Advanced Life Support in Special Circumstances IV

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Advanced Life Support

DROWNING

DROWNING: DEFINITION AND TERMINOLOGY

- "**Drowning** is the process of experiencing respiratory impairment from submersion or immersion in liquid".
- The term "near-drowning" is abandoned. Confusing terms, like 'dry' drowning and secondary drowning are eliminated.
- The drowning process begins when the patient's airway is below the surface of the liquid, usually water, which - if uninterrupted - may lead or not to death.

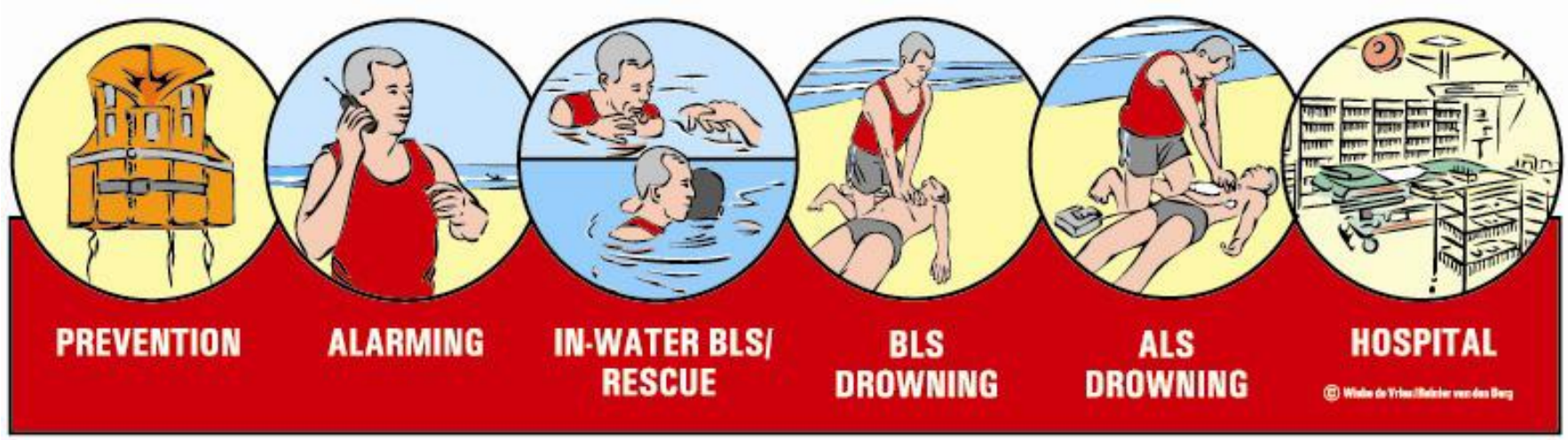
DROWNING: PATHOPHYSIOLOGY

- **Hypoxia** is the most determinant factor in drowning severity and reversal of primary hypoxia and prevention of secondary hypoxia are the determinant factors to outcome.
- **Ventricular fibrillation** is infrequent and is usually due to hypoxia and acidosis.
- In drowning, apnea comes first, and if the victim is not ventilated soon enough, then **circulatory arrest** will happen (secondary event).

