Airway

1. **Assess for signs of airway obstruction.**

a) *Look*:

- for the use of accessory muscles which suggests respiratory distress.[2]
- at the chest and abdomen. Complete obstruction causes "paradoxical" chest and abdominal movement with no detectable movement of air in the mouth ("see-saw" respiration).[1]
- for signs of central cyanosis (blue lips and tongue).

b) *Listen*:

- to verbal speech. Patient will not be able to speak when the airway is completely obstructed.[3] Patient who has no verbal response due to altered level of consciousness will not be able to protect their airway.
- for noisy breathing -
  - Gurgling sounds is caused by secretions in the upper airway.
  - Snoring sound occurs when the pharynx is partially obstructed by the tongue or palate. This is commonly seen in patients with decreased conscious level.

  - Inspiratory 'stridor' is high pitched rasping sound caused by severe upper airway obstruction due to laryngospasm or laryngeal oedema. This is commonly seen in patient with anaphylaxis.

  - Expiratory "wheezes" is high-pitched musical sounds associated with lower airways obstruction. This is most commonly seen in patients with asthma or chronic obstructive pulmonary disease.

c) *Feel* for airflow at the nose and at the mouth. Absence of airflow indicates complete airway obstruction.

Airway

2. **Perform head tilt chin lift** (Figure 1) **or jaw thrust** (Figure 2) to relieve airway obstruction caused by the tongue or soft tissue.

Figure 1. Head tilt chin lift: The head is tilted back by placing one hand on the forehead and chin lifted with anterior displacement of the mandible. This will relieve the obstruction caused by the tongue or soft tissue.

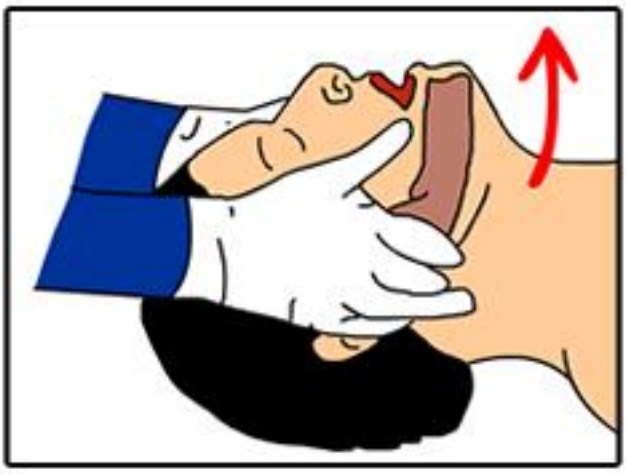

Figure 2. Jaw thrust: If suspected neck or cervical spine injury, use jaw thrust manoeuvre to displace the jaw forward by applying anterior pressure on the angle of the mandible.

3. **Place patient on the side** to maintain a patent airway and reduce the risk of airway obstruction and aspiration.

Airway

4. **Insert artificial airway** such as oropharygngeal airway (Figure 3 & 4) to maintain artificial passage for airflow by separating the posterior pharyngeal wall from the tongue. This is to prevent the tongue from falling backwards and cause airway obstruction. Oropharyngeal airway should only be inserted for unconscious patients as it can induce vomiting and risk of aspiration in patient with intact gag reflex.[4] Nasopharyngeal airway (Figure 5) can be used in semiconscious or conscious patients.[5]

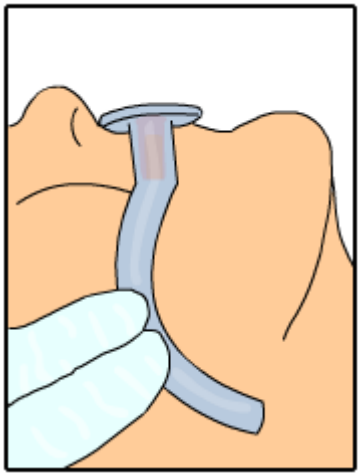

Figure 3. Oropharygngeal airway measurement: Align the airway from the corner of the mouth to the tragus of the ear or from the middle of the incisor to the angle of the jaw.

