DROWNING Adam Gent 20th January 2021 Resuscitation Today

To begin with, let’s just forget " near - drowning “. " dry drowning “, " wet drowning “, " freshwater drowning “, " saltwater drowning " and " secondary drowning “.

These terms are outdated and no longer accepted by The World Health Organization, the United Kingdom Resuscitation Council, International Liaison Committee on Resuscitation, the Wilderness Medical Society, the International Lifesaving Federation, the American Heart Association who all discourage the use of these terms.

Unfortunately, these terms still slip past the editors of major medical journals, allowing their use to be perpetuated. These terms are most pervasive in the nonmedical press and social media to add an illusion of gravitas, where the term drowning seems to be synonymous with death.

The currently accepted definition of drowning from the World Congress on Drowning is: "Drowning is the process of experiencing respiratory impairment from submersion or immersion in a liquid. "

Key to this, are:

Drowning is a process, not the end result. The definition of drowning does not include death.

There must be respiratory impairment. If a casualty is rescued from the water with no respiratory distress, they did not drown or ' near drowned ‘, they were simply rescued.

Submersion occurs where the whole body is submersed, including the airway. Immersion is where the body is within a liquid but not covering the airway.

Drowning is limited to liquids. Casualties submersed in powders (which behave as free flowing fluids) are asphyxiated.

Once it is determined a drowning incident has occurred, there are 3 possible outcomes:
Mortality (death)
Morbidity (illness or injury)
No morbidity.

Drowned casualties either die as a result of respiratory impairment, are rescued with consequential illness or injury following their respiratory impairment or have no lasting illness or injury.

The Process of drowning

Stage 1: Cold water Immersion Response (0-2 minutes):

Sudden immersion in cold water causes an immediate fall in skin temperature which triggers several body reflexes collectively (and annoyingly) known as the " cold - shock " response, and they last for just the first few minutes after falling in.

The " cold - shock " responses include:
1) instantaneous gasping for air
2) sudden increase in breathing rate
3) sudden increase heart rate
4) sudden increase in blood pressure
5) dramatic decrease in breath - holding time (from around 60 seconds to just 20-25 seconds).

A combination of gasping and a decreased ability to hold one's breath causes the casualty to inhale water. And this is the fundamental cause of drowning - respiratory distress.

Inhaling water appears to cause laryngospasm in the first instance (although this is debated) but real problem occurs when water enters the lower airway, in particular the alveoli; only a small amount of water is required to cause significant problems - less than 4ml / kg •

Regardless of the salinity of the water, the inflammatory response leads to increased permeability of alveoli capillary membrane and exacerbates fluid, plasma and electrolyte shifts into the alveoli resulting in pulmonary oedema leading to decreased oxygen and carbon dioxide exchange and some bronchospasm.
Water in the alveoli also causes surfactant washout and dysfunction and leading to reduced lung compliance and alveoli collapse.

The fundamental cause of death from drowning is hypoxia, leading to arrhythmias and cardiac arrest. It is or this very simple reason that lifejackets and personal flotation device (PFD) save lives by keeping the airway above the water during the first few minutes of uncontrolled breathing.

Shallow Water Blackout

A combination of inhaled water and hyperventilation might , at this stage cause shallow water blackout :

Ordinarily as we hold our breath, our oxygen levels are decreasing whilst our carbon dioxide levels are increasing. The desire to breathe is triggered by elevated CO_2 levels which usually occurs before our 0_2 levels drop below a particular threshold at which point, we go unconscious or ' blackout ' .