DROWNING: PATHOPHYSIOLOGY

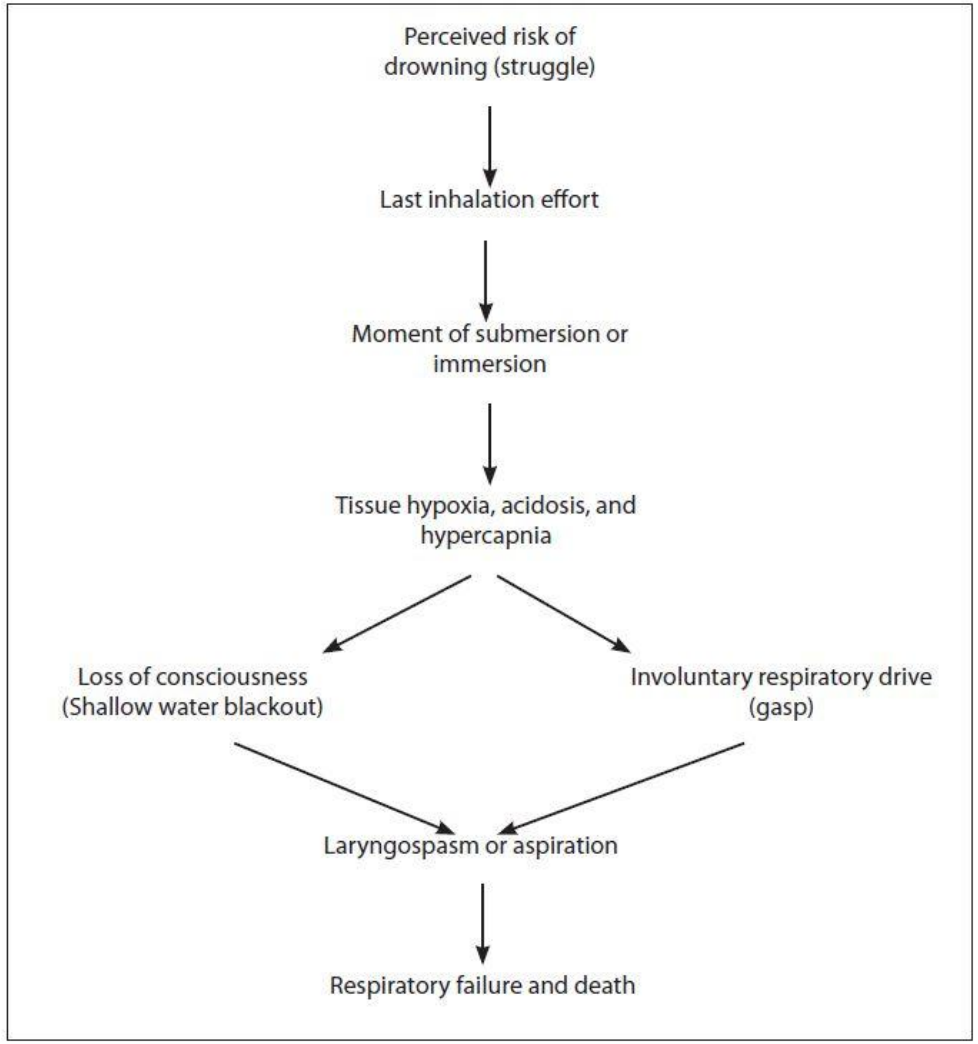
- In drowning survivors, permanent and severe neurologic results, usually occur following cardiac arrest.
- Difference between drowning in fresh and salt water has only significance for epidemiological purpose for planning prevention campaign.
- Humans rarely aspirate sufficient water to provoke significant electrolyte disturbances and usually do not need initial electrolyte correction.

Drowning Chain of Survival



The Drowning Process

Figure 3. The Drowning Process[22-25]



