objects, and water contamination. In addition, there are some unique hazards that need to be considered related to the dam edges, water visibility and usage which we will now discuss.

Farm dams are dug out of the earth, are often found in agricultural areas, and are predominately used by animals for drinking water (Image 6.5).

Image 6.5

Fenced farm dam with windmill

Photo by Farmsafe Australia

The sides can often be steep, muddy, slippery, and extremely hard to traverse once you have been in the water. Often there is no easy way out of dams unless there is a side which is less steep, however this side can also be muddier making exiting the water very difficult. One technique suggested for getting out of a dam is to make foot holes. This requires you to dig foot holes in the dam wall to enable your feet to grip the edges. These holes should slope downward in design to allow you to put weight on them without slipping back into the water. Another suggestion is to insert a stake into the ground with a rope hanging from it into the water. The rope should have big knots and loops to help climb up it.

Extricating yourself from mud in a dam.

When trying to get out of the mud, there are several suggested techniques. If the mud is covered in a layer of water you may be able to try and float or scull across the mud using your hand to gently pull you along. If you have a buddy with you, get them to throw you something or to place sticks and other long objects on top of the mud to help you pull yourself out and move across the mud. If a rope is available you could also use this to help pull yourself from the mud. Try and lean forward to angle your body in the direction you are being pulled.

Should someone disappear under the water, searching for people can be extremely challenging. Searching for people or other objects in muddy water should be undertaken in a grid pattern with a sweeping motion. This involves linking arms and moving forward with feet doing a circular motion as you move slowly though the water. If the water is too deep to walk in then you should use a technique where, as a group, you dive down move your hands in a circular motion to search the bottom and then return the surface and move backwards and undertake the process again, maintain a line with the other searchers.

Moving backwards when on the surface is important as we tend to move forward as we return to the surface and thus ensures we do not miss any areas. Once a person has been retrieved from the water undertake the process of Danger-Response- Send for Help-Airway-Breathing-Circulation-Defibrillation (DRSABCD). See Chapter 12 for more detail.

Young children

Water in general is fascinating for children, the way it moves, the reflection of light, the sound it makes, and the way it feels. As such, if a child is missing on a farm or area where there is a dam, checking the dam first is recommended, as time is of the essence. For young children, while some may seek out dams, especially those who have been to a dam before on several occasions and found the experience enjoyable, it is more common for children to be playing and to find the dam as part of their play.

Research has shown that most children drown in a dam that is within 200m of the house. While uncommon, it has been known for a child to travel several kilometres to the dam in which they have drowned.

Dams can be a fun place to recreate if used in a safe manner. Some of the bigger dams might even have pontoons and other water play equipment including row boats. The bigger dams may be used by jet skis or for water skiing. As with lakes when entering dams do so slowly and feet first, do not dive into unknown or shallow water, and be careful of steep drop offs. Submerged objects are common and the water can also be cold.

Remember to supervise children around dams. If you cannot fence the dam fence the house. For those working on farms, providing a child safe play area can help reduce the risk of the child wandering and getting into trouble. A child safe play area as the name suggests should be difficult for the child to get out of, ideally it would be like swimming pool fencing, i.e., at least 1.2m high, non-climbable, with no climbing objects around it and the gates are self-closing and self-latching. In the child safe play area, there should be a range of activities to keep the children entertained, such as swings, sand pits, toys, etc. Lastly there should be rules set about when the child can leave the area and who they should be with when this happens. Older children should not hold gates open for younger children.

Image 6.6

Example of a Child Safe Play Area on a Farm

Image from Royal Life Saving Australia

Image 6.7

Water leaving a dam

Edvin Johansson on Unsplash

Dams which provide water to other locations often have a slight current leading to a suction point where the water is either pumped out or naturally flows out (Image 6.7). In some places this is a spillway (i.e., the water runs over the top of the dam and then into a river, stream, or creek. The areas where the water is leaving the dam are extremely dangerous and should be avoided.

Most public dams provide some type of barrier to access these areas and often inlet areas will be covered by a cage to prevent debris from entering. These areas can often have vortexes which can suck a person down and make escape difficult. As with lakes, setting rules about where people can recreate and where they cannot, are important. Making sure that you enforce the rules no matter how unpopular the decision is vital, as rules without consequences are just suggestions that can be ignored.

As with all aquatic locations alcohol and dams do not mix. You will have read previously about the risk of mixing alcohol and undertaking aquatic activities and the same risks apply for dams. Dams may have pontoons. One activity which is seen to be fun is swimming under the pontoon and coming up the other side, however in water with low visibility this is a high-risk activity and if drinking alcohol, the risk is even greater.

Summary

In summary, dams can be great places to relax and have fun. They also vary in sizes from very small to very large. There are a number of hazards related to dams and these should be taken into consideration when deciding to interact with these environments. These include water quality, water temperature, slippery edges, and submerged objects. For young children, providing a safe play area around the house so children cannot wander and get into dams unsupervised is an important strategy to reduce drowning risk. As with all aquatic locations, do not drink alcohol prior to going into the water.

- *Make sure that you have what you need to keep everyone safe,*
- *Are there children who are unable to swim and will need to be supervised? Could you have them wear a lifejacket?*
- *What if something goes wrong? Is there mobile phone service and is your mobile phone in a waterproof bag?*
- *Do you have rope to throw and something that floats to send to a person in trouble?*
- *What are you water skills like? Have you swum a few laps in a pool lately? How did you go?*

Box 6.4

SWIMMING IN STILL WATER

Richard Franklin & Amy Peden

- ***Pick the location based on who is coming with you, especially children.***
- ***Try to avoid locations with mixed activities as these are common injury areas.***
- ***Bring a throwing buoyant rescue aid with a rope attached.***
- ***Enter slowly, feet first, preferably wearing protective footwear.***
- ***Never dive into water of unknown depth, shallow or with possible submerged objects.***
- ***Do not substitute flotation devices for the close supervision of children.***
- ***If you are going to consume alcohol do it after swimming and not before.***

We have previously discussed a range of hazards that are present in still water, such as submerged objects, cold water, watercraft, water quality, water visibility, weeds, debris, and outflow of water. In this section we will focus on where to swim and some things to consider before entering the water.

While it can be spontaneous, a trip to an aquatic location is often planned. This means that there is time to ensure that safety is a key consideration. Some factors to consider when choosing a natural water location for swimming are:

- Pick the location based on who is coming with you,
- If children are in attendance, does the location have a play area which is fenced if you need to prepare food?
- Is the location mainly used for boating or is it a popular swimming spot?
- Does it have a designated area for swimming?
- Are there lifesavers (although this is rare for still water environments) or public rescue equipment?

Picking a location

Often the safest place to swim is not where you first arrive, where you can park, or the entry to the location. Ask a local if unsure as residents in an area can be an important source of water safety information. Some areas provide access for dropping off boats and picking them up and can be particularly dangerous for swimming. Try and find a spot where people sitting on the shore can see those in the water and the location is free of other watercraft including jet skis, water skiing, sailing boats, etc.

When deciding to enter the water do so slowly and feet first, preferable with protective footwear. Popular locations may have broken glass and other rubbish under the water, which can cause injuries. Never dive into water of unknown or shallow depth or water where there may be submerged objects. This includes locations you have previously visited, as objects under the water can move. Be aware of the risks of cold water. Have a first aid kit.

Children

Children under five years of age should be within arm's reach at all times, with all of your attention focused on them. Do not substitute flotation devices or inflatable objects for supervision as these can tip over and place the child at greater risk. For older children change your supervision habits to allow them to grow and explore but maintain supervision and be ready to act if something goes wrong. For older, weak, or non-swimmers you might like to provide them with a lifejacket to keep them safe in the water.

Special hazards

Swimming in areas where there are weeds or other underwater hazards creates a risk. One of the most common is a person panicking because a weed has touched their leg, sometimes grabbing people around them and pulling them underwater. Where there are pontoons or areas which people can swim to, make sure that they or you can get there, remembering in cold water your strength to swim long distances is reduced.

If alcohol is to be consumed, it must only be consumed once the swimming has been completed, and not by a someone who is driving a boat or motor vehicle. Too often a person, usually male, has a few drinks and then attempts to swim across the lake or jump from a high place or swing into the water and gets into trouble and drowns. Searching for these people places others at risk and should be avoided.

Fitness is a key issue when swimming and you should not go further out than the distance you can swim back. In still water without a current this is easier to estimate, however it is important to note that if you think you are halfway you have probably gone too far, as you need to have some reserve energy in case something goes wrong and on the return you will expend more energy as you become exhausted.

Summary

Swimming in still water should be a planned event and you should consider the risk that may be present at your intended location and what you can do to ensure the safety of those with you. Alcohol and water do not mix so avoid consuming alcohol and swimming. Remember to always keep watch of young children within arm's reach with all your attention.

CHAPTER 7
BOATING AND WATERCRAFT

INTRODUCTION

John Connolly

Plan for Emergencies

That summer I was lifeguarding a sandy cove close to a small fishing harbour. There was a sailing club in the harbour with a public slipway used by both club members and public to launch boats, windsurfers, canoes, powerboats, and other watercraft. It was a good Irish summer with lots of consecutive sunny days and therefore plenty of work for the lifeguards.

Classes for windsurfers took place early Sunday mornings off the beach before it became crowded. The teachers took advantage of the lifeguards being present, using them to keep watch over the windsurfers, and the lifeguards didn't mind as it was a quiet time. The classes would end around noon when the cove began to fill with beach goers and club sailors took to the estuary water in their dingys and yachts for club competitions.

One Sunday, around noon, a windsurfing beginner became exhausted and abandoned his board. He was taken onto the beach by the lifeguards and warmed up. I swam out to the board, dismantled the sail, and towed it onto the beach. A second lifeguard began towing the board to the beach. Suddenly a powerboat, towing a female water skier, came around the headland at speed making a wide u-turn while the skier swept into shallow cove water showing off to those on the beach. The male helmsman was looking back at the skier instead of forward and she was waving to her audience on the beach. Neither saw the heavy windsurfing board. The lifeguard quickly dived and lay flat on the bottom. The boat missed the board but the skier did not. The water skis were smashed into pieces and the skier suffered shock, bruising, and a broken leg. The lifeguard surfaced, lifted the injured girl onto the board, and waited for help to arrive. She was treated by the team and removed to hospital by ambulance.

This was a completely avoidable event. The helmsman had ignored a byelaw warning sign on the slipway wall stating that power craft and yachts were forbidden inside bathing waters. Having ignored the byelaw and driven into bathing water, had the helmsman been looking forward instead of backward he would have seen the board and waving lifeguard and could have towed the skier away from it. Had the skier not been showing off to those on the beach she would have seen the board and lifeguard and been able to jump over it or let go of the tow rope and sink down into the water. They did not expect to find a windsurfing board in the water and had ignored the likelihood of there being swimmers in the water. Their attitude seems to have been we are big and fast and coming so get out of our way.

Whilst the accident I have just described could be considered unusual, most incidents can be predicted and planned for beforehand. Airline pilots use easy to follow checklists for most operations and especially 'what-to-do' lists for all foreseeable emergencies. Watercraft users can easily transcribe or copy what-to-do instructions into their own book of checklists and store it in a waterproof pouch to be accessed in case of emergency.

Image 7.1

Windsurfing

Photo by Vidar Nordli-Mathisen on Unsplash

BOATING AND WATERCRAFT

Roberto Barcala-Furelos, Silvia Aranda-García, José Palacios-Aguilar

- ***Inattention, alcohol consumption, and speeding are common causes of boating accidents.***
- ***The wearing of a lifejacket and nautical clothing can prevent hypothermia.***
- ***Check weather reports constantly and head for safety at first signs of bad weather.***
- ***Children should wear lifejackets suitable for their age and size.***
- ***Wear an approved aquatic helmet when operating a jet ski.***

General Hazards

The hazards that occur during boating and watercraft are mostly preventable since their main causes are related to human error. Other general hazards are caused by environmental conditions. Although hazards can affect anyone, they occur most frequently amongst young people in the 16 to 25-year-old age group. Each type of waterway, i.e., coastal, enclosed, and inland, has its own particular hazard or hazards, as well as differences in the recreational use of boats or personal watercraft (PWC). The most frequent hazards described in scientific literature are shown in Image 7.2.

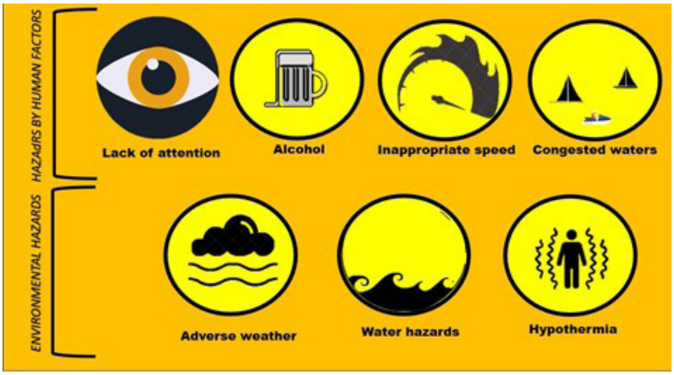


Image 7.2

Hazard triggers in boating and watercraft incidents

Roberto Barcala-Furelos, Silvia Aranda-García, José Palacios-Aguilar

Human hazards

Inattention is the main cause of incidents during navigation. Some recreational boats tow large floating toys or water skiers behind them which can cause a loss of attention in the direction of travel. Other common types of inattention are using a cell phone, admiring the scenery, or chatting with a crew member on the back of the PWC/boat. Attention is often impaired by fatigue or alcohol (or another drug) consumption.

Numerous drowning-related incidents have involved alcohol consumption, resulting in falls overboard, collisions with other boats, water structures and rocks, or encroachment into areas reserved for bathers. The consumption of alcohol or drugs while boating effects motor skills and responses (i.e., slower, and less precise), balance, coordination, concentration, and fatigue.

Another element increasing risk is inappropriate speed, especially in unfamiliar areas with varying bottom depths and rocks. Excessive speed is a risky behaviour in areas intended for bathers, boat entry, and exit channels (usually having speed limits of less than 5 knots), or in places of high density or congested waters where the risk of collision is increased (Image 7.3). Inappropriate speed, especially in PWC, causes bone injuries such as knee, leg and foot fractures, spinal cord injuries and head injuries.

Image 7.3

Hazards by human factors: congested waters

Image from Anna Baldellou

Environmental hazards

Knowing the weather forecast is essential before undertaking any nautical activity to reduce the risk of being out in adverse weather. Less favourable conditions are especially pertinent in the case of visibility (especially fog or storms, with or without thunder and lightning) and wind. Weather mainly affects open water and it can change suddenly. The level of experience of the sailors is important, and at the slightest sign of change, inexperienced sailors should look for shelter or a safe harbour.

Image 7.4

Vessel grounded by water hazard (not calculating the sea depth correctly)

Image from Adrián Santoro

The most relevant water hazards for boating and watercraft are caused by the type of seabed, rocks, or other submerged objects difficult to see. If the boat does not have a depth sounder, navigation should be in known depth areas and attention should be paid to any changes in watercolour (Image 7.4). The lower the draft of a craft the greater the risk of collision with the seabed or rocks. Waves can be highly dangerous depending on the size and the type of vessel being sailed.

Boats should avoid at all costs taking on water from the sides, as this may cause the boat to capsize coming down on top of one or more crewmembers. The risk of injury is very high in addition to the possibility of drowning or being trapped under the boat. Waves should be met head on, opening the throttle on the engine, to take the force of the wave. It is important to note that the propulsion mechanism of jet skis is a turbine that absorbs water, and in areas between waves where there is a large amount of foam, propulsion power drops. Rip currents can also be a hazard for paddle boats, as speeds of up to 7 km/h (4.5 mph) can be reached in the neck of the rip.

Hypothermia

Wind Km/h	5ºC	0ºC	-5ºC
0	5	0	-5
10	3	-3	-9
20	1	-5	-12
30	0	-6	-13
40	-1	-7	-14
50	-1	-8	-15

Table 7.1

Increased thermal sensation of cold in relation to wind speed.

The risk of hypothermia is caused by exposure to a temperature below body temperature, usually 36°C (96°F).

Any aquatic location below this temperature can cause hypothermia (depending on exposure time, water temperature, the victim's body fat percentage or clothing worn).

Hypothermia prevention is critical to boating safety, so nautical clothing or wetsuits are commonly worn by anyone using boats or jet skis.

It is important to adjust the layers of clothing or the thickness of the wetsuit neoprene to the conditions in which you are going to sail and should be appropriate for the climate and air temperature in order to resist the cold. An aggravating factor for hypothermia is thermal sensation, usually caused by wind chill and sailing speed (Table 7.1).

Immersion in cold water (below15°C) is particularly risky because it rapidly limits motor activity and prevents swimming, and in addition respiratory or electrical disturbances may trigger cardiac failure. Hypothermia has different stages and its evolution will depend on the castaway's ability to delay getting cold. The main symptoms are described in Table 7.2.

Normothermia.	*Mild hypothermia.*	*Moderate hypothermia.*	*Serious hypothermia.*	*Fatal hypothermia.*
37-36 °C	*35-33 °C*	*32-30 °C*	*29-25 °C*	*< 25 °C*
	- Shaking (Shivering) *- Speech Difficulty* *- 1 Tachycardia (HR)* *- 2 Bradycardia (HR)* *- Diuresis*	*- Bradicardia (4,HR)* *- Bradipnea (4,RR)* *- Difficulty and of coordination of movements* *- Level of consciousness* *- Mental confusion*	*- Disappearance of tremor (no shivering)* *- Failure of thermoregulatory mechanism* *- Blood pressure* *- Bradicardia (HR)* *- Arrhythmias* *- Muscle rigidity* *- No pupillary reactivity* *- No movement* *- No osteotendinous reflexes*	*- Cardio respiratory arrest*
HR: heart rate, RR: respiratory rate				

Table 7.2

Physiological behaviour in each phase of hypothermia.

Measures and recommendations to minimize hazards.

Before boating

- Carry out the “Check List” or list of checks indicated by the manufacturer and regulatory standards. Ideally, this should be done on a laminated support on the boat itself (navigation and communications equipment, engines, electrical system, oil, fuel, water, rigging, safety equipment, etc.).
- Maintain safety and environmental measures in the fuel supply.
- Check the weather report constantly and its possible influence on the route to be taken and pay attention to the evolution of the weather forecast.
- Check that the equipment required by the regulations is in good condition, for example 1 life jacket per person, 1 life ring with light and tail ring, 6 rockets with red light and parachute, 6 hand flares, 1 floating smoke signal, lights and navigation marks, 1 anchor line with length not less than 5 times the length of the vessel, chain length and anchor weight according to length, binoculars, charts and nautical books, fog horn, bell or similar, national flag, waterproof torch, signal mirror, radar reflector, signal code), 2 mooring poles, 1 pole, 1 oar or 1 pair of oars, 1 inflator and 1 puncture repair kit, fire and bilge equipment (according to navigation area, length and motorization).

- Check additional safety equipment (life jackets, life rings, poles, emergency kit, and thermal blanket).
- Each crew member should know how to use the above equipment and where it is located.
- Check the engine, battery, and fuel level.
- Check the functioning of communications (radio, cell phone).
- Prepare the route adequately.
- Inform a contact about the route, estimated time and people who will be navigating.

During boating

- Navigate according to the conditions and specifications of the boat (capacity, and manufacturer's specifications). Generally, the maximum number of passengers will be 2 persons for boats under 3m, 3 persons for between 3m and 3.5m, 4 persons for between 3.5m and 4.5 m., 5 persons for between 4.5m and 5m, 6 persons for between 5m and 5.5 meters and 7 persons for between 5.5m and 6m. PWC will vary between two or three occupants depending on the model.
- Respect navigation regulations (speed, distance, occupancy).
- Always pay attention to the navigation route.
- Be alert to possible weather changes, paying particular attention to possible variations in tides, currents, waves, wind, and fog.
- Avoid imprudent behaviour (speed, alcohol, overconfidence, unnecessary risks).
- The leader will always be responsible for "the man overboard" scenario during navigation.
- Always have VHF radio channel 16 open and a cell phone with a signal and the loudest sound and vibration activated. In the case of emergencies, the number 1-1-2 operates in Europe.
- Immediately report any incident that could put any crew member, bather, or the natural environment in real or potential danger, as well as any breakdown or malfunction of the engine.
- Control fuel consumption. Generally, the rule of 3 (1/3 outbound, 1/3 return and 1/3 reserve) or 2/3 roundtrip is recommended.
- Wear life jackets and helmets (don't just have them) on PWC and PWC speedboats.
- Powered craft should avoid being close to smaller, non-powered boats (sail or paddle) or swimmers, and always give way to any non-powered boat or swimmer.
- Avoid approaching large vessels, or institutional vessels in surveillance or salvage operations.

Boats and jet skis and children

As a general recommendation, in recreational boating activities, children should wear a lifejacket suitable to their size, preferably with a strap under the crotch. Children wearing too large lifejackets or ones without a crotch strap are vulnerable to falling out of them as the child sinks and the jacket stays on the surface. Jet skis are not recommended for children and recreational boats are not recommended for infants.

Lifejackets and helmets

Lifejackets and helmets are part of the personal protective equipment (PPE) recommended to minimize harm in an aquatic incident. Globally, lifejackets are regulated in most countries and are classified by their buoyancy or type.

European regulations classify lifejackets according to their buoyancy - in Newtons (N) - establishing 4 categories based on a person weighing 70 kg (50, 100, 150 or 275 N). The greater the distance from the shore, the higher the buoyancy level required. Table 7.3 shows the characteristics of each of the jackets.

Image 7.5

Not wearing lifejackets and overloading a small boat

Image from Roberto Barcala-Furelos

Image 7.6

Aquatic helmets for Boating and Watercraft

Image from Roberto Barcala-Furelos

Lifejackets	Buoyancy	Features
	50 N	• Buoyancy aid. • Suitable for people who can swim and maintain a correct position. • Suitable for inland waters, calm or close to the shore, where immediate assistance can be received. • Not suitable for unconscious persons (does not turn the victim over). • Suitable for water sports such as kite surfing, rowing, paddle surfing, etc.
	100 N	• Floats sufficiently to prevent a non-swimming person from sinking. • Suitable for unconscious people (they are able to flip it upside down and turn it upside down). • Used up to 5 miles offshore. • Whistle is provided to call for help.
	150 N	• Provides great buoyancy. • Most commonly used in recreational boating (up to 60 miles offshore). • Suitable for unconscious people (they are able to turn it upside down). • Manufactured with high visibility materials and colors and with reflective patches. • There are models with automatic inflation by means of gas bottles. • Once inflated, they make swimming difficult due to their large size.
	275 N	• Suitable for ocean navigation. • Great buoyancy even in rough seas or with heavy clothing. • Suitable for unconscious people (they are able to turn it upside down). • Once inflated, they make swimming difficult due to their large size.

Helmets should be worn in recreational PWC use. For aquatic environments, adjustable helmet models are available. They are made of resistant plastics - *e.g., acrylonitrile butadiene styrene* (ABS) - and provide a high level of protection.

