



## Cast 31 – Drowning

You are working in a regional ED when the AV brings in a 5 year old with a submersion injury from their home swimming pool.

**(a) List 5 risk factors associated with drowning:**

- Age
  - Toddlers
  - Older teenagers
- Gender
  - Male > Females
- Race
  - In Australia – Indians, Chinese & Nepalese are more at risk in 2023-24
- Alcohol and recreational drugs
- Seizure disorders increase the chance of drowning among children and adolescents nearly 20 times.
- Autism and other developmental and behavioural disorders increase risk in children as well.
- Prolonged QT syndrome

**(b) List four (4) prognostic factors at scene and on arrival to ED for a submersion injury**

On Scene	On Arrival to ED
Hypoxia	Hypothermia
Age <3 years	Severe acidosis
CPR > 10 min	Unreactive pupils
Duration of submersion > 5 min	GCS of 3
	Asystole or the need for ongoing CPR

**(c) List 5 key investigations to aid in prognostication for a child post submersion injury (5 marks)**

Any 5 from list below

- ECG - Prolonged QT, dysrhythmias and signs of ischaemia
- BGL for hypoglycaemia
- ABG - Hypoxemia, Hypercarbia, & Acidosis
- Bloods - FBE, UEC, LFT, Coags, Tni, Toxicology Screening
- Imaging - CXR, CT Brain, MRI
- Capnography if the patient is intubated



**(d) List five (5) discharge criteria for a child with submersion injury (5 marks)**

- Asymptomatic
- Observed for 8 hours from the time of drowning
- Normal respiratory examination
- SpO<sub>2</sub> ≥95%
- Education about water safety provided (see handout below)
- No ongoing safety concerns
- Referral to social work has been made if deemed appropriate

**Disposition:**

- Symptomatic patients should be admitted for treatment
- Patients with a history of apnoea, LOC, or hypoxia & any patients who manifest dysrhythmia or an abnormal CXR also require admission
- Patients who are asymptomatic on presentation to the ED, maintain a normal room air oxygen saturation, and have no CXR or ABG abnormalities can be discharged safely after an observation period of 6 hours with appropriate instructions

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**Additional possible questions in a drowning SAQ**

**List the 'x' number of key assessment / management steps for a patients with submersion injury.**

**Management:**

- *Telemetry & pulse oximetry*
- *Monitor Core temp for all unstable or lethargic patients*
- *Rewarming of a hypothermic patient may suffice for hemodynamic stabilization and improvement in mental status*
- *Empirical naloxone*
- *Early Intubation for*
  - *Resp Distress*
  - *Significant chest or head injuries*
  - *Dropping GCS*
  - *PaCO<sub>2</sub> > 50*



- CPAP for all patients with O<sub>2</sub> Sats oxygen < 90% or with a Pao<sub>2</sub> < 60 mm Hg even with high-flow

**Important Points to remember:**

- CPR to continue till core temp of 32 - 35° C
- Prolonged CPR
- Steroids don't improve outcome
- Barbiturate-induced coma, aggressive diuresis, neuromuscular blockade, & hyperventilation do not improve neurologic outcome
- Empirical antibiotics do not increase survival
- Only to be administered in patient submerged in grossly contaminated fluid
- Should not be rewarmed above 34° C
- Therapeutic hypothermia aimed at attenuation of reperfusion injury is a new and emerging field

**Additional Points of Interest in Drowning/Submersion Injury**

**Temporal Pattern:**

- January
- Sunday
- Afternoon

**Pathophysiology:**

- Unexpected submersion triggers breath-holding, panic, and a struggle to surface
- Air hunger and hypoxia develop, and the victim begins to swallow water
- As breath-holding is overcome, involuntary gasps result in aspiration
- The quantity of fluid aspirated, rather than the composition, determines subsequent pulmonary derangement
- >11ml/kg of body weight - significant intravascular abnormalities
- Autopsies show most drowning victims aspirate < less than 4 mL/kg body weight
- Aspiration of 1 - 3 mL/kg of either fresh water or salt water destroys the integrity of pulmonary surfactant
  - Alveolar collapse
  - Atelectasis
  - Noncardiogenic pulmonary oedema