Drowning treatment Algorithm

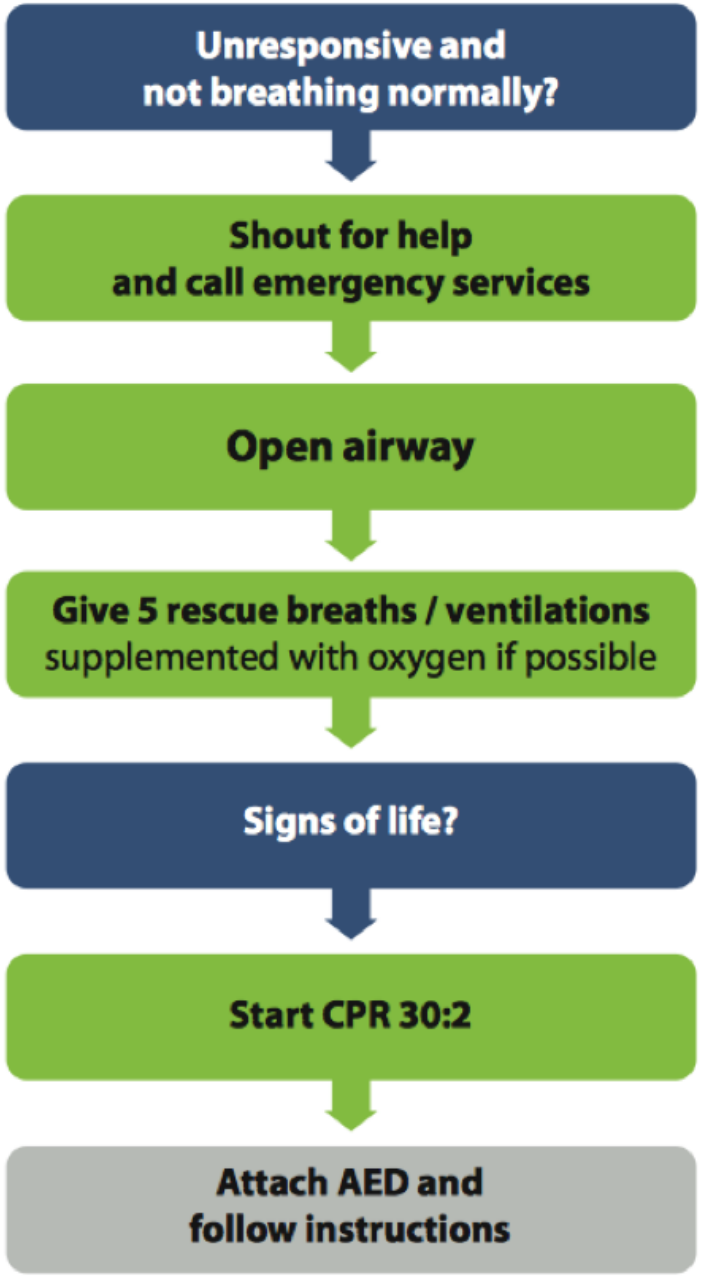


Fig. 4.6. Drowning treatment algorithm for rescuers with a duty to respond.

Advanced Drowning Life Support (ADLS) on site

- **Dead body** – Victim with submersion time over 1 hour in non-icy waters or with obvious physical evidence of death (rigor mortis, great injuries).

  Recommendation is to not start resuscitation.
- In the apneic victim start rescue breathing as soon as the airway can be opened and the rescuer's safety is ensured (mouth-to-mouth ventilations).
- When the victim remains in apnea, give rescue breaths for 1 min (10 breaths) and mechanical ventilatory support will be required.
- Do not delay bringing the victim to shore in order to protect the spine or to give rescue breaths
- Do not use abdominal thrusts in order to remove water from stomach or lungs

Advanced Drowning Life Support (ADLS) on site

- When the victim remains in apnea, give rescue breaths for 1 min (10 breaths) and mechanical ventilatory support will be required.
- Do not delay bringing the victim to shore in order to protect the spine or to give rescue breaths
- Dry the victim's chest and attach the AED pads as soon as possible
- Do not use abdominal thrusts in order to remove water from stomach or lungs

Advanced Drowning Life Support (ADLS) on site

- If the victim is not breathing Start chest compressions immediately
- Do not delay looking for pulse, difficult due hypothermia
- Chest compression is ineffective in the water
- Regurgitation of stomach contents is common. Use suction if possible and turn the victim's mouth to the side
- If the victim is breathing give high flow oxygen and consider CPAP or tracheal intubation
- Decompress and empty the stomach using a nasogastric tube

Advanced Drowning Life Support (ADLS) on site

- During prolonged immersion severe hypothermia is present < 30°C
- Limit defibrillation attempts to 3 and withhold drug administration until core temperature improves
- If moderate hypothermia is present (30-32°C) give IV drugs at longer intervals
- All victims need to be transferred to the hospital for treatment and monitoring for complications
- Some cases of drowning may die later (72h) from complications of drowning such as pneumonia, Adult Respiratory Distress Syndrome (ARDS) or ischemic encephalopathy.

Electrocution and Electrical Injuries

Electrocution : victims

- Many *electrocution victims* (those who die as a result of an electric shock) fall from a height, present with a dysrhythmia, or are simply found dead, and in many of these cases, the significance, and even the occurrence, of an electric shock can be difficult to determine.
- Electrical injuries tend to follow a trimodal *age distribution*, each accounting for approximately 20% to 25% of total injuries.

Electrocution : victims

- The first peak occurs in **toddlers**, who generally sustain electrical injuries from household electrical sockets and cords (home).
- The second peak occurs in **adolescents** who engage in risky behavior around electrical power lines.
- The third population is made up of **adults** who work with electricity for a living (workplace).

Electrocution

- **Six factors** determine the **outcome** of human contact with electrical current:

  Voltage, type of current, amount of current, resistance, pathway of the current, and duration of contact.

- In many cases, the magnitude of only a few of these factors is known
- *Low voltage* is arbitrarily defined at less than 1,000 volts.