Tips for the proper use of life vests and helmets

- Put them on before departing and choose the right size. The right size of helmet will have a better fit with perfect chin and neck support. The vest should be worn over the clothing (not underneath). This recommendation also includes raincoats, because the action of the vest and the air it retains, if activated, could drown the person.
- The function of the lifejacket is not to protect from cold or wind but to provide buoyancy. Although it may offer some thermal protection, it should not count as a warm garment.
- It is highly recommended that the lifejacket be fitted with a whistle and, if sailing at night, also with an approved waterproof light.
- After use, the lifejackets should be checked, washed with fresh water, and stored in a dry place which is protected from the sun.
- If they are inflated by means of a CO2 bottle, they should be checked periodically.
- High-visibility coloured vests and helmets with reflective bands can be seen at greater distances or in limited visibility conditions. On helmets, the reflectors are on the sides, top and back of the helmet.
- The use of helmets is a PWC recommendation. A helmet which is intended for an aquatic environment which is hydrodynamic and approved, should be chosen.

Ocean Survival

Being well prepared, having your safety equipment in order, and being well trained in safety and emergency procedures, can favour ocean survival when an incident occurs. Here are the most relevant aspects related to ocean survival.

Image 7.7

The proper use of a vest: train putting it on correctly before setting out, and ensure high visibility colour, reflective stripes, and a whistle.

Image from Silvia Aranda-García

Distress calls

A distress call should be made in the event of any serious incident requiring assistance or support from other vessels or marine rescue services (e.g., sinking or collision). The international distress message format includes:

1st - Check that the radio is on VHF channel 16.

2nd - Repeat three times *Mayday, Mayday, Mayday*. This message will take precedence over any radio communication and the rest of the boats that pick it up will come to the rescue.

3rd - Identify yourself with the name of the vessel by repeating it three times.

4th - State your position (GPS coordinates or precise references).

5th - Describe the nature of the incident.

6th - Explain the help needed.

7th - Add other information (number of people on board, estimated time before sinking, etc.).

Other types of call do not involve an imminent risk to life, and the format is as above, but substitute Mayday with PAN-PAN for emergencies without immediate risk to life (such as an injury with fracture), or with SECURITÉ for meteorological hazards or hazards threatening the safety of navigation.

Ways to leave a boat

If for any reason it is necessary to leave a boat that is at a standstill, the best strategy is to jump over the bow (front end of the boat). On the other hand, if the boat is in motion, jump over the stern (rear end of the boat), with the aim of keeping clear of the hull of the boat and the propeller as soon as possible. In certain incidents related to the steering of the boat, the boat may turn on itself. If the engine cannot be stopped and there is a risk of falling overboard, the crewmember will jump into the water on the side opposite the turn and get as far away from the boat as possible (Image 7.8).

In the event of having to abandon a jet ski, an attempt should be made to turn off the engine, which should be stopped by simply pulling the man overboard key. It should be abandoned by sliding towards the stern to prevent it from becoming unbalanced and overturning.

Avoiding drowning

The man-over board's first challenge is to stay afloat, keeping the airway out of the water. The use of life jackets is essential, since on many occasions the castaway will be so far from land that he/she will have to wait to be rescued. If a life jacket is not available, the person should remain afloat, minimizing efforts and in a horizontal position. Some items of clothing can become improvised floats as they retain air, or swimmers can try to reach a floating object.

A key aspect is to remain calm and avoid distress. Once your breathing has been sorted you should analyse the situation and try to make the best decision, staying with the boat or swimming to a safer place (if the engine is still running or if you are in a rocky area). The lifejacket, in addition to providing buoyancy, can help in gaining visibility for a rescue, due to its bright colour and whistle. It may be possible for more than one person to use a single lifejacket to stay buoyant, provided neither is in a panic. Lifejackets make swimming on the stomach difficult and it may be easier to turn onto the back while kicking the legs and waving the hands.

Survival swimming

Survival swimming is a swimming style in which the aim is to reach land or a floating point with the least possible effort. In the sea, waves, wind, or fatigue can make orientation difficult and cause the swimmer to move further away from the shore.

Image 7.8

Leaving the boat and jet ski safely.

Images from: José Palacios-Aguilar, Silvia Aranda-García, Roberto Barcala-Furelos

It is essential to use fixed elements as reference points for orientation to avoid confusion (e.g., lighthouses, distinguishable rocks, buildings on the coast) rather than moving elements (e.g., boats, floating objects ...) (Image 7.9).

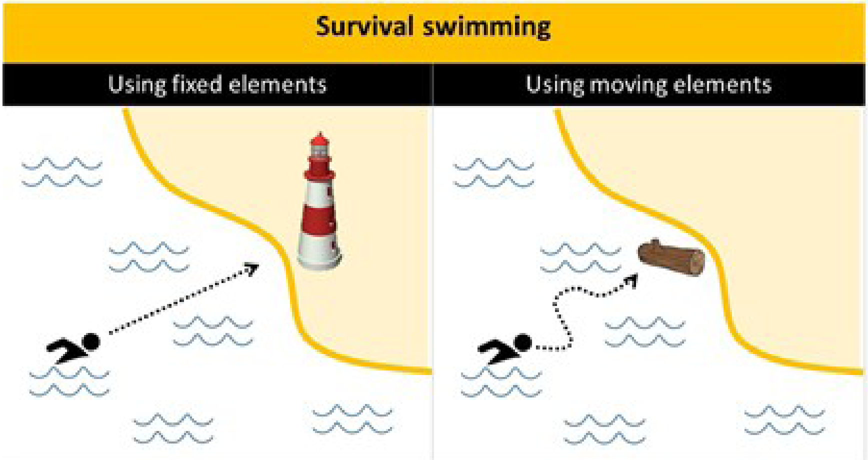


Image 7.9

Survival swim to get out of danger or reach dry land.

Images from: Silvia Aranda-García, Roberto Barcala-Furelos, José Palacios-Aguilar

Whichever swimming style is used the head should be out of the water to avoid heat loss and to keep reference points in view. It could be a head up breaststroke or a head-up overarm stroke. If the swimmer needs to rest, they can turn over and continue with a backstroke, turning occasionally to check the direction. Without a lifejacket the crawl style may be possible over a very short distance, lifting the head to check direction but should be avoided. A life jacket makes swimming difficult, but it is the only measure that will ensure buoyancy. If the swimmer is in cold water (below15ºC), inserting the head will generate a greater loss of body heat and activate the diving reflex. Therefore, the decision to swim to land or wait for rescue will be dependent on factors like distance, swimming skills, fitness level, and flotation equipment available and the insulation or thermal protection of the clothing.

Preventing hypothermia

Preventing hypothermia is one of the main challenges in cold water and also when exiting the water after rescue, especially in water below 15°C. Heat is lost much faster in cold water than in cold air, so a castaway should try to keep as much of the body out of the water as possible, and preferably on some kind of floating platform or clinging to the boat.

If this is not possible and energy must be saved, with more than one swimmer it is advised to stay in a huddled position with the head out of the water as this is the part of the body which is most sensitive to the cold and the one which loses the most heat.

After a rescue, preventing hypothermia will remain a key objective and basic first aid skills will be critical. If the victim’s airway is not affected, they can be transferred horizontally, thus preventing a drop in blood pressure. If the transfer is going to take a long time, the victim’s clothing should be removed and replaced with dry clothing. If dry clothing is not available, it should be wrung out as much as possible and replaced, and the victim should be completely insulated with an appropriate thermal blanket. A suitable thermal blanket will protect from air temperature down to -30ºC. It should be large enough to cover a big person including the head. The blanket should not only cover the victim, but also wrap around them, to insulate them from the floor of the boat, which may still cause heat loss (Image 7.10). For the transfer, place in a position on the boat with less exposure to the wind.

Image 7.10

Warm person with thermal blanket on a boat.

Image by José Palacios-Aguilar

Rescue

If someone falls into the water from the boat, shout "Man overboard!" to begin the rescue process. Lay rescuers should not enter the water. They should throw a life ring attached to a line or a rescue bag into the water or else try to reach the victim by holding out a rescue pole as close as possible to the victim (Image 7.11).

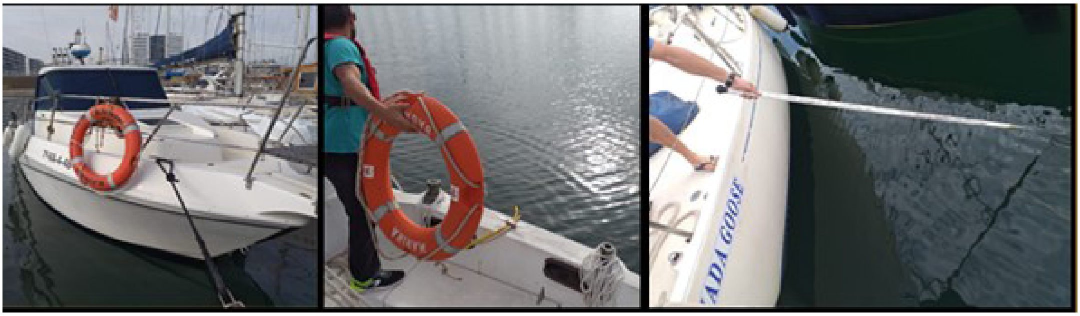


Image 7.11

Boat with lifebuoy. Using rescue hoop and rescue pole.

Image from Silvia Aranda-García

The objective will be to try to bring the victim back to the boat so that he can climb back up on his own, without holding onto the rescuer. In addition, life jackets, fenders, and other floating objects can be thrown in to help the victim grab hold of a floating device as soon as possible. If the vessel is equipped with a Chart-Plotter, the Man Over Board (MOB) warning button should be pressed. The engine will stop immediately to prevent propeller damage. If the castaway falls during navigation requiring the motor vessel to return for them, the Boutakov manoeuvre will be performed (Image 7.12).

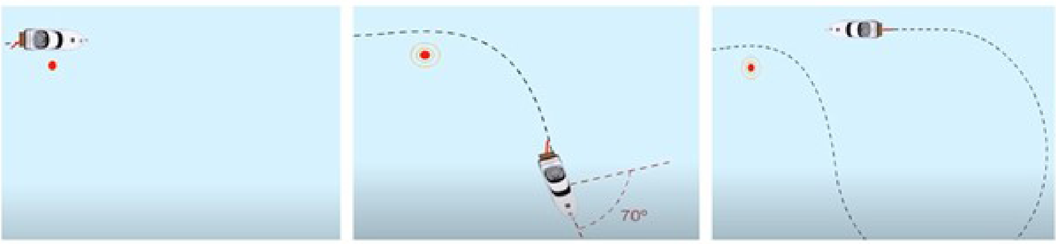


Image 7.12

Diagram of the Boutakov manoeuvre to return to the Man-Over-Board (MOB).

Image from Roberto Barcala-Furelos

Rescue bags or even a rescue tube can be used with jet skis, although due to the size and manoeuvrability of this vessel, if there are no added hazards (rocks, breakers), the rescue of a castaway will be done by approaching with the jet ski and telling the victim to come up over the stern (to avoid destabilization). The driver may use his right hand to give directions or move the victim to the stern. The left hand will always be fixed on the controls. (Image 7.13).

It is essential to avoid heroic or instinctive behaviour like jumping into the water if one does not have the appropriate training, experience, and materials, as the safety of the scene must always be considered. These aspects should be carefully considered in the case of getting into the water to rescue a victim, which would only occur in exceptional circumstances like when the boat cannot access the castaway or the victim's condition prevents him from helping himself by his own means (e.g., unconsciousness) (Image 7.14).

Image 7.13

Picking up a victim on a jet ski from the stern to avoid destabilisation and with the help of the skipper's right hand.

Image from Roberto Barcala-Furelos

Image 7.14

Assessment of safety, experience, and resources for water rescue

Image from Roberto Barcala-Furelos, Silvia Aranda-García, José Palacios-Aguilar

Summary

Prevention is the most effective measure for safe boating and watercraft activities. Human error is the most relevant trigger in any boating incident. Inattention, excessive speed, and alcohol consumption should be addressed in educational and prevention campaigns especially aimed towards young people aged between 16 and 25 years.

Active prevention should be an integral part of each trip plan and should involve checking weather conditions, the state of the boat and personal protection materials, as well as having clear communication and information about the specific route.

Survival at sea involves early warning, delaying submersion for as long as possible to prevent hypothermia, being visible (making oneself seen and heard at all times), and performing a safe rescue (without getting into the water).

The life jacket is a vital ally in survival. It will prevent submersion and keep the victim afloat until the rescue happens. If there is more than one casualty, the huddle technique will delay the loss of body heat.

If one chooses to swim to land or safety, using fixed landmarks in the swimming crossing is the most suitable way, but the victim should assess his or her capabilities and limitations, as swimming will speed up fatigue and increase heat loss, especially when one's head gets immersed in the water.

For an effective rescue, adequate care must be ongoing during the journey to land, thus preventing hypothermia by insulating the victim from the cold and practicing all necessary and possible care techniques (including cardiopulmonary resuscitation).

CHAPTER 8
SPECIAL SITUATIONS AND ACTIVITIES

INTRODUCTION

John Connolly

People before property

This chapter looks at several special situations where swimmers can find themselves in drowning trouble. It contains information on how to avoid getting into difficulty and what to do to survive and/or help others in these situations. Although the situations differ greatly there are still some common key survival principles.

If we consider the situation of a car about to enter deep water a key principle is that the need to save the occupants takes precedence over wanting to save the car. Sadly, sometimes a driver will first concentrate on trying to save the car and it is only when this fails that they start evacuating the occupants whereas evacuating the occupants should be the priority. Other misplaced priorities can occur in rock fishing where the reward of catching fish is sometimes placed above the dangers associated with a certain location, and in ice situations, where a short cut across lake ice may be preferred to a longer walk around the safer perimeter of the lake. Thinking about and talking about possible dangers beforehand can make a lifesaving difference. Having a prediscussed survival plan of action saves both time and lives. Families, for example, should talk about how they could evacuate their vehicle should it become necessary to do quickly with swimmers leaving before non-swimmers so they can support them in deep water. Buoyant objects such as cushions might need to be placed inside the car cabin for use by non-swimmers.

Another common feature to all drowning situations is the fact that unconscious people cannot help themselves. Transferring this to a fast car entering water it is important to keep seatbelts fastened until the vehicle stops moving. Also, when participating in extreme water activities wear a helmet. It is common for persons entering water from a height or at speed to be knocked unconscious by the impact unless the entry is vertical.

Entering cold water results in several physiological reactions collectively called cold shock which seriously impact on breathing ability producing fast shallow breaths. Practicing slowing down and deepening breathing in non-stressful situations prepares swimmers for the need to do so in life threatening situations. Knowing that the pain associated with cold shock is of short duration is important. Learning to swim in clothing in safe water avoids trying to figure out how to do so when in trouble. Having your phone inside of a waterproof cover in and on water so you can phone for help when you recover normal breathing is simple but smart.

ENTERING WATER FROM A HEIGHT

John Connolly

- ***Pull the body into a V shape when entering water from a height.***
- ***Use one hand to pinch the nose and pull the mouth closed.***
- ***Try to enter a breaking wave rather than flat water.***
- ***Once submerged, bend the knees to ease any bottom impact and to push up from the bottom.***

When considering surviving an entry into water from a height it is helpful to think of water as having a skin. Water does not have a skin but water molecules are strongly attracted to each other. When water touches air the molecules cling tightly together forming drops and act like a surface skin. This molecule attraction is called surface tension. Thinking that hitting water from a height is like hitting concrete is not accurate but it is not completely wrong either. Water will open after the impact breaks the surface tension thereby allowing a body to sink. Concrete that has set will not open after a fall impact.

Whether it is an accidental fall or a deliberate jump survival begins mid-air. A survival strategy can be broken up into three separate parts.

1. The pre-impact phase (falling through air)
2. The impact phase (hitting the water)
3. The post-impact phase (submerging in water)

Image 8.1

Fishing alone without a lifejacket

Image from John Connolly

Pre-impact Phase

When skydivers are excluded a falling person has little control over their fall speed through air. The following has been estimated by scientists.

A fall from 10 metres (33 feet) will result in an impact speed of approximately 50 kph (30 mph).

A fall from 30 metres (100 feet) will result in an impact speed of approximately 90 kph (56 mph).

A fall from 45 metres (150 feet) will result in an impact speed of approximately 105 kph (66 mph).

A fall from 76 metres (250 feet) will result in an impact speed of approximately 135 kph (84 mph).

kph = kilometres per hour   mph = miles per hour

To help put these heights into perspective:

Olympic high dive boards are 10 metres high.

The Golden Gate Bridge in the USA is 76 metres high.

A body will fall around 10 metres in 1 second.

A fall from Golden Gate Bridge lasts about 4 seconds.

Fallers have little control over their impact speed but they have some control over their body position when impacting the water. Pulling the body into a V or dart-like shape and entering the water vertically, feet first, is recommended as it reduces the possibility of serious injury. High cliff divers do this knowing that their upper body cannot withstand a head-first entry. The world record height for a successful professional feet first water entry is around 60 metres (200 feet). Survival, without major life-threatening injury, after an inexperienced fall from heights exceeding 50 metres is unlikely. Recorded falls from the 76 metre high Golden Gate Bridge are around 98% fatal (Image 8.2).

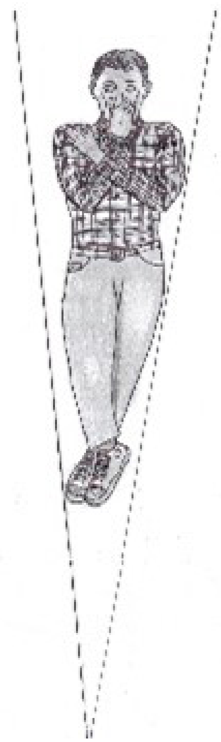


Image 8.2

V shaped entry into deep water

Image from John Connolly

The recommended survival position should be practiced at low heights often to make it an automatic response in a high fall situation (Image 8.3). There will be very little time to think about what to do once a fall begins. The body is held straight with the legs crossed to prevent them being forced wide open on impact. The toes are pointed downward (45 degrees) so that they are first to touch the water. The nose should be pinched closed to prevent water being forced up through the nostrils. The mouth is held closed and covered with the hand palm to prevent inhaling water from the cold-water gasp response on submersion. This is recommended by the United States Naval Service to survive falling from the near 20-metre-high flight deck of an aircraft carrier. It is practiced often at a safer lower height (as shown in the image).

Image 8.3

Entering water from a height

Image courtesy US Naval Service

Impact Phase

Drowning, with multiple fractures and organ damage, is a common recorded cause of death in high fall incidents. The initial impact pressure (the squashing) when a body touches the water surface does the damage especially if the body is in a horizontal or 'belly flop' position. The resulting injury depends on how fast the person's body is moving and the body shape at impact. Deep abdominal injury results from belly flops. Surface tension is not a problem in falls under 10 metres and clothing can reduce any stinging skin sensation. In higher falls a body will usually break the surface tension and sink. A lifejacket offers some protection for the torso but not the head. It will bring a jumper's back to the surface but if it is not secured with a crotch strap the jacket may by torn up off the body as the swimmer sinks.

In high dive competitions air bubbles are released from the bottom of the pool to break the surface tension for competitors. In open water, if a faller can determine when to jump, it is better to enter a breaking wave than flat water as the wave will break the surface tension. Cliff divers time their dives to achieve this.

Post-impact Phase

Following an injury free entry, the survival outcome still depends on the deceleration rate of the body following impact. As the body sinks the water begins to support it but it needs to be at least 2.5 metres (8 feet) deep, adding an extra metre (3 feet) depth for every 3 metres (10 feet) fall height over 2 metres. Hitting a shallow bottom headfirst can cause spinal injury, with possible paralysis or death, and a feet first bottom impact can result in broken leg bones.

Clothing worn can slow down a descent. Once the head is submerged bending the knees can ease a bottom impact and can facilitate pushing off the bottom to the surface. Once the descent stops swim to the surface and float on the back while recovering.

Tombstoning

Tombstoning is so called because the cliff or bridge jumper falls like a stone. Jumpers can fall climbing to a jump site or the jump can be misjudged, resulting in serious or fatal injury. It is to be strongly discouraged. Depths change with the tide and the water may be shallower than before bringing submerged rocks closer to the surface than previously. Exiting the water can be more difficult than realised, especially with a leg injury.

SELF-RESCUE FROM SUBMERGING VEHICLES

Gerry Dworkin

- ***Think of saving passengers before saving a vehicle.***
- ***Drivers should avoid crossing flooded roadways.***
- ***Have window breakers and seatbelt cutters close to hand.***
- ***Open electric windows immediately the vehicle stops moving.***
- ***Swimmers should exit before non-swimmers to support them in deep water.***

Each year, there are thousands of submerged vehicle incidents resulting in numerous deaths. In the United States alone, there are approximately 1,200 – 1,500 incidents annually resulting in 400 – 600 vehicle related drowning deaths. Public service announcements (PSAs) and campaigns should be increased to educate the public about the risks of driving through flooded roadways; driving in close proximity to bodies of water during snow, rain, or other slippery conditions; or driving over frozen bodies of water. The following information should be included within these PSAs:

- It only takes approximately 6" of water to sweep a person off his/her feet and, it only takes 1' to 2' of water to float a vehicle off its wheels. Drivers need to heed warnings about high water levels on roads and should never attempt to cross flooded roadways.
- No ice should ever be considered as safe ice! If you are going to risk driving over frozen bodies of water, at least 8"- 12" of new, clear, hard ice is required to drive a small vehicle over the ice; and 12" – 15" of new, clear, hard ice is required to drive a full-sized pickup truck over the ice.
- Wearing seat belts will increase your chances of surviving a crash into the water. If the vehicle is travelling at speed do not open a seatbelt until it comes to a stop or you risk being knocked unconscious at impact.

A sinking vehicle

If a vehicle leaves the road and lands in deep water, most passenger cars will float on the surface for a short period of time (30 seconds to several minutes). During this time, the vehicle will begin to fill with water as it seeps in through the floorboards. As the water enters, the vehicle will continue to sink deeper into the water. If the water is deeper than the height of the vehicle, it will submerge and disappear beneath the surface.

Factors that can affect the float time of the vehicle include closed and intact windows and the weather seals around the windows and doors. Other factors include the design, body style, construction quality and the condition and age of the vehicle. If the location of the motor is in the front of the vehicle it will immediately assume an angled nose down position in the water.

A vehicle with the windows and/or doors open will fill more rapidly and will submerge faster than the same vehicle with its windows and/or doors closed. The faster the water enters the interior of a vehicle, the faster buoyancy is lost and the quicker it descends. A vehicle that has all the windows and doors closed and intact will initially descend slowly, but as the water continues to seep in, the vehicle will rapidly lose buoyancy and the speed of descent will increase (Image 8.4).

Image 8.4

Submerged vehicle

Image from Wikipedia

Local municipalities can take steps to mitigate these incidents and should install appropriate guardrails along roadways that are adjacent to bodies of water. Regardless, drivers should prepare for submerged vehicle incidents and drivers and occupants should discuss the emergency procedures for survival in the event of a submerged vehicle incident.

