Complemental Material 2 – Drowning & Aquatic Injuries Dictionary

Term (Item Content Value Index I-CVI)		Definition
	Sub-term (I-CVI)	***Definition***
An asterisk (*) denotes where the main term is included in any sub-terms		
Activity while in water stress / distress (0.80)		The water activity that a person was engaged in immediately prior to the drowning. Activity categorization should preferably follow the International Classification of Disease (ICD) code for drowning (e.g., W64.0 - pool drowning while engaged in sports activity; W64.1 - pool drowning while engaged in leisure activity code).
Acute respiratory distress syndrome (ARDS) (0.90)		A disease process characterised by widespread inflammation following a direct injury to the lung or other organ/systems. It results in a decrease of the lungs' ability to adequately exchange oxygen into the person's blood.
Advanced life support (ALS) (0.70)		A set of clinical interventions for the urgent treatment of cardiac arrest and other life-threatening medical emergencies, as well as the medical resources, knowledge and skills to deploy those interventions.
Age [by recommended ranges] (1.00)		Age should be recorded in a continuum metric, but if unable to, then categorization should be less than 1 year old, and then follow a minimal standard of 5-year increments. Code as: UNKNOWN, <1 yo, 1-4, 5-9, 10-14, ...)
Aggressive cerebral resuscitation therapy (0.50)		Any medical intervention conducted to preserve brain function that carries a higher risk to the patient or is associated with uncertain efficacy but may be worthwhile attempting considering the critical nature of the situation.
Alcohol consumption (0.90)		The amount of alcohol consumed before the drowning incident, which may or not be related to the occurrence of the event. Code as: YES, NO or UNKNOWN. If YES, or suspected, this should be quantified by recording the alcohol consumption either by measured blood alcohol concentration [BAC] or provide an estimate consumption based on the person and/or witness testimonies.
	Drowning indirectly related to *	A drowning event where alcohol is involved but not consumed by the person who drowned (e.g., an operator of a vessel under the influence of alcohol and the passenger (having not consumed alcohol) drowns). Code the same as alcohol consumption.

Aquatic (0.80)	Relating to water
**** Adult supervision***	A key strategy for reducing drowning in children. It comprises four elements: preparedness, continuity, attention and proximity. Supervision during aquatic recreation by peers is an equivalent drowning mitigation strategy for teenagers and adults.
**** Disaster***	An emergency situation where services are strained by an overwhelming need for resources due to a high number of casualties or the extent of the emergency overwhelms the capacity of the rescue operations/agency.
**** Incident***	Any adverse water-related event that requires external support, such as assistance or a rescue.
Aquatic activity resulting in incident (1.00)	The water activity that resulted in an incident involving either a death or non-fatal injury, or both (see INCIDENT)
Aquatic activity demarcated area (0.90)	An area in a body of water exclusively defined for a specific water activity (e.g. swimming, surfing, boating, fishing, or other).
Aquatic and first aid education/training strategy (0.70)	A method for delivering information and training in water safety and first aid. The amount of time undertaken in water safety education may reflect the results. Programmes can be delivered in person, through e-learning or mixed. Examples of educational programmes include: lecture (less than 2 hours) (T); workshop (2-5 hours) (T&P); course (over 5 hours) (T&P); conference/symposium (2-10 hours) (T); congress (> 1 day) (T&P). See **Figure 1.** *Note: Theoretical (T); Practical (P).*

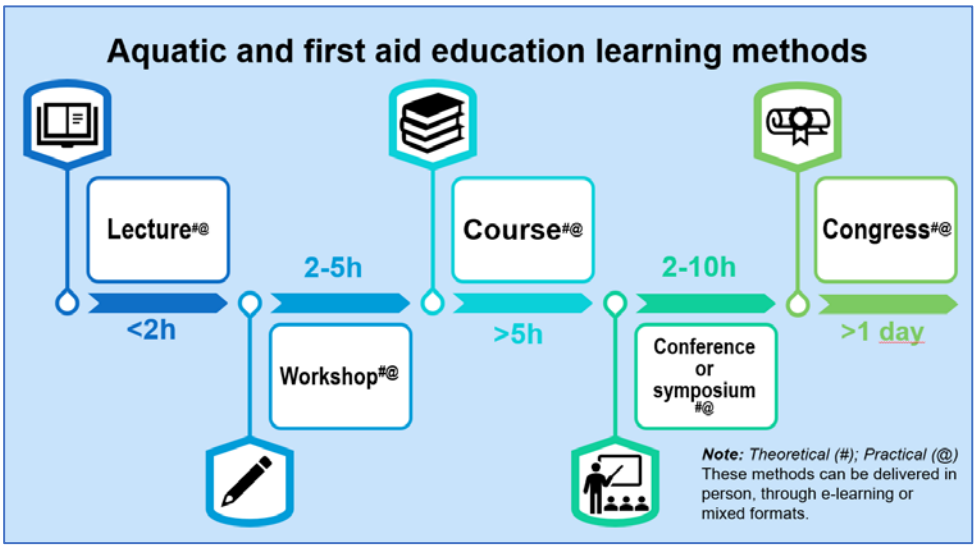


Figure 1: A diagram depicting various educational programme structures separated by length of time involved. There are multiple learning structures and they can include other variables that should be considered (e.g., target audience, course content, etc).

Aquatic barrier (1.00)

Any natural or erected structure that separates a person from a water location and prevents (or delays) drowning by avoiding an inadvertent entry or fall into the water (e.g., fence, retaining walls, walls of buildings, gardens, etc).

Fence with self-closing gate and self-latching gate

A fence that has a gate with the capacity to close and lock automatically after use.

Aquatic competence (in a drowning prevention context) (0.80)

The sum of all personal aquatic movements and the associated water safety knowledge, attitudes, values, judgment and behaviours that facilitate safety in, on and around the water (see SWIMMING COMPETENCE). See **Figure 2**. (Stallman et al., 2017)

Momentary loss of *

A situation in which a swimmer suffers a momentary physical disorder either in breathing, floating or swimming, or in their ability to move within the water. If this situation is not resolved either by the swimmer or by external support, loss of control could progress into a distress situation, and eventually to a drowning incident (see PRE-EXISTING MEDICAL CONDITIONS).

Water Competency Framework			
1	Safe entry a) entry into the water b) Surface and level off	9	Clothed water competencies
2	Breath control Integrated and effective breathing	10	Open water competencies
3	Stationery surface competencies a) Float front and back b) Tread water	11	Knowledge of local hazards
4	Water orientation a) Roll from front to back, back to front b) Turn, left and right, front and back	12	Coping with risk a) Recognize and avoid risk b) Judgement of risk and action
5	Swimming competencies a) Swim on the front b) Swim on the back	13	Assess personal competency
6	Underwater competencies a) Surface dive b) Swim underwater	14	Recognize/assist a drowning person
7	Safe exit	15	Water safety attitudes and values
8	Use of personal flotation devices (PFDs)		

Figure 2: A framework outlining essential aquatic competences (Stallman et al., 2017).

Aquatic condition (1.00)

A description of water characteristics when the event occurred (e.g., calm, current, waves, temperature, tide, etc)

Aquatic depth (related to an individual) (0.90)

The depth of water relative to an individual's airway, when standing. Deep water for that individual is defined as when the vertical distance from the water surface to the bottom is greater than that to the airway.

Aquatic environment (1.00) See **Figure 3.**

Natural (open water) any waterway that was not created by humans.	**Fresh**	**Beach:** landform alongside a body of water which consists of loose particles (fresh or salt). **Lakes/ponds**: a large body of water surrounded by land (can be of salt water). **River**: a large natural stream of water flowing in a channel to a sea, a lake, or another stream. **River Backwater**: part of a river in which there is little or no current. It can refer to a branch of a main river, which lies alongside it and then re-joins it, or to a body of water in a main river, backed up by the tide or by an obstruction such as a dam. **River mouth**: the point where a stream or river empties into a larger receiving body of water, such as a lake, sea, or ocean. **Stream (brook or a creek)**: any natural flow of water on a smaller scale or a minor tributary of a river. **Waterfall:** a place where water flows over a vertical drop or a very steep section of a stream or river.
	Salt	**Bay**: a broad inlet of the sea where the land curves inward. **Estuary**: the tidal mouth of a large river, where the tide meets the beach. **Lagoon:** a pool at the beach/ocean formed by the water entrance during high tidal. **Ocean beaches:** a wave-deposited accumulation of sediment along a coastline.
Anthropogenic any water body built or modified by humans		**Canal:** broad artificial or excavated waterway created for the movement of boats. **Culvert**: a tunnel carrying a stream or open drain under a road or railroad. **Dam:** barrier that stops or restricts the flow of water or underground streams. **Weir**: a low dam built across a river to raise the level of water upstream or regulate its flow. **Ditch:** narrow artificial waterway for drainage along roads and fields. **Drain** (storm water): is the primary mechanism for removal of any excess water to be funnelled away to reduce potential for damage and/or for storage. **Irrigation channel**: a passage dug in the ground and used to bring water to land to make plants grow. **Pool:** a body of standing liquid. **Residential:** any water reservoir (e.g., bucket, laundry machine) used for different purposes in a household. **Water through or artificial watering point**: a human-made or natural receptacle intended to provide drinking water to animals, livestock on farms or ranches or wild animals. **Well:** an excavation or structure created in the ground by digging, driving, boring, or drilling to access groundwater in underground aquifers.

Figure 3: Examples of aquatic environments and their associated definitions

Aquatic training course (0.67) A course designed to develop an individual's competency in the water (See AQUATIC COMPETENCY or SWIMMING COMPETENCY). (Stallman et al., 2017)

Aquatic safety intervention (0.70) A preparatory (educational), preventive or reactive action for the purpose of reducing the incidence or mitigating the impact of an aquatic incident.

Public [water safety] education A type of safety intervention designed to educate the public about issues and topics related to water safety (e.g., direct communication, information flyer, advertising, television or social media).