Electrocution

- As a general rule, *high voltage* is associated with greater morbidity and mortality, although fatal injury can occur with low voltage as well.
- *AC exposure* to the same voltage is considered to be about 3 times more dangerous than exposure to the same voltage of *DC current*.
- The differences in the 2 types of current have practical significance only at low voltages; at high voltages both currents have similar effects.

Electrocution: Injuries

- Electrocution causes injury in several ways.
- The conversion of electrical energy to thermal energy can result in massive *external* and *internal burns*.
- The direct effect of current on body tissues can lead to *asystole, VF,* or *apnea*.
- The scene of an electrical injury may present many hazards for rescue personnel, so extra consideration must be taken to ensure *scene safety*.

Electrocution: Injuries

- Electrical shock is not prevented by the rescuer wearing rubber gloves and boots unless these are specifically designed for the voltage present
- Ideally, it is best to turn off the source of electricity before contact with the victim.
- The most common causes of death from electrical injury are **cardiac arrhythmia** and **respiratory arrest**.
- AC current is more likely to cause VF, whereas DC is more likely to cause asystole.

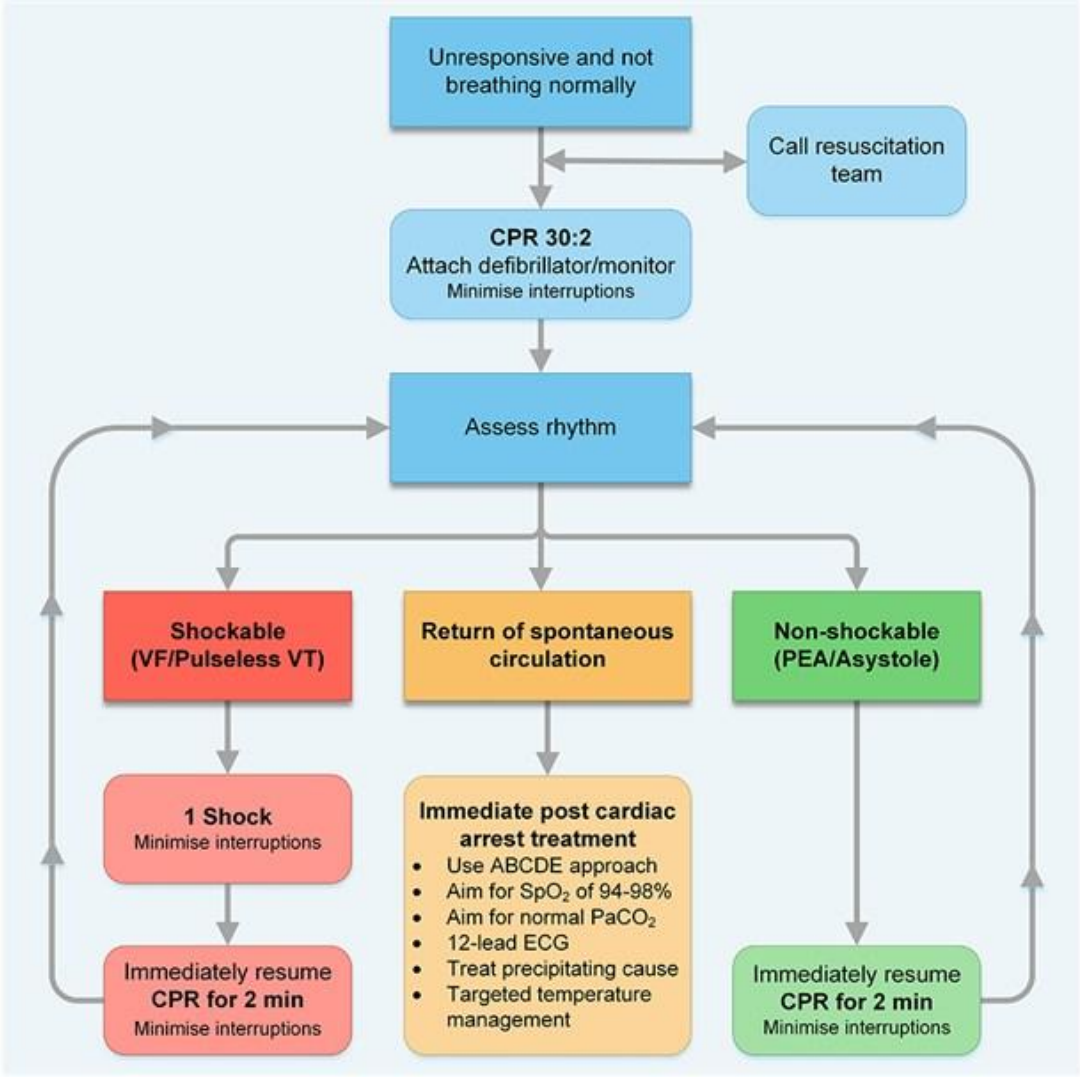
Management

- **Rescue breathing** should be instituted as soon as possible for lineworkers in respiratory arrest, even while still on utility power poles.
- As soon as the victim is lowered to the ground, **chest compressions** should be initiated if the patient is in cardiac as well as respiratory arrest
- The most common ECG alterations are sinus tachycardia and nonspecific ST-T-wave changes, which usually revert with time
- Ventricular fibrillation is the commonest initial arrhythmia after AC shock

Management

- Normal **BLS** or **ALS resuscitation protocols** should be used, keeping in mind any necessary adjustments for rescuer safety and patient access.
- In-line immobilization of the spine, IV access, cardiac monitoring, and measurement of oxygen saturation should be started after the primary survey is completed.
- The primary electrical injury is the **burn**.
- Rescuers should assume that victims of electrical trauma have multiple traumatic injuries, multi system injury with high morbidity and mortality

ALS STANDARD PROTOCOL



During CPR

- Ensure high quality chest compressions
- Minimise interruptions to compressions
- Give oxygen
- Use waveform capnography
- Continuous compressions when advanced airway in place
- Vascular access (intravenous or intraosseous)
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks

Treat Reversible Causes

- Hypoxia
- Hypovolaemia
- Hypo-/hyperkalaemia/metabolic
- Hypothermia
- Thrombosis - coronary or pulmonary
- Tension pneumothorax
- Tamponade – cardiac
- Toxins

Consider

- Ultrasound imaging
- Mechanical chest compressions to facilitate transfer/treatment
- Coronary angiography and percutaneous coronary intervention