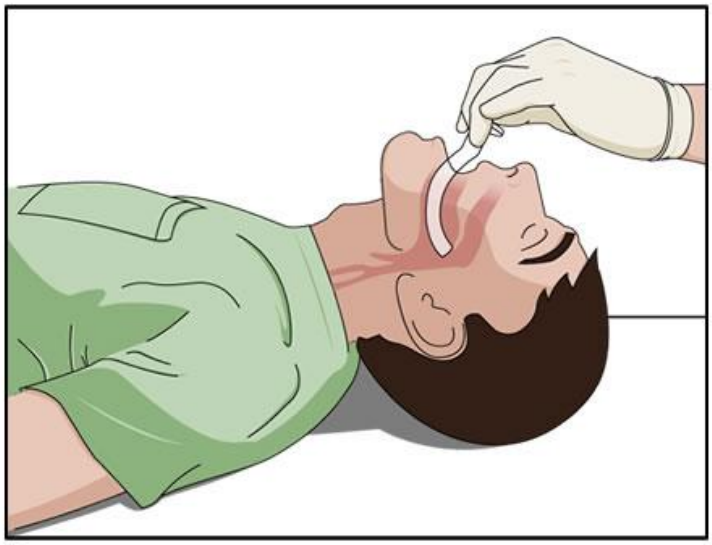

Figure 4. Oropharygngeal airway insertion: Insert the airway upside down.

Airway

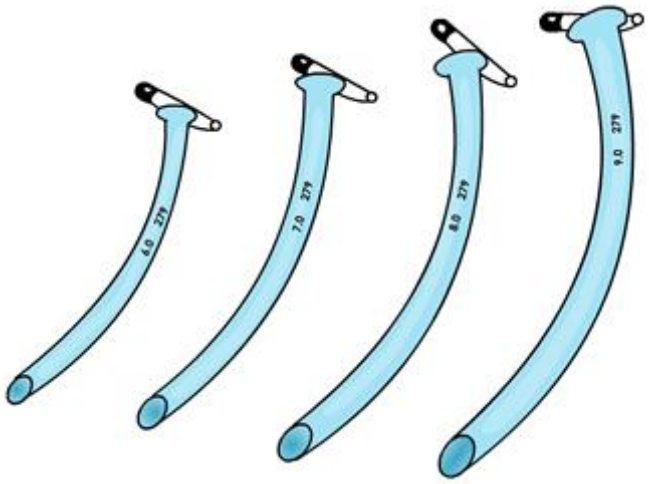

Figure 5. Nasopharygngeal airway

5. **Perform suctioning** to remove fluid, vomitus or secretion that caused airway obstruction.[2] Suction should be limited to 10 seconds for each pass to prevent hypoxia.[6]

Airway

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Breathing

1. **Count respiratory rate.** The respiratory rate is the most sensitive indicator of the development of critical illness.[1] The number of respiration should be counted in one full minute and is between 12 to 20 breaths per minute. A high respiratory rate or increasing respiratory rate trend is a warning sign of patient deterioration.[2]

2. **Assess respiratory pattern.**

- *Regularity*: Periods of apnoea alternative with periods of hyperpnoea, known as Cheyne-Stokes breathing pattern, can indicate damage to respiratory centre or chronic heart failure.
- *Depth*: Besides increasing respiration rate, the body also increase the depth of respiration (tidal volume) to correct hypoxaemia and hypercapnea.[1] Deep and rapid breathing can suggest Kussmaul breathing which occurs in metabolic acidosis or ketoacidosis.[3]

3. **Assess chest movement** for any asymmetrical or uncoordinated chest movement which may indicate unilateral pathology, for example, pneumothorax, flail chest or pleural effusion.

4. **Check for cyanosis**, a late sign of hypoxemia. It is only detectable when the oxygen saturation drop < 85%.[4]

- *Central cyanosis* (Figure 1): Often due to a circulatory (heart) or ventilatory (lung) problem that leads to poor blood oxygenation in the lungs. Causes include airway obstruction, respiratory compromised and heart failure.