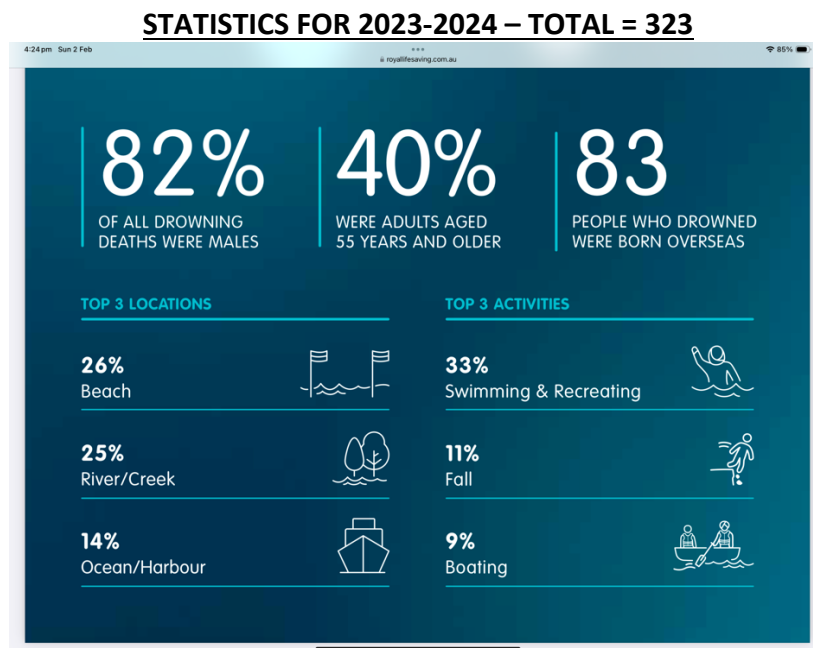


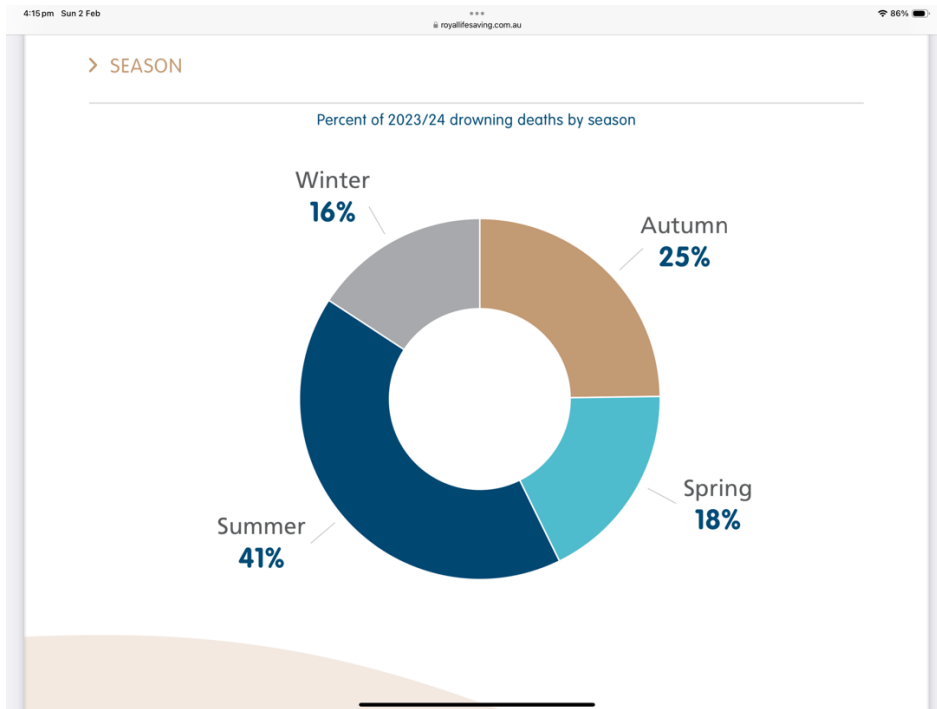
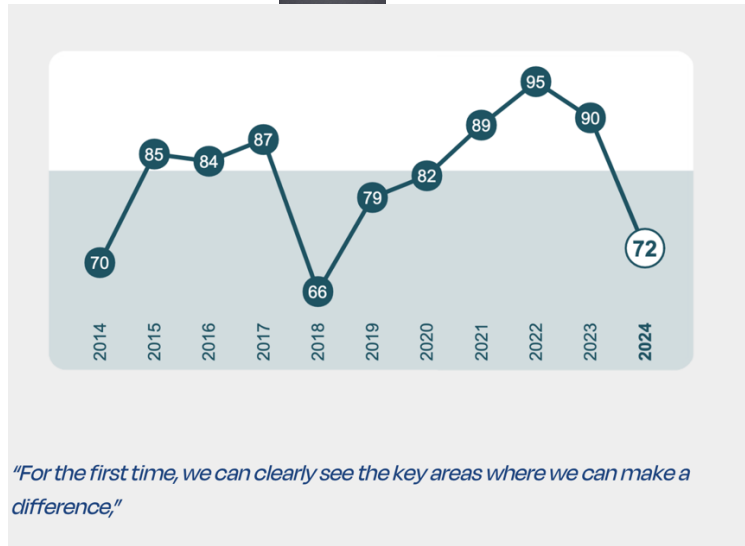
- Intrapulmonary shunting
- Ventilation-perfusion mismatch
- Profound hypoxia and metabolic and respiratory acidosis ensue, leading to cardiovascular collapse, neuronal injury, and ultimately death