- Extracorporeal CPR

Modifications

- Extensive soft-tissue swelling may develop rapidly, complicating **airway** control measures.
- *Early intubation* should be performed for patients with evidence of extensive burns even if the patient has begun to breathe spontaneously.
- As significant as the external injuries may appear after electrothermal shock, the underlying tissue damage is far more extensive

Modifications

- For victims with hypovolemic shock or significant tissue destruction, rapid intravenous **fluid administration** is indicated to counteract shock and correct ongoing fluid losses due to third spacing.
- Fluid administration should be adequate to maintain **diuresis** to facilitate excretion of myoglobin, potassium, and other byproducts of tissue destruction.

Lightning Injury

- **Lightning** is a unidirectional cloud-to-ground current resulting from static charges that develop when a cold high-pressure front moves over a warm and moist low-pressure area.
- It is neither a direct nor an alternating form of current.
- Although lightning can release greater than 1 million volts of energy and reach temperatures as high as 50,000° F, the actual amount of energy delivered may be less than that typical of high-voltage injuries because its **duration** is as short as a few milliseconds
- There are *5 basic mechanisms of injury* that occur with lightning strike

Injuries

- 1. **Direct strike**: A direct strike is more likely to hit a person who is in the open and unable to find shelter. This type of lightning strike is usually *fatal*.
- 2. **Splash injury**: This occurs when lightning strikes an object (such as a tree or building) or another person, and the current "splashes" to a victim standing nearby.

  Current can also splash to a victim indoors via plumbing or telephone wires.
- 3. **Contact injury**: This occurs when the victim is in physical contact with an object or a person directly struck or splashed by lightning.

Injuries

- 4. **Step voltage/ground current injury**: When lightning hits the ground, the current spreads outward in a radial pattern.
- Because the human body offers less resistance to electrical current than does the ground, the current will preferentially travel through the body (e.g., up one leg and down the other).
- 5. **Blunt trauma**: Victims of lightning strike may be thrown by the concussive forces of the shockwave created by the lightning.
- 6. A lightning strike can also cause significant *opisthotonic muscle contractions*, which may lead to fractures or other trauma

Management

- Lightning strikes may cause multisystem injuries, the most common cause of death is immediate **cardiorespiratory arrest**
- The cardiac effects of lightning injury can include anything from *nonfatal arrhythmias* (including bradycardia, tachycardia, premature ventricular contractions, ventricular tachycardia, and atrial fibrillation), to myocardial depolarization and *asystole*.
- Lightning may also cause paralysis of the medullary respiratory center, leading to prolonged **respiratory arrest**.