Recreational [water safety] education A type of safety intervention designed to educate those participating in a specific recreational activity or present

	at a specific aquatic location (e.g. direct communication, information flyer, advertising, television or social media).
Aquatic supervision (0.80)	The act where a competent person is overseeing the behaviour and safety of people in and around the water.
Aquatic temperature (0.80)	The measurement of water temperature in ^{o}Celcius or ^{o}Fahrenheit at the drowning location. Code as either a continuous scale or a range (e.g., Icy, 0-5, 6-10, 11-15, 16-20, 20-25^{o}C, …), instead of cold or warm. This may affect the drowning process and resuscitation outcome.
Aquatic trained supervision (0.90)	The act where a qualified and competent person for that purpose is overseeing the behaviour and safety of people in and around the water.
Aquatic transportation (1.00)	The movement of humans, animals or goods from one location to another over the water by using a floating watercraft. The watercraft can be personal or not, private or public.
Aquatic users (the number of at a certain time/location) (0.90)	The total counted or estimated number of people engaging in aquatic activities (in, on, under or near the water) within a timeframe and/or location (see SURVEILLANCE ZONES). It can be assessed per length of water body during a certain period or by digital technology.
Aquatic Victim-Instead-of-Rescuer syndrome (AVIR) (0.90)	An aquatic incident where the rescuer drowns instead of the person who was in distress in the water. Situations that can result in this include: a parent, partner, relative or bystander; an unfamiliar water hazard; a 'rescuer' who is not a trained rescuer; and then the primary drowning person usually survives.
AVIR-Animal (AVIR-A)	Where the rescuer drowns while rescuing an animal (either family/domestic pet or farm animal). (note: Authors prefer to avoid referring to the drowning person as a victim throughout this text, as it implies a random event instead of a possible preventive one. This is one exception where this term is validated by literature used).
Arrest (legal) (0.90)	The detention of a person by a lifeguard, lifeguard agency or other law enforcement agent for apparent violations of local, state, or federal laws or regulations (where applicable).
Bag-Valve-Mask (BVM) (1.00)	A ventilation device used for artificial ventilation consisting of an inflatable bag, a unidirectional valve and a face mask used with or without supplemental oxygen.
Basic Life Support (BLS) (0.80)	A level of medical care provided with limited or no resources (e.g., pocket mask) with or without

	supplemental oxygen. It is a set of procedures for a drowned person with life-threatening illnesses or injuries provided by bystanders or a trained person until advanced life support begins. It can be provided by anyone trained to do so. (Nolan et al., 2015)
ABC (Airway – Breathing – Circulation)	A resuscitation algorithm that begins with assessment/management of the airway, breathing (e.g., ventilations), and then circulation (e.g., chest compressions). It is the preferred choice for cardiac arrest due to a respiratory cause (e.g., drowning)
CAB (Circulation – Airway – Breathing)	A resuscitation algorithm that begins with assessment/management of circulation (e.g., chest compressions), followed by opening of the airway, and breathing (e.g., ventilations). Preferred choice for cardiac arrest not due to a respiratory cause (e.g., myocardial infarction).
CCO-CPR (Chest Compression-only CPR)	A resuscitation algorithm using chest compressions only. This is an option where ventilation is not possible or the rescuer is not trained in other techniques. Also known as CO-CPR (Compression only) or HO-CPR (Hands-only CPR).
Bather (0.90)	A person in or around the water for the purpose of aquatic recreation (See SWIMMER).
Boat (1.00)	A flotation vessel (powered or non-powered) which is used to transport one or more persons and may be used to conduct or assist in a rescue.
Assisted *	A vessel not in immediate danger but which is unable, using its own power, to reach the intended destination or the shoreline.
**** warning (including Personal Watercraft (PWC))***	A notification delivered by a water safety professional to a boat operator, while performing unsafe actions and/or violating operating laws.
On-* resuscitation	A resuscitation procedure performed on board of a boat.
Rescued-* passenger(s) (in number)	The number of person(s) in a boat who were rescued from danger.
Rescued-* property	A boat that, if had of been left unattended by rescue personnel, would have been in danger of sinking, becoming damaged, or causing damage to other people and/or property.
Body (1.00)	See CARDIOPULMONARY RESUSCITATION, DO NOT START
**** decomposition (Corpse)***	The process in which the human body break down into simple organic matter over time. Signs of body decomposition include livor mortis, rigor mortis, and algor mortis. These signs are indications to not begin resuscitation (e.g., Do Not Resuscitate [DNR]).
**** not found (not recovered)***	A situation where a submerged body was not found after a search and rescue effort.
**** search***	A search for a supposedly drowned person. The search can be by any means.

**** temperature assessment of a drowned person***	The method used to measure the body temperature of a drowned person. Methods include: non-invasive (skin [very imprecise]; mucosa [buccal or rectal – difficult to use]); infrared; tympanic); or invasive (central - via central venous catheter or oesophagus probe).
Bystander (0.90)	A person who is present at an event or incident but does not take part (See LAYPERSON).
Cardiopulmonary (0.90)	
**** arrest (CPA)***	A sudden loss of blood flow resulting from the failure of the heart to effectively pump combined with the cessation of pulmonary function (e.g., spontaneous respiration). This is also known as Cardiac Arrest (CA).
Cardiopulmonary resuscitation associated terms (See Figure 4)	
Submersion time (min)	An estimated time that the airway is submerged in liquid (recorded in minutes).
No-flow time (min)	The submersion time plus CPR time to start (BLS or ALS) (recorded in minutes). Also described as total hypoxic or anoxic time.
BLS time to start (min)	An estimated time from when a drowned person's airway was removed from the water until the beginning of BLS (recorded in minutes).
ALS time to start (min)	An estimated time from when a drowned person's airway was removed from the water until the beginning of ALS (recorded in minutes).

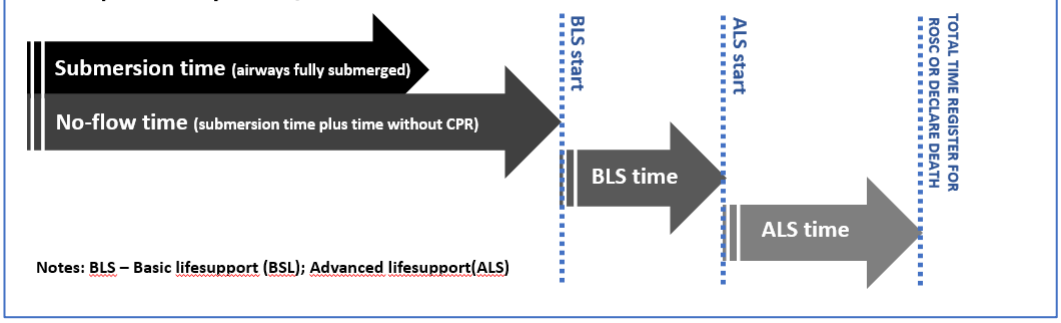


Figure 4: Drowning resuscitation terms demonstrated over a timeline

**** resuscitation (CPR)***	An emergency procedure that utilizes chest compressions (with or without ventilations), in an effort to preserve brain tissue with the aim of obtaining a return of spontaneous circulation (ROSC).
Do not start *	A type of CPA with no indication to start CPR (e.g., deceased). There is no uniform criteria agreed upon in literature, however, some commonly cited include: submersion time greater than 1 hour, or physical signs of death (e.g., rigor mortis, body decomposition, or livor mortis). Also known as Do Not Resuscitate (DNR), or Do Not Attempt Resuscitation (DNAR).

Indication for discontinuation	An indication to stop performing CPR. Examples include: signs of life reappear (e.g., spontaneous ventilation, improvement of drowned person´s level of consciousness, and/or arterial pulse present), rescuer becomes physically exhausted (with no one to assist), scene becomes unsafe or advanced life support arrives to proceed with CPR.
**** successful***	A cardiac arrest that achieves return of spontaneous circulation (ROSC).
**** unsuccessful***	A cardiac arrest that does not achieve return of spontaneous circulation (ROSC) and results in a fatal incident.
Casualty	See DROWNED PERSON
Cerebral Performance Category scale (1.00)	A validated tool to measure someone's cognitive and functional ability following a drowning event (usually post-CPR). Often used to assess the neurological impairment after a non-fatal drowning (see **Figure 5**). (Phelps et al., 2013)

CPC 1 – Normal cerebral function and normal living;
CPC 2 – Cerebral disability but sufficient function for independent activities of daily living;
CPC 3 – Severe disability, limited cognition, inability to carry out independent existence;
CPC 4 – Coma;
CPC 5 – Brain death.

Figure 5 - Cerebral Performance Category scale (Phelps et al., 2013)

Cervical collar (0.90)	A device used to limit neck/head (cervical spine) movement.
Cervical spine injury (CSI) water related (0.90)	An injury to the cervical spine resulting from physical trauma while engaged in water activities.
Chest compression-only CPR (CCO-CPR)	See BASIC LIFE SUPPORT, examples of BLS Algorithms.
Citation (0.80)	A fine or penalty issued for a violation of a specified water safety code/policy/law, issued by a lifeguard, lifeguard agency staff or law enforcement agency.
Code X (0.78)	A way for rescuers to communicate that there is a missing underwater person (land or in the water).
Complementary drowning investigations (0.90)	A medical test or procedure conducted to complement the physical examination for a diagnosis and/or prognosis. This can be: biochemical (e.g., blood gases, electrolytes), radiographic (e.g., chest X-ray), or invasive (e.g., bronchoscopy, biopsy).

Community at risk (1.00)	A community with a set of common characteristics, vulnerabilities or under specific threats that result in an increased drowning risk.
Compression-only CPR (CO-CPR)	See BASIC LIFE SUPPORT, examples of BLS Algorithms.
Current (1.00)	A body of water moving in a direction, that is typically non-uniform in space and unsteady in time. It may exist adjacent to surrounding areas of water, where there is less movement.
**** alongshore***	A shore-parallel flow close to the shoreline of beaches that is primarily caused by wind-generated waves approaching the shoreline at an angle, or may exist as a smaller feeder current which leads into offshore flowing rip currents. Also known as a longshore current or alongshore drift.
Rapid *	A very strong flow that is highly turbulent and typically occurs in narrow and steep sections of rivers.
Rip *	A strong, narrow offshore flowing current that occurs on any beach characterized by waves breaking across a surf zone. Most rip currents exist in deeper channels between shallow sand bars and initiate close to the shoreline. They flow at speeds that can easily transport bathers and swimmers offshore through the surf zone and some distance beyond. They typically consist of an alongshore feeder current which transports water towards a narrow rip-neck that eventually slows down as an expanding rip neck beyond the surf zone.

