Clinical Practice Guidelines:
Environmental/Diving emergencies

<table>
<thead>
<tr>
<th>Policy code</th>
<th>CPG_EN_DE_0221</th>
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<tbody>
<tr>
<td>Date</td>
<td>February, 2021</td>
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<tr>
<td>Purpose</td>
<td>To ensure consistent management of diving emergencies.</td>
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<tr>
<td>Scope</td>
<td>Applies to Queensland Ambulance Service (QAS) clinical staff.</td>
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<tr>
<td>Health care setting</td>
<td>Pre-hospital assessment and treatment.</td>
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<tr>
<td>Population</td>
<td>Applies to all ages unless stated otherwise.</td>
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<tr>
<td>Source of funding</td>
<td>Internal – 100%</td>
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<tr>
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<td>Clinical Quality &amp; Patient Safety Unit, QAS</td>
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<tr>
<td>Review date</td>
<td>February, 2024</td>
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Diving emergencies result from changes in ambient pressure, encompassing: decompression illness (decompression sickness and arterial gas embolism), barotrauma and hypoxic blackouts.\[1-6\]

- **Decompression sickness (DCS)**\[1\]
  Occurs if a diver is unable to perform a slow controlled ascent. Inhaled nitrogen is unable to leave the body naturally, causing bubbles to form in the diver’s blood and tissues. These bubbles cause a reduction in blood flow and subsequent end tissue/organ cellular ischaemia.

- **Arterial gas embolism (AGE)**\[1\]
  Results from pulmonary barotrauma when expanding gas within the alveoli ruptures the alveoli/capillary membrane allowing bubbles to enter the arterial circulation via the lungs.

- **Barotrauma**\[2,3\]
  Occurs when trapped air expands during the diver’s ascent, due to decreasing pressure, causing trauma. This can occur in any gas filled space including the pulmonary system, ears, eyes, sinuses, dental structures, gastrointestinal tract and even the dive mask or dive suit.

- **Hypoxic/shallow water blackout**\[6\]
  Loss of consciousness while swimming or diving underwater, during an apnoea submersion, often preceded by hyperventilation prior to diving, when other causes of unconsciousness have been excluded. The term ‘shallow water blackout’ can be misleading, as drowning can occur at depths greater than five metres, hence the term ‘hypoxic blackout’ may be more appropriate than shallow water blackout.\[6\]

<table>
<thead>
<tr>
<th>Diving Emergencies relative to type of diving</th>
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<tbody>
<tr>
<td><strong>Free Diving</strong></td>
<td>No form of diving equipment. Divers simply hold their breath</td>
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<tr>
<td><strong>SCUBA Diving</strong></td>
<td>Self Contained Underwater Breathing Apparatus or ‘dive set’ that consists of a buoyancy vest, regulator and compressed air cylinder</td>
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<tr>
<td><strong>Surface Supplied Breathing Apparatus</strong></td>
<td>Diver breathes compressed air through a helmet or regulator via an umbilical air line attached to a wharf or boat</td>
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<tr>
<td><strong>Rebreather Diving</strong></td>
<td>Expired gas is recycled through a breathing loop and granular CO₂ absorbent. Use various gas mixtures including Helium-Oxygen, Nitrogen-Oxygen or Oxygen.</td>
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<tr>
<td><strong>Saturation Diving</strong></td>
<td>Chamber/bell pressurised to a set depth that can be rapidly raised or lowered from a ship, allowing divers to remain at ‘depth’ for up to four weeks</td>
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- **DCS & AGE**
- **Severed or contaminated umbilical air line**
- **DCS & AGE**
- **CO₂ build up – hypercarbia**
- **Caustic steam airway burns from water contamination in CO₂ absorbent**
- **Explosive decompression**
- **Other cardiac/medical/respiratory problems**
Clinical features

Neurological:
- headache
- visual changes
- motor/sensory deficit
- cranial nerve palsies
- seizures
- paralysis
- ALOC

Respiratory:
- dyspnoea
- haemoptysis
- chest pain
- APO
- pulmonary barotrauma
  - pneumothorax
  - pneumomediastinum
  - subcutaneous emphysema

Cardiac:
- chest pain
- cardiac arrest

Clinical features (cont.)

Localised symptoms:
- skin itch and/or rash
- pain in the joints (the ‘bends’) and/or muscles (especially shoulders/elbows)
- tremors.

Risk Assessment

- Onset of decompression illness symptoms may occur more than 24 hours after any form of deep diving.

Additional information

- Presentations may be subtle, but ALL symptoms should be considered relevant. Clinicians should have a low threshold for seeking expert advice (see below) or transporting patients to definitive care.
- Divers Alert Network (DAN) is a worldwide diving safety association providing 24/7 medical information for diving related illnesses – phone: [blank]
CPG: Clinician safety
CPG: Standard cares

Cardiac arrest?

Y

Unconscious or respiratory distress?

N

Manage as per appropriate CPG:

- CPG: Resuscitation (age specific)
- CPG: Resuscitation – Special circumstances

N

Consider:

- Posture the patient supine (without leg elevation)
- Oxygen (high flow)
- Maintain normothermia

Y

Consider:

- IPPV
- IV fluid
- LMA/ETT

Transport to hospital
Pre-notify as appropriate

Note: Clinicians must only perform procedures for which they have received specific training and authorisation by the QAS.