Management

- Although lightning produces significant heat and voltage, severe burns are uncommon because of the short duration of exposure
- Rescuers should care for lightning strike victim using **standard BLS and ALS principles**
- Lightning strike victims with obvious injuries (such as long bone fractures, external burns, respiratory compromise, cardiac arrhythmias, hypotension, or altered mental status) should be transported to a **trauma** or **burn center** for evaluation.
- The appropriate precautions, including proper *spinal immobilization*.

Examples

Case 1

- Paramedics are dispatched for a 13-year-old male who climbed up a 30-foot fence to get a basketball and grabbed an active power line while on the fence.
- He is found lying next to the fence, pulseless and apneic.
- There is a distinct burn on the right palm and explosive-appearing burns on both feet.
- His initial heart rhythm is asystole

Management

- The energy involved in this case is likely more than 100,000 V of DC current.
- Scene safety is the top priority for the responding agencies.
- However, because there is not actually a power line down, this is likely to be a safe scene.
- Cervical spine precautions must be taken because of concerns of spinal trauma from the fall or possibly from tetanic muscle contractions.

Management

- Vigorous attempts at resuscitation should be performed for this young, otherwise healthy, patient.
- This would include high-quality CPR, airway management, and appropriate pediatric ALS medications.
- IV crystalloids should be started at approximately 20 to 40 ml/kg per hour.
- The patient should ideally be transported to a trauma center for further treatment.

Examples

CASE 2

- You are called to the scene of a lightning strike on a golf course with ***4 male* victims** in their sixties.
- One victim is in cardiorespiratory arrest.
- His 2 friends, who also report being struck, have been performing CPR.
- The fourth, who has an extensive cardiac history, is sitting nearby, diaphoretic and complaining of chest pain.
- Lightning is visible on the horizon, and the rain is just starting to fall as paramedics arrive on the scene.