Escaping a sinking vehicle

There is a very short time for self-rescue. Therefore, the decision to escape the vehicle must be made as soon as the vehicle starts to leave the roadway and enter the water. If the occupants delay their escape from the vehicle, once the water outside the vehicle reaches the windows, it may be impossible to escape until the water pressure has equalized inside the vehicle. Unfortunately, by that time, it may be too late to escape.

Image 8.5

Organised escape training

Image from ResQMe

If the depth of the water is greater than 14 inches (350cm) there is chance that, as the vehicle descends, it may end up on its roof, rather than right side up on its wheels. Being upside down in a dark environment with water is disorientating. If confused under water put one hand over the mouth and slowly blow air out, forming bubbles. Bubbles rise to the surface so follow the bubbles (Image 8.5).

Because of the angled nose-down position of the vehicle in the water, and the pressure exerted by the water against the doors, it may be extremely difficult, or impossible, to open the driver's or passenger car doors to escape. If the vehicle sustained structural damage during the incident, that would also affect the ability to open the doors. Therefore, the only avenue of escape may be through the car door windows.

Most, if not all, late model vehicles are equipped with electric window switches and motors designed to raise and lower the windows. Once the vehicle enters the water, although the electric power may stay on for a while, once the switches and motors get soaked, they will generally short out and the windows will no longer be able to be lowered. Therefore, to escape the vehicle before it submerges, the occupants must lower or break the side door windows. If the windows are made of tempered glass, the glass will easily shatter using a commercial escape tool or a spring-loaded window punch. However, these tools do not work on laminated glass. Most late-model vehicles are now being manufactured with laminated, instead of tempered glass.

Lifesaving Resources (www.lifesaving.com) advocates the following emergency procedures to escape your vehicle.

Seatbelts (off or cut)

Windows (open or break)

Children (removed)

GO! (get out)

Talk and rehearse

These emergency procedures should be rehearsed before the emergency occurs. As an example, the driver should practice finding the location of the door latch and window switch by touching their knee or hip with his near hand and then move the hand towards the latch or switch. If the vehicle has tempered glass in the door windows, a commercial rescue tool or a spring-loaded window punch should be immediately available for use to punch out the window. If there are multiple occupants, once an escape route has been established (through a door or window), each occupant should hold hands to form a human chain, and everyone should exit from the same route. In deep water, swimmers should exit before non-swimmers so they can help keep them afloat once they leave the vehicle. Anything loose and buoyant should be used to help keep them on top of the water.

There is no doubt that if a vehicle leaves the roadway and plunges into the water, it would be an extremely frightening experience, especially during the winter months with cold water posing additional risks and hazards to the occupants. By rehearsing the emergency escape and survival procedures, occupants can rapidly self-extricate themselves from this situation before the vehicle sinks.

HOW TO SURVIVE IN FLOOD WATER

Adrian Mayhew

- ***Learn the flood history of your area and stay away from hot danger zones.***
- ***Swimmers need to be on their back in floodwater, feet up, facing the water flow direction.***
- ***Find and hold on the chest something that will provide buoyancy.***
- ***Swimmers can use their hands to paddle their bodies across floodwater.***

With global climate change ever increasing and impacting on the world population, at some point people are likely to find themselves involved in flood water in some way. This generic advice gives a small understanding of how to survive such an event.

Prepare

Survival starts with preparation. Take the time to research the environmental history of your area. Is it on a flood plain or close to a water course likely to flood? Do you know what the weather warnings mean and how they might impact your area? Finally, what action should you take. Much information can be found on government websites giving information on preparedness and planning for families and households.

Being safe around water – zoning

Operating safely around water is essential, be it flood or natural water courses. One way, especially in flood situations, is what the Fire and Rescue Services observe and follow in western society. They call it zoning, whereby a 3-meter rule of keeping away from the "hot zone" ensures there is reduced risk of potentially falling into flood water (Image 8.6).

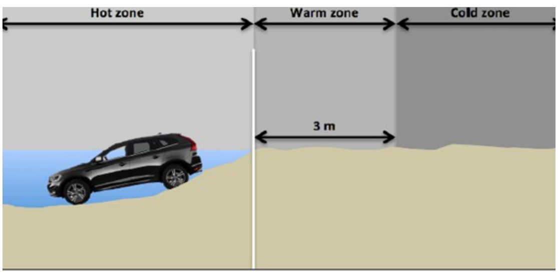


Image 8.6

Kind permission from Crown copyright 2018 DEFRA

Flood Rescue Concept of Operations-Open Government Licence v.3.

The “zoning” practice allows a person to realise there is an increased risk, and therefore you should stay in the cold zone where it is safe. In the warm zone consider that if you trip or slip you may end up in the water. Rescuers treat both hot and warm zones as dangerous and require specialist training and equipment to enter these areas.

Accidently falling into fast flow

Falling into fast moving flood water is frightening and extremely dangerous. Without training or the correct personal protection equipment, survival can be extremely low. In the first instance flood water is extremely cold, and the victim will be exposed to a natural phenomenon called the “cold water shock response”. It is here the person must try and stay calm and “float to live” until the cold-water response dissipates.

In flood water the swimmer’s body position is essential. The swimmer needs to be on their back, on top of the water, with their feet up pointing downstream. This is known in flood rescue as the “defensive position”, (Image 8.7). In this position a swimmer can use their feet to push off or away from any debris. Look for something to hold onto that floats. If you can bring the float towards the chest it will assist in lifting the body towards the surface.

Image 8.7

Defensive Position. Kind permission from Surf Life Saving GB

Copyright 2012- Inland Water Safety Awareness V.2

It is also essential for the swimmer to keep their bottom up and their feet up! In flood water, debris may float at different levels in the flow, surface, mid depth and grounded. Any impact can injure the swimmer, and more serious point is a situation called entrapment. This is when a large body of water can effectively pin part (such as a foot) or a whole body against an object that is not moving, such as a bridge support. The force of water in floods is immense, and if the swimmer becomes entrapped, survivability is limited without immediate on scene trained rescue personal, and death is the likely outcome.

It is essential to control any impulse to panic, to get your bearings, and to be situationally aware. Arms can be used in a double/single back stroke to reduce body speed. This will allow the victim to try and spot a possible way out. Look for a calm body or area of water. This could be a natural "beach" area or behind an object such as a boulder or in an urban environment, a letterbox. But not a car as they can move.

To achieve this, the swimmer must adopt two techniques:

1. Roll onto their front and freestyle hard into the eddie. They will need to work very hard until they feel the water around them is less turbulent. Once into calmer water, ONLY put the feet down until you can get to the bank or can see the bottom. (Diagram 8.8)
2. The swimmer remains on their back and uses their hands as paddles to "ferry glide" their body across the flow. Water moves in straight lines and therefore changing the angle of the body allows the victim to be pushed across. The angle should be between 60 degrees to 45 degrees from the main flow angle. Using your body as a boat, navigate to the chosen side. The way to remember is whichever side the swimmer chooses to go, their head and body line should be angled towards that exit point.

Exiting the Water

Once in a relative safe area, the swimmer needs to carefully remove themselves from the water and contact the emergency services. They will need to be medically checked over and details reported to the statutory emergency services.

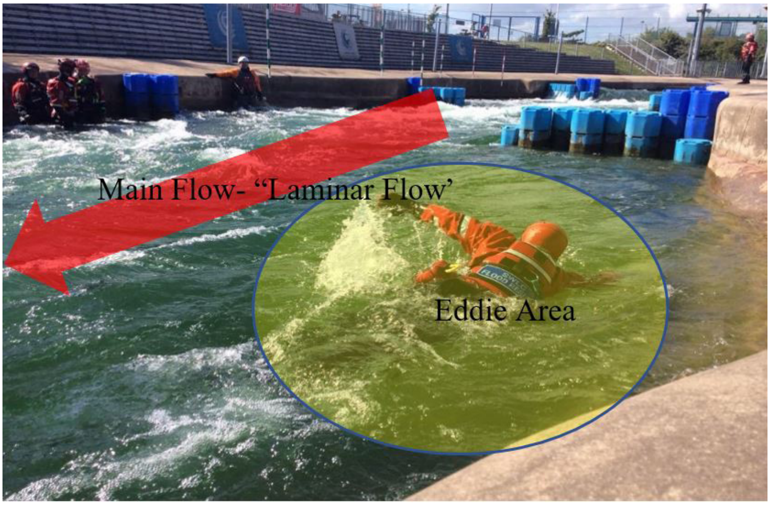


Image 8.8

SLSGB Flood technicians demonstrating a freestyle (aggressive) manoeuvre from main laminar flow to an eddie.

Image by kind permission of Adrian Mayhew

SURVIVING ROCK FISHING

John Connolly

- ***Don't place a good fishing location above a dangerous location.***
- ***Fish in groups so that help is immediately available if someone falls into the water.***
- ***Have a high safe place to run to if a big wave rises before you.***
- ***Wear an appropriate lifejacket and have your phone in a waterproof bag.***
- ***Wear head protection in anticipation of a fall on wet rocks.***

Rock fishing is the practice of fishing from rocks or rock ledges close to deep water. It is a dangerous activity with multiple drowning deaths recorded annually worldwide. This is due to the locations where people fish, the type of ground underfoot (wet, slippery, uneven), and the sometimes unpredictability of conditions at open water locations. These conditions make rescue difficult. No place is perfectly safe for rock fishing. Those fishing are advised to fish in minimum groups of three in known places used by experienced anglers. Inserting the intended location into a web search engine may show previous deaths or rescues at the location. You should always inform significant others of your plans and of your expected return time. The outcome of a rock fishing drowning event, be it death, injury, or no injury, is often determined by the amount of proper planning beforehand. Rock fishing is an activity where the aim of ***not getting trouble in the first place*** cannot be overstressed.

Location

A common mistake is when the catching of fish is placed above safety considerations. Finding the best fishing spot can involve walking over or climbing onto dangerous rock platforms. An easy walk carrying rod and tackle box at low tide can become difficult or near impossible once a tide is flooding. What will your fishing spot be like in a few hours' time with tide changes and weather deterioration? Avoid long fingers of rock which can only be reached at low tides, as these can leave you stranded (Image 8.9).

Image 8.9

Dangerous fishing location.

Image by John Connolly

Spend time watching the wind and wave action to get a feel for a new location before deciding to stay. Keep clear of black rocks covered with slippery algae. Think about where you can run to quickly if a big wave rises up before you and where you can get out of the water if you fall in? If you can't easily and safely run to safety or exit the water unaided fish elsewhere. Does the location have a phone signal? If help is needed can it be called immediately from that location or will time be lost looking for a viable signal? Is your phone in a waterproof bag?

Lifejacket

Wear a lifejacket. Lifejackets are essential for rock fishers providing them with the highest level of safety if they fall into the water. Many can be worn comfortably over clothing. Someone in the sea wearing a lifejacket is four times more likely to survive than someone without one.

Footwear

Wear light weight shoes with non-slip soles or traction cleats. These are essential on wet, weedy rocks. Avoid heavy footwear or open footwear that can fill with water and drag you down. Sports trainers float. Whatever you wear you should be able to float at a minimum and swim a little in them.

Clothing

Wear lightweight clothing that is easy to swim in. In cold conditions wear layers of clothing. Some anglers like to wear wetsuits. If you are swept off the rocks you want to be buoyant and able to swim. It can be tempting to protect yourself against the elements with big, heavy, waterproof clothing to keep you dry and warm. These clothes will weigh you down and encourage you to try and remove them. Air trapped inside clothing provides insulation against cold and some buoyancy in the beginning. Wear a lifejacket over layers of clothing. If you can float in your fishing clothing do so waiting for the effects of cold shock passes. If you decide to swim you can remove problem clothing while floating.

Head Protection

Wear head protection against falling and striking your head on a rock. Slipping on wet rocks is a common cause of injury. A low-level head wound may bleed a lot and can blind you if it enters your eyes. Concussion leads to confusion. Minimum protection could be a woolly hat. Headgear should be attached to clothing so that if it falls off it is not lost and can be replaced.

Waves

Image 8.10
Have somewhere high to run to
if a high wave lifts up in front of you.
Image from John Connolly

On arriving at a fishing spot, take time to watch the waves. Wait and observe a full swell cycle so that you know exactly how the water is behaving before you start fishing. Some rock ledges look safe until the swell rises and hits them with a powerful wave. Remember that the swell will be at its most unpredictable shortly after stormy weather and at changing tides. Rocks that are wet have been splashed or swept by waves. What happened before can happen again. Figure out where the safe spots are and think about what would happen if a big wave lifted in front of you. You won't have thinking time when it happens (Images 8.10). What is your safety procedure? Don't ever turn your back on the sea. If the waves, weather, or swell threaten your fishing spot leave immediately.

In Trouble

If you find yourself in trouble stay calm. A lifejacket will keep you on top of the water. If you can climb out immediately do so. If not, there is a danger of being bashed against rocks, so swim away a little and then float. This allows time to take stock of your situation. Look for a safe place to come ashore or stay afloat and wait for help to arrive. If your phone has a signal and is in a waterproof bag you can summon help. Fishing groups should bring a buoyant throwing aid like a throw bag, a powerful flashlight, and a first aid kit. All should know how to perform CPR and to control bleeding.

Communication

Fish in a group of at least three people and stay within sight of each other. If someone is washed in, one person can stay and help while the other alerts emergency services. Check the reception on your phone before starting to fish. Phone home telling them where you are and when you expect to finish. Whichever communication devices you choose, you must be able to reach them easily in an emergency and they must be protected from water ingress. Check the equipment before leaving home.

Tides

Check the tide tables so you know when high and low tides occur and the expected water heights. Know that the largest incoming movement caused by tides is the two missile hours of a six-hour cycle. Be prepared to move your location.

Weather

Make sure you are aware of local weather, swell, and tidal conditions before going fishing. Once at a fishing location take time to observe the current conditions, they may be different to those predicted or may be changing.

Image 8.11

Safe ice thickness

Image from US National Weather Service

ICE SAFETY AND SURVIVAL

Gerry Dworkin

- ***No ice on top of water should be considered safe ice.***
- ***Immediately put your hand over your mouth and nose to prevent the inhalation of water.***
- ***Clothing will help provide some insulation from the cold.***
- ***You have about 10 minutes of arm strength to pull yourself up onto the ice.***
- ***Pull yourself up onto ice you had previously walked on as you know it can support your weight.***
- ***Once off the ice get help quickly.***

NO ICE should ever be considered as **SAFE ICE**. The public is encouraged to be cautious when fishing, skating, skiing, or snowmobiling on frozen ponds. And, just as important, the public should know what to do and be prepared in the event of an emergency.

Every year, several people drown while venturing out onto ice in an attempt to save their pets that have fallen through the ice. Keep your pets under control and off the ice. In the event of your pet or a person falling through the ice, immediately call or direct someone to call the emergency services and only attempt a shore-based rescue by throwing something or extending something to the victim from the safety of the shore or solid ice.

Before venturing out onto the ice take the time to assess the thickness, integrity, and consistency of the ice. But be aware that ice does not freeze evenly across a body of water. The ice might be 4 inches (10 cm) in one location, but only 2 inches (5 cm) a short distance away. Moving water, partially or fully submerged objects (i.e., tree branches or rocks), fish and birds, are all going to impact the integrity of the ice (Image 8.11).

At least 4 inches (10 cm) of new, clear, and hard ice is required to support a single person for walking, skating, skiing, or ice fishing, and groups require 5 – 6 inches (15 cm) of new, clear, hard ice. At least 5 – 6 inches of new, clear, and hard ice is required to support a snowmobile. At least 8 – 12 inches (20 cm) of new, clear, and hard ice is required to support a car or small pick-up truck, and at least 12 – 15 inches (37 cm) of new, clear, and hard ice is required to support a full-sized pick-up truck.

Be prepared

Being prepared is an important survival act. When venturing out onto ice carry a pea-less plastic whistle that can be used to signal others in the event of an emergency. A pea-less whistle can get wet, be fully immersed in water, and will work after emptying the water out. Also, carry ice picks that can be used to get yourself out of the water and back onto solid ice in the event of a fall-through.

Consider purchasing and wearing a float-coat or anti-exposure coveralls when out on the ice. These are Personal Flotation Devices (PFDs) that are designed to keep you warm and dry when on the ice; and they provide buoyancy and extended hypothermia protection in the event of a fall-through into the water. A float-coat or anti-exposure coveralls (Image 8.14) would be especially useful for ice fisherman and snowmobilers.

Image 8.12
Whistle without a pea
Image from Wikipedia

Immediate action

In the event you fall through the ice, immediately cover your mouth and nose with your gloved hand to prevent you gasping and aspirating cold water into your mouth and airway. Don't panic! You need to concentrate on getting your breathing under control, so you don't hyperventilate. Try to take slow, even, and full breaths. Do not remove your clothing. Your clothing will trap air and provide you with a degree of buoyancy to help you stay afloat. Your clothes will help insulate you from the cold water.

It is important that you take immediate and deliberate steps to self-rescue. Turn back in the direction you came from and try pulling yourself onto that section of the ice as it was strong enough to support you prior to your fall-through. Kick your feet hard to get your body up horizontal in the water. Then, continue kicking with your legs and swim up onto the ice. Place your elbows on the ice shelf and let the water drain out of your clothes. If you have ice picks, use them to pull yourself out onto the ice using short choppy strokes. Do not extend your arm fully as you drive the pick into the ice. Short choppy strokes are needed to pull you up and out of the ice hole.

Image 8.13
Ice picks
Image from Wikipedia

If you don't have picks try to slowly pull your body up onto the ice shelf with your arms and elbows while kicking your feet for propulsion and keeping your body horizontal.

Once out onto the ice, stay horizontal and roll away from the hole until you are on solid enough ice to crawl and then walk away. Once off the ice, seek immediate shelter to dry off and warm up.

Summary

We advocate the principle of the 1-10-1 Rule. Upon entering the cold water, you have **1-minute** to get your breathing under control. You have **10-minutes** of meaningful movement of your arms and legs to perform a self-rescue before your muscles stiffen up from the cold. And, if clothed, you have **1-hour** before losing consciousness from hypothermia.

Image 8.14(a)

Float Coat

Image from Wikipedia

Image 8.14(b)

Coveralls

Image from Wikipedia

CHAPTER 9
ENDURANCE SWIMMING

INTRODUCTION

Nuala Moore

Being able to recognise cold water incapacitation could save a life

December 2013, Tyumen, Siberia, water temperature 0° C; Air Temperature minus 20° C
World record longest distance swim of 2400 metres in water at 0°Celsius.

Henri Kaarma is a world-class ice swimmer from Estonia, and possibly the greatest ice swimmer in the world. He was attempting to break the then 2150m world record distance in 0°C water.

Henri dived into the 25m pool craved from ice. The first 1650m were rhythmic. The Russian pool side team were ice swimming specialists with a full recovery team and sauna waiting. Cold water forces the body into survival mode. The eyes are the window to the soul making stress visible. Previously I had witnessed a swimmer swim to unconscious. I was in a heightened state.

His stroke rate was even and powerful as he passed 2000m. At 2150m I noticed the look in his eyes. I signalled the referees that we needed to increase our vigilance. I was new to the group and don't speak Russian but we understood the extremes of the sport and respected each other's experience. At 2200m, Henri missed his turn, and there was a pause before he pushed through. Was I panicking or was this a risk sign? I noticed that his body was lower in the water.

Image 9.1

During the swim

Image from Nuala Moore

His legs had dropped and he was gasping but he had broken the old record and was still swimming (Image 9.1). At 2300m I was on my knees as he reached the wall. I touched his hand. His head jolted backwards towards me. His eyes were pierced and vacant. I released his hand and he pushed away. He was moving at a slower pace, his head struggling to turn, his mouth open into the water, his arms were uncoordinated with his breathing, and his power had gone. I was very concerned. Few present were aware of his situation.

The challenge was 'how do we stop this swim?' Henri was on autopilot and stopping him would be a delicate balance. I walked the lengths shouting "Henri, Henri, Henri". I was at each pool end, touching his hand and releasing him, building up to the moment I would grab and stop him. It was important to bring him back to us for his recovery.

At 2400m I grabbed his hand and did not let go (Image 9.2). He pulled backwards. It was a huge call, stopping a world record attempt. The Russians managed his exit quickly, placing him in a horizontal position for recovery. I was concerned that I had made the wrong decision. One hour later, he stood on the podium with a new world record. Seven months later, at a competition in Argentina, we discussed that swim. How he remembered it compared to the reality was so different. I had made the right call.

Understanding the challenge and having an experienced team is vital as is having the courage to make the hard call. It is the gold standard. Henri's recovery was challenging, but he was very experienced, as were the Siberian team. It's not about, 'if the cold will stop you but when'. We pioneered competitive ice swimming for four years, before the rest of the world caught up with us in 2015. Experience allowed us to introduce many safety procedures for ice swimming. Extremes will always have limits. If we respect the rules, stay honest, so much is possible.

Image 9.2

Stopping the swim

Image from Nuala Moore

EXTREME COLD SWIMMING

It's Not All About The Swim

Nuala Moore

- ***Most year-round open water swimming in Ireland and the UK is in very cold water.***
- ***Swimmers often do not understand the risks involved and are unable to identify hazards.***
- ***There is a limit to all swimmer's immersion time in cold water.***
- ***Cold shock is not a problem for experienced extreme swimmers as they are habituated to it.***
- ***Creating a plan is integral for all swims in extreme conditions of temperature and/or time.***
- ***An extreme swimmer can be unaware that he or she is drowning.***

The following is not theory. I am speaking from personal experience as one of the world's leading extreme and ice swimmers. I am focusing on swimming in temperatures at or below 10°(degrees) Celsius or 50°Fahrenheit. This is the situation in Irish and United Kingdom waters for 8 months of the year. My aim is to explain how cold-water swimmers can find themselves in difficulty and in need of rescue. This applies to both experienced and inexperienced swimmers.

Definitions

Cold water swimming, extreme swimming, or ice swimming are all different facets of the same thing. Wild swimming is a recent term and implies swimming in remote locations. All usually involve swimming in a body of very cold water. Ice swimming is swimming in temperatures of 5°Celsius (C) and lower, sometimes in holes or pools cut into ice. The difference in the definitions can be as small as a 1°C change in water temperature, or a specific location. FINA (FÉDÉRATION INTERNATIONALE DE NATATION) enacted rules in 2017.

"*OPEN WATER SWIMMING shall be defined as any competition that takes place in rivers, lakes, oceans, or water channels except for 10km events.*

MARATHON SWIMMING shall be defined as any 10km event in open water competitions."

I view ‘extreme swimming’ as swimming at locations, where risk and outcome require a support team to mitigate the challenges, where rescue capability is not immediately on hand, or when training for the challenge requires a more advanced skill set. The terms sometimes merge, and the general understanding of specific risks gets diluted so much that swimmers are sometimes unable, to identify certain risks or even understand that any risks exist. Injury can sometimes be viewed only as short discomfort. It is important that the risks particular to different situations are considered. Survival can depend on a swimmer’s belief in themselves as to what they can endure and do.