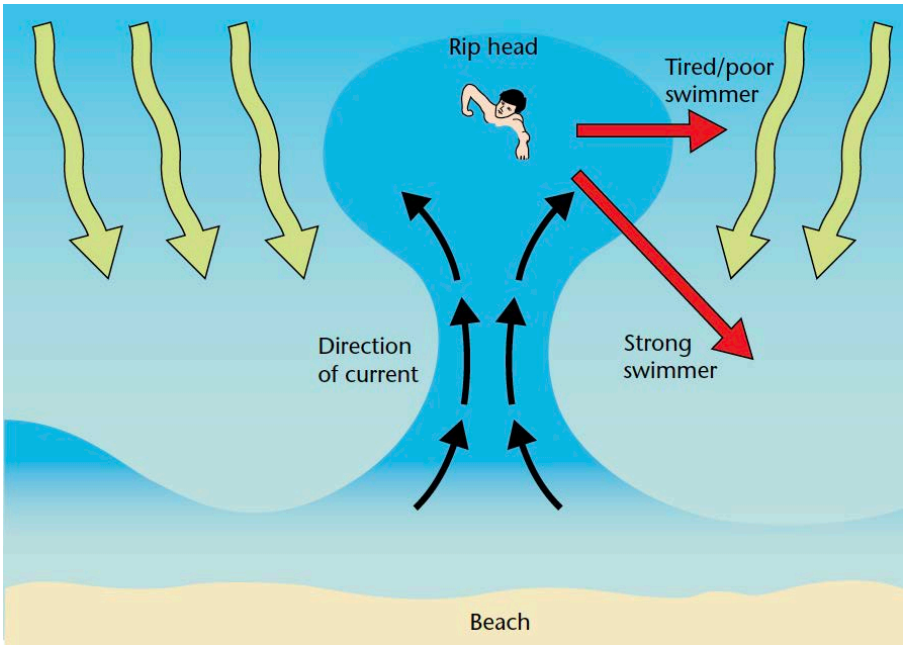


Figure 6: Diagrammatic example of a rip current and ways to respond to it (RLSSA, 2010)

C-Zones framework (0.67)	A number of zones (e.g., C1-concern, C2-crisis, C3-critical, C4-cardiopulmonary resuscitation (CPR), C5-coma, C6-conclusion) to be used as a tool for discussing and analyzing rescue and drowning incidents. (Connolly, 2012)
Debriefing of incident (0.90)	An interview (or a series thereof) or group discussion, to allow rescuers to review the event and share their experiences with a facilitator in a way to evaluate processes, actions and procedures, usually for educational purpose. (See PSYCHOLOGICAL)
Defibrillator (External) (0.90)	A device that performs synchronized or unsynchronized electrical cardioversion in an attempt to re-establish an effective cardiac rhythm.
Automated External * (AED)	A portable device that automatically recognizes certain cardiac dysrhythmias and performs unsynchronized electrical cardioversion (e.g., defibrillation) without requiring the user to press a button to deliver the shock.
Semi-automated *	A portable device that automatically recognizes certain cardiac dysrhythmias and performs unsynchronized electrical cardioversion but differs from an automated device which requires the rescuer to press the shock button if indicated.
Manual *	A device that requires the expertise of a healthcare professional to recognize the cardiac arrhythmia on the electrocardiogram mode (ECG or EKG) and then manually determine the energy (Joules) and timing for the electrical shock.
Disability-Adjusted Life Year (DALY) (1.00)	A measure of disease burden expressed as the number of years lost due to premature mortality or morbidity.
Diving (0.90)	An aquatic activity involving going underwater with appropriate equipment to interact with the environment for recreational, sportive or occupational purposes.
SCUBA *	A mode of underwater diving with a Self-Contained Underwater Breathing Apparatus (SCUBA), which is completely independent of surface supply, allowing the user to breathe underwater.
Snorkelling * (or skin diving)	A mode of underwater diving while equipped with a diving mask, a shaped breathing tube called a snorkel, and usually swim fins. No supplemental oxygen is used. The mask can be a full-face mask and integrated with the snorkel.
Diving entry (0.50)	A method of entry into the water (e.g., headfirst with or without outstretched arms above the head, or feet first). May involve a high risk of head or neck trauma in some situations.
Drone (for surveillance and/or rescue) (0.89)	An unmanned aerial vehicle (UAV). UAVs are a component of an unmanned aircraft system (UAS), which

	include a UAV, a ground-based controller, and a communication system between the two. Drones have the potential to assist lifeguard services in surveillance, as well as search and rescue operations.
Drowned (0.80)	
**** person (or drowning person)***	A person that has been through an aquatic stress or distress event with liquid aspiration, independent of the outcome.
**** potential person***	Anyone at risk of drowning.
unconscious * person	A person who is unable to interact with the rescuer nor respond while in the water.
Drowning (0.90)	The process of experiencing respiratory impairment from submersion or immersion in liquid. The drowning process begins with respiratory impairment as the person's airway goes below the surface of the liquid (submersion) or water splashes over the face (immersion). If the person is rescued at any time and, the process of drowning is interrupted, it is termed a nonfatal drowning. If the person dies at any time because of drowning, this is termed a fatal drowning. Any submersion or immersion incident without evidence of respiratory impairment should be considered a water rescue and not a drowning. (Van Beck et al., 2005)
**** behaviour***	The way in which one acts or conducts oneself during a drowning event (may include all reaction and mitigation actions while in the water).
Drowning 4W Model (0.89)	The 4W model of drowning enables the understanding of the dynamics of drowning for risk assessment, accident prevention, and safety promotion from water safety organizations, local authorities, and the general public (See **Figure 7**). (Avramidis et al., 2007)

Rescuer characteristics	Casualty characteristics	Location	General circumstances
Training	Physical water fitness	The specific geographical characteristics of the country	Relationship between casualty and equipment
Current level of experience, expertise, physical strength, vision, health, swimming speed	Disability or medical problems	Size and the shape of the working area	Risk as physical demand of aquatic activity
Knowledge of the particular dangers of the aquatic area	Age	Lighting, heating, air quality, water clarity	Presence of others
Professionalism (adequate number of lifeguards, visible appearance, clothing, written operating procedures)	Sex	Weather and environmental conditions	Time, day, season of occurrence
Ability to do risk assessment, work as educator, recognize the instinctive drowning response, remain alert, and react ignoring the bystanders' lack of response	Ethnicity	Social and emotional environment	Rescue type
	Socioeconomic background	Ethical issues	Aquatic activity
	Area of residence		
	Number and type of family members		
	Occupation		
	Casualty behaviors		

Figure 7: The Drowning 4W Model: Who (Rescuer & Casualty), Where (Location) & Whatever circumstances (General) (Avramidis et al.,2007)

Drowning categorization (1.00) A method of organising drowning outcomes into two groups: fatal or non-fatal.

Fatal drowning A drowning event from which the person does not survive. A fatal drowning may be immediate and may occur later due to a complication caused by the drowning event such as: pneumonia, or others.

Non-fatal drowning A drowning event from which the person survives. In non-fatal drowning, the process of respiratory impairment is stopped before death. A proposed framework categorizes non-fatal drowning along two dimensions (see **Figure 8**):

1. The severity of **respiratory impairment** immediately after the drowning process is stopped. There must be evidence of respiratory impairment to be classified as a non-fatal drowning.
2. The **morbidity** category at the time when non-fatal drowning information is gathered. For the purposes of this categorization framework, morbidity is defined as any decline from the individual's functional capacity prior to the drowning. (WHO, 2020)

Severity of respiratory impairment after the drowning process is stopped.		
(1) Mild	**(2) Moderate**	**(3) Severe**
• Breathing • Involuntary distressed coughing[a] AND • Fully alert or slight disorientation	• Difficulty breathing AND • Disoriented but conscious • Difficulty breathing AND • Unconscious	• Not breathing AND • Unconscious
Morbidity category (based upon any decline from previous functional capacity[b]) at the time of measurement.		
(A) No morbidity	**(B) Some morbidity**	**(C) Severe morbidity**
• No decline	• Some decline	• Severe decline
[a] The following descriptors serve to better characterize the meaning of "involuntary distressed coughing": coughing up liquid / moving liquid out of the airway; in water, in distress and coughing; sustained coughing. [b] The phrase "previous functional capacity" includes the person's cognitive, motor, and psychological capacity		

Figure 8: Categorization Framework for Non-fatal Drowning (WHO, 2020)

Drowning Chain of Survival (1.00)

A series of steps that when enacted, attempts to reduce mortality associated with drowning and attempted aquatic rescue. The 5 links of the chain are: prevent drowning, recognize distress, provide flotation, remove from water, and provide care as needed (see **Figure 9**).

Figure 9: Drowning Chain of Survival (Szpilman et al., 2014)

Drowning classification (1.00)

By liquid type Code as: sea water, fresh water, chlorinated water, brackish water, other (e.g., oil, etc.), or unknown.

By severity Code as: person rescued, grade 1-6, or deceased. (Szpilman et al., 1997)
Rescued person – no aspiration
Grade 1 - Cough with normal lung auscultation,
Grade 2 - Rales in some pulmonary fields,
Grade 3 - Acute pulmonary edema without hypotension or shock,
Grade 4 - Acute pulmonary edema with hypotension or shock,
Grade 5 – Isolated respiratory arrest,
Grade 6 – Cardiopulmonary arrest (CPA),
Deceased – Obvious signs of death (submersion time > 1 h or obvious physical evidence of death).

By the cause Code as: primary (no precipitant disease/trauma), secondary (precipitated by disease/trauma) or unknown.

	As an example, a person struck by a boat who becomes unconscious and drowns is an example of secondary drowning.
By contamination with water germs	Code as: no-pollution (CFU<10^8), uncertain (10^8< CFU <10^{20}), or polluted water (CFU>10^{20}).
By contamination with other substances	Code as: chemical, radiological, nuclear, or other.
By intent	Code as: unintentional, intentional (e.g., suicide or homicide) or undetermined (see DROWNING INTENT).
By location	The place where the person drowned. Categorization should preferably follow the ICD-10 code for drowning including the fourth subdivision - place of occurrence. It is advisable to make the distinction, if available for drowning and submersion in natural water (W69-70) as described further at water location natural fresh and ocean and non-natural. (World Health Organization, 2004, ICD-10) (see **Figure 10)**

.0 Residence
.1 Collective housing
.2 Schools, and other public institutions
.3 Sports area
.4 Street and roads
.5 Business and service area
.6 Industrial and building areas
.7 Farm
.8 Other specified places
.9 Other places not specified

Figure 10: Fourth subdivision for the ICD-10 code for drowning (place of occurrence)