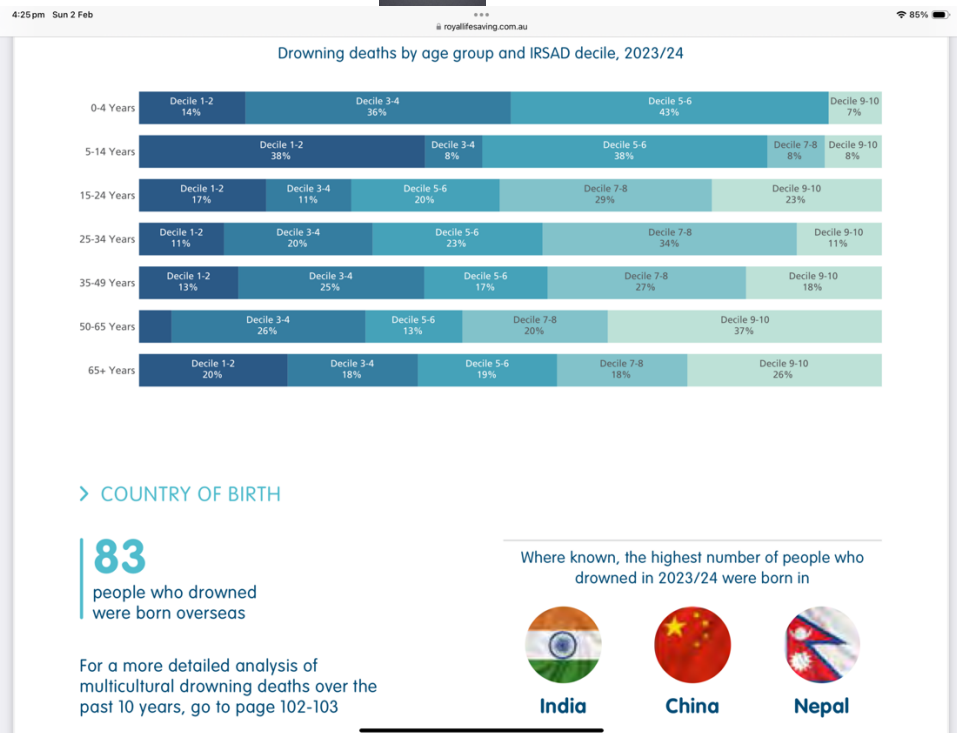
**Myths:**

- *The classic hypothesis was that 10 to 15% of drowning victims die without aspiration of a significant amount of water - Dry Drowning*
- *Such deaths were supposed to be because of severe laryngo-spasm causing hypoxia, convulsion, and death without entry of fluid into the lungs*

***Dry drownings more appropriately reflect deaths from causes other than simple submersion***







**Fatal outcome:**

- *A retrospective study of submersion injury in children noted that all patients who present with an abnormal head computed tomography (CT) scan within the first 24 hours eventually die.*
- *Furthermore, an abnormal head CT scan at any time is associated with poor outcome (death or persistent vegetative state)*

**DIFFERENTIAL CONSIDERATIONS: - Consider other causes of cardiac arrest.**

- *Drug or Alcohol intoxication*
- *Cardiac arrest*
- *Hypoglycaemia*
- *Seizure*
- *Attempted suicide or homicide*
- *In children - non accidental injury should be kept in mind*
- *Unless signs of trauma are present C-Spine collar is not indicated*
- *Marine envenomation*



## **References**

- Royal Life Saving Society – Australia (2024) National Drowning Report 2024, Sydney Australia. <https://doi.org/10.62977/85070>
- RCH Clinical Guideline on Drowning  
[https://www.rch.org.au/clinicalguide/guideline\\_index/Drowning/](https://www.rch.org.au/clinicalguide/guideline_index/Drowning/)
- Chandy D, Weinhouse G. *Drowning (submersion injuries)*. 2019, UptoDate. Retrieved from [https://www.uptodate.com/contents/drowning-submersion-injuries?search=drowning%20children&source=search\\_result&selectedTitle=1~79&usage\\_type=default&display\\_rank=1](https://www.uptodate.com/contents/drowning-submersion-injuries?search=drowning%20children&source=search_result&selectedTitle=1~79&usage_type=default&display_rank=1) (viewed 4 July 2019)