The recent large surge in the number of those swimming in open water all-year round poses a safety challenge for the cold-water swimming community. There has been a large increase in the number of rescues of open water swimmers. Many of those rescued were in serious life-threatening condition when removed from the water.

“For many years, the majority of open water competitions were reserved for the hardy few who would specialize in specific training to overcome the special challenges they would face. However, over the past two decades literally millions of swimmers at every level have ventured into the world of open water swimming. With the increasing popularity of triathlons and the thousands of recreational and competitive open water races now offered around the world, this number continues to increase rapidly. Many of these uninitiated swimmers can focus on the distance and not include the challenge of cold water, and as a result be unaware of what they are getting themselves into, and the hazards and potential for trouble or tragedy have multiplied. The need for efficiently organising safe swims was always an imperative, and today this imperative is all the more important.”

Introduction, FINA OPEN WATER SWIMMING GUIDE 2018 EDITION

Areas of importance

In cold water swimming there are two areas of importance - the biological mechanics of a human body swimming in cold water and the characteristics of the specific body of water they are swimming in. The concept of cold-water injury is long associated with casualties falling into water and is often misunderstood. Cold shock is an immediate acute physiological response to immersion in cold water. It should not be confused with hypothermia, in which the body core cools below 35°C and takes longer to effect a swimmer. Swimmers new to cold water temperatures/winter swimming are vulnerable to cold water injury, need careful supervision, and should be mindful of their limits until they become habituated.

Cold Shock is not usually associated with injury in experienced cold-water swimmers. They can become habituated to entering such water, but they are not immune to the dangerous responses in ice cold water. Being generally healthy and managing the cardiac responses to cold are vital for positive outcomes in extreme swimming. As more swimmers expose themselves to cold temperatures the number of new and novice swimming casualties has increased. This can be a result of planning to swim too long a distance, of being unable to recognise the impact of cold on your ability to swim or exceeding an immersion time limit. The colder the water - the shorter the swim - the more emphasis we require on our recovery time when we exit the water. Experienced cold-water swimmers can and do swim long distances and sometimes in very cold water. In temperatures of 5°C and below. 1000m is considered a long-distance swim. This distance is far beyond the limits of recreational swimmers used to swimming thousands of metres in warmer waters. Being a fast pool swimmer or long-distance pool swimmer are not reliable indicators for being a successful cold open water swimmer. Extreme swimmers need mental strength.

It is especially important for persons new to cold water swimming to understand the risks associated with waters of different temperatures. They need to spend time acquiring detailed knowledge about their new sport. If you are to seriously swim long distances in cold water and undertake ice swimming challenges, you need to get a medical check-up specifically for that stated purpose. This should be from a medical doctor who understands the impact of cold water on your body. Remember we are talking about an ‘extreme sport’. When you start swimming in cold water it is very important that you swim within a group who understand the challenges. Plan each swim according to the lowest level of experience/ability in the group. That includes staying inside safety margins for locations, according to the group experience. One individual, in turn, takes ownership of the swim route, timing each swim and monitoring the weather. This develops a nice team dynamic and encourages shared responsibility to naturally occur within the group.

It is reasonable to assume that swimmers do not willingly place themselves in situations that can result in a fatal drowning incident. Therefore, we may presume that the cause of certain incidents was a lack of understanding of the impact of cold water on the body, inexperience, complacency, or ignorance of their surroundings. We now need to consider how a swimmer should approach a swim.

Image 9.3

Nuala Moore swimming in 3°C water at Beagle Channel, Chile, with Italy Glacier in background.

Image from Nuala Moore

The 4 T's

My aim is to provide a basic understanding of cold-water swimming and its associated risks. It is important to create a cocktail of things we can juggle around to ensure a positive outcome. You are not just going for a swim. The safety limit is determined by 4 factors. I call them the 4 T's.

- Time
- Temperature
- Training
- Team

Understanding the 4T's will allow swimmers plan their swim and then swim their plan. The topic is complex and I will focus on areas that help you understand how swimmers can find themselves in trouble. I will consider the swim, the environment, situational awareness, personal responsibility, and cold-water injuries. Usually, the trouble is not primarily caused by an accident or external incident but from a failing ability to continue swimming.

Time

Experienced cold-water swimmers usually know that there is a limit to their immersion time after which they should no longer continue to swim. If a swimmer is used to spending around one hour in water above 10° C and the temperature drops by 2°C or 3°C it can be difficult to accept that a shorter immersion time is necessary for safety reasons. A one-hour swim at 12°C is not the same as one hour at 10°C, and one hour at 10°C is not the same swim as one hour at 8°C. There are other factors like a strong wind, a cold air temperature, your personal physical state, and your mental state, that need to be incorporated into your plan. Bringing all together is very important for the swimmer's safety. One crucial area is allowing time to recover after a swim. The longer the time in cold water, the more time we require to recover. Once rewarmed I suggest that you allow yourself another thirty minutes to relax before you undertake tasks such as driving, etc.

Water temperature

British Triathlon has these guidelines for events. Note the colder the water the shorter the swim.

The minimum water temperature at which wetsuits are optional is 14 degrees Celsius.

At temperatures less than 11 degrees Celsius, no swim takes place.

At the following water temperatures, the maximum swim distances are mandatory:

13 degrees C – 2000m; 12 degrees C – 1000m; 11 degrees C – 500m."

- Moderate water has a temperature between 10°C to 15°C (50° to 60° Fahrenheit).
- Cold water has a temperature between 5°C to 10°C (40° to 50° Fahrenheit).
- Ice water has a temperature between 0°C to 5°C (32° to 40° Fahrenheit).

Acclimatising to ice cold water

I suggest you start distance swimming in open water in the summertime. Around Ireland and the United Kingdom summer water temperatures would be 12°C and 15°C. Understand the risks and challenges of spending time in water at temperatures of 10°C and lower. If you are ice swimming follow the ice swimming guidelines. Always work with a group or a club where knowledge of the times, temperatures, and challenges are known and understood. Extreme temperatures will keep you very focused. Being sharp and in tune with your body and mind is vital for cold water swimmers.

The greatest challenges to your body occur swimming in water below 10°C. Allow your body one summer and one winter to build up resilience to the cold. Physical acclimatisation comes slowly. Some swimmers may not like this but moving slowly is the safer option. It gives your body time to adapt physiologically to the pressures you are placing on the organs involved, especially the heart. I competed in the first Russian Swimming Championships in Siberia in 2012. Prior to competing I was swimming five and six hours daily in 10 - 12°C water. In that competition my longest swim lasted three minutes due to the cold water effect and my lack of experience. You should avoid taking on a major cold-water distance swim in your first season.

The second important areas we need to focus on are the visualisation and understanding of immersion in cold water. It is a combination of mind and body. When you enter cold water there is an increase in blood pressure, due to vasoconstriction – a narrowing of the blood vessels. This blood pressure increase causes responses both in your heart, your brain, and the inner workings of your body. Stress and anxiety add to the increase in blood pressure and fast breathing rate when experiencing the 'cold pain' early on. Entering cold water, produces a large response from the respiratory system.

The more a swimmer understands the challenge and visualises the outcome the more their respiratory system will relax thereby, resulting in a controlled respiratory response and an adjustment of our blood pressure, with a more positive outcome. Acclimatisation must include education, knowledge gathering, having a health check, and understanding the challenge. These will give you confidence and a better outcome to your swim.

Saltwater v Freshwater

Buoyancy is very important. Many ice swims take place in rivers and lakes. If you are a regular sea swimmer, and take on a freshwater swim, your buoyancy is less (Image 9.4). You will be lower in the water. This makes a difference to the mechanics of your swimming stroke. This drop in buoyancy may also impact your ability to self-rescue, therefore understanding how you float is important.

When cold water incapacitation sets in, the new lower body position will result in a changed head position and arm action resulting in breathing difficulty. Your body position may drop lower again, as your legs fatigue and slow, due to prolonged immersion in cold water. In the event of an incident understanding your environment, your buoyancy, and your ability to self-rescue, are vital components of a successful swim outcome.

Cold Water Incapacitation

Many swimmers training for channel swims or special cold-water distance swims, can frequently swim for up to six hours or more at 10°C. These are a unique set of swimmers. For this consideration we are talking about an average swimmer. In 10°C or lower water temperatures the speed of the cooling of muscles and organs is much faster than in warmer water. Entering water your general body temperature is 37’5°C. In as little as 10 to 15 minutes the deep muscle temperatures of your arms and legs can drop below 27°C. Cold research indicates that the maximum power output of muscles falls by 3% per degree centigrade fall in muscle temperature. When muscle temperature is lower than 27°C fatigue can occur quickly.

It is important to realise that in many of the recent open water rescues, the swimmers have been close to the shore. If a swimmer gets into difficulty close to the shore and is unable to swim 50 m or 100 m to safety we can conclude that an element of cold water incapacitation or swim failure is occurring. Ensure swim buddies understand the impact of cold water on our bodies, especially on our muscles. Swimmers may swim to shore and then find themselves unable to exit the water due to fatigue.

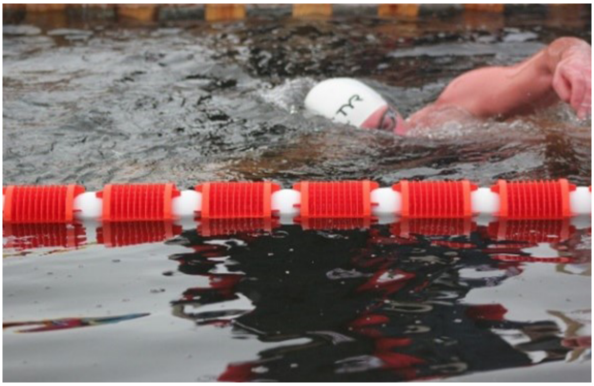


Image 9.4

Low swimming position indicating loss of power before swim failure.”

Image from Nuala Moore

We can help beforehand by having a swim plan that identifies easy exit places. When the arms and legs fail to propel us, we fail to swim. Cold will eventually incapacitate us all during exercises in cold water.

The muscles of the limbs become stiffer so when the swimmer attempts to leave the water they may be unable to stand or walk unaided or even remove their goggles. They may be unable to dress themselves or to make a phone call. Being incapacitated by the cold is very dangerous in and out of water and can have poor outcomes. One certainty is that at some point during a swim the swimmer will lose his/her swimming ability if they fail to remain within their limits. “Never risk a bad swim” was the best advice given to me, during our record-breaking Round Ireland Swim Relay. Always stay within the limits of your safety plan. It is always advisable that you have a support team (Image 9.5).

Image 9.5

Team recovering Nuala Moore from 7°C water at Drake Passage, Cape Horn.

Image from Nuala Moore

Wearing a wetsuit helps mitigate this cold water incapacitation/swim failure. Be aware that it just delays incapacitation and does not stop or prevent it. If you are used to wearing a wetsuit and start swimming in skins, in your swimming togs only, the cooling of the muscles happens at a much faster rate.

What are the signs of swim failure?

How do we recognise swim failure before it becomes an issue? The stroke rate will drop and the body drops lower in the water as the arms become weak and power is reduced. The legs become heavy and fall down causing the head to rise out of the water.

The stroke becomes uncoordinated and progress through the water deteriorates. The head and the hands can fail to co-ordinate so that when the head turns to take a breath the arms may not have finished their rotation. It may cause the swimmer to inhale water. This may occur, over a period of several hours at temperatures under 12°C. It can occur within ten minutes at lower temperatures.

A swimmer and their team should be very aware of these signs and understand that there is now a risk of drowning (Image 9.6). The element of team is vital in all swims of an extreme nature. Through my personal experience both in distance and ice swimming, I have witnessed swimmers, swimming to the point that they neither had the ability to assist themselves, nor the ability to remove themselves from the water. This need to 'finish' at all costs, when swimmers ignored their signs and symptoms of physical failing, is often driven from external pressures, such as social media, sponsorship, and team.

Image 9.6

Pedlars Lake Ice Mile swim 2013. 1800 metre swim in 3°C water with full team.

Image from Nuala Moore

As I was inexperienced and unaware of the risks, this very dangerous state was only observed once the swimmer was removed from the water. It is a shocking outcome. Their bodies had remained swimming, albeit it in a slow state, but once they were removed from the water, they became unable to respond to commands, or assist themselves. They had overridden their ability to recognise their limits and to stop. This is not as uncommon as one would think and is backed by research.

Situational awareness

Situational awareness includes knowing the water, the swimmer, the rescue options available, medical expertise, equipment available, and where to land a casualty with access for an ambulance or helicopter. An experienced team/experienced swimmer will compute all these factors quickly and as a swim progresses will make continuous judgement calls.

The team

When you are preparing to swim in cold water have an informed team around you. A swimming group is also considered a team. Before every swim, the group should decide the route of the swim, the exit strategy, the time limit in the water, and then stay within the limits of the group. The risks of the swim should be known to all. Team members must be made aware of their roles during the swim. It can be more than helping before and after a swim. It might be as a safety boat crew member or a spotter on land. In the event of an emergency, their role is no longer just spotting. It becomes that of a First Responder or at a minimum part of a First Response Team. Do not put your team at risks for a successful outcome.

Assessing risks and briefing the team and swimmers prior to cold water swims is a vital role within a team. Check the water temperature. The swim route is always determined based on the weakest swimmer in the group at the water temperature i.e., if one swimmer is unable to swim more than 500m at that temperature, then 500m is the maximum distance of that group/swim. If one swimmer has a maximum of 60 minutes as their swim profile, then the limits of time, should not extend beyond 80% of that time, taking conditions into consideration. Every single swim day the group needs to organise the swim profile according to the water conditions, the maximum time in the water, the temperature of the water, and the experience of the group. By following some basic rules, swimmers can reduce the likelihood of becoming incapacitated by the cold. There should be warm drinks and warm clothing afterwards.

On swims, involving extremes of time, temperatures, and remote locations, teams need to train how to act and react. The members need to know what should happen and what to do when it doesn't happen. Swimmers need to have confidence in their team. They may be too cold to speak coherently and must communicate through sign language. Work on signs like 'I need help' and 'Your swim is over'. One of the hardest things a team member may have to do is to stop a swim, especially close to the end, but if it must be done then do it. Uncertainty or unwillingness to disappoint a swimmer could cost them their life. When told that a swim is over swimmers must accept the instruction without argument. It is unlikely that a general team, different from a specialist team, will have medical doctors or other skilled paramedics as members. Choosing the right team members is important when swimmers are intending to push their limits in water (Image 9.7).

Visibility

As open water swimmers, we share our ‘swimming pool’ with many other water users. Once in open water, it is so important to be visible to other water users and from the shore. Tow floats do this and also offer external buoyancy to rest if needed. I use my tow float, as a dry bag. I carry a phone in a waterproof pouch, a dry tee shirt and shorts, in case I need to get out, and the keys of my car/camera etc. Tow floats are available in many different styles and functions. Always chose a brightly coloured hat, not one which blends with the white or blue of the water and sky” (Image 4.19).

Summary

How do we keep ourselves safe within the sport of cold open water swimming, ice swimming, or wild swimming? First, we assess our experience as a swimmer. Second, we look at the conditions of each separate swim, making ourselves aware of the risks involved, and then we make an informed decision. There is a world of difference both in physical and safety challenges swimming a mile in 10°C and a mile in 7°C yet these sea temperatures may only be about 10 weeks apart. Being aware of your limits and the impact of cold water could change your approach and your plans and may save your life.

If you are a pool swimmer transitioning to open water swimming stay within the limits of a confined space until you develop the skill and experience to go into open water. Learn about and be aware of tides, currents, weather conditions, wind strength and direction, and stay within the limits of your experience. Keep to the front of your mind, that in water below 10°C there are challenges to how your body functions, how your mind assesses risks, so this is when we need to be at our sharpest.

Vigilance is the price of safety and even though you may feel that there are very few risks attached to your swim, always have a plan. Having a safety plan makes you feel safe. Be capable of self-rescue (check your buoyancy) and be aware of where and how to get out of the water in the event of an emergency. Extremes will always keep us honest and by staying honest with ourselves, we have the best opportunity of staying safe and can continue to push our limits in cold water. Swim by time and not by distance as the temperatures reduce. Swim to recover, once your recovery is excellent after your swim, that is when you increase your distance. Always be aware of the signs and symptoms of swim failure.

Educate and learn and mostly know that to excel in cold water/in extreme swimming, we must always present as the best version of our selves.

THE DANGERS OF LONG-DISTANCE OPEN WATER SWIMMING

Janet Wilson

This resume is a mixture of observation and personal experience over a period of around 50 years and does not seek to explain or hypothesise on any of the technical or physiological aspects involved in completing a swim. The distance involved depends very much on the individual swimmer, and may start at as little as 5 miles, but more commonly 10 to 20 miles, and perhaps more, is usually regarded as a long distance. Whilst some swimmers will enter the realms of extreme conditions and pursue a swim greater than 20 miles or in waters under 10 degrees Celsius, most will enjoy their swims within the limits of 5-20 miles in 10–20-degree water. The sport is carried out by individuals wearing only the briefest of a costume or trunks, a silicone or thin rubber hat and a pair of goggles. Grease, ear plugs, and nose clips are also used, but not by all swimmers. The above are also the rules of the British Long Distance Swimming Association, both in their championship events and when swimmers seek to have an individual swim recognised.

There are of course several inherent dangers in subjecting the body to the above conditions. They can be roughly divided into those associated with the individual themselves, the swim course being attempted, the environment, and the contribution of others involved in the attempt. Of course, there is some overlap with all of these factors.

Firstly, the individual swimmer, although the other factors are just as influential. The biggest danger here is the mental state of the swimmer. Swimmers who are anxious or unsure of themselves or their crew in any way are usually consigned to failure from the start. The seamless working of a team is vitally important and is mentioned again later. Conversely swimmers sometimes are so determined to complete a swim that they will push themselves beyond safe limits of their capability. This is not always a bad thing, as determination and stamina often provide a good 50% of the reason for a successful swim. In short it is always good advice to swimmers to “get their mind right” before any swim. Training in the physical sense of the word is also important, but only secondary to the state of mind of the swimmer. Whilst a lack of training may cause a swimmer to abandon a swim, a lack of mental preparation will lead a swimmer into much more dangerous situations.

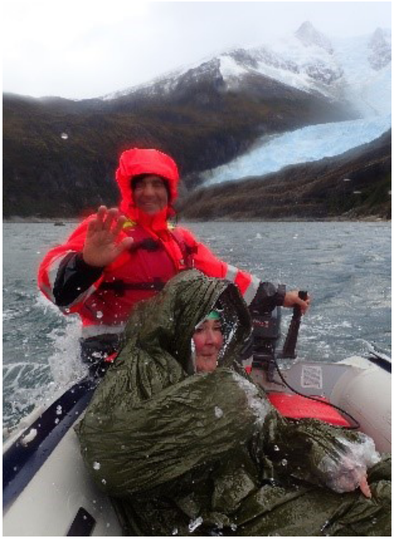


Image 9.7

Recovered after swim at Italy Glacier, Chile. A 28-minute training swim in 3°C water.

Image from Nuala Moore

There are undoubtedly some long-term adverse effects of long-distance swimming, ranging from musculoskeletal injuries from prolonged effort to chronic ear infections from immersion in water.

The others involved in the attempt contribute the lion's share of the safety responsibilities of any long-distance swim, and many dangerous situations can occur if the safety crew, both on land and water are not absolutely switched on to the job. The swimmer must trust them completely and their attention to the task has to be unconditional, in the same way as a parent looks after a small child. Swimmers often struggle to find such dedication and therefore end up with unsuitable crew who are either unwilling or unable to apply themselves to the task properly. Sometimes swimmers do not have confidence in the crew to take the right route and end up swimming away from the boat, but equally an impatient crew will sometimes stay on course and make no attempt to retrieve a swimmer who has gone off route. This clearly leads to a potentially dangerous situation with other water users and medical conditions developing whilst the swimmer is not in sight of the crew.

It is vitally important that the whole team have a plan for this situation before entering the water, to avoid the danger from escalating. Navigation plays a big part in a long-distance swimming attempt, and there is therefore a great deal of danger in a crew who cannot navigate accurately and take the swimmer of course or into dangerous water. Handling of whatever boat is used sometimes also causes potentially dangerous situations, when an engine fails, oars are lost, or the crew are inexperienced in changing weather conditions (Image 9.8).

Image 9.8

Support boat

Image from Outdoor Swimmer

The course of a swim often determines the dangers encountered and usually needs careful consideration and planning. There are many possible dangers here from getting tide information wrong on a sea swim and being swept into a danger zone, to failure to recognise a shallow patch in a lake and running aground. It is important to risk assess every part of the course and be prepared to change plans in the light of a dynamic assessment on the day of the swim. There are many inviting stretches of water which could be lethal to swimmer and crew if not researched and planned properly.

The environment is often blamed for the abandonment of a swim, but although a contributing factor, good planning of the course, together with the planning, preparation, and execution of the task by swimmer and crew, can overcome many of the environmental factors. The biggest danger to swimmers is usually the cold temperatures encountered. Habituation to the cold goes a long way to mitigating this. It is known that some humans can tolerate cold much more than others for various physiological reasons, but no one tolerates it without a degree of habituation first. At its most serious cold-water shock can develop, sometimes without warning, and the swimmer dies. Other medical conditions are exacerbated by the cold, so it is very important to get the balance of any regular medication right to minimize the risks. Sometimes crew have not been briefed on how to deal with a changing condition because of the cold and are also beginning to suffer themselves as well. This also links to the mental state of the swimmer and causes a dangerous situation. Other weather-related dangers of long-distance swimming can include thunderstorms, unusually high tides, heavy rainfall causing currents from swollen streams and high winds blowing the swimmer and crew off course. Although the main environmental factor is the cold, heat can also produce some dangers. Swimming is an activity where a higher than normal rate of exhalation occurs, thus resulting in dehydration. This coupled with a hot air temperature can produce a dangerous situation for the swimmer, who doesn't feel they are overheating, because they are in relatively cold water. Frequent drinks must be taken to counteract this. The sun itself, whilst a welcome companion to the long-distance swimmer, is very capable of burning any exposed flesh on the back of the body, including the legs. Another aspect of the environment which can be at best irritating, and at worst life threatening, are the creatures that live in the water. The most obvious ones are jellyfish, which could be fatal to someone allergic to their sting, but there are others that nip and bite and cause discomfort. This sometimes also applies to certain vegetation found in the water.

There are several rights and wrongs to consider if any of the dangers described above manifest themselves, and whilst it is usually the crew's responsibility to rescue a swimmer there are things the swimmer can do to get themselves out of danger. Primarily it is to know their own body and its limits, and communicate this to the boat crew before things get worse. The crew should be aware of any medical conditions and actions to take before the swim starts. The swimmer needs to relay any change in function to the crew as they cannot see everything like a pain or nausea for instance. This may be dealt with by requesting pre agreed medication or changing stroke or speed temporarily. If it is decided to abandon the swim, then the swimmer needs to listen to instructions on how they are to be removed from the water. Although not impossible, this is very difficult in a small boat as it will be unstable and possibly not big enough. The best way is usually to get the swimmer to the water's edge by holding on to the front of the boat and being carried along or to summon the services of a fast RIB. Whichever method is used the priority must be to get the swimmer out of the water and into warm dry clothes. In cases where a swimmer has been in the water for several hours there may be an issue with oxygen supply to the brain if they are raised to a vertical position quickly after being horizontal for some time.