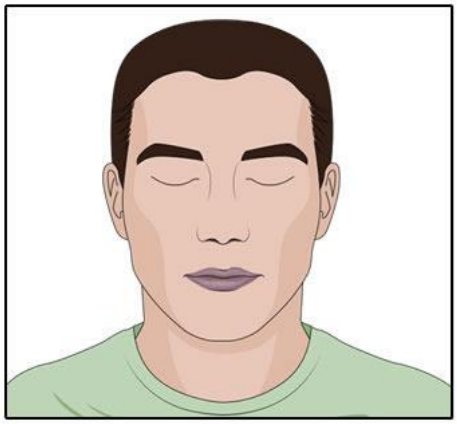

Figure 1. Central cyanosis: Bluish or purple discoloration of mucous membrane of the tongue, lips and linings of the mouth.

- *Peripheral cyanosis* (Figure 2): Occurs as a result of inadequate circulation to the peripheral limbs such as toes and fingers. Causes include vasoconstriction due to cold environment and hypovolemic shock; and arterial or arterial venous obstruction from peripheral vascular diseases.

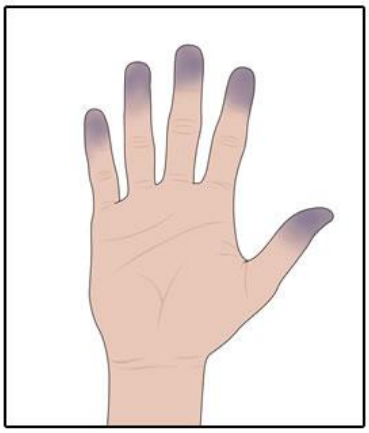

Figure 2. Peripheral cyanosis: cold and blue fingers.

Breathing

5. Measure oxygen saturation level (SpO_2)

- *Pulse oximetry*: The normal SpO_2 reading is considered to be between 95% to 100%.[2] It is important to note that SpO_2 may be normal during the early phase of deterioration due to a rise in respiratory rate to compensate for the inadequacy of oxygen delivery. Therefore respiratory rate is a better indicator of a deteriorating patient than SpO_2. The pulse oximetry does not give a reading or provide unreliable reading if the patient has poor peripheral perfusion.[1] Although it measures how well haemoglobin is saturated with oxygen (arterial oxygenation), it does not measure carbon dioxide level or how adequate the oxygen is delivered to the tissues.[5]
- *Arterial blood gas (ABG)*: Besides SpO_2, ABG provide more information on the adequacy of oxygenation and ventilation (See Table 1).

Arterial Blood Gas	Reference Range
pH	7.35 – 7.45
Arterial O_2 (PaO_2)	75 – 100 mmHg
Arterial PCO_2 ($PaCO_2$)	35 – 45 mmHg
HCO_3^-	22 – 26 mEq/L
Base Excess (BE)	−2 to +2 mmol/L
Oxygen saturation	95 – 100%

Table 1. Arterial blood gas result.

6. Auscultate chest for breath sound.

- Inspiratory "stridor" is high pitched rasping sound caused by severe upper airway obstruction due to laryngospasm or laryngeal oedema.

- Expiratory "wheezes" is high-pitched musical sound associated with lower airway obstruction. This is most commonly seen in patients with asthma or chronic obstructive pulmonary disease.

Breathing

- Rhonchi is a low-pitched loud sound heard during inspiratory and expiratory phases. It suggests there is excessive secretion in the upper airway.

- Crackles (crepitation) is non-musical sound, caused by fluid in the alveoli. It is associated with the reopening of a collapsed airway. This is most commonly seen in patients with respiratory conditions such as pneumonia and pulmonary oedema.

- Pleural friction rub is leathery/creaking sound heard during inspiration and expiration. It is evident when normally smooth pleural surfaces are roughened and rub on each other.

- Unilateral absent or reduced breath sound suggests unilateral pathology, for example, pneumothorax or pleural effusion.

7. **Place patient in head-up position** to maximize and expand chest movement.

8. **Initiate and titrate oxygen** for all deteriorating patients before progressing to any further assessment. The aim is to achieve a SpO_2 of more than 94% in patients who are not at risk for hypercapnic respiratory failure.[6] For patients who have Chronic Obstructive Pulmonary Disease (COPD), high concentration of oxygen can suppress the hypoxic drive. However, this should not take priority as these patients will also suffer from end organ failure if oxygen is

withheld. With this group, oxygen is titrated by keeping the SpO_2 within 90-92% or at patient's baseline level.[6] It is important to use the appropriate oxygen devices which are classified into:

- *Fixed performance devices* - These include Venturi masks (Figure 3). The device provides fixed flow rate of oxygen concentration and is unaffected by the patient's respiratory pattern (see Table 2). These are most suitable for patients at risk of hypercapnia, for example patients with COPD.