Drowning complication (1.00)	Any negative health outcome following a drowning event. It may be transient or permanent and may have some influence on the prognosis of the drowned person. Examples include: cardiac dysfunction, myoglobinuria, haemoglobinuria, renal insufficiency or failure, shock, sepsis, and neurologic impairment.
Categories	Code as: none, minor (little restrictions on daily living), major (requires daily care from others) or critical (requires life support).
Drowning consciousness (1.00)	The degree to which one is aware of their surroundings. Drowned persons may present with a variety of degrees of consciousness, such as: alert, confused, apathetic, unconscious or permanent vegetative state (e.g., coma). This can be assessed using the Glasgow Coma Scale or a simplified method such as AVPU (Alert-Verbal-Pain-Unresponsive). Also, can be referred to as level of consciousness.
Drowning detection system (1.00)	An automated, computerised or artificial Intelligence device that can automatically detect submerged persons

	and sounds an audio and/or visual alarm to notify a person or rescuer.
Drowning diagnostic (1.00)	A method of identifying if an individual has experienced respiratory impairment from submersion/immersion in a liquid. Methods include: witnessed, clinical, laboratorial, and/or anatomopathological examination.
Drowning discharge category (1.00)	A method of describing where a person was released to after leaving the aquatic facility following a drowning incident. Code as: home, emergency department, hospitalization or morgue.
Drowning education program (0.70)	A structured program for the development of individual competency in aquatic activities underpinned by demonstration of swimming skills (see WATER COMPETENCE).
Drowning education resource (0.90)	An information tool with drowning-related content designed to educate the public (e.g., courses, videos, flyers, banners, leaflets, games, t-shirts, puppets, online and technology, etc).
Drowning hazard (0.80)	A natural or human source with the potential to cause a drowning.
Drowning incident report (0.90)	A form (e.g., written, or digital, or voice) that describes a drowning event. A drowning incident report should preferably be completed as soon after a drowning incident as possible. Standardization is advised for future comparison.
Drowning instinctive response (0.90)	An automatic, without thinking or reasoning, action while an individual is experiencing a drowning event. (Pia, 1974)
Drowning intent (1.00)	A drowning classification divided into 3 categories: (1) Unintentional; (2) Intentional; or (3) Undetermined. (WHO 2004)
Unintentional	A drowning event that occurs without a purposeful intent. Code as: accidental or incidental and/or using the adequate ICD-10 coding (see ICD).
Incidental	A sub-category of unintentional drownings. This drowning event is possible to predict or anticipate. This is the majority of drownings.
Accidental	A sub-category of unintentional drownings. This drowning event occurs without a deliberate intention and cannot be anticipated or predicted (ie., not incidental). An example of this is a person who drowns after falling out of a boat into the water by a sudden whale strike.
Intentional	A drowning event that is done on purpose and can be inflicted by others (homicide) or self-inflicted (suicide).

	Code as: homicide or suicide and/or using the adequate ICD-10 code.
Undetermined	Those not categorized by above.
Drowning location (1.00)	
By geographical position	The geographical location where the drowning event occurred, or where the body was recovered. Exact location is ideal. Minimal levels of information should include: local (city/county), regional (state), and national (country).
By waterway type	The place or facility where the drowning event occurred. Can be a natural or built waterway. Type and specificity of the categories to use might differ among organizations. Categories suggested are: river, ocean beach, lake, canal, ditch, swimming pool, water park, oil tank, or other.
Drowning outcomes (categories)	See DROWNING CATEGORIZATION
Drowning person identification (0.90)	The minimum data collected of a drowned person should be sex, approximate age (ideally exact age), place of residence (address), date of birth and ethnicity.
Drowning prevention (0.90)	
**** awareness***	The education, knowledge or perception of how to prevent drowning with the intent of inducing a behaviour change.
**** public education***	A population level educational action/strategy with the goal of avoiding the occurrence of a drowning event. These can target the general public or specific at-risk sub-populations (e.g., school).
**** competence training***	An educational activity that promotes the acquisition of skills and adoption of behaviours to avoid the occurrence of a drowning event.
**** advocacy***	A form of public support for drowning prevention (e.g., lobbying, recommendations, guidelines, policies, others).
**** legislation, policy (with or without enforcement) and/or law***	A regulation measure in place with the goal of reducing the rate of drowning events.
Drowning public health (1.00)	The science and art of promoting health, preventing and prolonging life through the organized efforts of society focus on drowning. (WHO., 1998)
Drowning related near-death experience (0.60)	An experience reported after revival from a drowning episode in which, (a) during the episode, the drowning victim perceived subjectively that their consciousness was functioning apart from the physical body, observing the material world and/or trans material (spiritual) domains and entities, and (b) after the episode, the survivor manifested particular aftereffects that they attribute to the subjective perception. (Holden et al., 2017)

Drowning timeline (1.00) See **Figure 11.** (Szpilman et al., 2016)

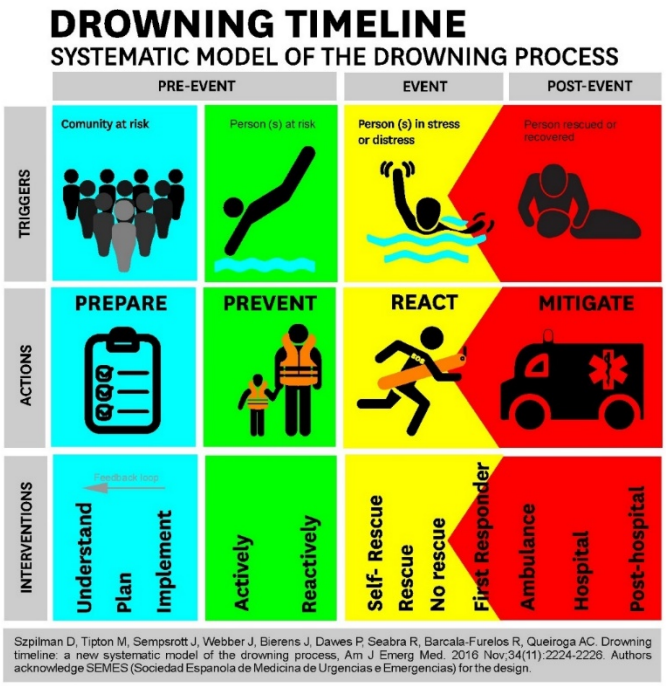


Figure 11: The Drowning Timeline (Szpilman et al., 2016)

Action	A category of measures taken during any phase of the drowning process (timeline). Categories of actions include: preparation, prevention, reaction or mitigation. Every action is activated by specific trigger(s) and will lead to specific interventions.
Trigger	A stimulus that initiates or precipitates an action. In this model, we have identified “community at risk” as the trigger for preparation; “person(s) at risk” as the trigger for prevention; “person(s) in stress/distress” as the trigger for reaction; and “person being rescued or rescued” as the trigger for mitigation.
Water stress/distress	Two processes that occur when a person feels at risk of drowning. Stress evokes the person to try to find ways to get out of the situation. If the ability to rationally cope with the stressful condition is overwhelmed, a distress situation follows.
Intervention	A measure taken during a specific category of action that will influence what happens, modifying or hindering the impact of a drowning event.
Phase	A part of a series of related actions occurring during the drowning timeline. There are 3 phases: pre-event (before the drowning starts), event (during it) and post-event (after it).
Pre-event	The phase before the drowning event starts that comprises of two actions (preparation and prevention) that are triggered either by a community at risk (preparation) or a person/group at risk (prevention).

Preparation	An action that is directed at a community at risk, taken before an incident occurs. Aimed at improving the effectiveness of later actions (Prevention, Reaction and Mitigation).
Prevention	An action that is directed at reducing risky environments and users' behaviours, taken before an incident occurs. Aimed at avoiding the drowning event from occurring (see DROWNING PREVENTION).
Active	An action that is directed at reducing risky environments at the scene (e.g., signs, fences, drain covers, others).
Reactive	An action that is directed at reducing risky behaviour (imminent danger) of individuals or groups (e.g., lifeguard whistling, parent warning a child, etc).
Event	The phase during the drowning event that comprises any action taken in the water while the drowning process is taking place. Possible actions are self-rescue, rescue, or no rescue. If the rescue is being performed by the first to respond, be it a layperson or a professional, some mitigation interventions might take place while the drowned person is still in the water, such as attempts to provide in-water resuscitation.
Reaction	An action that is directed at a person (or group) in stress or distress, taken after an incident starts and while they are in the water. Aimed at interrupting the progress of drowning once it has started. Reaction will only stop with the extrication of the drowned person from the water/danger (see RESCUE).
Post-event	The phase after the drowning event that comprises exclusively of mitigation actions. It commences after the drowned person is extricated from the water and extends until all the health care ceases, such as ambulance attendance, hospital and post-hospital care. or 'it starts when removal from the water has ended'.
Mitigation	An action that is directed at a specific person, or group, taken while performing the rescue or after the rescue. Aimed at reducing the impact of the injury on the drowned person(s). This is also known as treatment. A mitigation action in the post-event phase is initiated only after extrication from immediate danger has occurred.
Drowning victim	See DROWNED PERSON
Drowning witness (0.50)	A person who was present and witnessed all or part of the drowning process of another person or persons. The drowning event's witness status can be coded as: either witnessed (all or part) or unwitnessed.
Electronic equipment for prevention and safety (0.70)	A device set to identified/alert/avoid a drowning situation by using any electronic means (E.g., a closed-circuit television (CCTV) camera, an alarm to any get into de pool water, etc).

Emergency action plan (EAP) (1.00)	A set of written guidelines detailing the planned emergency response/interventions to an event. The EAP includes all relevant staff and provides them with guidance for preparation of the emergency interventions, including an outline of specific roles and responsibilities of the staff during the event.
Emergency room (ER) or department (ED) (1.00)	A medical treatment facility specialized in emergency medicine for the acute care of patients who present without prior appointment, either by their own means, after being referred by a Medical Doctor or by an ambulance. The ED is usually found in a hospital or other primary care centre.
Enforcement action taken by a lifeguard/authority (0.90)	A measure taken in reaction to a violation of a law, rule or regulation.
Exposure (0.90)	The state of being in contact with a hazard or situation that can increase the risk of drowning. Potential hazards include characteristics of the waterway, the geographical location (e.g., rural or metropolitan), time spent in the water, the activities undertaken while in-water, the person's age, or co-morbidities.
-adjusted person-time	The estimate of time (in years, months, or days) a person is exposed to a risk (disease or trauma).
Extracorporeal Life Support (ECLS)	see EXTRACORPOREAL MEMBRANE OXYGENATION
Extracorporeal Membrane Oxygenation (ECMO) (0.90)	A technique to provide prolonged cardiac and respiratory support to persons whose heart and/or lungs are unable to provide an adequate amount of gas exchange or perfusion to sustain life. It involves removing blood from the body (extracorporeal) temporarily, before re-infusing it with necessary substances for life. ECMO may be used as a final resource in certain drowning circumstances where the victim is in a critical hypoxic condition.
Fatality (other than drowning) (0.90)	A death, either caused by a disease or injury, in and around the water including guarded and unguarded areas that is not the result of drowning.
First aid (0.90)	A level of basic health care provided to individuals (victim/casualty) suffering from a sudden illness or trauma until full medical care can be received.
- station	A building (normally near the guarded zone) where lifeguards perform first aid.
Flood (1.00)	An overflow of water that submerges usually dry land. In the context of rivers, a flood occurs when flow exceeds bank full discharge, often during either extended periods of rain or during short, intense periods (resulting in flash

floods). In the coastal context, it is typically associated with inundation caused by super-elevated water levels due to storm surge in response to storm events characterized by low barometric pressure, strong onshore winds and high waves. Coastal flooding may also occur during high tide of a king tide event.