There is a very efficient piece of equipment called a Jason's Cradle, which rolls over the side of the boat and allows the swimmer to lay flat on it. It is then rolled back into the boat with the swimmer still lying flat until an assessment can take place. For obvious reasons a sea swim should not be attempted with a small boat as the rescue opportunities are limited with no possibility of reaching the shore quickly (Image 9.9).

Image 9.9

Jason's Cradle

Image by Jasonscradle.co.uk

In the unfortunate event of a swimmer becoming separated from their support boat, then it is easy to say, they should not panic! This will increase the anxiety and energy used, reducing the chances of survival. If the situation cannot be remedied by shouting or swimming back to the boat, because the boat is too far away, then the swimmer should stay put and periodically try to raise the alarm by shouting and waiving one arm. Frantic movement or trying to swim on will probably result in exhaustion much quicker than staying still, and any rescue boat will be looking where they last saw the swimmer. There may be some advantage to adopting a huddle position to conserve some heat, but it is unlikely that the swimmer will feel much benefit of this as the body will cool very quickly. All effort must be made by the crew to find the swimmer as the swimmer can do very little else in the way of self-rescue. Swimmers should not attempt a swim without a crew as this situation may then occur with no prospect of rescue. Other self-help measures may be possible, such as moving out of a strong current or turning the face away from waves, but the swimmer will probably be too disorientated to do any of this, particularly where there is no boat or land in sight.

As with any potentially dangerous situation the key is to risk assess at every stage from when an attempt is first thought about to the moment the water is entered, and then to constantly do it again throughout he swim. Risk assessing as a team effort and engaging all possible mitigating acts to reduce risk can make long distance swimming as safe as any other sport, but of course it is not possible to remove all dangers when one is competing with nature.

CHAPTER 10
WATER COMPETENCE

INTRODUCTION

John Connolly

Sometimes plans go wrong.

I was 12 years old when I learned to swim. I was self-taught which was an achievement but also a handicap later when I developed an interest in lifesaving.

Every year a swimming teacher would base himself in a local pier and teach swimming to those who could pay him. I could not pay. As the classes took place in an open public place I would sit at the edge of the pier and watch him teach. When a class ended I would move to a different part of the pier and practice what I had just watched. He had a simple and clear lesson structure without the use of teaching aids. He would start with a mushroom float, to establish that human bodies have natural buoyancy. He then had his students stretch out their legs and hands into a long face down (prone) float position, followed by a prone push and glide from the pier wall in waist deep water, and then adding a leg kick to extend the glide. He had his pupils bend down in waist deep water and practice a crawl arm action. The next step was push, glide, kick, and add the arm action. The final part was adding breathing by rolling without lifting the head. It was successful with most of his pupils – including the non-paying me!

In time I found that I could 'swim' across the width of the pier in waist deep water (Image 10.1). Then I faced his graduation test – swim across the mouth of the pier at high tide. He would tread water midway lifeguarding his pupils should they fail but I faced it alone – without his 'safety net'. I was stretched to do this but achieved it and then considered myself 'a swimmer'. I was confident enough to join the boys and girls who jumped and dived into the deep water from the steps inside of the pier wall. Great sport!

I was the only one of my friends who could enter deep water at that time. They set up a dare for me – jump off the high storm wall and swim around to the steps at the pier mouth. This would happen the following weekend. I thought about, formed a plan, and accepted the challenge. I secretly travelled alone to the pier every day. I paced out on the ground the distance to be swum from the jumping-in start place, along the wall and around a right-angled turn, to the steps. I then paced out the same distance in the shallow end at low tide. I swam the measured distance very day in waist deep water. I was confident that I could swim the distance in deep water but never tried.

The day of the test I climbed up onto the top of the storm wall, pinched my nose, and jumped into deep water. I had not practiced a jump this high and did not realise how deep I would sink. I struggled to kick to the surface where I treaded water with difficulty before rolling onto my back, kicking my legs, while catching my breath. I then rolled over onto my stomach and set off swimming along the wall towards the bend. I was moving slowly but steadily and my confidence grew. I turned the bend, and to my horror, saw that a group of teenage boys were playing in the water with a ball. They blocked my way. I didn't want to risk swimming through them and decided I would have to swim out around them. This added extra distance to my swim and I began to struggle. I knew that I was in real trouble. Then I heard a male voice. "Keep kicking lad. You are doing fine. I am right behind you to help if you need it." Hearing him I got new energy and confidence and kept kicked until I reached the steps. I clambered up them on my knees. I stopped and looked around to see who had rescued me without ever touching my body. There were several men and youths swimming around, ignoring me. I had no idea which one had been my saviour. My friends congratulated me on my achievement not realising that they could have watched me drown.

Image 10.1

Mouth of the pier

Image by John Connolly

WATER COMPETENCE & SURVIVAL TRAINING

Stephen J. Langendorfer

- ***Water competence includes being able to survive common drowning situations.***
- ***Water competence comprises different skills, knowledges, and attitudes.***
- ***Elements include being able to swim in street clothing and in open water.***
- ***Elements include knowledge of risks and hazards and how to cope with them.***
- ***We need additional research about relationships among water competence elements and drowning prevention.***

The way we describe aquatic activity makes an important difference in terms of the skills involved and how those activities are best acquired to reduce the risk of drowning. "Swimming" has been described as the "ability to swim" (see discussion in Chapter 2) or as "swimming skill level." These descriptors focus on the specific physical aquatic skills and their performance. They fail to consider how the demands made by specific tasks and characteristics of the water environment plus knowledge and attitudes may impact the performance of these skills and reduce drowning. This is how water competence applies.

Origins of Water Competence

The modern construct of *water competence* first emerged in 1995 as a gender-neutral synonym for "watermanship." Watermanship originated in the 19th Century in England to describe those individuals, called boatman, ferryman, or rowers, who operated a variety of small watercraft around the waterways of England at the height of its dominance as a naval power. It was intended to describe the business or skill set of any person (almost exclusively male) who was adept at manoeuvring a variety of small boats. In 1995 *water competence* originally was intended to describe similarly any person who was widely skilled at a variety of aquatic tasks from swimming strokes to water games to lifesaving.

Since its initial introduction, the definition of water competence has gradually morphed into several different, albeit related, meanings. In 2006 one group of authors recommended that water competence replace the term "swimming ability" as a more encompassing notion when addressing drowning prevention. In 2013, Dr Kevin Moran PhD offered that water competence should mean "the sum of all personal aquatic movements that help prevent drowning as well as the associated water safety knowledge, attitudes, and behaviours that facilitate safety in, on, and around water."

More recently, in 2015, authors from the American Red Cross proposed five physical water competencies that allow a person to swim in deep water. They concluded that water competency meant being able to anticipate, avoid, and survive common drowning situations, as well as being able to recognize and help those in need. It included basic swimming skills, water safety awareness, and helping others. The most radical definition for water competence was published in 2018 as "the degree to which a person's aquatic behaviours, knowledge, and attitudes meet (or exceed) aquatic task demands and aquatic environmental conditions moment-to-moment, over time, and for a wide variety of aquatic solutions." This definition draws upon principles from dynamical systems, notably Newell's 1986 constraints model (Image 10.2).

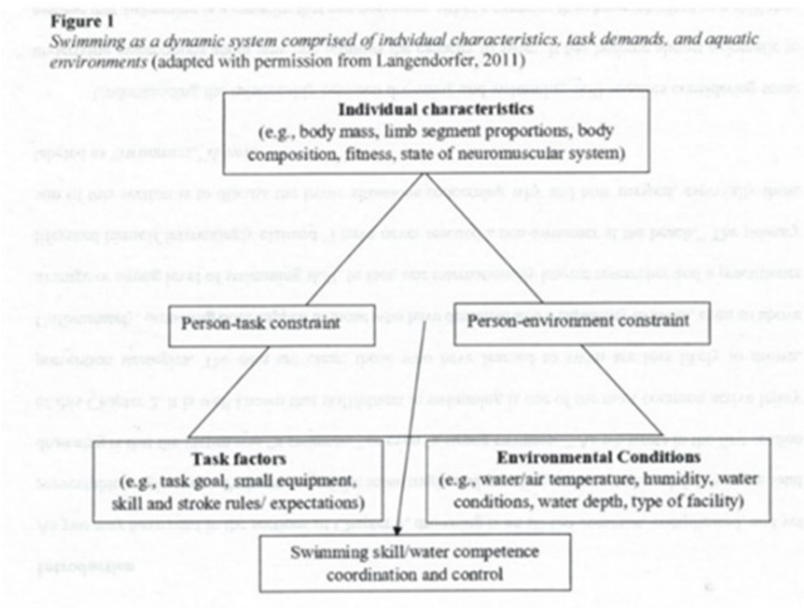


Image 10.2

Newell's 1986 Constraints Model

This latest definition of water competence takes into consideration how much an individual's behaviours are shaped by the specific aquatic tasks and the aquatic environments. It poses the challenge that a single definition and aquatic performance cannot be a static capacity that is possessed by everyone.

Comprehensive elements of water competence

Stallman et al. (2017) published the most comprehensive paper so far regarding water competence. Notably, the authors proposed that water competence as a capacity to prevent drowning is comprised of fifteen unique elements (Table 10.1). Each element was thoroughly researched and discussed in the paper to illustrate the evidence that supports each element.

What is important about water competence as illustrated in Table 10.1 is the detail identified of the seven physical tasks and the three task and environmental relationships along with the several elements of knowledge and attitudes identified. The scheme emphasizes the complexity of water competence to prevent drowning. The necessity for acquiring physical skills expressed under different tasks and environments along with knowledge of general and specific water safety risks and overarching attitudes considering the importance of water safety values are inherent in the definition of water competence.

Water Competence Elements		
Safe entry tasks a) Entry into water b) Surface and level off		Clothed water performance person-task constraints
Breath control tasks a) Breath-holding during submersion b) Effective inspiration during tasks	0	Open water performance person-environment constraints
Stationary water surface tasks a) Float front and back b) Tread water	1	Knowledge of local risks and hazards a) Awareness of hazards b) Evaluation of risks
Body orientation in water tasks a) Roll from front to back, back to front b) Turn L & R, onto front & back	2	Coping with risk and hazard tasks a) Recognize and avoid risk b) Judgment of risk in actions
Water propulsion tasks a) Propulsion in water on the front b) Swim on the back (and/or side)	3	Assess personal water competence a) Psychomotor tasks b) Knowledge and attitudes
Underwater tasks a) Surface dive b) Swim underwater	4	Rescue drowning person tasks a) Recognition b) Appropriate assist actions
Safe exit tasks a) Recover to edge/support b) Exit from water or maintain position	5	Water safety a) Attitudes – positive and negative b) Values
Personal flotation device (PFD) person-task-environment constraints a) Appropriate type, sizing, and wear b) Adjust to aquatic tasks in environments		

The 15 elements of water competence related to preventing drowning (adapted from Stallman et al. 2018)

The importance of demonstrating proficiency not only in the seven psychomotor elements (i.e., entry and exit from the water, breath control, stationary water surface tasks, changing orientation in the water, moving through the water, moving under the water) but also in the three relational elements (i.e., personal flotation device use, swimming while clothed, swimming in open water) has not been emphasized sufficiently in the drowning prevention literature.

The role of knowledge of risks and hazards and how to cope with them along with self-evaluating one's own personal competence and appreciation of water safety likewise has received much too little attention, but they certainly need to receive more emphasis in learn to swim and water safety education programs (Image 10.3).

Appreciating how to advance an understanding and pursuit of drowning prevention through the concept of water competence offers an important potential for reducing the tragedy of drowning worldwide. The complexity of approaching water competence through a variety of physical tasks, knowledges, and attitudes suggests the need for a well identified future line of inquiry to provide additional research evidence about the relationships among the water competence elements and drowning prevention (Image 10.4).

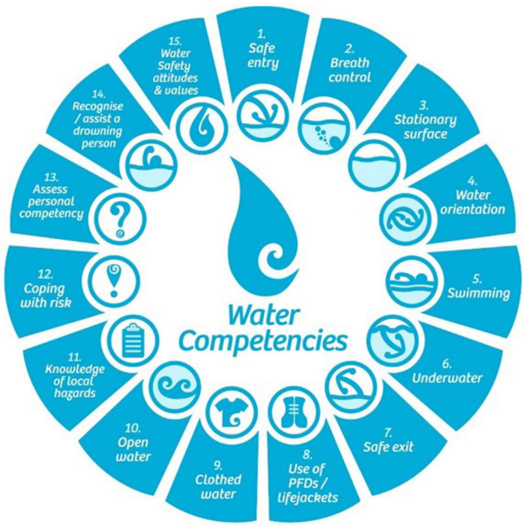


Image 10.3

Water Competencies (page 153)

Courtesy of Drowning Prevention Auckland (DPA), New Zealand

at: https://www.dpanz.org.nz/research/water-competencies/

Image 10.4

Learning to swim in clothing

Image from John Connolly

TRANSFER OF LEARNING IN SWIMMING

Stephen J. Langendorfer

- ***Previous similar experiences make it easier to perform a new task – positive transfer.***
- ***Some previous experiences make it difficult to perform a new task – negative transfer.***
- ***Too much early dependence on buoyancy aids makes swimming unaided difficult.***
- ***Breath holding when learning to swim makes it difficult to learn rhythmic breathing.***
- ***Recent research has established that pool-based competences may not transfer to open water.***

Defining the concept of transfer

Have you ever wondered why it seems like you can perform some tasks more easily than other tasks? One possible reason this happens is that you may have already had some related experiences that provided you with a stronger foundation for the activities you found to be easy to learn. In the study of movement, this phenomenon is called transfer. This means that some experiences make it easier to perform a task if the person has experience with the earlier activities first. An interesting example of this is learning to ride a bicycle. If a child has experience using a scooter or a bicycle with a very wide rear wheel, learning to ride a normal bicycle will be much easier for the child. This is because the balance and steering involved in operating a scooter and a wide wheel bicycle are very similar to the balance and steering required to ride a regular bicycle. We can say that the earlier scooter balance and steering experience transferred to later bicycle riding. Even more interesting, the popular use of "training wheels" on a child's bicycle actually makes it harder to learn to ride the bicycle without the training wheels because training wheels allow a child to lean the wrong way on the bike, thereby interfering with the balance requirements for normal bicycle riding.

In the area of aquatics, not much study has focused on whether some prerequisite activities can promote other swimming tasks. Learn-to-swim programmes and swimming instructors often employ progressions as if activities promote other activities, but we don't have good evidence of the accuracy of that assumption. We will provide information about some examples of transfer in swimming and raise questions about how we might be able to employ the concept of transfer in the specific area of drowning prevention.

Positive and negative transfer

When a person has had earlier experiences that make later experiences easier to learn, this is called positive transfer. Something about the earlier experiences was similar to the later experiences and thus can be transferred to the later learning. Positive transfer occurs when a child has experience on a scooter or wide rear wheel bicycle and then learns to ride a regular bicycle.

Sometimes, such as when a child has used training wheels, riding a regular bicycle is more difficult. This is called negative transfer. Negative transfer occurs when basic elements of earlier activities are different enough that they interfere with the subsequent activity. In the case of training wheels, the child can successfully ride a bicycle without tipping over, but the training wheels allow them to lean in either direction in a manner that does not simulate how one balances on a regular bicycle while turning. Without the training wheels, the child does not have the artificial side support and finds balance on the bicycle to be quite difficult initially.

So, what about swimming? What are examples of possible positive and negative transfer in swimming? I think one example may be the use of flotation devices. I believe that depending upon how flotation devices are used in learning to swim either positive or negative transfer can occur. If a flotation device provides some, but not too much, flotation support and encourages a child to be suspended in a semi-horizontal position in the water and is not used excessively while in the water, I suspect positive transfer occurs to when the child no longer has the flotation device. In contrast, when a parent or instructor always slaps a very buoyant flotation device on a child who is held in a near-vertical position for the duration of when they are in the water, negative transfer to unsupported floating and paddling in the water likely occurs.

Another example may relate to acquiring breath control. If the only kind of breathing activity that a child (or adult) experiences is simple breath holding, I suspect rhythmic breathing especially during strokes will be more difficult for them to learn. This, of course, would be an example of negative transfer. Why does negative transfer occur from breath holding to rhythmic breathing? If the primary experience a swim learner has is simply holding their breath when their face or head is submerged, especially for extended periods of time (e.g., 5-10 seconds), then they will not have experience with controlling their breathing to match the specifics of an aquatic task or stroke. Instead, if a swimmer's early breathing experiences always focus on breathing in and then immediately breathing out and encourage water to be allowed in and around the mouth, they should positively transfer to rhythmic breathing with floating, gliding, and paddling much more easily and effectively.

You will note that I have prefaced these two swimming examples as “possible.” To my knowledge, very few, if any, aquatic research studies have explored the presence of either positive or negative transfer in the aquatic environment. It is an area rife with possibility. A great deal more research needs to occur to improve our learning progressions. Specifically, we need to understand what progressions seem to enhance positive transfer and which ones may accidentally induce negative transfer.

Transfer in water competence and drowning prevention

In the previous section of this chapter, as well as the sections in chapter 2, the construct of water competence has been introduced and discussed. Importantly, the latest water competence definition from a dynamical systems perspective proposed that water competence should be “the degree to which a person’s aquatic behaviours, knowledge, and attitudes meet (or exceed) aquatic task demands and aquatic environmental conditions moment-to-moment, over time, and for a wide variety of aquatic solutions.” This definition nicely addresses the issue of transfer albeit without mentioning it specifically. Notice that water competence is seen as a probability or likelihood among a person’s behaviours including knowledge and attitudes and the specific aquatic tasks and the conditions associated with the aquatic environment. It proposes that an individual’s water competence changes “from moment to moment and over time” as the person’s personal capabilities change in relation to the aquatic tasks being undertaken and to the aquatic environment. In other words, a person cannot be said to possess water competence because it depends upon the relationship among the person, task, and environment elements of water competence.

In 2015 the American Red Cross’s Scientific Advisory Council proposed an operational definition for water competence that involved the performance of basic skills in a pool including jumping into deep water, submerging, coming to the surface, treading water, or floating for a time, turning over and swimming at least 25 years, and exiting the water. In their article they did note that water competence might change under different task or environmental conditions without providing any examples.

Essentially the authors were pointing out that few if any studies had been conducted to examine whether the pool-based definition of water competence positively transferred to other aquatic tasks (e.g., immersed while clothed) or in different environmental conditions (e.g., immersed in open water). In other words, a pool-based test as proposed may be accurate in the warm water of a pool on the day it was performed, but it may not transfer positively to another day, for other tasks, or in cold open water not in pools. Such evidence is sorely needed.

Fortunately, in the years since 2015 researchers have conducted numerous studies systematically examining elements of water competence under different task conditions and in different aquatic environments. For example, several studies have illustrated that street clothing can negatively impact swimming speed, distance to swim, and getting out of a pool, but it also may improve flotation when clothing can trap air. Similarly, when wearing lifejackets, swimming speeds were slower, and it was much harder to exit a pool, but obviously it strongly improves flotation. Other studies that employed a wave machine to simulate open water also showed that waves slowed swimming speed and reduced distances and made entry more difficult. These systematic research inquiries are important and will provide us all information about positive and negative transfer related to drowning prevention.

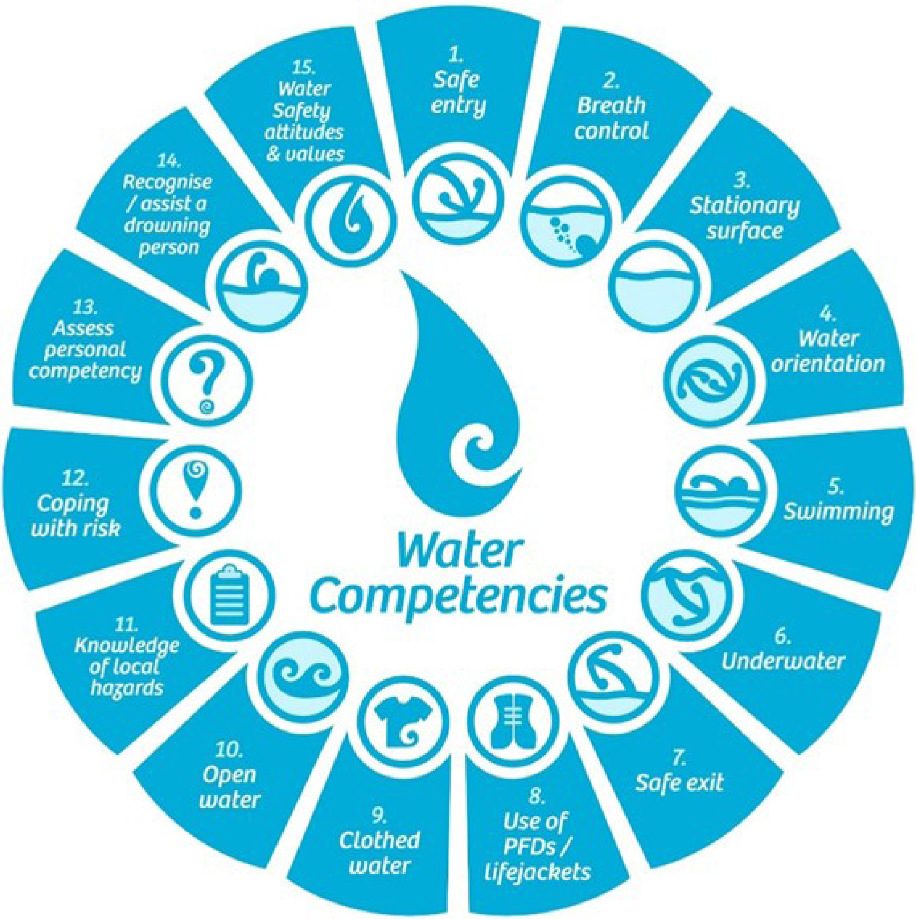


Image 10.3

Water Competencies

CHAPTER 11
SURVIVAL PSYCHOLOGY

INTRODUCTION

John Connolly

A deceased mentor of mine served in the Royal Navy in World War II. He was a junior deck officer on a large warship. Whilst in charge of a party of sailors tasked with dropping anchor in Valetta Harbour, Malta, he somehow managed to break a bone in his right little finger. Such a small injury. The ships surgeon deemed him medically unfit to remain on board as the warship was due to escort a convoy, through a major aquatic battle zone, to Tobruk. He was declared unable to climb or descend steep stairs or ladders quickly and safely. His captain ordered him ashore on the understanding that he would re-join the ship when it returned to Malta. It never returned. The ship was sunk by German or Italian aircraft some days later with a great loss of life.

Depending on your beliefs you may consider his minor accident a piece of good luck or even divine providence. He told me that he suffered from what we now call ‘survivor guilt’. He felt ashamed that, because of a very minor injury, he had not been on board his ship, at his action station, when it was attacked. He hoped that he had been spared for some important mission. Twice afterwards he volunteered for hazardous missions behind enemy lines and on being selected suffered injuries during training that kept him out of the operations. A huge frustration was bottled up inside him and he sometimes wondered what his life was being saved for.