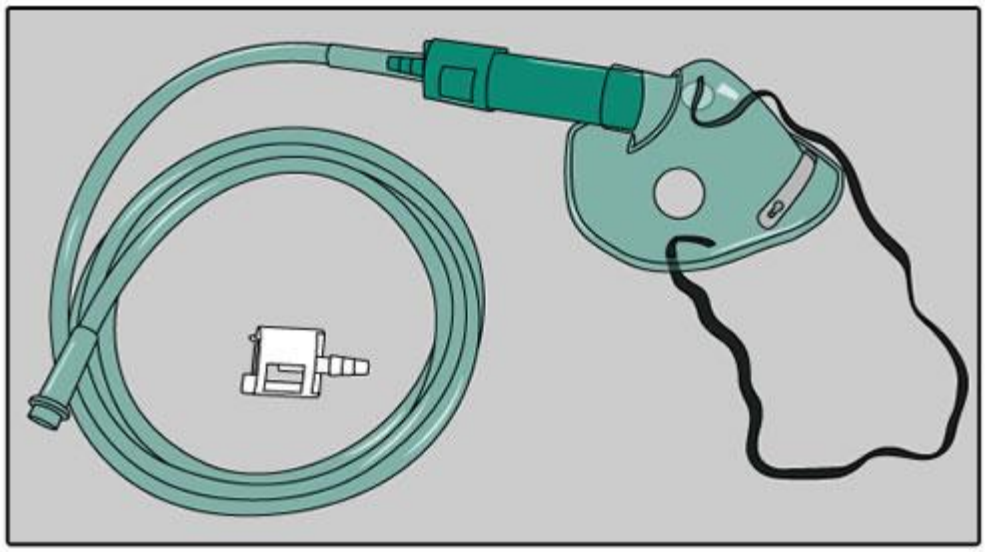

Figure 3. Venturi masks.

Diluter colour	Diluter Setting Inspired Oxygen	Flow Rate
Green - low concentration	24% 26% 28% 30%	3 L/min 3 L/min 6 L/min 6 L/min
White - medium concentration	35% 40% 50%	9 L/min 12 L/min 15 L/min

Table 2. Inspired oxygen and oxygen flow rate with Venturi masks.

- *Variable performance devices:* These include nasal prong (Figure 4), simple Hudson face mask (Figure 5) and non-rebreathing mask (Figure 6). The device will not provide all the gas required to meet the patient's respiratory demand. The inspired oxygen concentration depends on the patient's respiratory pattern and oxygen flow rate. These devices are not recommended to be used for the acutely and critically ill patients except for non-rebreathing mask.

Breathing

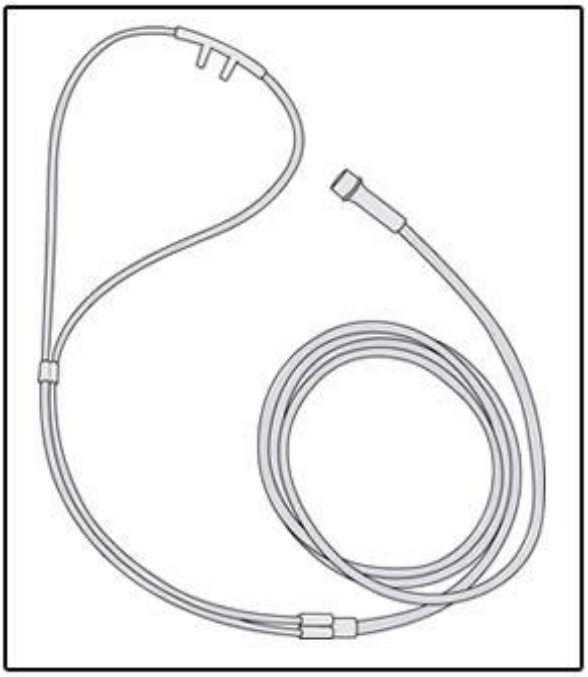

Figure 4. Nasal prong: Oxygen flow rate of 2 - 4L/min.