Flotation aid (0.90) A device that is used for the purpose of leisure or teaching to float (different from PERSONAL FLOTATION DEVICE).

Rescue improvised * A piece of non-rescue gear that may be used during a rescue to help keep a drowning victim at the surface (e.g., flotation).

Forensic evaluation (1.00) The application of science to criminal and civil laws that may be used to investigate a drowning, especially if it relates to a criminal investigation. The evaluations are governed by the legal standards of admissible evidence and criminal procedure.

Free diving (0.90) The human activity of going underwater without any oxygen apparatus device, using apnea voluntarily.

Gender (1.00) The range of characteristics pertaining to, and differentiating between, masculinity and femininity. Depending on the context, these characteristics may include biological sex, sex-based social structures, or gender identity. This term is frequently used interchangeably with "sex" but regarding data collecting what should be recorded is the sex (male, female or other) of the casualty (see SEX). When collecting gender information, code as: male, female, transgender, cisgender, other, or unknown.

Hands-only CPR (HO-CPR) see BASIC LIFE SUPPORT, examples of BLS Algorithms.

Head Lifeguard (coordinator) (1.00) The person who is leading a team of lifeguards with responsibilities for maintaining and applying written operating procedures of any aquatic facility (including beaches).

Healthcare professional with: (0.90)

Advanced life support skills A person who is trained in a set of clinical interventions for the urgent treatment of cardiac arrest and other life-threatening medical emergencies, as well as the knowledge and skills to deploy those interventions.

Intermediary skills A person who is trained on a set of clinical interventions for the urgent treatment of cardiac arrest and other life-threatening medical emergencies, as well as the knowledge and skills to deploy those interventions with a few exceptions of medical procedures (e.g., intubation,

	intravenous profound access, etc). This term may refer to different professions in different regions.
Hemodynamic stability (1.00)	A state of adequate tissue perfusion. It can be assessed by lifeguards through a combination of: blood pressure, heart rate, casualty's colour and temperature, peripheral pulse, capillary refill test and/or mental status.
Hypothermia (1.00)	An abnormally low body temperature when a body dissipates more heat than it absorbs. In humans, it is defined as a core body temperature below 35.0 °C (95.0 °F). It can be categorized as: mild (32-35 °C), moderate (28-32 °C), or severe (less than 28 °C).
Therapeutic (Neuroprotective) *	The purposeful reduction of a person's core body temperature to give neuroprotection to a brain that has suffered an injury (usually from hypoxia). Also known as targeted temperature management (TTM)
Hypoxia (0.89)	A condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level.
Hypoxic blackout (0.89)	A condition resulting in a loss of consciousness due to the brain being deprived of an adequate oxygen supply. It is the result of a person engaging in activities such as hyperventilation preceding underwater swimming and/or extended breath-holding underwater. Formerly known as shallow water blackout.
Incident report (1.00)	A form (code as written, digital, voice, recorded or not) that describes any occurred event by a lifeguard or other first responder involving injuries, accidents, near misses or others, that need to be reported to a supervisor, insurance agency and/or health care staff or for quality control. An incident report should preferably be completed just after an incident occurs. Standardization is advised to permit comparison of data.
Infection prevention and control (1.00)	A scientific approach and practical solution designed to prevent harm caused by avoidable infection to patients and healthcare workers while dealing with drowning and aquatic related injuries.
Improvised floatation aid	See FLOTATION AID, and RESCUER IMPROVISED.
Injury (trauma) (1.00)	The damage caused to the body by an external force (e.g., mechanical, chemical, thermal, etc.) in amounts or at rates that exceed the threshold of human tolerance. It may also result from lack of essential energy such as oxygen (e.g.; drowning) or heat (e.g.; hypothermia). (Haddon et al., 1973)
Injury control	See DROWNING TIMELINE, MITIGATION.

Injury-related disease (!.00)	A disease subsequent to a trauma event (e.g., pneumonia).
In-water resuscitation (IWR) (0.80)	The provision of ventilation to a non-breathing casualty while still in-water.
International Classification of Disease (ICD) (1.00)	A system of diagnostic codes for classifying diseases, including a wide variety of signs, symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or disease. It promotes international comparability in the collection, processing, classification, and presentation of these statistics and is revised periodically (currently in its 10th revision). (ICD 2004) **Figure 12** lists all of the ICD drowning codes.

T75.1 - Non-fatal drowning;
Unintentional Drowning Related Codes
W65 Drowning and submersion while in bath-tub
W66 Drowning and submersion following fall into bath-tub
W67 Drowning and submersion while in swimming pool
W68 Drowning and submersion following fall into swimming pool
W69 Drowning and submersion while in natural water
W70 Drowning and submersion following fall into natural water
W73 Other specified drowning and submersion
W74 Unspecified drowning and submersion
V90 Accident to watercraft causing drowning and submersion
V92 Water transport related drowning and submersion without accident to watercraft
X38 – Flood (not specific for drowning);

Intentional
X71 – Suicide by drowning;
X92 – Homicide by drowning;

Undetermined intent
Y21 – Drowning.
Y36.4 Drowning during war.

Figure 12: International Classification of Disease 10 (ICD-10) for drowning

Inundation	See FLOOD.
Laryngospasm (0.90)	A muscular spasm of the larynx (including vocal cords) which causes airway obstruction and if persistent can lead to hypoxia.
Layperson (0.60)	A person without professional or specialized knowledge in a subject area.
**** with prevention training***	A person with a basic level of training in drowning risk assessment and behavioural measures aimed at reducing drowning events.
**** with water rescue training (competence to perform a rescue)***	A person with a basic level of training used to rescue a drowning person until they can be given full lifeguard assistance.

**** with Basic Life Support (BLS) training***	A person trained in a basic level of medical care used to assist in the immediate resuscitation of a patient. Content possibly included in the training: CPR, haemorrhage control, fracture immobilization, spinal motion restriction, and basic first aid (in North America is strictly basic CPR + AED).
**** with BLS training for drowning***	A person trained in a basic level of medical care used to assist in the immediate survival of a drowning patient, including CPR, until they can receive full medical care.
**** without training***	A person without any training to assist in a drowning or aquatic related injury event.
Lifeguard (1.00)	A person who has completed professional training and is competent to prevent injury, rescue those at risk, and provide first aid to those in and around aquatic environments. Lifeguards may be paid or volunteer, but regardless, they are expected to uphold their professional responsibilities when fulfilling the role.
****competency***	A person who is described or recognized as being competent has the attributes to enable them to perform tasks and skills to an appropriate pre-determined standard.
Lifeguard guarded area (length in kilometres or meters) (0.90)	A location under the surveillance of lifeguards (e.g., patrolled), as determined by the lifeguard provider, or within a designated swimming area. This can be directly guarded (e.g., in front of a staffed lifeguard tower or between the flags), or intermittently (generally within vision but not the area of direct focus, e.g., close but outside the flags or 2km beach with a roving LG in a truck).
Temporarily	A location that is not guarded always during daylight, but only during certain periods of the day, week, months or seasonal (e.g., festivities set for a certain place on the beach that usually do not have lifeguards on duty).
Unguarded area	A location without lifeguard surveillance or lifeguard on duty code as: with or without warning signalizations. Also known as unpatrolled.
Lifeguard tower number (0.89)	The number of the tower/station/post where lifeguards are on duty.
Lifeguarding (0.80)	An act related to a lifeguard
Lifeguarding equipment (1.00)	A piece of gear used for the lifeguard´s' work (see **Figure 13**)

Binoculars: An optical instrument that allows extended vision for both eyes used for lifeguard surveillance.
Chair: An elevated chair or platform used to provide an enhanced field of sight for lifeguard surveillance.

Clothing: An item that provides identification and personal protection for lifeguards.
Fin: An accessory worn on the feet to aid aquatic and underwater displacement, providing increased speed and manoeuvrability.
Hat/Cap: An item that shades the face, ears and neck from direct and reflected sunlight to minimize exposure to the sun.
Megaphone: A device that provides voice volume increase or a sound alert at a greater distance.
Public Address system (PA): A set of electronic devices that increases the volume of sound in a place of great attendance, specifically used to address a larger public gathering with relevant safety information.
Personal Protective Equipment (PPE): All protective equipment and/or garments that provide protection to the wearer from injury and/or infection after exposure to a hazard. These include protective clothing, helmet, goggles, mask, life vest, etc.
Portable transmitter communicator (e.g., Walkie-Talkie, Radio): An audio transceiver which can transmit and receive radio waves, allowing for bidirectional person-to-person communication. Used by rescuers as a communication system to improve prevention, surveillance and intervention.
Professional flotation equipment or device: A piece of equipment with floating properties designed to be used by rescuers to provide flotation to the rescuer and/or victim. These include rescue-tubes, rescue-cans, lifesaving buoys, or rescue-boards.
Spinal board (aquatic): A rigid platform device with flotation properties used to immobilize and/or transport a person with suspected spinal trauma or any disabling injury. **Fastening straps:** A set of straps that secure the drowned person securely to the spinal board. **Head immobilizers:** Two supports used to reduce movements to the head, and to some extent the neck, to the spinal board.
Station: An installation from where the lifeguarding service provides first response to any user of the aquatic space who has an accident or illness. It is also used for surveillance and is usually from where public addresses are communicated via a PA system.
Sunscreen: also known as sunblock, is a topical product that absorbs or reflects some of the sun´s ultraviolet radiation.
Sunglasses: Glasses which provide ocular protection from direct and reflected sunlight, enhancing vision.
Tent: A lifeguarding shelter consisting of sheets of fabric or other material draped over, attached to a frame of poles or attached to a supporting rope.
Tower: An elevated lifeguarding elevated that provides a better viewpoint for surveillance and shelter.
Water goggles/mask: Pieces of equipment that seal around the eye sockets, providing clearer underwater vision, usually in the form of goggles (eyes only) or a mask (eyes and nose).
Whistle: A communication device used for making high pitch sounds by means of exhaled air, used by lifeguards to warn people in risk of drowning and communicate among lifeguards.

Figure 13: A summary of common pieces of lifeguard equipment

Lifejacket (0.80)	A type of Personal Flotation Device (PFD) designed to assist its wearer to stay afloat and/or to keep the airway of an unconscious person out of the water. They are available in different sizes to accommodate variations in body weight, clothing type and circumstances. Designs differ depending on the user's preference and objectives. Lifejackets are categorized into types I-V.

Lifesaver (0.80) A person with no duty to respond but still acts to prevent, rescue or provide first aid to a person in and around water through informing, supervising and preventing known risky behaviours.

Lifesaving See LIFEGUARDING and LIFESAVER.