Normal dive

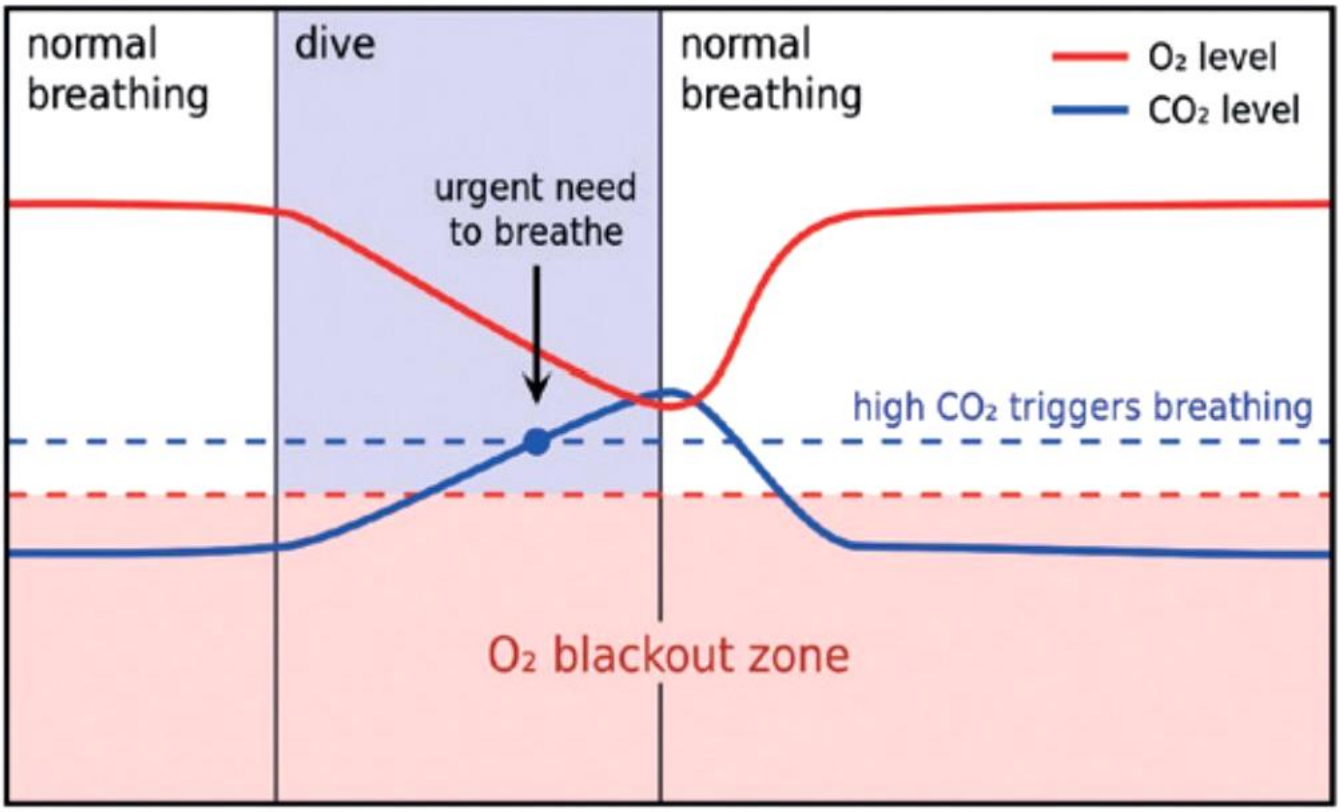

Image source: Wikipedia. CC BY-SA 4.0, File:Shallow water blackout diagram 1 revised.svg

If the casualty has been hyperventilating, they have a normal amount of oxygen in their blood stream but vastly reduced CO_2 levels. As they attempt to hold their breath, they reach the low 0_2 threshold of blackout before their raising CO_2 levels have triggered a desire to breath .