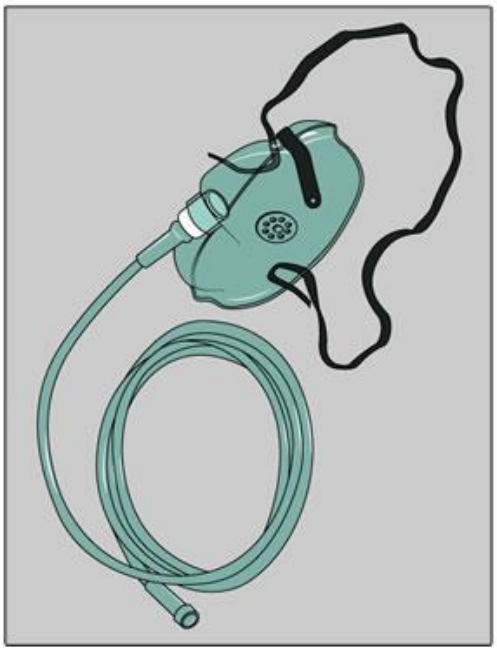

Figure 5. Simple Hudson face mask: Oxygen flow rate of at least 5L/min. Flow rate less than 5L/min should not be used due to carbon dioxide retention in the mask.[7]

Breathing

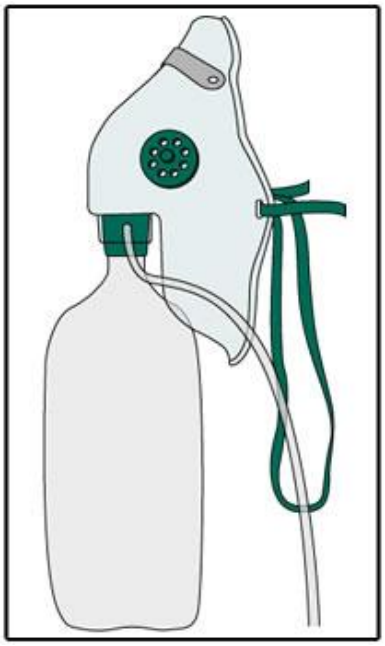

Figure 6. Non-rebreathing mask: Oxygen flow rate of 15 L/min (inspired oxygen concentration almost 100%).[7] It is highly recommended for acutely and critically ill patients who require high concentration of oxygen.[7]

Breathing

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Circulation

1. Count pulse rates.

- The pulse rate of > 100 beats per minute is known as tachycardia (Figure 1). Persistent sinus tachycardia is often one of first indicators of patient's deterioration. It is often a compensatory mechanism to maintain adequate cardiac output and hence oxygen delivery to the tissues.[2]

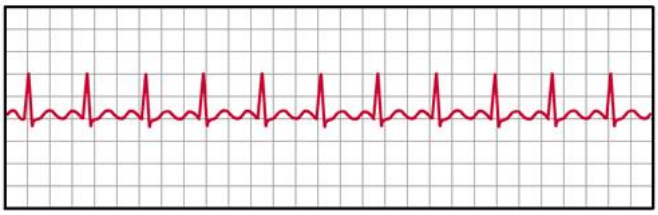

Figure 1. Sinus Tachycardia

- The rate of < 60 beats per minute is known as bradycardia (Figure 2). It may indicate life threatening heart block or preceding asystole.[3]

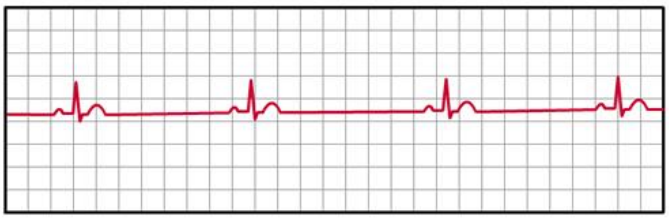

Figure 2. Sinus Bradycardia

2. Palpate pulses.

- *Regularity*: An irregular pulse may suggest atrial fibrillation (Figure 3).