Classified as medically unfit for active duty due to his injuries he was placed in charge of the Officers Club in a large Mediterranean naval base. The club had a swimming pool and voluntary swimming lessons were provided for non-swimmer officers. One day, during a bout of horse play, an officer in uniform was knocked into the deep end of the pool where he started to drown. On being rescued he said that he could swim but had found it difficult to do so in his naval uniform. My friend realised that his shipmates would have been wearing battle protective clothing when their ship was sunk and, just like the officer in the pool, they probably had found themselves unable to swim in the clothing and died before they could find a buoyant aid or be pulled into a boat.

He asked the officer in command of the base for permission to organise new special swimming classes for officers and non-officer ratings. Permission was needed because those taking part in the classes would be taught to swim, in their naval uniforms and then in protective battle clothing, in the harbour. Exercises would include jumping into the harbour from moored ships. He would teach them drowning survival techniques under simulated battle conditions. Permission was granted and he set about his first tasks – figuring out what specific survival skills needed to be taught and how to do so safely!

The classes were successful and popular. After the war he became a physical education teacher and for close on 50 years played a major role in developing international lifesaving and lifeguard education. His influence continues today through the content of this swimmer survival book.

Image 11.1

Swimming in Uniform

US Navy Image

SURVIVAL PSYCHOLOGY

John Wells & Suzanne Denieffe

- ***Survivor Syndrome was accepted as a medical condition in the 1960's.***
- ***A person's capacity for problem solving and resilience can contribute to surviving an event.***
- ***The impacts of panic include a sudden loss of emotional control, disorientation, and an inability to problem solve to address an immediate life-threatening situation.***
- ***Drowning persons panicking have been known to drown would-be-rescuers.***
- ***Post-traumatic Stress (PTS) is a common short-term reaction to a life-threatening situation whereas Post-traumatic Stress Disorder (PTSD) is a long-term condition needing treatment.***

Overview of Survival Psychology

The psychology of survival and a traumatic life threatening or life ending event involving water is complex. Such events can have psychological impacts not only on an individual who directly survives the event but also on a person who witnesses the event or a person who was involved in the traumatic event but not its victim (such as a rescuer). It can also affect a person who was not at the event but in some way blames themselves for not being present when the event took place, for example a family member.

Survivor psychology, as a field of study within clinical psychology, arose from therapeutic work in the in the late 1940s with former Holocaust concentration camp prisoners, many of whom suffered from guilt and depression over their personal survival referenced to their many fellow prisoners who had been murdered. As a result of this work *survivor syndrome* came into being as a clinical diagnosis in the 1960s. The syndrome was defined as feeling guilty about perceived personal failure for having survived when others did not, characterised by symptoms such as depression, sleep disturbance, often accompanied by nightmares, mood swings and social withdrawal. In the 1990s survivor syndrome as a psychological and medical diagnosis was subsumed into Post-traumatic Stress Disorder.

Whilst there is inevitably a strong clinical focus on the psychological problems associated with survivorship, there is another dimension of survivorship psychology which is also significant. This dimension explores the psychological characteristics of someone who survives a traumatic event such as drowning and does not experience negative psychological impacts.

Often such people are resilient and adaptable. It is these positive psychological qualities that are likely not only to predict how well someone psychologically deals with a drowning experience both at the time the experience occurs but also with the immediate and long-term psychological consequences of the event. As such a person's capacity for problem solving and resilience may be a contributor to surviving the event itself.

Panic

Panic may be defined as a sudden onset of intense fear or anxiety which triggers an interaction between heightened cognitive and physiological arousal resulting in frantic agitation. Consequently, the sympathetic nervous system is activated in which 'fight or flight' reactions overtakes an individual's thoughts and behaviours. Panic can be a contributing factor to drowning and is often brought about by a fear that one is going to drown. There is often a loss of the ability to swim accompanied by racing thoughts to stay above the surface of the water and to leave it as quickly as possible but with no clear sense as to how to achieve this.

Panic is thus a reaction to a situation which is perceived as immediately threatening/ catastrophic or alternatively a reaction to a perception of threat. In either circumstance it is characterised by the same physiological symptoms. These include a shortness of breath and subsequent hyperventilation; increased heart rate accompanied by a tight feeling across the chest; shaking; feeling sick and sweaty. These physiological reactions are interpreted as signs of distress and threat leading to further cognitive distress which in turn reinforces the sympathetic nervous system reactions.

The cognitive impacts of panic primarily revolve around a heightened sense of arousal and a sudden loss of emotional control, disorientation and inability to problem solve to address the immediate situation which is causing the panic (sometimes referred to as cognitive paralysis). Catastrophic thinking overtakes the individual's cognitive processes in which thoughts such as, 'I am having a heart attack', 'I am going to drown' or 'I can no longer swim' (in the case of the latter the person gives up), with little cognitive capacity left to focus on how one might try and regain control of oneself in the water nor how to get out of the water. In some cases, this level of catastrophic thinking and cognitive paralysis can lead to insensibility and death.

It is reported that 80% of deaths that take place in triathlon events occur during the swimming event and panic has been implicated in at least some of these sporting tragedies. Panic in these instances seems to be associated with crowded swimming triathlons in which the swimmer becomes disorientated and panicked by the crowd around them in the water.

Unfamiliar settings also seem to be a contributing factor to onset of panic in the water. Thus, competitive swimmers who are used to controlled environments within the swimming pool, can suddenly feel incapable of swimming in open water where defined boundaries, such as depth, and predictability of water current are unknown and thereby require different swimming skills. Recreational swimmers are also reported to experience incapacitating panics in open water when feeling the sudden physiological shock of cold water that in turn induces a loss of muscle strength and a significant decrease in swimming abilities. This is also true when suddenly encountering an unexpected object on or beneath the water. Thus, scuba divers have panicked when entangled with underwater debris.

In addition to its contribution to the drowning of swimmers, panic can also lead to fatalities amongst would be rescuers. In what has been termed the "*Aquatic Victim-Instead-of-Rescuer Syndrome*", would-be rescuers approaching panicking people in the water have been drowned as the person panicking lashes out uncontrollably and grabs them to stay above the surface of the water, thereby dragging the rescuer down below the surface with them.

Managing Panic in the Water

One of the best ways to manage a panic attack is to prepare oneself for it beforehand. This facilitates an individual to recognise the signs and symptoms should a panic attack happen to them in water and thereby manage its consequences more effectively. In this contingency planning one should consider what might be the psychological and physical triggers that could lead to a panic attack – personal triggers – and address these by becoming familiar with them. Through exposure approaches to the triggers their power to induce panic is diminished.

In terms of managing a panic attack in water, the first requirement is to regain control of one's buoyancy and breathing. This involves the individual floating on the back or holding onto a buoyant object and then making a deliberate effort to slow down their breathing by focusing on the out breath through the nose and thereby create a slow breathing rhythm. Inhalation should be relaxed and not deep. Focusing on regaining control of breathing will also distract the mind from racing thoughts of catastrophe. Once hyperventilation is reduced one needs to try and progressively relax muscle groups either through slower swim strokes or continuing to float.

Post Non-Fatal Drowning Experience Panic

Non-fatal drowning experiences, that is experience of near suffocation by water, can leave survivors feeling anxious or experiencing panic attacks whenever they perceive themselves to be near a body of water or indeed, in some cases, looking at representations of water.

Others experience panic not because they themselves experienced drowning, but they have witnessed someone else drown and it is the memory of this traumatic experience that triggers a panic response whenever they are near water. These panic responses to water can be long-lasting and, in some cases, socially disabling. As such they are then recognised as signs of post- traumatic stress disorder and it is to this that we now turn.

Post-Traumatic Stress Disorder

Any traumatic life event can have long term repercussions and a non-fatal drowning incident can result in the development of psychological consequences that can impair an individual's ability to get on with their life post that event. According to the Diagnostic and Statistical Manual V (a criterion referenced manual used by psychiatrists and clinical psychologists to diagnose psychological problems) a potentially traumatic event is defined as a sudden and direct confrontation with death or its equivalents (such as serious injury, assault, or witnessing a cataclysmic event). Non-fatal drowning (the term now used by World Health Organization) falls within this definition. Post-traumatic Stress is a normal reaction to such an event but is usually short lived and does not significantly interfere with an individual's social and occupational functioning. However, if it becomes persistent and does interfere with everyday life, then it transcends into the disorder known as Post-Traumatic Stress Disorder (commonly referred to as PTSD)

PTSD made its way into the American psychiatric nomenclature as a formal diagnostic entity in 1980 when PTSD was first recognized as a diagnosable psychiatric disorder in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) and ICD-10 (International Classification of Diseases, 10th edition).

PTSD is a tenacious and disabling clinical condition that requires professional intervention. For a diagnosis of PTSD to be made under the DSM classification, a person must have experienced intense fear; helplessness, or horror when the traumatizing event occurred. The signs and symptoms (see Box 1) must have been present for at least one month (this one-month presence requirement does not apply in the ICD-10 classification). The signs and symptoms must cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Acute PTSD becomes chronic if it lasts for longer than three months. Symptoms usually begin shortly after the trauma, but they are said to have delayed onset if they start at least six months later. Most people diagnosed with delayed onset PTSD often have had symptoms within six months of the trauma, but they have presented late, or their symptoms went initially unrecognized.

Many people will experience severe stress symptoms shortly after traumatic events such as non-fatal drowning. Whilst specific figures for the prevalence of PTSD amongst people with post non-fatal drowning are not available, PTSD has been reported to develop in 15-24% of people who are exposed to traumatic events.

The incidence of PTSD has been shown to increase with the severity of that trauma. Studies have reported an incidence of more than 50% amongst victims of rape; 30-40% for people involved in major disasters and around 19% amongst surviving veterans of the Vietnam war. Rates for other traumas including accidents and non-physical assaults tend to be lower. Prospective research suggests that rates reduce rapidly over time. For example, after the 11th of September (9/11) terrorist attacks in New York, probable post-traumatic stress disorder in people living south of 110th Street reduced from 7.5% at one month to 1.6% at four months and 0.6% at six months. This recovery trajectory is important when deciding how best to provide for individuals after traumatic events.

Comorbidity (two or more conditions) rates are often more than 80% in relation to the psychological impact of a traumatic event.

Re-experiencing phenomena (at least one required)

Recurrent and intrusive distressing recollections

Recurrent distressing dreams

Acting or feeling as if the events are recurring

Intense psychological distress to cues

Physiological reactivity to cues

Increased arousal (at least two required)

Difficulty sleeping

Irritability or outbursts of anger

Difficulty concentrating

Hypervigilance

Exaggerated startle response

Avoidance and numbing (at least three required)

Avoidance of thoughts, feelings, and conversations

Avoidance of reminders

Psychogenic amnesia

Greatly reduced interest in related activities

Detachment or estrangement feelings

Restricted range of affect

Sense of a foreshortened future

Box 11.1

Characteristic symptoms of post-traumatic stress disorder adapted from DSM-V

The most common comorbid conditions are depressive disorders, panic disorder, other anxiety disorders, and substance misuse or dependence. Younger children often present with other phenomena directly related to the trauma (such as repetitive play and drawing) or more general emotional and behavioural difficulties such as regression, new fears, and aggression (National Collaborating Centre for Mental Health 2005).

Cognitive Theory and Other Factors Associated with Onset and Maintenance of PTSD

Central to cognitive theories of PTSD are an individual's pre-existing beliefs and models of the world (known as *schema*) through which they organise and make sense of information in the environment around them. The nature of memory recall plays a central role in relation to the development of PTSD. In this context memories are divided between ones that are easily accessed and give rise to emotions related to the trauma and memories that cannot be deliberately accessed and give rise to symptoms such as dreams and flashbacks. PTSD develops when these memories induce a sense of current threat promoted by excessive negative appraisals of the recollection of the trauma.

There are a range of associated memory factors that contribute to both onset and maintenance of PTSD post the drowning event. These are collectively called peritraumatic disassociation and are referenced to the range of reactions experienced by the individual at the time the trauma took place.

They include for example, the degree to which one felt one was an observer of what was happening to you at the time (known as depersonalisation); detached from the events and people involved (known as derealisation); emotionally numb and an altered sense of the passing of time. These feed into an individual's negative self-appraisal and thereby serve to maintain PTSD. In other words, the more the individual experienced these feelings at the time of the trauma the more they feed into a negative self-perception which then reinforces the PTSD.

Standard Treatment for PTSD

There are two standard treatments, often used in a complimentary combination, for PTSD. These are Cognitive Behaviour Therapy (a range of psychological treatments) and medication (usually involving an anti-depressant drug). Cognitive Behaviour Therapies (CBT) include exposure to the trauma related events, memories, and feelings as a means to habituate the individual to them and thereby diminish their impact. Cognitive therapy is used to retrain individuals in relation to negative thinking patterns. Eye movement and desensitisation involves asking an individual to access traumatising memories and associated negative thoughts and replace these with adaptive thoughts. Repeated practice replaces the negative with positive thoughts in relation to the memory. These and other CBT approaches have good outcomes and are recommended by both the American Psychiatric Association and the National Institute for Clinical Excellence (NICE) in the UK.

The other approach to treatment is through the use of medication. The primary medication used to treat the depressive effects of PTSD involve the prescription of a group of anti-depressants known as SSRIs (Selective Serotonin Reuptake Inhibitors).

They are used not as a replacement for psychological approaches but more as an adjunctive therapy to facilitate depressed individuals engaging with psychological therapies.

There is some evidence that being physically active or engaging with an exercise programme may also act as a positive adjunct to psychological therapy in relation to PTSD. However, exercise by itself is unlikely to be an effective intervention.

Stress Inoculation

Prior training in stress management could be a factor in prevention of the development of PTSD in relation to non-fatal drowning episodes. A single case history was recently published in which a CBT therapist was trapped for a prolonged period of time underwater and came close to drowning.

During this experience he was able to use a variety of cognitive coping strategies to survive the ordeal. Later, following his survival, he did not develop post-traumatic stress disorder but did experience an alteration of his assumptions about risks of trauma in general and an increase in the strength of his spiritual values.

This was just one case report and would require more substantial research before one can conclude that previous stress inoculation training might help in preventing PTSD post a non-fatal drowning incident. It does however continue to suggest that previous psychological pre-disposition, training in dealing with stressful situations and other life experiences are all factors which interplay post a non-drowning incident.

The above case shows that not every individual who experiences a near drowning event will develop psychological issues, and in these individuals the traumatic experience is assimilated without the development of a pathological response (DSM V). Therefore, clearly there are factors at play in the development or non-development of any such post trauma disorders.

Psychological protective factors in relation to PTSD, guilt, and post traumatic growth

It should be emphasised that most people who experience a traumatic event such as a non-fatal drowning event do not go on to experience PTSD. Therefore, the question arises what are the psychological factors that protect a person from developing PTSD? The nature of a person's resilience is most associated with protective pre-dispositions in relation to the development of PTSD and positive psychological recovery post a non-fatal drowning event. These predisposing factors include the capacity of an individual to problem solve and being self-reliant in relation to managing one's emotions. In addition, social support and engagement through family and friends as well as involvement in activities which focus on helping others appears to be significant.

A willingness to seek help and an ability to self-disclose about the trauma are also associated with a positive resilience. Finally, identifying as a survivor rather than a victim is a good indicator of both a positive mindset and an ability to retain a realistic perspective on the event and one's role within it.

In this context, the phenomenon of what is called Post-Traumatic Growth (PTG) following a traumatic event is reported by up to 80% of survivors. PTG is distinguished from resilience and recovery in that it is not just that a person goes back to the way they were before the trauma but that they experience a positive reorientation of their thinking and what is important to them in moving forward with their lives as a consequence of having survived a trauma such as a non-fatal drowning experience.

Survivor Guilt

As indicated at the start of this chapter, the therapeutic study of survival psychology has its roots in addressing issues of guilt expressed by concentration camp survivors. Survivor guilt in relation to fatal and non-fatal drowning events appears to be a particular issue for parents of young children involved in such incidents. Children are the largest group to be involved in non-fatal drowning events. For example, in Australia it is reported that children aged between 0-4 years make up 41.9% of non-fatal drowning incidents, which is 14 times higher compared to other age groups. The high proportion of children involved in non-fatal drowning events reflects the fact that they are unlikely to be in the water alone and thereby likely to be rescued once they get into difficulties.

However, even though many children are rescued - on average for every child that drowns seven are rescued - there are a number of studies that show that parents of such children experience considerable feelings of guilt in relation to what they perceive as their failure to protect and safeguard their child. An existential crisis in their sense of parenthood. This guilt often persists for years after the event and can negatively impact on the relationship with a spouse (divorce being common) and over-protective behaviour not only to the child who was involved in the drowning event but also to siblings.

This self-questioning can manifest itself in a range of behaviours such as sleep disorders, persistent anxiety, and increased alcohol consumption. In turn the disruptive impact of such behaviours can generalize beyond the family to an inability to focus on work and maintain social relationships. A further complicating factor is the reaction of broader society where parents of children who have drowned or have survived a drowning event report that they experience judgmental negative attitudes towards them, with a lack of support and understanding; further reinforcing their sense of failure and guilt.

It is important, therefore, to recognize that the drowning event can adversely affect the valued social identity and status of being a parent within society and thereby increase both their distress and ability to resume a normal parenting relationship with their children. Indeed, in terms of professional support to parents in dealing with a drowning event (both fatal and non-fatal), the first therapeutic approach should be to affirm and ensure that a range of resources are put in place that affirm that their pre-existing identity remains intact. This will greatly help them to deal with their sense of guilt and cope with their potential psychological problems.

Summary

It is interesting to note that many of the clinical guidelines for the management of non-fatal drowning do not address the psychological effects of such an incident, with the focus remaining on physical health. Likewise, many papers which look at morbidity post non-fatal drowning fail to address or even mention any psychological impacts. Bearing in mind both the trauma involved in the experience of drowning either as someone who survives or someone who witnesses the event, this is surprising and should be addressed going forward. This chapter highlights the broad issues affecting the psychology of drowning events in terms of panic, post-traumatic stress, and survivor guilt in relation to what little we do know about the emotional and cognitive impacts of drowning. In terms of the management of such the following needs to be considered:

Panic in the water can lead to drowning;

- The best way to manage panic in the water is to prepare for its potential occurrence beforehand.
- Control of breathing is the key to regaining control of one's thoughts.
- Post-traumatic stress is normal following a non-fatal drowning event and post-traumatic stress disorder (PTSD) whilst not uncommon is rare for most people and most likely to occur in either rescuers or parents of children involved in a drowning event.
- A person's psychological and social resources will protect them in developing PTSD.
- Cognitive Behaviour Treatments have the best outcome for PTSD.
- Parents of children involved in a drowning incident need to be supported and not judged if they are to make a successful adjustment to dealing with the aftermath of a drowning event.
- Survival of a non-fatal drowning event can be an opportunity for personal growth rather than an event that has negative psychological consequences for an individual if they are supported.

CHAPTER 12
THE RESUSCITATION OF DROWNED VICTIMS

INTRODUCTION

John Connolly

Resuscitating drowned persons begins with inflating their lungs.

The following situation is possible on a beach. Two adult males lie unconscious on the sand. One, the younger adult son, has been rescued from drowning. The older adult father has suffered a major heart attack in response to his son's drowning. Both hearts have stopped pumping and neither person is breathing. Both are clinically dead (no respiration and no pulse) and in need of immediate resuscitation. How they are resuscitated will determine their final outcomes – whether they live or die.

For thousands of years all research into resuscitation was aimed at restoring life to drowned persons. Anyone suffering a heart attack either recovered by themselves or died. In the second half of the twentieth century advances in medicine made the successful resuscitation of heart attack casualties possible, first in hospital, and then outside. Worldwide the number of persons who die from heart attacks greatly exceeds the number who die by drowning and so the focus of research understandably changed from resuscitating the drowned to resuscitating heart attack victims. The recent promotion of compression only Cardio-Pulmonary-Resuscitation (CPR) has resulted in some confusion regarding the resuscitation of drowned persons.

When the father suffered his heart attack the circulation of blood around his body quickly stopped, as did his breathing. His lungs are undamaged and his blood contains oxygenated red blood cells. Chest compressions will start circulating oxygenated blood through his body. The blood being moved through his lungs will exchange carbon dioxide for oxygen. The small amount of air sucked into his lungs as his chest rises after being compressed will provide enough oxygen to keep his unconscious body alive.

The drowned son's lungs were most likely damaged during his drowning. The pinky white foam in the mouth associated with drowning is a sure sign of lung damage. His heart continues to pump blood around his body until all the oxygen in his blood is transferred to his cells. The blood in his unconscious body contains almost no oxygen and his lungs are damaged.

It is necessary to first inflate his lungs several times, to push air into any undamaged lung tissue, so that when blood is pumped into the lungs by chest compressions it can pick up oxygen before carrying it around his body. Compression only CPR will most likely pump blood without oxygen around his body and he will die.

When resuscitating drowned victims you should first inflate the lungs five times, then carry out 30 chest compressions, inflate the lungs twice, do 30 more chest compressions, and so on to give the drowned person a chance of living. His heart stopped because his body ran out of oxygen. Defibrillation will not restart it. He needs oxygen not electricity.

Image 12.1

Resuscitating a drowned person

RLSS UK Image

Image 12.2

The Drowning Chain of Survival

THE RESUSCITATION OF DROWNED PERSONS AND HYPOTHERMIA

Jeroen Seesink & Joost Bierens

- ***Treatment differs whether the drowning is caused by submersion or immersion.***
- ***Ventilating a drowned casualty as fast as possible is the key treatment start.***
- ***Immersion or submersion hypothermia can be serious complicating treatment factors.***

Providing first aid is the last link in the “Drowning chain of survival” (Image 12.2). In the previous chapters it has been described in detail that each individual situation has specific consequences for the rescue of a drowning person. This also applies to the underlying pathophysiological way in which a drowning person drowned. Although chapter 1 described the several mechanisms of drowning, the practical question when starting a resuscitation is rather simple and basically depends on two mechanisms of drowning. Has this individual been underwater and become hypoxic, suffered serious breathing difficulty (submersion mechanism), or has this person become hypothermic due to prolonged stay in water (immersion mechanism)? The execution of the rescue differs between these mechanisms significantly. The accidental drowning primarily discussed in this book will in most cases involve sudden submersion, in which the major challenge is the acute need of oxygen. The rescue should therefore be aimed at getting the drowning person back to the surface as soon as possible and, if necessary, starting the resuscitation of the drowning person.

Unlike many accidents on land, neck and spinal injuries are rare in drowning people. Only assume this if there is also a severe head or spine injury. In all other cases, no time should be lost and a drowning person should not be immobilized unnecessarily, while prolonging the period without oxygen to the brain.