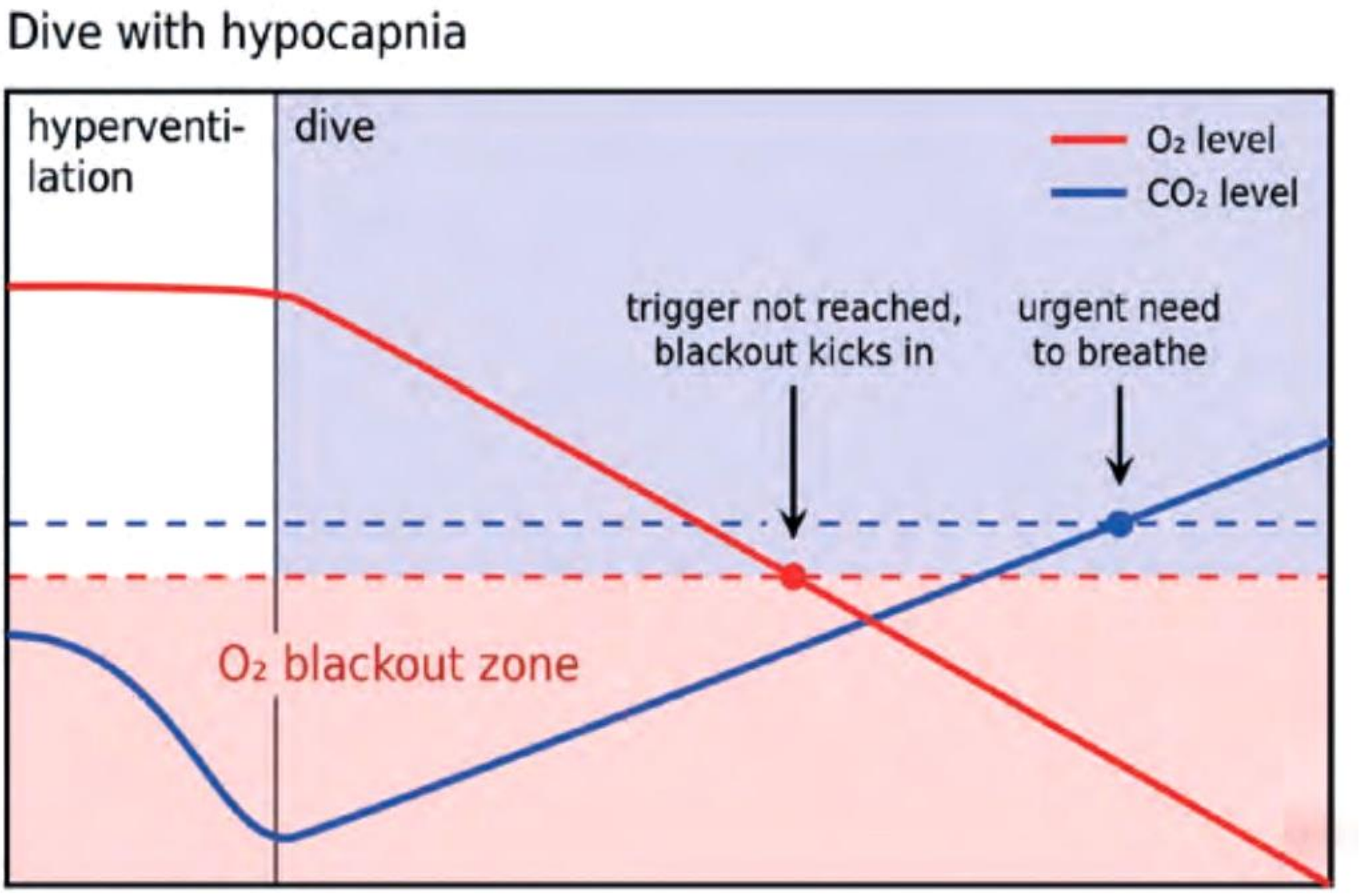

Image source: Wikipedia. CC BY-SA 4.0 File:Shallow water blackout diagram 2 revised.svg

Stage 2: Functional Disability (2-30 minutes)

If the casualty has survived the ' cold - shock ‘, rapid cooling of the muscles reduces contractility preventing normal muscle movement; the casualty may be unable to swim or may have lost manual dexterity preventing them from grasping rescue lines or ordinarily climbing out. It is this loss of muscle control which is why drowning may not appear as drowning:

1. Except in rare circumstances, drowning people are physiologically unable to call out for help due to uncontrolled breathing.
2. A drowning casualty may not wave for help, favoring swing their arms to keep their airway above the water.

Stage 3: Hypothermia (> 30 minutes).

After prolonged exposure, the casualty will become hypothermic. Unconsciousness can be expected around 30-32^{0}c but even in very cold water this can take over an hour to achieve. If the casualty was not wearing a life jacket of PFD, it is likely they died of drowning rather than hypothermia. If the casualty's airway is protected by a life - jacket and they are breathing normally, they are not a Drowned casualty, they are a hypothermic casualty and should be treated as such.

To rescue or not?

National Operation Guidance decision tool based on the work of Dr Mike Tipton is a model which is designed to give casualties every reasonable chance of rescue and resuscitation and is balanced against the risk of harm to responders when carrying out rescues. The length of time submerged and the temperature of the water are the two main factors determining survivability; generally, the longer a casualty is submerged and the warmer the water, the lower the chances of survival. Other factors affecting survivability include the age and / or size of the casualty, as smaller and / or younger people can survive longer than larger people or adults.