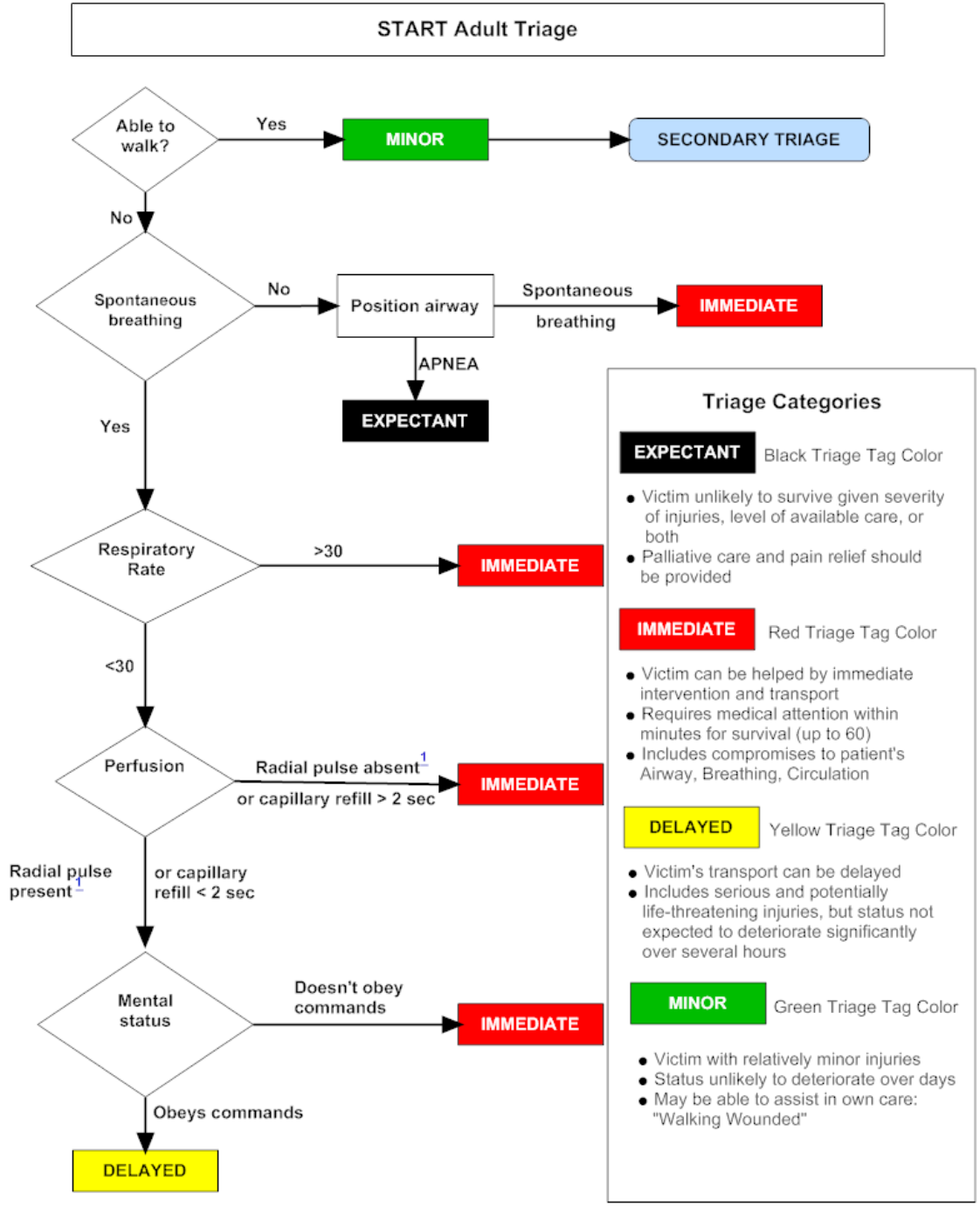
Management

- The patient with the cardiac history experiencing active chest pain will require urgent assessment and treatment,
- But unlike typical multicasualty trauma triage scenarios, the patient in cardiac arrest should be tended to first, with rhythm evaluation for potential defibrillation and appropriate airway management.
- Appropriate spinal immobilization precautions should be observed.

Management

- The man with chest pain should be treated next, according to usual BLS and ALS protocols.
- Although the third and fourth victims are not experiencing symptoms debilitating enough to prevent them from performing CPR, they also should be transported for hospital evaluation even without any specific complaints.

Mass Casualty Situation


START Adult Triage
Able to walk?
Yes
MINOR
SECONDARY TRIAGE
No
Spontaneous breathing
No
Position airway
Spontaneous breathing
IMMEDIATE
APNEA
EXPECTANT
Yes
Respiratory Rate
>30
IMMEDIATE
<30
Perfusion
Radial pulse absent[1] or capillary refill > 2 sec
IMMEDIATE
Radial pulse present[1]
or capillary refill < 2 sec
Mental status
Doesn't obey commands
IMMEDIATE
Obeys commands
DELAYED
Triage Categories
EXPECTANT
Black Triage Tag Color
Victim unlikely to survive given severity of injuries, level of available care, or both
Palliative care and pain relief should be provided
IMMEDIATE
Red Triage Tag Color
Victim can be helped by immediate intervention and transport
Requires medical attention within minutes for survival (up to 60)
Includes compromises to patient's Airway, Breathing, Circulation
DELAYED
Yellow Triage Tag Color
Victim's transport can be delayed
Includes serious and potentially life-threatening injuries, but status not expected to deteriorate significantly over several hours
MINOR
Green Triage Tag Color
Victim with relatively minor injuries
Status unlikely to deteriorate over days
May be able to assist in own care: "Walking Wounded"

Management

- If there are a lot of people with severe injuries and you can't help them all, you may have make some hard decisions about who can use your help the most.
- It is important to set up a *safe management center* near the accident scene.
- First proceed to the accident scene with great precautions and safety measures

Management

- Many first responder teams use the START system.
- It stands for Simple Triage and Rapid Treatment.
- The START system technically involves using colored tags to triage (sort) people according to how injured they are.
- You probably won't have tags, but the general guidelines can help you decide who you should spend your main time on