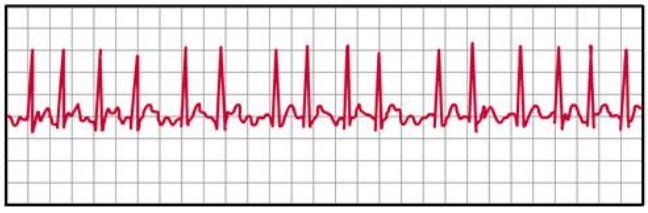

Figure 3. Atrial Fibrillation

- *Strength (volume)*: A weak and thready pulse suggests poor cardiac output. A bounding pulse may indicate early vasodilation phase in septic shock due to high cardiac output stage.[4]

Circulation

3. **Measure blood pressure to detect hypotension.** Hypotension is defined as either a drop of more than 20% from baseline blood pressure or systolic pressure of less than 90 mmHg. It is a late sign of shock indicating that the compensatory mechanisms such as peripheral vasoconstriction and increase in heart rates, has not been able to provide adequate oxygen delivery to the tissue. A low diastolic BP suggests arterial vasodilation caused by anaphylaxis or sepsis. A narrowed pulse pressure (difference between systolic and diastolic readings) indicates arterial vasoconstriction as a result of cardiogenic or hypovolemic shock.[4]

4. **Check for peripheral skin (colour, temperature and moisture).**

- Pale cold and clammy skin indicates poor peripheral perfusion due to peripheral vasoconstriction.
- Flushed and warm skin indicates peripheral vasodilation. It occurs at early phase of distributive shock e.g. sepsis.[4]

5. **Measure capillary refill time (CRT)** to check for peripheral circulation. Normal CRT is < 2 seconds. A prolong CRT indicates poor peripheral perfusion.

6. **Measure body temperatures to check for hypothermia or hyperthermia.** A sudden rise in temperature (> 38˚C) usually indicates sepsis which is a body response to an infection. Sepsis occurs in 3 stages:

- *Early Sepsis* - Starts with systemic inflammatory response syndrome (SIRS) which is part of the body's response to an infection. SIRS is the presence of two or more of the following conditions.[5]
    - Temperature > 38°C or <36°C.
    - Heart rate of > 90 beats per minute.
    - Respiratory rate > 20 breaths per minute or $PaCO_2$ < 32 mm Hg (normal range is 35 to 45 mm Hg).
    - White blood cell count > 12,000 cells/mm^3, < 4,000 cells/mm^3, or the presence of > 10% immature forms.
- *Severe Sepsis* - Presence of sepsis with organ dysfunction, hypotension or poor perfusion. Signs include hypotension (SBP < 90 mmHg), altered mental state,

hyperglycaemia (in the absence of diabetes), hypoxaemia, acute oliguria, coagulopathy and raised serum lactate (lactic acidosis).[6]

- *Septic Shock* - Severe sepsis with hypotension that does not respond to intravenous fluid resuscitation.[7]

7. **Check urine output to detect oliguria.** Urine output should be more than 0.5 ml/kg/hr. Poor urine output of 100 ml to 400 ml in 24 hours is known as oliguria. It is often associated with hypovolemia causing decrease renal perfusion. Acute renal failure can occur if oliguria is not treated promptly, usually with fluid challenge.

8. **Lower head of bed position** to a supine position to promote venous return and thus, improve blood pressure. Raising patient's legs may also increase blood pressure.[8] However, this position is inappropriate for patients with signs of fluid overload.

9. **Establish intravenous access** with a large bore IV cannula (14G to 16G) for rapid infusion of drugs and IV fluids[6]. While inserting IV cannula, blood can be drawn for urgent laboratory analysis e.g. full blood count (FBC), urea and electrolytes, coagulation panel and group and cross match (See Figure 4 for different blood tubes).[9]

Figure 4a

Figure 4b

Figure 4c

Figure 4d

Figure 4. Blood tubes: (a) full blood count (FBC), (b) urea and electrolytes, (c) coagulation panel, (d) group and cross match.