The resuscitation of drowned casualties

If the rescued person is not breathing, resuscitation should be initiated as soon as possible. Basic life support for drowning people differs from that for the usual cardiac arrest for several reasons. Not only do the often dangerous and challenging conditions make drowning resuscitation unique, the mechanism behind the cardiac arrest is also clearly different from other forms of cardiac arrest. Often a myocardial infarction is the cause of cardiac arrest in adults. A sudden blockage of an artery will cause a lack of oxygen in a specific part of the heart and can cause a serious arrhythmia resulting in sudden cardiac arrest.

Until the moment of the cardiac arrest, the lungs are unaffected: oxygen is absorbed into the blood and pumped around until the moment of the arrest. When the heart suddenly stops pumping the blood due to an arrhythmia, oxygen will still be present in the blood. Resuscitation should therefore be aimed at taking over the pump function as quickly as possible by manual chest compression and make this oxygen circulate. The cause, the underlying arrhythmia, should also be treated by defibrillation as soon as possible with a defibrillator or Automatic External Defibrillator (AED). An electric shock through the heart tries to restore the heart rhythm. In these resuscitations, ventilation is of secondary importance to chest compression and defibrillation.

In the case of drowning, resuscitation is very different. The initial problem is not located in the heart, but in the lungs that have become incapable of breathing air. As a result, no new oxygen is absorbed into the blood, while the heart continues to pump blood for some time. More and more oxygen is absorbed by the tissues leading to shortage of oxygen in the blood. The lack of oxygen will lead to a loss of consciousness and eventually the heart will stop functioning. Reduced consciousness occurs before the actual cardiac arrest because the brain is most sensitive to oxygen shortage. Therefore, irreversible damage first occurs in the brain in case of oxygen deficiency. In a heart that suffers from a lack of oxygen, complete cardiac arrest is often preceded by an increasingly slower rhythm after which it loses its pumping function. Resuscitation should focus on getting oxygen back into the bloodstream as quickly as possible. Therefore, the resuscitation of a drowned person should be started with 5 initial breaths unlike starting with chest compression as in normal resuscitation, aiming to refill the collapsed alveoli with air. The oxygen in these air-filled alveoli can then be absorbed into the blood and circulated by manual chest compressions. Every second counts in order to prevent irreversible damage to the brain. To restore the oxygen level in the blood as quickly as possible and to compensate for any lung damage that limits the oxygen uptake, additional oxygen therapy in high concentration is advised, if available. Compression-only CPR does not seem effective as this will only circulate blood without oxygen and should be avoided in drowning resuscitation. When oxygenated blood returns to the heart, it can lead to the recovery of the cardiac function. Sometimes even signs of life are seen almost immediately after giving these initial breaths. If this is the case, the drowning person's own breathing must be reassessed. If normal breathing is observed, the drowning person can be placed in a recovery position and further first aid can be provided. Submersion duration of less than 10 minutes is associated with a relatively high possibility of a favourable outcome. In contrast, a submersion duration of more than 25 minutes is associated with a relatively small chance of a favourable outcome.

Treatment algorithm for rescuers with a duty to respond

Due to the evident importance of oxygen and adequate ventilation, the algorithm for resuscitation of a drowning person has been adapted for emergency services with the responsibility to be able to respond adequately. The algorithm is shown in Figure 2. It is important that proper training is followed, skills are maintained and repeated training of drowning scenarios are essential. Most effective are scenario trainings that mimic real-life settings as much as possible. As with basic resuscitation in adults, this type of resuscitation starts by checking consciousness and breathing. Also, immediate help must be called and professional care providers must be warned. The protocol differs by starting with 5 initial breaths. If no signs of life are observed after this, resuscitation is continued by alternating 30 chest compressions and 2 breaths as in the normal algorithm. The defibrillator must be connected once effective CPR is ongoing and the AED's instructions followed. One should not forget to dry the chest to ensure that the defibrillation pads connect well with the skin. Defibrillation is of less importance in case of drowning because a primary shockable rhythm is rarely seen in the case of oxygen deprivation and hypothermia.

Additional challenges in drowning resuscitation

Drowning resuscitation is challenging for various reasons. Ventilation will be more difficult, because the elasticity of the lung decreases after water has entered the lungs and the alveoli are damaged or collapsed due to the loss of surfactant. This is further complicated by narrowing of the airways due to water aspiration. There may be a stiff chest due to hypothermia. Even though ventilation takes more effort, it is recommended not to inflate for longer than 1 second. Increased ventilation resistance induces the risk of air inflation into the stomach significantly. Moreover, a lot of water is swallowed during drowning which further increases the risk of vomiting.

In-water resuscitation

Highly trained lifeguards might try to start the initial breaths in the water. In such cases it important to have a floating device available to keep the head of the victim above water during the ventilations. Depending on the circumstances such as the distance to the shore and support of a rescue boat or helicopter, the person who is drowning must be swum ashore as soon as possible after the initial breaths or in-water ventilations will be continued until further assistance arrives. Performing rescue breathing in surf is particularly challenging as in addition to observing the casualty the rescuer must always be aware of breaking waves.

A decision will be needed whether it is better to give a small number of breaths and then remove the person from the water quickly to facilitate an assessment and the commencement of compressions or if there has only been a short submersion to assume that the persons heart is pumping blood and to continue with rescue breathing while waiting for help.

Treatment of hypothermia

Hypothermia requires a different approach of treatment in drowning situations and is a major challenge if a drowned person has been in the water for quite some time. Unlike with acute submersion, more caution than haste is required. Basically, the body of a person that has been immerged in cold water for a prolonged period will likely be in a very unstable circulatory status and weak condition. Therefore, it is important to perform a careful and horizontal rescue or removal from the water in cases of hypothermic persons who are breathing themselves, as far as the circumstances allow. This is easier to understand with the following explanation. Heart rate, respiration rate, and blood pressure decrease as the body cools down (see chapter 1). In addition, the heart is increasingly sensitive to changes in heart beating rates. Vigorous movements of a drowned person can lead to dangerous irregular heartbeats. Treating this disorder is complicated by hypothermia, even when treatment is immediately started on removal from water. Because the skin and underlying muscles cool down relatively quickly, the body reacts by narrowing the blood vessels that go to the skin and muscles. This keeps the warm blood more central and allows the body to survive longer. The pushing of blood to the centre of the body will be further increased by the pressure the water exerts on the body. The deeper underwater, the more pressure is exerted on the body. This means that, in a vertical position in the water (e.g., in a life jacket or hanging onto a buoyant object), the feet experience most of this external water pressure. This will force blood from the legs up to the thorax and other parts of the body closer to the water surface. The extra volume of blood in this central part of the body will be sensed by the pressure sensors in the blood vessels that direct the kidneys to regulate blood volume. As a result, a lot of urine is produced to compensate for the central overfilling. Together with the cooling of the blood, this means that the thickness (viscosity) of the blood increases. If a drowned person is pulled upright from the water, the pressure that the water exerts on the body is suddenly removed and thereby the upward driving effect on the blood vessels. As a result less blood flows back to the heart for a short time. For a hypothermic heart that is very sensitive to arrhythmias, this can cause a fatal arrhythmia and must be prevented by carefully and horizontally removing the person from the water.

Once the victim is out of the water, it is important to pay attention to the victim's body temperature. Drowned persons will in most cases be cooled and often even hypothermic. Further heat loss must be prevented by removing wet clothing and drying the drowning person carefully but thoroughly. After this, the person should be well covered, preferably with both thick blankets and rescue blankets. If possible, warm the environment or move the drowning person into a warm environment. Try to wrap the limbs separately and to cover the head well except for the face. Shield the drowning person from wind. In cases of severe hypothermia, unnecessary movements, should be avoided. Hypothermia must be recognized noting that the absence of shivering in a cold person can be a sign of severe hypothermia. In that case, get professional medical assistance as soon as possible and cover the victim warmly without moving them unnecessarily. A severely hypothermic person should not be actively warmed, for example by rubbing the skin or by a hot shower. Also, no alcoholic drinks should be administered, as this causes expansion of the blood vessels in the skin drawing blood from the centre out to the skin thereby causing the person to cool down faster, despite possibly feeling warmer. In a hospital, active heating can take place in a controlled manner with close monitoring, for example by warm intravenous fluids and special heating blankets. The latest development in this field is to use extracorporeal membrane oxygenation (ECMO). This is a heart-lung machine that is only available in specialized medical centres and in which the temperature can be set very efficiently and increased in stages. ECMO can also temporarily take over the function of lungs damaged by drowning or even the function of the heart.

Post-rescue aftercare and prognosis

When the person is adequately breathing on his or her own, the rescuer can focus on other first aid than CPR. Place the victim in the recovery position or in a side position in case of unconsciousness. This prevents the airway from becoming obstructed by vomit or a relaxation of the tongue. Medical problems after a drowning incident are mainly related to the lungs and brain. Most lung problems resolve within a couple of days with good care such as mechanical ventilation. Brain damage is often permanent. The brain is very sensitive to a lack of oxygen, and in many cases neurological damage is permanent. Neurological disability is an often-underestimated problem with substantial consequences for quality of life.

Summary

Resuscitation of drowned persons requires specific skills and training. Thorough education and repeated training of drowning scenarios are essential. Both during and after the rescue, the pathophysiology of the drowning must be taken into account. In submersion, a drowned person with the face underwater should directly be rescued and resuscitated, with the priority to get oxygen back into the circulation as soon as possible. However, water aspiration creates a variety of issues that make CPR technically challenging. In immersion, a drowning person who is rescued with symptoms of severe hypothermia should be carefully and horizontally removed from the water. It is important to recognize the severely hypothermic patient, to prevent further cooling, to warm up passively and to avoid unnecessary movements. Obviously, professional medical assistance must be warned in time in all cases. Drowning persons must be taken to a hospital in most cases for further investigation, because secondary damage to the lungs or brain can be significant and requires long-term treatment.

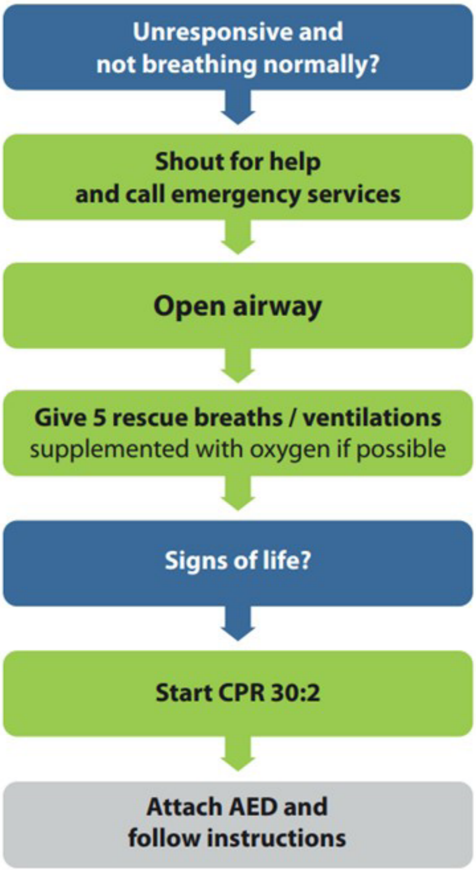


Image 12.3

Drowning treatment algorithm

By the European Resuscitation Counsel.

CHAPTER 13
FUTURE RESEARCH

INTRODUCTION

John Connolly

The Curse of Convenience

“Go to a lifeguarded location” has been promoted worldwide as a good piece of water safety advice. However, many don’t follow this advice because it is inconvenient. Several reasons are given for not doing so.

They say that it is too much trouble to go to a lifeguarded beach. These include reasoning like why drive many miles extra to reach a lifeguarded beach when there is a good beach much closer. Another excuse is the time it may take to find a parking place at a busy beach or the cost of parking for many hours. Added to this is the likelihood that, having found a parking place, it will be necessary to carry all the beach equipment a long distance to a recreational spot. The nearer beach does not have lifeguards but it is possible to park on the beach for free and no need to carry our equipment at all, we only have to take it out of the car. And it is private and quiet and much better than the crowded lifeguarded beach.

If you choose to take your family to a beach that does not have lifeguards you must undertake the roles that lifeguards do. You must assess the water conditions and determine if there are hazards that become hidden during full tide. Is there a rip current? You must provide any first aid that may be needed. Foot and leg injuries are common injuries treated by first aid qualified lifeguards. Does the beach have a phone signal?

If a rescue is needed who will perform it? Has he or she received rescue training? Can anyone perform CPR if one of your family stops breathing or has a heart attack?

Following the advice and going to a lifeguarded beach brings with it another convenience curse. “We go to lifeguarded beaches because the lifeguards will protect our children and we can relax.” This is a dangerous assumption. Parents and supervisors have the primary safety responsibility. Being on a lifeguarded beach does not mean that you can allow young children play in the water unsupervised. A new safety statement, based on recent drowning research, has established that child drowning events arise out of short lapses in supervision rather than a lack of any supervision. If you have children in water you need to be in the water with them. In drowning survival seconds do really count.

Go to a lifeguarded beach and share the safety responsibility with the lifeguards. Don't become a victim of the Curse of Convenience.

Image 13.1

Drowning Headline

FUTURE RESEARCH

Richard Franklin

- ***Local empirical studies are needed to augment national and international studies.***
- ***Research on we improve the implementation of large-scale safety programmes is needed.***
- ***Wider research is required to understand immersion exposure survival better.***
- ***Studies are needed in how to use technology and Artificial Intelligence (AI) to save lives.***
- ***More studies are needed to explore the emotional, social, and financial costs of drowning.***
- ***Disaster research is an area requiring significant future work.***

Introduction

The area of water safety / drowning prevention has a long history of developing new ideas about how to keep people safe when on, in, or near water. Life jackets hark back to the late 1700's and early 1800's centuries where a range of differing designs incorporating cork were used to keep a person afloat. Even earlier than this we started to see experimentation to explore ventilation and what today we know as Cardio-Pulmonary-Resuscitation (CPR). With the development of lifeboats and the lifesaving movement we started to see more innovation and experimentation. The early explorations were often of trained volunteers trying out different techniques to see what worked. This practice has evolved to very complex and rigorous studies. However, there is still more work to be done.

The following exploration of future research does not differentiate by high and low-income countries although there is a difference in the research needs and resources available. We take a global perspective on research noting that there will always be local needs for research to meet the needs of the local population. We also note that those involved in drowning prevention research are a very broad group, from epidemiologist to engineers, behavioural scientists to medical researchers, education specialists to economists, and lots in between.

This chapter is outlined as follows: the size of the problem and risk factors; primary prevention strategies; rescues; physiology, resuscitation, and rehabilitation; the impact of drowning including costs, emotional and social; environments and activity; policy; and disasters.

Size of problem and risk factors

While research (publishing empirical studies based on experimental design) has been going on for decades much of this work has focused on describing the issues with little evidence around what works. That is not to say that these studies are not important. They can be and are used for advocacy purposes and the directing of resources for prevention. Many countries now produced a report each year describing the last 12 months of drowning incidents (predominately deaths) by a range of factors such as age, gender, aquatic location, activity, use of safety devices, cultural background, and presence of drugs and alcohol. These reports are often the focus of the media and used in drowning related stories to emphasise the size of the problem, and the need for preventative action and more resources.

There has been an increase in the number of published papers exploring the impact of drowning deaths with some work also looking at those who are rescued and who required medical care. These papers are not evenly distributed across the globe and while work by the Global Burden of Disease Collaboration has provided estimates of drowning deaths for all countries, this work needs to be augmented by local studies which provide greater detail around the circumstances including location, activities, age, sex, season, presence of drugs and alcohol, medical conditions, rescue, safety present, etc. While we still need descriptive studies of who is drowning, especially from countries where there has not been a publication in the past. There is also a need to evolve these studies, looking in more detail at actual risk and the effectiveness of prevention programs. There is a need to explore what is required for the effective implementation of large-scale programmes and to explore who are and are not receiving prevention advice.

Box 13.1 Understanding the need for exposure.

> For example, there may be 100 children under the age of 5 who drown every year in a dam and 20 people over the age of 70 years. From this basic information we would say that dams are a greater risk for children and we need to do something about it. A true statement. However, if we know that 1,000 children visit a dam each year then we could say that 1 in 10 children drown while visiting a dam and if we know that 100 people over 70 visit dams then we would say 1 in 5 people over 70 drown while visiting dams. Now we would say that there is a greater risk of a person over 70 drowning while visiting a dam or that the relative risk is 2 times higher for people over 70 years of age.

While we know a great deal about risk factors such as children being most vulnerable, alcohol placing you at greater risk, rips, currents, flooding, there is more work required especially around understanding immersion exposure (Box 13.1).

Exposure is one of the greatest drowning challenges so not having information about exposure means that you do not fully understand the risk.

Drowning was defined in 2002 and this has then been expanded to explore critically the drowning ‘chain’ or sequence of events that commonly occur, from a person entering the water, getting into trouble, rescue, resuscitation, hospitalisation, and death, noting that intervening at many of these stages breaks the chain thereby minimises the impact. Research is needed across all these areas, how do people choose where they swim, what survival skills do they bring with them, and how can we build or enhance these skills, and what is required to rescue someone. Further work has also started to define other areas of drowning prevention and this work is ongoing.

Primary prevention

A lot of what is undertaken in water safety is based on trial and error over many years, which is both encouraging, as it is likely to work, and a challenge for strong evidence about what works. For example, how do you show that learning to swim is an effective strategy for drowning prevention? What do I mean by evidence? This is information that can be verified, repeated, and holds true in a range of set circumstance. There are broadly two types of evidence, the intellectual evidence which is what we have been using in drowning prevention for many years i.e., it is obvious or evident and empirical which is where research comes into place, noting that these two areas overlap. To prevent more people from drowning we will need more empirical evidence.

There is a need for more research on how do we improve what is working and understand how to deliver it to more people, for example how do you enable parents to better supervise their children when they are in the water, why don’t people swim between the flags, how to prevent people being injured while undertaking rescues, how to get more children into swimming lessons, what is the best way to teach a particular rescue technique, and so on. There is also a need for new and novel approaches to drowning prevention i.e., safer boats, protecting older people, exploring the impact of alcohol on drowning, looking at marginalised populations who drown, what is the best way to prevent a drowning suicide, how do you communicate safe messages to teens, etc.

Rescues

Rescue is a fundamental part of preventing drowning deaths from occurring and much of the work of a modern lifesaver / lifeguard is to stop people getting into trouble in the first place. This area of rescue has received much attention over the years and there are a range of effective devices and techniques that are used to enact an effective rescue, however more work is required.

As you will have read previously people continue to drown while undertaking a rescue. These are mainly people who are not trained to the level of a ‘profession’ lifesaver (a person who volunteers or is paid to undertake rescues).

Rescues are undertaken in a wide variety of settings and to know what works best in these settings should be explored, noting that there are currently some very effective tools and techniques used. With technology comes opportunity, including the use of drones to reach people in trouble quickly. Artificial intelligence is being developed to quickly recognise a person in trouble and then direct the rescue crew, lifejackets with inbuilt locator beacons that enable the rapid finding of a person in trouble are all being developed and will need further testing and refinement.

There is also a need to focus in on training, especially the lay person who undertake a rescue, what skills do they need, can they use or know how the use the equipment nearby, when should they be trained and to what level and when should these skills be updated, do they know how to rescue in teams or should it just be about one-on-one. Who should deliver this training and how should it be paid for? This also extends to first responders such as police, ambulance officers, and firefighters.

We also need to continue to explore effective rescue techniques and search strategies, equipment, removing people from the water, physical requirements, and potential devices that can help. We also need to look at the psychological burden of undertaking rescues and consider post-traumatic stress.

Physiology, resuscitation, and rehabilitation

The physiology of drowning continues to develop its evidence base. Recent work has focused on the impact of cold water on the physiology of the body and the impact of cold shock. More work is required to understand how this physiology changes as a person ages, how we can train for and adjust the physiology according to the age of the casualty, what impact do medical conditions, drugs and alcohol have on the physiology around water and drowning prevention.

The area of resuscitation has been researched for a long time. What we know today as CPR is over 50 years old, however there is still further work required both in the pre-hospital area, such as the use of monitoring devices, airway stabilisation, skill development and retention, and knowledge. In the hospital environment there is need for more studies exploring appropriate techniques and drugs and their impact on survival.

There is little however on the area of rehabilitation and drowning, while there is excellent research generally around rehabilitation there is little that specifically focuses on its links to drowning.

Impact of drowning including cost, emotional and social.

The impact of drowning is enormous with nearly 300,000 recorded deaths per annum and a likelihood of a real figure far higher. Few studies have explored the emotional, social, and financial costs of drowning. Work in the 1980's in Australia found that families who lost a child to drowning were more likely to divorce. Parents report that there is a greater stigma from losing a child to drowning than some of the other ways a child may die, such as cancer where there are strong well-funded support groups.

The financial burden of drowning has been estimated in a few countries, often based around years of life lost, however there is a need for more and better economic studies. These include exploring the cost of drowning, the cost benefit and cost effectiveness of drowning prevention, the cost of implementation of policies, and the cost of not enacting prevention strategies. Social costs are often considered as part of the economic costs, however little is known of the impact of a drowning at a community level. Does it change engagement with water behaviour, does it drive people to send children to swimming lessons, does it cause ongoing trauma and guilt. This is an area needing more work.

Environments and activities

We are only now starting to scratch the surface of what we know about drowning in various aquatic locations. At the moment we are covering the big one such as beaches and swimming pools for children with recent work exploring rivers, canals, and lakes. However, we need to know more about all the aquatic environments under different conditions and how people are interacting with these environments.

There are a wide range of activities that are undertaken in, on, or under the water and much more work is required on drowning prevention related to activity. Scuba diving is an area where there is a lot of research and continuing innovation. We know a little about people swimming or recreating in water however this is still not well understood about why people drown, there is some excellent work exploring the swimming skills of people, however, more is required. We have seen research around canoeing, kayaking, boating, surfing, fishing (including rock fishing), bouldering, cave diving, wind surfing, etc. Again more is required, looking at these by location, age, gender, etc.

Policy

For there to be effective prevention of drowning there will need to be effective policy. There are several local policies which appear to be effective and some research exploring these has occurred.

For example, pool fencing, an effective pool fence is one that is four-sided (i.e., you must enter the pool via a gate), has a self-closing self-latching gate, and is at least 1.2m in height with no climbable objects around the fence. The introduction of these policies has seen a reduction in children under the age of 5 years drowning in home swimming pools. Another example is the use of signage to warn people of the dangers in an aquatic location, there has been some excellent work internationally to try and ensure that the signage is consistent, however local policy need to recognise this and implement it in their jurisdiction for it to be effective.

There is a need for more research around policy, this includes the effective implementation of policy, what makes policy effective in the drowning prevention space, how can policy be transferred to other jurisdiction, cost benefit of policy, ethics around policy and much more.

Disasters

With the changing climate we are seeing an increase in disasters, especially floods and cyclones which bring with them the risk of drowning. Much disaster research has focused more broadly on risk management and resilience, however there is a little work focusing on drowning and disasters, these include: drowning and floods; driving through flood water; cyclones and drowning; children and floods; flood mitigation; etc.

Recently we have seen the impact of dam walls collapsing; flash flooding causing major drowning deaths; ravine flooding moving into areas with large populations and people being trapped in their homes or driving through water; and a large number of drowning deaths from tsunami’s.