1. Start The Clock

The main factors are the length of time the casualty has been submerged and the water temperature. It is not possible to know for certain when a casualty became submerged, so the clock should start when the first attendance arrives on scene. It should not be assumed that the person has been submerged for longer than this.

2. Risk Assess

A risk assessment should balance the likelihood of casualty survival and the likelihood and severity of harm to rescuers . The decision will consider whether an immediate rescue can be started or if one should await specialist resources.

3. At 30 minutes

Further risk Assessment should be considered given the reduced likelihood of survival against the danger to rescuers which may be increased (darkness , cold , exposure , fatigue , changing tides or river levels).

If the water is ' icy - cold ' (below 7^0c) the casualty should be considered survivable, although the likelihood of survival reduces as time passes. If not, the operation should move to recovery of the body, if safe.

4. At 60 minutes

If rescue operations have continued at 60 minutes a further assessment should be made . If the water is ‘icy - cold ' and the casualty is known to be young and / or small they should be considered survivable, although again their chances are further reducing as time passes. The risk assessment should be revisited to decide if rescue should continue or if the incident should switch to body recovery.

5. At 90 minutes

After 90 the decision should be taken to switch to body recovery because the circumstances are regarded as no longer survivable.

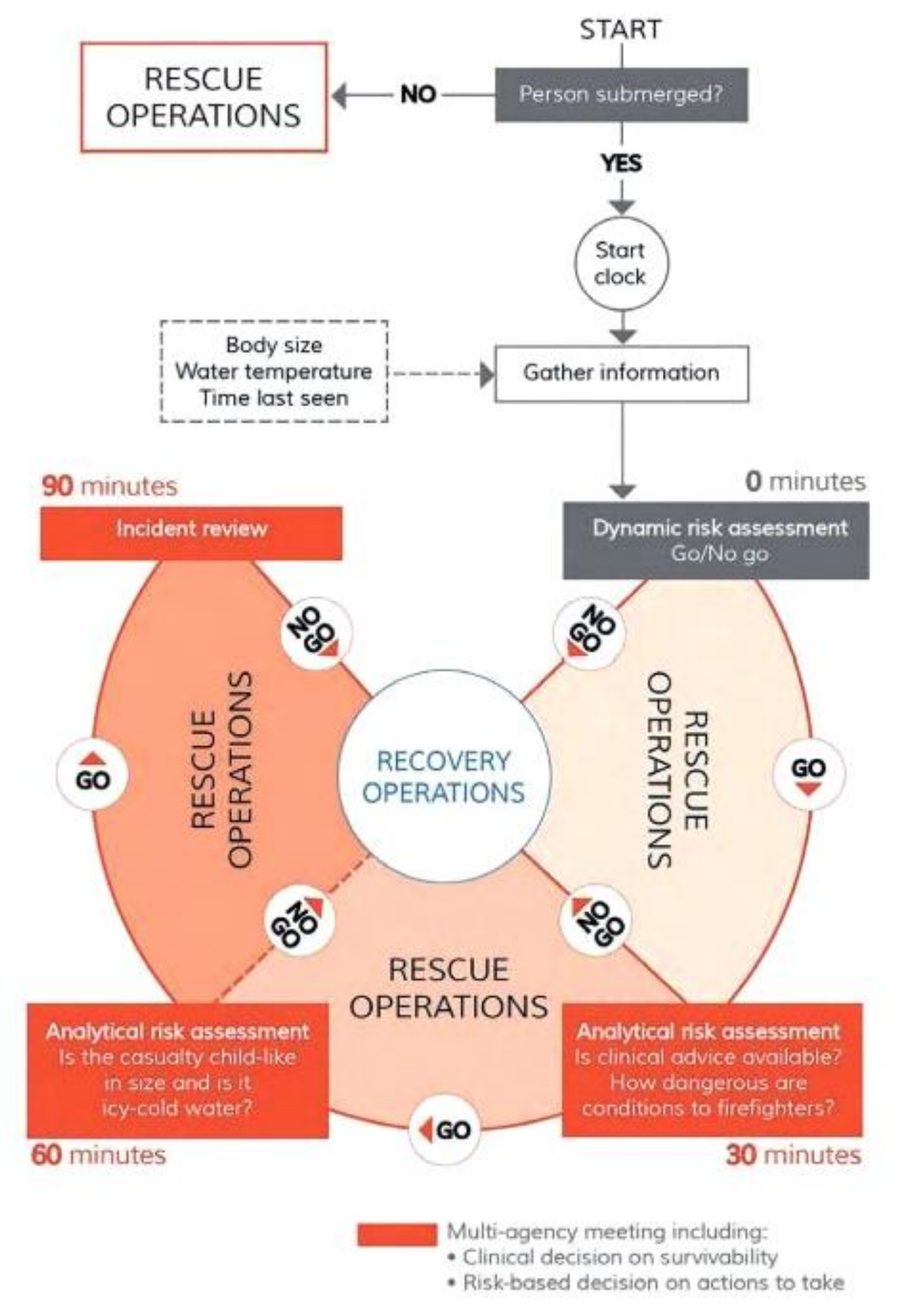

Image source: National operational Guidance: Water Rescue and Flooding". National Central Programme Office. https://www.ukfrs.com/pdf/print/node%3A20802 Accessed on 9th January 2021

Rescue

Avoid entry into the water whenever possible. If entry into the water is essential, use a buoyant rescue aid or flotation device.

Remove the victim from the water and start resuscitation as quickly and safely as possible.

Cervical spine injury is uncommon in drowning victims (approximately 0.5 %). Spinal immobilization is difficult in the water and delays removal from the water and adequate resuscitation of the victim.

Consider cervical spine immobilization if there is a history of diving , water slide use , signs of severe injury , or signs of alcohol intoxication .

Despite potential spinal injury, if the victim is pulseless and apneic, remove them from the water as quickly as possible (even if a back support device is not available) whilst attempting to limit neck flexion and extension.

Try to remove the victim from the water in a horizontal position to minimize the risks of post - immersion hypotension and cardiovascular collapse.

Ventilation

Prompt initiation of rescue breathing or positive pressure ventilation increases survival. If possible, supplement ventilation with oxygen.

Give five initial ventilations as soon as possible.