Lightning (0.60) A natural weather phenomenon that can pose a serious threat to people recreating in, on or near aquatic settings.

Likelihood of survival (1.00) The probability that a person will continue to live despite having experienced a drowning event.

Lost person (0.90) A person who is separated from their children, parents, or other companions and there is concern for their safety.

Mass casualty incident An overwhelming event, which generates more casualties in a period of time than the locally available resources can manage using routine procedures.

Multiple casualty incident An event where emergency services are temporarily strained due to a more than normal number of casualties. However, despite this stress, the system is not overwhelmed because the number of casualties did not exceed the rescue operations/agency capacity. See *AQUATIC DISASTER*.

Mechanical chest compressor An automatic device which provides chest compressions during CPR.

Mechanical ventilation The medical term for artificial respirations where an external force is used to assist or replace spontaneous breathing. This may involve a machine called a ventilator or the breathing may be assisted by a person compressing a bag or set of blows (manual ventilation). Mechanical ventilation is termed "invasive" if it involves any instrument penetrating the trachea through the mouth (such as an endotracheal tube) or through the skin (such as a tracheostomy tube).

**** with positive end-expiratory pressure (PEEP)*** The provision of artificial ventilations from an external force with the addition of expiratory pressure resistance.

**** with positive pressure resuscitation device*** The provision of artificial ventilations from an external force with equipment (usually portable) that uses positive pressure to ventilate a non-breathing casualty.

Medical (0.70)

**** life boat rescue*** A lifeboat prepared to provide rescue and health assistance. Code as: basic (lifeguards with basic first aid equipment), intermediary (staffed by health care between a lifeguard and advanced care [may be inexistent in some countries) or advanced (paramedics,

	nurses or physician with intensive care unit equipment and/or hyperbaric chamber).
**** helicopter rescue***	A combined medical and rescue helicopter.
**** care level on aquatic location***	All clinical and traumatic cases requiring care other than drownings.
Minor aid	A first aid intervention which does not require a higher level of medical care beyond the one provided by the lifeguard(s) (e.g., bruise on dry land).
Intermediate aid	A first aid intervention which requires medical care (EMT or similar expertise) beyond what is provided by the lifeguard but still has a low risk of death (e.g., shoulder dislocation). This may require further in-hospital care afterwards.
Major aid	A first aid intervention which requires a higher level of medical care (advanced pre-hospital care - staffed with paramedic, registered nurse or medical doctor) as the injury or disease is associated with high mortality (e.g.: cardiac arrest, stroke, etc). This will require further care in-hospital.
Medication (used in a drowning event) (1.00)	A pharmacological aid used to improve the recovery or reduce the injury of the victim (e.g., oxygen, bronchodilators, glucocorticoid, surfactant, etc.).
*** related to the event**	The absence, failure, interaction or sub-therapeutic level of medications that may precipitate the event (e.g., failure to take one's anti-epileptic drug which results in them having a seizure).
Non-cardiogenic pulmonary edema	See PULMONARY NON-CARDIOGENIC PULMONARY EDEMA.
Outcome predictor of (1.00)	
*** a drowning event**	A factor, sign or symptom that may predict the outcome after a drowning event (e.g., submersion time, water temperature, BLS time arrival, etc).
*** successful CPR**	A factor, sign or symptom that may predict the outcome after CPR (e.g., brain injury signs, consciousness level, etc).
Out-of-hospital cardiac arrest (OHCA) (1.00)	The cessation of cardiac mechanical activity that is confirmed by the absence of signs of circulation and that occurs outside of a hospital setting. **OHCA-D** is caused by drowning.
Oxygen delivery device (1.00)	A device used to supply oxygen to the patient. Code as: Non-invasive airway access (e.g., nasal catheter or prongs) or Invasive airway access (e.g., orotracheal tube, supraglottic device, etc.).
Oxygen flow provider (1.00)	A device which provides oxygen. It can either be of low-flow (e.g., nasal catheter/cannula) or high-flow oxygen (e.g., mask).

Oxygen saturation (0.90)	The percentage of red blood cells (via haemoglobin) that are filled with oxygen in one's body. It can be measured by a peripheral pulse oximeter using a probe (SpO_2). See PULSE OXIMETRY.
Partial pressure of O_2 (PxO_2) and CO_2($PxCO_2$) (0.90)	The part of the total blood gas tension that a single gas in one's blood contributes to the total. The subscript x in each symbol represents the source of the gas being measured; "a" meaning arterial, "A" being alveolar, "v" being venous, and "c" being capillary. Blood gas tests (such as an arterial blood gas) measure these partial pressures.
People attending a water location	The people recreating in and around the water zones (see SURVEILLANCE ZONES). This is usually a visual estimate, but technology is being developed and used for a more reliable count.
Person (0.90)	
Drowned *	See DROWNED PERSON.
Drowned * profile	The personal characteristics of a drowned person, such as age, sex, education level, nationality, ethnicity, etc).
***** at risk***	A person at risk of drowning due to belonging to an identified and characterized group at risk or because their behaviour around water puts them at an increased risk.
***** in water stress/distress***	recognition is the second element in drowning chain of survival and a key element that ensures early activation of professional rescue service and EMS. A person is in a near vertical body position, head tilted back, ineffective downward arm movements, ineffective pedalling or kicking leg actions and little or no forward progress in water.
***** rescued or recovered***	A person in water stress/distress that is removed from the water without signs of respiratory impairment (no signs of water aspiration).
Personal Flotation Device (PFD)	See LIFE JACKET.
Pneumonia from drowning (1.00)	An infection of the lung which affects primarily the small air sacs known as alveoli. It is caused most often by bacteria and less commonly by other microorganisms. Typically, symptoms include some combination of productive cough, chest pain, fever, and respiratory distress. Severity is variable. Diagnosis after drowning is often based on the symptoms and physical examination, or in conjunction with radiological and/or laboratorial measures. Code as: early-onset or late-onset. Late-onset pneumonia (also known as nosocomial, hospital-acquired infection or healthcare-associated infection) is the one acquired in a hospital or other health care facility.

Pneumonitis (1.00)	An inflammation of the lung tissue due to factors other than microorganisms. Following drowning situations, it can be caused by physical and chemical contaminants of the water aspirated or the inhalation of food or gastric contents (in the case that a person vomits).
Pocket mask (0.90)	A ventilation device with a filter used as a barrier to give ventilations through a one-way valve. Also known as resuscitation mask.
Post-immersion collapse	A clinical condition characterized by a sudden drop of arterial blood pressure after a rescue in cold water leading to shock or cardiopulmonary arrest.
Pre-existing medical conditions (co-morbidity) (1.00)	An injury, condition or disease that may have played a role in the drowning event which existed prior to the person entering the water (e.g., epilepsy, cardiac condition, etc)
Pre-hospital (0.89)	An event or intervention that occurs before in-hospital care.
Prevention level	See DROWNING TIMELINE, PREVENTION.
Professional course (1.00)	A course dedicated to qualifying someone to become a certified professional in their respective field. See WATER COMPETENCE.
**** with advanced lifesaving support training for drowning***	An example of participants: lifeguards.
**** with Intermediate lifesaving training for drowning***	Examples of participants: swimming teachers, water sports athletes, surf instructors, etc.
**** with basic rescue training for drowning***	Examples of participants: firefighters, police, teachers, etc.
Prolonged hospitalization (0.90)	A description of a hospitalization which is longer than anticipated for a disease/injury due to the severity of that case.
Psychological (1.00)	
**** care***	A form of professional assistance for the drowning victim, rescuers, relatives or witnesses regarding their mental health. For example, rescuers may have symptoms or signs of stress beyond their coping ability following a rescue (regardless of the victim outcome). This is a form of psychological stress that may require professional help if it does not improve on its own.
**** debriefing***	A process following a stressful event that consists of interviews which are meant to allow individuals to directly confront the critical event and share their feelings

	with the facilitator to help structure their memories of the event. It is done to help to mitigate long term negative health consequences such as Post-Traumatic Stress Disorder (PTSD). See DEBRIEFING.
**** first aid (FA)***	An action of mental health support to a casualty (or a rescuer) who is suffering from stress in an emergency.
Public rescue equipment (PRE) (0.90)	A type of rescue equipment available in public spaces that can safely be used by a layperson/bystander to perform a rescue (e.g., a flotation ring hung on a wall).
Pulmonary (1.00)	
**** damage from drowning***	An injury of the lungs determined predominantly by the amount, tonicity and chemical composition of water that was aspirated during a drowning event and its resultant effects.
**** cardiogenic edema in drowning***	The accumulation of fluid into the tissues and airspaces of the lungs due to a failure of the heart's left ventricle to remove blood adequately from the pulmonary circulation leading to an increase in pulmonary pressures (also known as cardiogenic pulmonary edema).
**** non-cardiogenic pulmonary edema***	The accumulation of fluid in the tissues and airspaces of the lungs caused by a multifactorial insult (not primarily cardiac in origin). In drowning, this is usually due to either water aspirated and/or the airways reaction to this water.
Pulse oximeter (0.90)	A device to measure the peripheral oxygen saturation (SpO_2). See OXYGEN SATURATION.
Rescue (noun) (1.00)	An act of saving or being saved from danger or distress. A person rescued who is judged to be in imminent danger and is helped to safety by a rescuer (e.g., lifeguard, lay bystander, other).
Rescue (verb) (0.80)	To save (someone) from a dangerous or distressing situation in the water. This is not limited to physical contact.
Categorized by difficulty	Code as: simple (one rescuer can execute it without extra help), difficult (more than one rescuer needed to accomplish a safe rescue), or complex (the rescuer(s) required the use of a rescue boat/PWA/helicopter to ensure the safety of the operation). Note: A rescue that only include whistling or moving people to a safe place is a preventive intervention.
Categorized by the risk a rescuer is taking:	low, moderate or severe.
Rescue (0.80)	
Advanced * equipment with mechanical propulsion	Examples include: rescue-boat, rescue-personal watercraft (PWC), rescue-helicopter.