Disaster research is an area which will require significant more work over the coming years to keep people safe during the event (including prior mitigation strategies), while rescuing people and recovering afterwards.

Summary

The list of areas where research is required could go on and I am sure there are areas which have been missed or require further elucidation. However, what I would like you to take away from this chapter is that there is research required across all areas and a need for us to build on the past success. It does not matter what your discipline, there is a fit for you in drowning research and we need more, better quality, innovative research.

BOOK AUTHORS

EDITORIAL TEAM

John Connolly MA in Ed. (Ireland)

John Connolly is a retired primary school head teacher. In 1973 his was the first public school in Ireland to provide swimming instruction to pupils during school hours. Other schools followed and it became a countrywide practice. Joining the Royal Life Saving Society (RLSS IRELAND) between 1977 and 2004 he served in a voluntary role as Branch Water Safety Officer, Branch Technical Officer, Chief Examiner, Branch Secretary, and Branch President. Interested in lifeguarding he established voluntary lifeguard services at two Waterford beaches. He worked as a professional pool lifeguard and as a voluntary surf lifeguard for 30 years and taught thousands to swim. In 1999 he established the RLSS IRELAND Overseas Aid Subcommittee to provide financial and technical aid to lifesavers in developing countries. The Overseas Aid Sub-committee was converted into the Irish Lifesaving Foundation and incorporated as a not-for-profit charity in 2003. In 2010 it was re-incorporated as The Lifesaving Foundation in recognition of its international membership. The Foundation promotes drowning research. He has extensively studied and published on the questions of why swimmers drown and suicide by drowning. John has been the recipient of many awards including honorary membership of The Royal Life Saving Society (UK and Commonwealth) and Surf Life Saving GB.

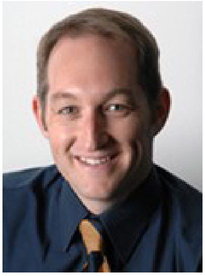
Dr Shayne Baker OAM, D. Prof (Australia)

Drowning Prevention has been the primary motivation for Shayne Baker's involvement in lifesaving. Since gaining his first lifesaving award at school and as a volunteer lifeguard his involvement increased, he gained his instructor/examiner qualification with the Royal Life Saving Society Australia (RLSSA). He has trained and assessed hundreds of students as they undertook RLSSA courses including Swim and Survive, Lifeguarding Awards, Resuscitation and Emergency Care qualifications. He has also contributed as a member of the state board, the national sports committee and then National President of RLSSA. His contribution, combined with his enthusiasm and passion for the trans-disciplinary opportunities in lifesaving has been recognised with life membership of RLSSA, an Australian Sports Medal, an Order of Australia Medal and the Ireland Medal. Today he works with RLSS at a national and international level, is often seen on the pool deck as the announcer at Life Saving World Championships, is a selector of the Australian Lifesaving team, holds membership of the Lifesaving foundation in Ireland, the International Drowning Research Alliance, Philippines Lifesaving Association, Surf Life Saving Australia and the International Life Saving Federation. Today he is still proud to patrols beaches, compete in masters' lifesaving competition, research, and contribute to lifesaving and drowning prevention worldwide and facilitating workshops in the Philippines, South Africa, and Malaysia.

Today he works with RLSS at a national and international level, is often seen on the pool deck as the announcer at Life Saving World Championships, is a selector of the Australian Lifesaving team, holds membership of the Lifesaving foundation in Ireland, the International Drowning Research Alliance, Philippines Lifesaving Association, Surf Life Saving Australia and the International Life Saving Federation. Today he is still proud to patrols beaches, compete in masters' lifesaving competition, research, and contribute to lifesaving and drowning prevention worldwide and facilitating workshops in the Philippines, South Africa, and Malaysia.

Professor Joost Bierens MD, PhD, MCPM (The Netherlands)

Joost Bierens worked as a lifeguard before and during his medical studies. Having qualified as a medical doctor, specialising in anesthesiology and emergency medicine, he obtained a PhD with the thesis "Drowning in the Netherlands, pathophysiology, epidemiology and treatment" (1996). He gathered together a group of (inter)national partners to assist in organizing the first World Congress on Drowning in Amsterdam (2002) with the essential support of Maatschappij tot Redding van Drenkelingen. The congress was the first all-inclusive world gathering ever on the topic of drowning. The knowledge collected, and the recommendations made, were summarized in the Handbook on Drowning (2005), updated in 2014. Joost is member of (inter)national commissions, task forces and research initiatives related to drowning. During his professional career as an anesthesiologist, he promoted the development of emergency and disaster medicine in his country. He was appointed as the first academic professor in Emergency Medicine in the Netherlands (2000-2009). Retired from clinical tasks, he has an appointment as visiting professor to the Research Group Emergency and Disaster Medicine, mainly serving as thesis coordinator for international students at the European Master of Disaster Medicine. He has (co)authored over 200 articles and book chapters related to drowning, emergency medicine and disaster medicine.



Professor Richard C Franklin PhD, FPHAA, FARL (Australia)

Richard C Franklin PhD is Professor of Public Health at James Cook University, Queensland Australia. He is a pracademic who uses an evidence-based approach to developing real world solutions to improving health, safety and wellbeing with a focus on drowning, injury prevention, health services, rural populations, those working in agriculture, disasters, and resilience. He is the Director for the World Safety Organization Collaborating Centre - Injury Prevention and Safety Promotion at James Cook University. He has worked on projects in the areas of general injury prevention, farm safety, rural safety, workplace health and safety, health promotion, alcohol, disasters, and aquatic safety. He was the first National Manager for Research and Health Promotion at the Royal Life Saving Society - Australia and continues as a volunteer Senior Research Fellow, during this time he developed for the society new courses aimed at older Australians called the Grey Medallion and for pool fence inspectors. He is the current co-convenor of the Injury Prevention Special Interest Group of the Public Health Association of Australia and on the editorial board of the International Journal of Aquatic Research and Education. He is Chair of the 14th World Conference on Injury Prevention and Safety Promotion.

Professor (Em) Stephen J. Langendorfer PhD (United States of America)

Stephen J. Langendorfer, Ph.D., is Professor Emeritus with Bowling Green State University, Bowling Green, Ohio, USA. He earned degrees from SUNY-Cortland, Purdue University, and University of Wisconsin-Madison. Dr. Langendorfer is a recognized authority and prolific author in the areas of developmental and instructional aquatics and lifespan motor development. He is co-author of *Aquatic Readiness: Developing Water Competence in Young Children*. He is the Founding Editor for the *International Journal of Aquatic Research and Education.* Currently, he serves on the American Red Cross Scientific Advisory Council and chairs the Research Committee for the Lifesaving Foundation. His research and service in aquatics has been recognized with admission to the Lifesaving Hall of Fame, Longfellow Society, and the Academic Hall of Fame, SUNY-Cortland, a Paragon Award, International Swimming Hall of Fame, and the 2013 Ireland Medal from the Lifesaving Foundation. Beyond his academic career, he has worked as a lifeguard, Red Cross Water Safety Instructor, USMS adult learn-to-swim instructor, canoeing and bicycling instructor, and master's swim coach (including currently coaching and daily swimming with the Bowling Green Masters Team).

AUTHORS

Professor Silvia Aranda-García PhD (Spain)

Dr Silvia Aranda-García has a Bachelor and PhD in Physical Activity and Sports Sciences. She has an MSc degree in Study of Interventions in Emergencies and Catastrophes. She is a First aid teacher in the Degree in Physical Activity and Sports Sciences course at INEFC-*Universitat de Barcelona,* Professor of Emergencies in different master's studies. Silvia is interested in research in the fields of drowning, aquatic safety, lifeguarding, first aid, and new technologies. She has qualifications as a lifeguard, boat skipper, and a basic life support and AED instructor.

Professor Roberto Barcala-Furelos PhD (Spain)

Lifesaving professor at University of Vigo (Spain). Bachelor and PhD in Physical Activity and Sports Sciences. Bachelor and PhD in Nursing. Head of REMOSS (Lifesaving research group at University of Vigo). Coordinator of lifesaving group of Spanish Society of Emergency Medicine (SEMES). Co-founder of IDRA. Author of papers in international and national journals, books, book chapters, and audiovisual publications in the field of drowning. Professor of hundreds of training courses for lifeguards and health workers.

Professor Rob Brander PhD (Canada & Australia)

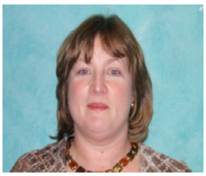
Rob Brander is a Professor in the School of Biological, Earth and Environmental Sciences at UNSW Sydney. Originally from Canada, he is a coastal geomorphologist and beach safety researcher and co-founder of the UNSW Beach Safety Research Group. Rob has expertise in the rip current hazard on beaches and has published over 70 scientific articles and book chapters related to rip currents and beach safety. In the early 2000's he started a community beach safety program called the 'Science of the Surf (SOS) which has won numerous awards and received significant media attention earning him the nickname 'Dr Rip' and an Australian Government Eureka Prize for promoting understanding of scientific research. He is a Life Member of the Tamarama Beach Surf Life Saving Club in Sydney, is passionate about beach safety, and loves to bodysurf.

Dr Hannah Calverley PhD (Australia)

Dr Hannah Calverley is the Manager - Research and Evaluation for Life Saving Victoria (LSV). Hannah assists in the management and undertaking of LSV's research and evaluation of injury prevention and water safety issues, including swimming and water safety education programs; lifesaving service delivery; water competency among children and older adults; inland waterways drowning prevention; public pool safety; multicultural water safety campaigns and international drowning prevention research. Hannah holds a Bachelor (with Honours) of Sport Development with Coaching, a Master of Psychology, and a PhD which investigated alcohol-related drownings among young people. Hannah has been involved in lifesaving sport, volunteering and research for over 15 years, was a Youth Ambassador for the Royal Life Saving Society UK, and has presented her research at the World Conference on Drowning Prevention.

Santiago Cervantes-Lópe (Mexico)

Santiago Cervantes López is Professor of Aquatic Rescue at the University of Guadalajara (Mexico). Graduate in Secondary Education in the Area of Natural Sciences, Master's Degree in Education and the Master's Degree in Civil Protection and Emergency Management. President and founder of the Group for Teaching, Development and Research in Aquatic Rescue (GEDISA). Representative in Mexico of the International Group of Prevention and Lifeguard Activities (GIAPS). Researcher interested in the field of aquatic rescue, contributions of techniques in aquatic rescue. He has been an active lifeguard for more than 30 years with over 25 years' experience in training lifeguards and in publicising aquatic rescue at a national and international level, both for the Mexican armed forces, for groups dedicated to emergencies and civil protection, as well as for the population in general.



Dr Suzanne Denieffe PhD

Dr Suzanne Denieffe PhD is Head of the School of Humanities at Waterford Institute of Technology since April 2018. Prior to that, she was Head of Department of Nursing and Health Care. She holds a BSc (Hons) in Nursing and an MSc in Nursing (Education and Research) from University College Dublin and a PhD from the Royal College of Surgeons in Ireland. Suzanne is involved in cross disciplinary research in areas including education, well-being and bio-medical research and has taught at undergraduate and post-graduate level for over 15 years on courses such as Clinical Governance and Decision Making, and Management and Leadership for Nurses.

Gerry Dworkin B.Sc. (United States of America)

Gerry Dworkin is responsible for the development of all Lifesaving Resources' educational programs; the conduct of all Lifesaving Resources' training programs; and for technical consulting. He is also an internationally recognized forensic expert witness for drownings and aquatic injury cases. As an author Gerry has written books on Ice Rescue, Water Rescue and Aquatic Safety. In addition to his books, Gerry has published a library of articles and resources that, in addition to the Lifesaving Resources website, have been published in trade publications including the Journal of Emergency Medical Services (JEMS), Fire Chief Magazine and Parks and Recreation Magazine. He has served as a volunteer, paid-on-call, and professional Firefighter and Emergency Medical Technician (EMT) continuously for over 40 years. He is currently a Firefighter for the Kennebunkport Fire Department, and an EMT for the Kennebunkport EMS, both in Maine.

Melinda Jackson B. Es (Australia)

Professionally Melinda Jackson is a high school teacher of Science, Maths, Marine and Aquatic Studies and the Japanese language. She has a Bachelor of Environmental Science, Graduate Diploma of Education, and a Graduate Diploma of Japanese language. She has been a member of Surf Life Saving Australia since 1980. She is an active patrolling member and competitor on the Gold Coast
as well as the current Team Manager of the Australian Youth Lifesaving Team.
She has over 40 years' experience in delivering training in Aquatic Rescue, First Aid and Resuscitation within Australia and is a qualified Trainer, Assessor and Facilitator. She is an experienced, qualified, and practicing pool and ocean coach on the Gold Coast and has previously taught at the Institute of Marine Science and Sport in Japan. Melinda is passionate about lifesaving, safety in the aquatic environment and improving community awareness.

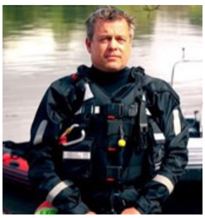
Will Koon MPH (United States of America)

William Koon is a drowning prevention practitioner and researcher from California specialising in coastal hazards, drowning and injury. He spent over a decade working as a professional ocean lifeguard in California, and has experience in lifeguard rescue boat operations, emergency communications, emergency medical service delivery, and beach management.

Will also served as an instructor for ocean lifeguard and Emergency Medical Services courses and was involved in several major state-wide systems updates including protocol and policy revision. He completed a Master's in Public Health at the University of Washington in Seattle where he focused his studies on injury epidemiology and biostatistics, specifically related to drowning and ocean lifeguarding. Before moving to Sydney to commence his PhD research, Will worked as a consultant in California specializing in drowning prevention and open water lifeguarding, managing a diverse array of projects for municipal agencies, councils and other land managers, hospitals, non-profit organizations, and start-up private enterprises. William is a co-founder of the University of New South Wales (UNSW) Beach Safety Research Group, is a collaborating member of the International Drowning Research Alliance (IDRA), and the Grupo Internacional de Actividades de Prevención y Socorrismo (GIAPS) [international group of rescue and prevention activities].

Dr Jasmin Lawes PhD (Australia)

Dr Jasmin Lawes is a committed science communicator and published researcher with experience spanning university and industry sectors. Her role as the lead researcher at Surf Life Saving Australia includes the production of the National Coastal Safety Report, maintaining SLSA's National Fatality Database and coordinating a diverse portfolio of coastal safety research projects that work to safeguard both the general public and SLS members. She is passionate about science and education programs that investigate and support interactions between people and the environment. Jasmin is gaining recognition within coastal safety with her capacity to engage in, and lead, multi-disciplinary research being central to this success. Jasmin believes education and awareness strategies driven by evidence-based research are the most effective tool to transform attitudes and change behaviours to enhance public safety in, and around, the coast.



Adrian Mayhew (United Kingdom)

Adrian Mayhew has 25 years in the Fire & Rescue Service and has served as an officer in Fire along with completing a six-year secondment to National Resilience running an Urban Search and Rescue Team. He was part of the Chief Fire Officers Association (CFOA) working group that developed the National Flood Rescue standards now set by DEFRA Concept of Operations for Flood Rescue through the Flood Rescue National Enhancement Project. Whilst this was his professional role he has also been an international multisport athlete competing in many open water events and since 1978 been involved in lifesaving.

In 2011 Adrian became part of Surf Life Saving GB Commission and advisor to safety standards near, on or in water. In 2012 Adrian was nominated to ILS and in 2021 became Chair of the International Rescue Committee providing technical and medical advice to members and the World Health Organisation in life saving, open water safety and civil protection against disaster. Now serving 4 years fulltime with Surf Life Saving GB; is the creator and author for the National Life Saving Patrol framework, National Flood Rescue framework and is the voice for safety within the charity. He sits as an adviser for the National Water Safety Forum, UK Search and Rescue Operators Group. He works closely with key stakeholders including HM Coastguard, Swim England and UK Fire and Rescue. Presently Adrian is now advising South Africa, India and Portugal in water/flood disaster management.

Nuala Moore (Ireland)

Nuala Moore is an Irish Open Water swimmer, mostly known for her extreme ice swims. She has pushed boundaries in some of the most dangerous icy waters and remote locations in the world. She is a pioneer, a cold-water safety specialist, a coach, and a mentor. In 2014, she developed the Ireland Ice Swimming Program to focus and grow the sport of ice swimming within the perimeters of safety. She authored a manual "An Insight into the World of Ice Swimming" and served as a faculty member on the Ocean Extreme Medicine course, for the World Extreme Medicine. She was the first woman in the world under the IISA rules to complete a 1000m in 0 deg ice in just swim togs, hat and goggles. Nuala was twice nominated as the World Open Water Woman of the Year, in 2014 and 2016 for her work on extreme swimming and her focus on safety. She has two Guinness World Records for extreme swims,

- International relay team to swim from Russia to the USA across the Bering Strait,
- World's first swim from the Pacific Ocean to the Atlantic Ocean south of Cape Horn.

Professor José Palacios Aguilar PhD (Spain)

Professor José Palacios Aguilar has a Physical Education Bachelor degree and Ph.D. He is a professor at the Faculty of Sports Sciences and Physical Education of the Universidade da Coruña. Creator and Coordinator of the International Group for Prevention and Lifeguard Activities (GIAPS). Coordinator and IP of the Research Group on Aquatic Activities and Lifeguard (GIAAS) of the Universidade da Coruña. President of the Association for Environmental and Consumer Education - Environmental Education Foundation (ADEAC-FEE). Author of 138 articles in international and national journals, 40 books, 48 book chapters, and 40 audiovisual publications. Professor of hundreds of training courses for trainers and emergency professionals.

Professor (Em) John Pearn OA, MD, PhD (Australia)

Professor John Pearn is a renowned Brisbane paediatrician, former Honorary Consultant at the Royal Women's Hospital, former staff member at the Royal Brisbane Hospital and Senior Clinician at the Royal Children's Hospital for 46 years. For many years he served as Professor of Paediatrics and Child Health at the University of Queensland and at the Royal Brisbane Women and Children's Hospital. In 1975 he established the Medical Genetics Clinics at the Royal Women's and the Royal Children's Hospitals His extensive research publications the international literature has contributed to child safety and welfare, clinical genetics, neuromuscular disease, and medical ethics. Professor Pearn has received numerous awards including the Order of Australia for service to medicine, particularly in the areas of paediatrics and medical ethics, to medical history, and to the community through injury prevention, safety promotion and first aid programs.

Dr Amy Peden PhD (Australia)

Dr Amy Peden is an injury prevention researcher and lecturer in the School of Population Health at UNSW Sydney and holds an Australian National Health and Medical Research Council (NHMRC) Fellowship. She holds adjunct appointments with James Cook University and the George Institute for Global Health. Much of her work focuses on drowning prevention, regional and remote communities, social determinants of health and alcohol. Dr Peden is also an honorary Senior Research Fellow with Royal Life Saving Society – Australia and is a member of the International Life Saving Federation Drowning Prevention and Public Education Commission.

Rui Seabra (Portugal)

Dr Rui Seabra is a Portuguese marine biologist who researches the impact of Global Warming on rocky shores (www.coastalwarming.com/norterocks). With nearly two decades conducting his research between the high and low tide marks of shores across the Atlantic Ocean, Rui has become an expert on the nuances of tidal patterns and how they interact with nearshore bathymetry, oceanographic and meteorological conditions to shape coastal dynamics. Rui is also a long-time wave-rider and an expert in water safety and drowning prevention. Rui is a co-founder of www.ElectricBlue.eu, a tech co-op developing instruments for environmental monitoring and bio-logging.

Dr Jeroen Seesink MD (The Netherlands)

Dr Jeroen Seesink MD, MSc. is a Dutch doctor who currently specializes as an anaesthesiologist, with special attention for emergency medicine and prehospital emergency medicine. In particular, he focuses on the theme of drowning and hypothermia. He discovered his passion for water sports at a young age. At the age of 12 he also decided to become a lifeguard in the Dutch village of Ouddorp and contribute to the safety of water sports, after which he spent many years working on this theme for various organizations and still does. After studying medicine, he gained experience in emergency care and intensive care. All this experience now comes together in his specialization as an anaesthesiologist. In addition, he works pre-hospital for the ambulance service. He uses this prehospital and clinical experience by providing medical training and performing medical scientific research.

Dr Jonathon Webber DProf, BHSc (New Zealand)

Jonathon Webber is an advanced qualified lifeguard (ret.), and life member of the Piha Surf Life Saving Club and Surf Life Saving Northern Region (New Zealand). A senior lecturer in the Department of Anaesthesiology at the University of Auckland, he is a founding member of the International Drowning Researchers' Alliance, executive member of the New Zealand Resuscitation Council, and corresponding member of the International Life Saving Federation Medical Committee. Jonathon has presented and published extensively on drowning detection and response, lifeguard perception and performance of CPR, leisure-related injuries at New Zealand beaches, human factors in lifeguarding, airway management in drowning, and first aid training and resuscitation in the aquatic environment.

Professor John Wells PhD (Ireland)

Professor John Wells is Head of the School of Health Sciences at Waterford Institute of Technology (WIT). He qualified as a registered mental health nurse in the UK in 1988. He then practiced in a range of mental health clinical areas including child and adolescent psychiatry, rehabilitation psychiatry and acute adult psychiatry. In 1998 he moved to Waterford Institute of Technology (WIT) in Ireland to continue his career at a time when nursing education in Ireland changed to an all-graduate profession. At national level he sits on the National Research Ethics Committee of Ireland and is a board member of the Institute of Industrial Engineers and Safety Management Systems, advising the Institute on employee well-being.

He is a Fellow Ad Eundem of the Faculty of Nursing and Midwifery of the Royal College of Surgeons in Ireland and a Marie Skladowska-Curie Senior International Fellow and holds Visiting Professorial appointments in Nursing at King's College, University of London, UK and at the University of Maribor, Slovenia.

Janet Wilson FIBMS (United Kingdom)

Ms Janet Wilson is a retired Biomedical Scientist who has been in, on or around open cold water for approximately 60 years. Involvement has been with lifeguarding and water safety training through RLSS UK, and long-distance swimming as an individual, and as a member of the British Long Distance Swimming Association. She has served on many committees nationally and internationally, with practical involvement as a lifeguard and Long-Distance Swimmer. She has swum Loch Lomond in Scotland (21.6 miles) and organises that event every 2 years for the British Long Distance Swimming Association. (BLDSA) It is here that most experience in dealing with swimmers in the open water environment has been gained. As a trainer with St. John Ambulance there have been many opportunities to deliver standard courses with the addition of all the extra relevant actions to take with swimmers in difficulty. There are around 20 BLDSA swims every year, as well as many individual attempts at various routes, and Janet often heads the First Aid Team at these. She spends her spare time walking outdoors, sometimes locally, and further afield, having climbed Mont Blanc, and trekked to Everest Base Camp.

Why do swimmers accidentally die by drowning?

1. ***They get into trouble unnecessarily.***
2. ***They don't know what to do when they get into trouble.***
3. ***They do the wrong things first because they don't know what to do.***

This book has the answers.

PERIDIS PUBLISHING

ISBN 978-0-947225-80-3