Rescue breathing can be initiated whilst the victim is still in shallow water provided the safety of the rescuer is not compromised.

If the victim is in deep water, open their airway and if there is no spontaneous breathing, start in - water rescue breathing if trained to do so .

In - water resuscitation is possible, but should ideally be performed with the support of a buoyant rescue aid.

If normal breathing does not start spontaneously, and the victim is < 5 min from land, continue rescue breaths while towing. If more than an estimated 5 min from land, give rescue breaths over 1 min, then bring the victim to land as quickly as possible without further attempts at ventilation.

Regurgitation

Expect the casualty to vomit.

If regurgitation occurs, turn the victim's mouth to the side and remove the regurgitated material,

There is no need to clear the airway of aspirated water as this is absorbed rapidly into the central circulation.

Do not use abdominal thrusts or tip the victim head down to remove water from the lungs or stomach.

Chest compressions

As soon as the victim is removed from the water, check for breathing. If the victim is not breathing (or is making agonal gasps), start chest compression immediately.

Continue CPR in a ratio of 30 compressions to 2 ventilations.

Most drowning victims will have sustained cardiac arrest secondary to hypoxia. In these patients, compression-only CPR is likely to be less effective and standard CPR should be used.

Post Rescue Care

After drop

A phenomenon known as 'After Drop' can occur as a result of aggressive rewarming; peripheral vasodilation can lead to a redistribution of blood and a drop in core temperature. This can occur during treatment or even after recovery. This can be prevented by moderated warming techniques; If the casualty has vital signs, is insulated and immobile, there is no rush to actively warm them.

Circum Rescue Collapse

Particularly evident in immersion hypothermia casualties, ' Circum Rescue Collapse ' has been attributed to the aggressive repositioning of the casualty from a floating horizontal position to vertical as they were winched out of the sea using a hoist. Standing up quickly can cause orthostatic hypotension; a drop in blood pressure as the vascular system cannot constrict fast enough in the lower limbs and abdomen to squeeze oxygenated blood up to the brain; this is noticeable by the " head rush ' or feeling of light - headedness as the brain is momentarily deprived of oxygen.

Combined with the immediate loss of hydrostatic pressure which was being exerted on the body whilst the casualty was immersed, this drop in blood pressure can reduce cerebral perfusion to the point of unconsciousness and cardiac perfusion to the point of cardiac arrest. Both immersion and severely hypothermic casualties are now rescued horizontally and as such, should remain in this position until rescue.

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