Basic * equipment	Examples include: rescue-can, rescue-tube and rescue-board as well as basic propulsive equipment for rescue (e.g., fins).
**** board***	A floating material that can be made with various designs, shapes, sizes and composition, which facilitates the work of the lifeguard, in the approach, control, IWR and transport of the drowning person.
**** board not designed for***	A floating material that can be made with various designs, shapes, sizes and composition, which was designed for purposes other than water rescue.
**** boat or watercraft***	A motorized or non-motorized boat that improves safety and speed in lifeguard services and allows a quicker assessment of the victim and the start of BLS (if necessary).
**** breath***	A ventilation used to provide oxygenation in the absence of spontaneous respirations of the casualty (e.g., a person in respiratory arrest)
**** can***	A rigid, high buoyancy oval shape buoy with a strap that is connected to the lifeguard and has handles on its sides to which the rescued person can grab on. Also known as a torpedo buoy.
Cliff *	The extrication of a person who is trapped on a steep rock face near the water.
**** harness/brace***	A rescue device that is secured to the lifeguard and can be deployed into the water via an attached rope, which is controlled from outside the water.
Helicopter *	A rescue performed using a helicopter.
Personal water * craft	A recreational watercraft adapted for rescues that the rider sits or stands on, rather than inside, as on a boat. Also known as a jet ski.
Safe * technique	A reach-rescue of a drowning person with an object such as a pole, towel, or tree branch or by throwing a buoyant object, reducing the risk of the rescuer becoming a second victim.
SCUBA diver *	A rescue made underwater using SCUBA diving equipment.
**** sled***	A rescue flotation platform used in the back of a PWC to transport the lifeguard and/or potential casualties.
Surf *	A rescue performed in the surf zone.
Swiftwater *	A rescue performed in fast moving fresh water such as rivers, flooded creeks or flood control channels.
**** triage***	The process of assigning degrees of emergency to aquatic injuries or illnesses to decide the attendance priority at the water. See Figure 15 for an example of one triage system, the aquatic START method. (Oliveira 2015). See SENTINEL SYSTEM FOR RESPONSE TO DROWNING.

Figure 15: An example of an aquatic specific triage system – the aquatic START method (Oliveira et al., 2015)

**** tube***	A floating material with an elongated and flexible shape, adaptable to a person's body.
Rescuer (0.90)	A person that performs or tries to perform a rescue. The rescuer can be a professional trained for that role (who is on-duty or not) or a layperson. See LAYPERSON, AVIR, LIFEGUARD and LIFESAVER.
**** distractor noise***	
Internal	A stimulus due to the lifeguard's own thoughts and emotions that results in them diverting their attention performing quality surveillance.
External	A stimulus not from the lifeguard themselves that results in them diverting their attention from performing quality surveillance (e.g., crowd sound, high volume music, etc).
Resilience (0.90)	The personal or community capacity to experience a stressful situation and become more resistant to a future similar stressful event. It depends on a great variety of actions, including prevention, preparation, response, mitigation and reconstruction.
Respiratory arrest (0.70)	An involuntary cessation of respiratory effort**.** Also known as involuntary apnea.
Risk (1.00)	The possibility/probability of suffering an event (drowning or other) because of the exposure to a danger.
**** advice intervention using whistle/voice/siren***	An intervention using a sound in a situation where someone is at risk of drowning to directly warn the person(s) at risk.
**** assessment***	A systematic process of evaluating the potential factors that that may be involved in a drowning event.
**** behaviour***	A way in which a person acts or conducts themselves which exposes them or others to an increased likelihood of harm. See DROWNING TIMELINE, REACTIVE PREVENTION.

**** factor***	An element that increases a person's likelihood of drowning.
**** evaluation***	The establishment of qualitative and/or quantitative relationships between benefits and associated likelihood of harms.
**** management***	The practice of identifying, analysing and taking precautionary actions to reduce or eliminate one's likelihood of harm.
**** reduction***	An action to reduce the likelihood of harm.
Risky water scenario (0.80)	A situation in or near the water that poses increased probability of an adverse event such as injury or drowning. The event probability can be coded as: rare, unlikely, possible, probable and almost certain.
**** place***	A location, in and around the water, that may represent increased likelihood of drowning.
Safety (1.00)	The condition of being protected from or unlikely to cause danger, risk, or injury.
**** promotion***	The use of policies and programs to keep safety.
Sand bar (bank) (0.90)	A subaqueous accumulation of sand seaward of the shoreline on beaches (including rivers) that is dynamic in shape and location. Often separated from the shoreline by a deep trough.
Season (1.00)	A division of the year (can be coded as spring, summer, autumn, and winter or wet vs dry) marked by weather patterns and daylight hours.
**** characteristic***	A characteristic related to a specific timeframe.
**** sporadic risk event***	An incident that occurs more likely during a holiday or festivities.
Self-escape (1.00)	The process of a person getting out of a stressful situation in the water by their own means. (Moran, 2013) Formerly known as self-rescue.
Sentinel system for response to drowning (SENTINEL) (0.75)	An in-water triage matrix that provides levels of response to the drowning patient. The colour/status codes correlate to those used by emergency departments and ambulance services in New Zealand. (Doyle et al., 2007)
Sex (noun) (1.00)	A human characteristic which is defined based on one's reproductive organs. There are two main categories male and female, however, others do exist.
Shallow water blackout	See HYPOXIC BLACKOUT.
Shock (0.90)	A condition characterized by abnormally low blood pressure with end-organ dysfunction (e.g., symptoms or signs that tissues are not being perfused such as, altered

	mental status, decreased urinary output, tissue ischemia, shortness of breath, or decreased capillary refill).
Shore break (1.00)	The location of wave breaking along the shoreline of a beach.
Spinal cord injury (1.00)	A trauma resulting in damage to any part of the spinal cord or nerves that may cause permanent or temporary changes in strength, sensation and other body functions at and below the site of the injury.
Spinal Motion Restriction (SMR) (1.00)	The preventive or damage control procedure used on a patient with possible spinal cord injury.
Storm surge or flood (0.89)	A coastal flood of rising water commonly associated with low pressure weather systems (such as tropical cyclones and strong extratropical cyclones). It is a measure of the rise of water beyond what would be expected by the normal movement related to tides.
Surf zone (1.00)	On beaches, waves will begin to slow down and change shape at a depth of half the wavelength and will eventually steepen and break at water depths approximately 80% of the wave heights. The distance from the offshore extent of breaking waves to the shoreline is the area of wave breaking, often termed as the surf zone. Also known as wave zone.
Surf zone injury (0.90)	A trauma that occurred to a bather, swimmer or surfer on a beach caused by collision with the bed of the beach, other persons, or board craft.
Surge	See FLOOD.
Surveillance (0.90)	The monitoring of behaviour, activities, or information for influencing, managing, directing, or protecting people.
Lifeguard * zone	An area with lifeguard surveillance.
**** action***	A water safety intervention applied in and/or around a water location to improve safety (e.g., minimizing a risk may include education, environmental changes, policy, and/or legislation).
**** patrol***	An action performed by a lifeguard across the surveillance zone
**** scanning***	The visual observation of the patrons in an aquatic facility with standardized patterns and methods. Scanning may include the moving of the lifeguard's head in horizontal, vertical lines or in other ways, in specific timing (e.g.: each 10 seconds for pools or 30 seconds for open water). It applies a systematic process of visual observations of a pre-defined area or venue by someone (lifeguard or not) of the activities and behaviour of the users. It is considered a critical component of effective lifeguard

	surveillance to be able use their knowledge and recognition of potential aquatic dangers to protect the users. The application incorporates an - Intensive scan of a specific area by individual lifeguards. - Extensive scan by several lifeguards of an entire area or venue. - Combined scan using both systems to ensure a safe zone for swimmers that might be too large or complex
**** Zone***	The area being surveillance by a lifeguard. Code as: primary, secondary or tertiary. See **Figure 16**.
primary	An area of surveillance in the water (including boats/PWC).
secondary	An area of surveillance immediately next to the water edge.
tertiary	An area of surveillance outside or behind the primary and secondary zones as far the lifeguard's hearing and/or vision can go.
**** sign***	A written, graphical and/or visual display designed to inform patrons, increase safety and/or provide warnings of potential danger.
**** signalization***	The act of using water safety signs to inform about dangers and and/or recommend protective measures.

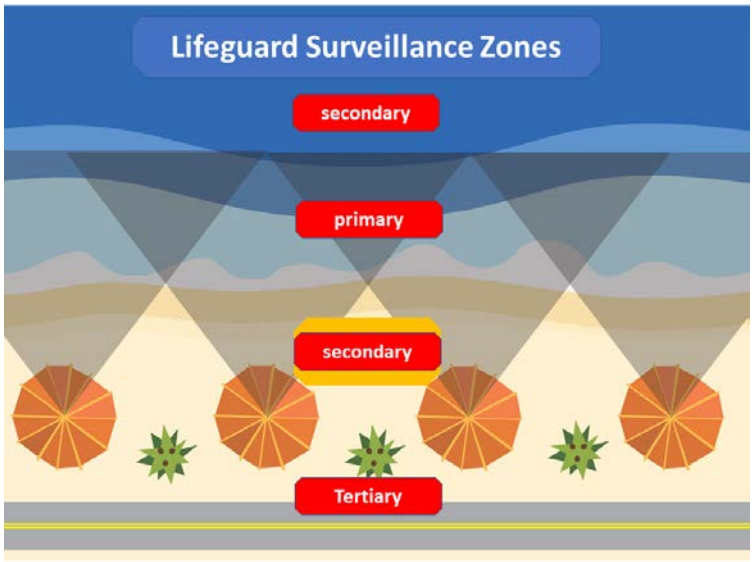


Figure 16: Beach surveillance zones. Licensed by Themisson & Szpilman

Swash (1.00)	The combination of water rushing up the beach (uprush) and washing down the beach (backwash) associated with wave breaking at the shoreline.
Swimmer (0.90)	A n individual with competence to propel across the surface of the water.

Non-* A person who is unable to propel themselves across the surface of the water. See SWIMMING COMPETENCE.

Swimming (1.00) The act of using one's arms and/or legs to move through a body of water.

**** competence*** A swimmer's skill proficiency for moving their body through the surface of the water, limited to a specific waterway (e.g., warm, cold, calm, rough, shallow, deep, murky, etc). See **Figure 17** for an example. (Szpilman et al., 2020) See AQUATIC COMPETENCE.

DROWNING risk table

Levels	Water competency Definition (*)	Drowning risk (Odds Ratio compare to level 1)		
		Pool with no waves or Current	Dam, lake, river and beach with no waves or current	River, beach or pool with waves or current
1	Swimmer with risk analysis and rescue training	Low (1,0)	Low (1.0)	Very high (1.0)
2	Swim 4 strokes	Low (1,35)	Low (0,64)	Very high (1,13)
3	Swim more than one style with advanced floating skills(1)	Low (1,45)	Low (1,30)	Very high (1,53) †
4	Water basic floating skills(2)	Medium (3,41) †	Medium (2,76) †	Very high (1,76) †
5	NO swim or floating	Very high (9,24) †	High (3,73) †	Very high (1,22)

Notes: (1) Float vertically and at the backs and submersion respiratory control; (2) Float vertically. Levels of significance test for X^2; (†) Risk estimative compare to level 1, showing OR ($p < 0,05$).

Figure 17 - water competence categorization and drowning risk (Szpilman et al., 2020)

Competitive * An activity where the purpose of swimming is for racing not leisure.