Triage

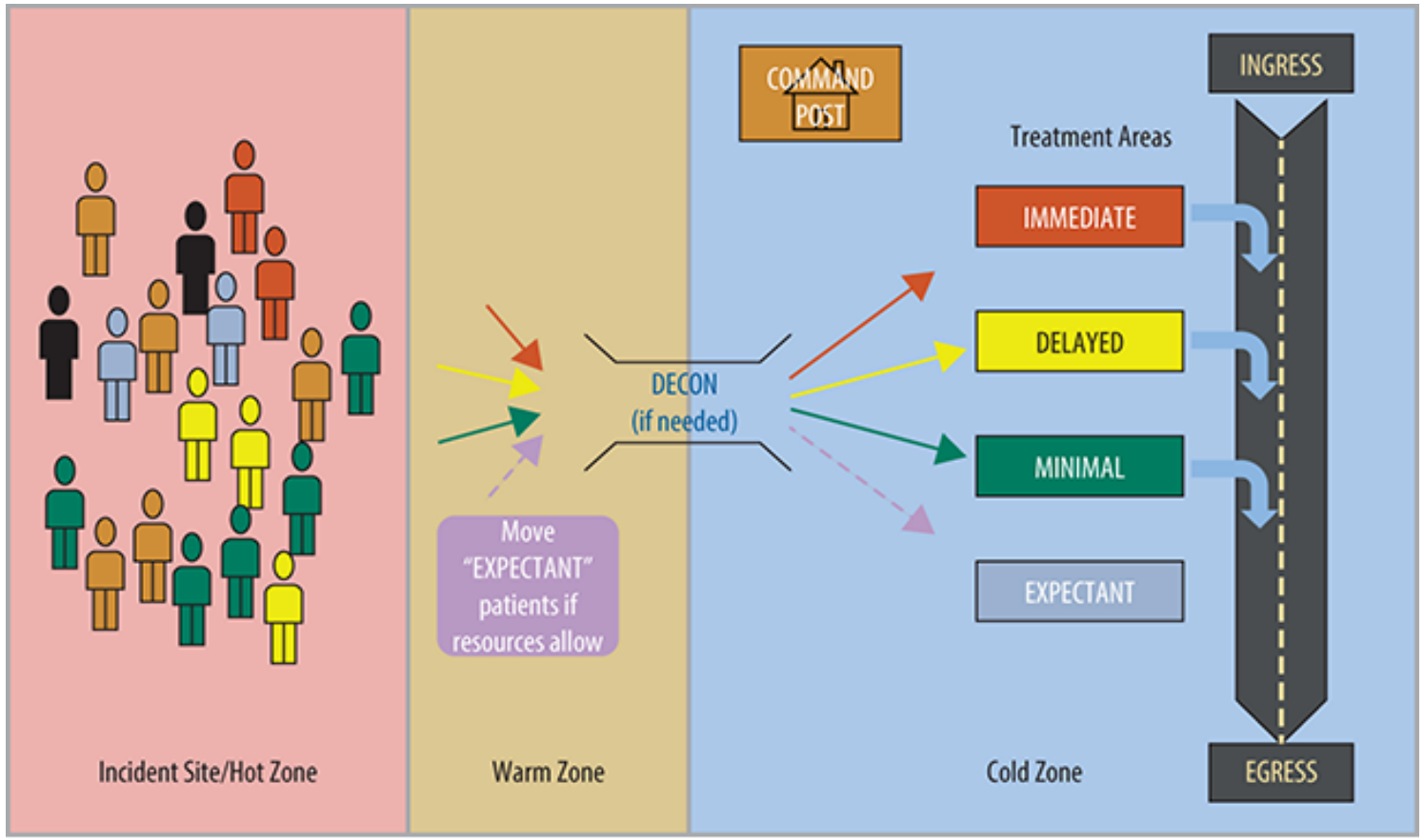
The categories are:

- **Black**: Are so severely injured they're unlikely to survive no matter the treatment
- **Red**: Have life-threatening injuries that need immediate treatment if they're going to survive
- **Yellow**: Have injuries but can likely wait for treatment until the red group is treated and transported
- **Green**: Have fairly minor injuries—sometimes called the walking wounded

Then proceed with standard ATLS protocols for each victims

TRIAGE

- Speed is important
- A fast way to separate victims is to ask all who can walk to move to one area by themselves
- This way EMS perform quick ABCDEs to the remaining victims
- A doctor experienced with triage should be in charge
- Triage is dynamic and may be repeated more than once if circumstances change



Source: Derek R. Cooney: *Cooney's EMS Medicine*: www.accessemergencymedicine.com

THANK YOU
FOR YOUR ATTENTION