**** instruction/lesson*** The act of being taught how to control and improve the proficiency of one's movement patterns through water.

**** instructor/teacher*** A person who teaches someone else to control and improve the proficiency of their limbs' movement patterns through water.

**** pool (wading pool or paddling pool)*** A structure designed to hold water to enable swimming, sports or other leisure activities. They can vary in size and depth, may be portable and may be fenced.

**** cover*** A device that wraps over/enfold the water of a pool. It may have safety properties, but usually is designed only to keep the water warm and clean.

**** suction drains to avoid body entrapments*** A suction device or structural format that prevents/avoids entrapment of body parts.

**** suction drain cover to avoid hair entrapment*** A device that covers the drain to avoid hair entrapment.

**** with current/river flow*** A swimming pool with a system that generates flow/current.

**** with waves (or wave pool)*** A swimming pool with a system that generate waves.

Recreational* An activity with the purpose of fun, fitness, or health.

**** skill***	The controlled, repetitive physical movement patterns associated with safely moving into, through and under a body of water (distinguished from swimming competence).
Tidal flow (1.00)	The movements of water associated with incoming (flooding) and outgoing (ebbing) tide. They tend to be stronger near tidal inlets and along coastlines with higher tide ranges.
Tide (1.00)	The periodic rise and fall of the surface of a large water body due to the gravitational forces of attraction of the moon and the sun. (Brander, 2017; Castelle, 2016)
**** king***	The highest spring tides experienced generally twice per year.
**** neap***	The periods of lower tide ranges associated with new and full moons that occur approximately every 2 weeks.
**** range***	The vertical differences between water level at high and low tide.
**** spring***	The periods of higher tide ranges associated with new and full moons that occur approximately every 2 weeks
**** storm***	A period where storm waves or storm surge coincides with high tide.
Time records (1.00)	
Time of the day	The time on a 24-hour scale when an intervention (preparation, prevention, rescue or mitigation) has taken place (e.g., 7:00am or at 1800h).
Day of the week	Code as: weekday, weekend and/or holiday; or the exact day
Time of the year	Can be coded as: dry and wet, or spring, summer, autumn, and winter or other.
Intervention time	The range of time (duration) when an action took place.
Response time	The time between notification of an occurrence (call) and rescuer (lifeguard, ambulance or other) arrival at the scene.
Tourist drowning location (0.90)	The location/city/county/region where the tourist drowned.
Tourist place of origin (0.90)	The residential location/city/county/region where the drowned tourist came from.
Trauma	See INJURY.
Tsunami (0.90)	A wave or a series of waves caused by a sudden displacement of a large volume of water, typically caused by earthquakes, volcanic eruptions, landslides, and underwater landslides. They are often referred to as 'tidal waves', which is incorrect as they are not related to tidal generation. Tsunami waves have extremely long wavelengths and travel at great speeds and large events

	can cause major coastal inundation, loss of life and damage to infrastructure.
Unconscious drowning victim (0.80)	A drowned person unable to interact or respond to their surroundings.
***Utstein* style for drowning resuscitation (1.00)**	An international consensus-based guideline for a uniform reporting of resuscitation of drowning victims. (Idris 2017)
Vacation colony or resort (0.89)	A geographic location, featuring water as a touristic attraction for holidaying during various periods of time (e.g., during seasonal vacation/holiday times).
Ventilation pattern (1.00)	A spontaneous ventilation mode of a person. In adults, can be categorized as: normal (10-20), tachypnea (fast, respiratory rate > 20), bradypnea (slow, respiratory rate < 10), gasping or agonal gasp (intermittent respiration that does not provide adequate oxygenation), apnea (non-breathing) or other rarer forms.
Victim	See DROWNED PERSON.
Visual cue (0.90)	A simple visual gesture used by lifeguards that allows effective communication with peers (e.g., hand signals). See **Figure 18**.

Figure 18: Arm signals for communication. Licensed by Sobrasa

Warning (1.00)	A verbal or written instruction that indicates a possible or impending danger, problem, or other unpleasant situation (different from citation).
-flags or signs	A warning cue/strategy used to reduce the risk of drowning incidents. It can mark the hazard and/or the safety place. See **Figure 19**.

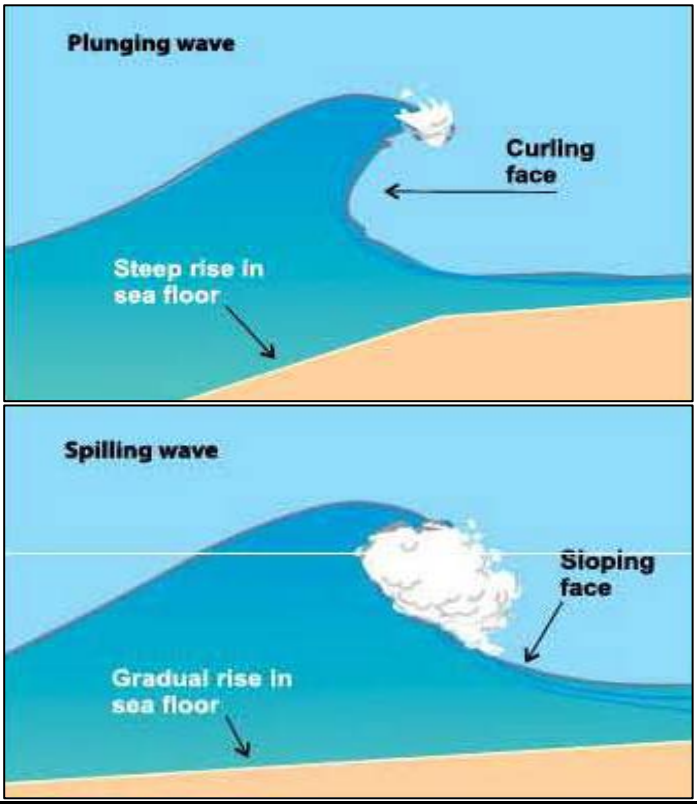
Figure 19: Examples of warning flags

Water — See AQUATIC.

Wave — The periodic rise and fall of the water surface formed by wind. (Brander et al., 2017; Castelle et al., 2016)

* ***breaking*** — The process of wave crests becoming unstable due to the orbital water motion exceeding the velocity of the wave form as waves enter shallow water. See **Figure 20**.
* ***collapsing*** — A wave that breaks vertically with great force on steep beaches.
* ***plunging*** — A wave that curls over and breaks with great force in one location on moderately sloped beaches or where there is a sudden transition from deep to shallow water. Often associated with impact and spinal injuries.
* ***spilling*** — A wave that breaks gradually over a wide area on gently sloping beaches.

**** surging***	A wave that rushes up and down moderate-steep sloped beaches with great force.
**** zone or surf zone***	An area where waves will begin to slow down and change shape at a depth of half the wavelength and will eventually steepen and break at water depths approximately 80% of the wave heights. The distance from the offshore extent of breaking waves to the shoreline is the wave breaking zone, often termed as the surf zone.
**** height***	The vertical distance between the wave crest and the wave trough. See **Figure 21** for various wave characteristics.
**** period***	The time between two successive wave crests to past a fixed point.
**** swell***	A wave that has travelled significant distances from a wind generating source that have periods of between 8-20 seconds.
**** wavelength***	The distance between two wave crests.
**** wind***	A wave formed locally by wind that have periods of between 3-8 seconds.



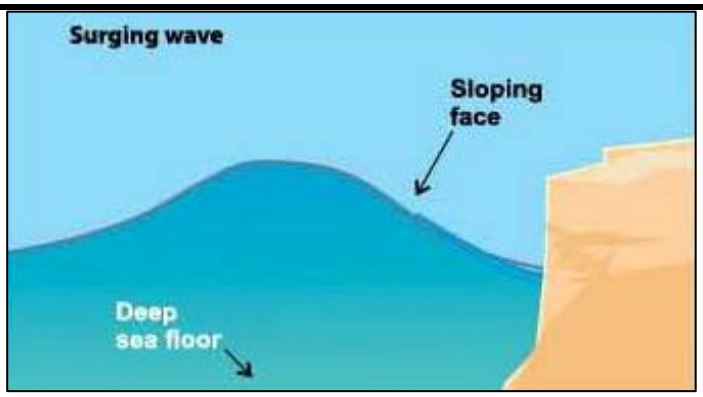


Figure 20: Examples of breaking waves. (top) Plunging Wave (middle) spilling Wave (bottom) surging wave (RLSSA, 2010)

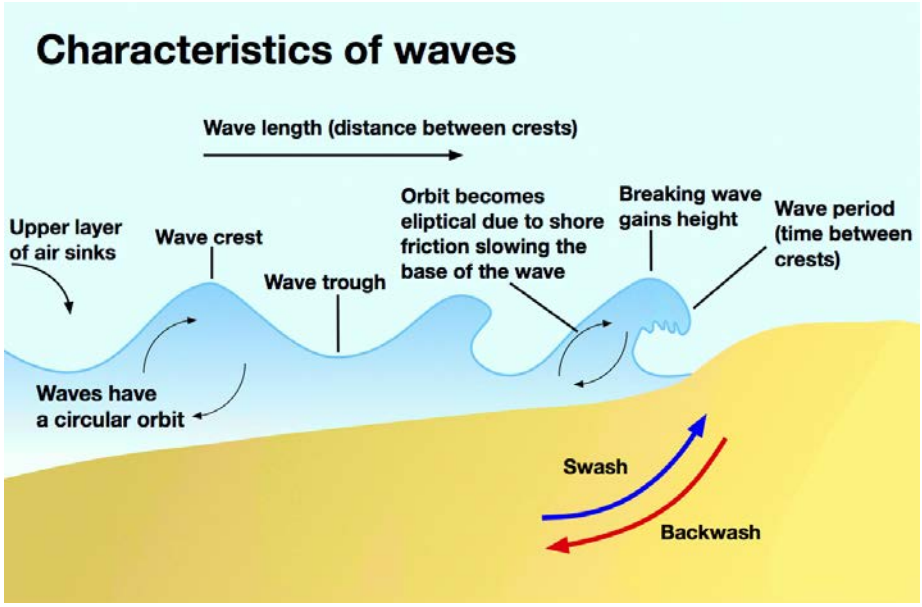


Figure 21: A diagram depicting the various characteristics of waves

Weather (0.90)	The state of the atmosphere (hot or cold, wet or dry, calm or stormy, clear or cloudy, etc) that might have a possible drowning or aquatic incident cause-effect. See AQUATIC CONDITIONS.
Written operating procedures (Standard operating procedures) (1.00)	A set of provisions containing all daily actions and interventions needed to safety manage an aquatic facility. The content is to be known and practiced by the rescue personnel. See LIFEGUARD REPORT and AQUATIC INCIDENT REPORT.

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