Circulation

10. **Prepare IV fluid for fluid challenge.** A slow drip could be administered while waiting for the doctor's prescription. Hypotension is often caused by hypovolemia which respond well to fluid challenge.[10] A bolus of 500 ml of a crystalloid solution (0.9% Normal Saline) over 15 minutes is often prescribed for normotensive patient. The fluid bolus may be repeated until the target blood pressure (usually > 100 mmHg systolic) is reached. If the patient has cardiogenic shock, smaller volumes of crystalloid solution (e.g. 250 ml) should be administered. However, as fluid challenge could lead to fluid overload, it should NOT be given without doctor's prescription. These patients should be closely monitored for signs of fluid overload (e.g. dyspnoea, increase heart rate and pulmonary crepitation on auscultation). Other fluids such as Compound Sodium Lactate (Hartmann's), gelofusine or albumin may be ordered (See Figure 5):

- Hartmann's (lactated Ringer's) solution (Figure 5a): crystalloids containing electrolytes with additional lactate as buffer. It is used intravenously as a systemic alkalizer and as a fluid and electrolyte replenisher.[11]
- Gelofusine solution(Figure 5b): isotonic colloid solution used as plasma volume expander by drawing in additional fluid from the interstitial space.[2]
- Albumin 5% solution (Figure 5c): colloid solution used as plasma volume expander and for patient with low albumin.

Figure 5a

Figure 5b

Figure 5c

Figure 5. IV fluids : (a) Hartmann's (lactated Ringer's) solution, (b) Gelofusine solution, (c) Albumin 5% solution.

Circulation

11. **Attach a cardiac monitor** to continuously monitor the heart rates and the presence of cardiac arrhythmias.[12] Life threatening arrhythmias include (Figure 6) ventricular tachycardia and ventricular fibrillation (Figure 7).

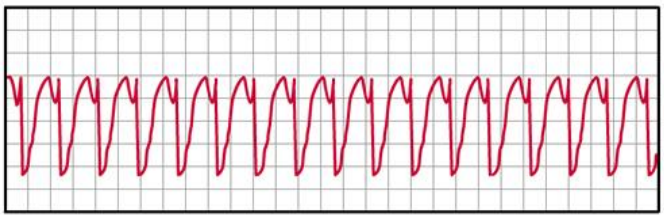

Figure 6. Ventricular Tachycardia

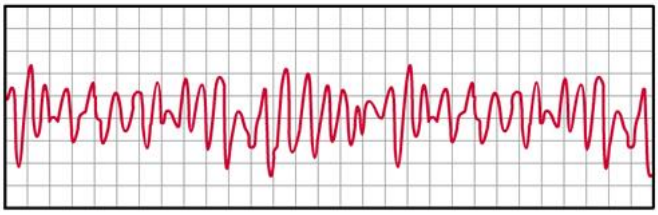

Figure 7. Ventricular Fibrillation

12. **Perform 12-lead electrocardiogram** if chest pain is present. This is to detect the present of acute coronary syndrome (ACS).

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Disability

1. **Assess level of consciousness** using the:

- AVPU scale (Table 1) for initial quick assessment.[1]

A	**A**lert
V	Responds to **V**oice
P	Responds to **P**ain
U	**U**nconscious

Table 1. AVPU Scale

- Glasgow Coma Scale (Table 2) for assessing patient with cerebral injuries.[2]

Glasgow Coma Scale		
Features	**Response**	**Score**
Best Eye opening		
Spontaneously	Open eyes without any external stimulation	4
To Speech	Open eyes to sound of voice	3
To Pain	Open eyes to painful stimulus	2
None	No eye opening to verbal or painful stimuli	1
Best Verbal Response		
Orientated	Able to answer accurately details of time, person, and place	5
Confused	Can speak in sentences but answer one or more of the above questions incorrectly	4
Inappropriate words	Words or phrases that make little or no sense	3
Incomprehensive sounds	Responds to speech or painful stimulation with no understandable words	2
None	No verbal response	1
Best Motor Response		
Obeys commands	Follows and acts out commands	6
Localizes pain	Purposeful movement to remove the painful source	5
Flexion to pain	Flexes arm at elbow in normal reflex action withdrawal from painful stimuli	4
Abnormal flexion	Spastic abnormal flexion of limbs; decortication posturing	3
Extension to pain	Plastic abnormal extension of elbow with internal rotation of wrist; decerebrate posturing	2
None	No movement	1

Table 2. Glasgow Coma Scale

Disability

2. **Examine pupils'** size, equality, and reaction to light. Any changes can be due to:

- Sympathetic overactivity (e.g. fear stress and anxiety) which can cause the pupils to be dilated (Figure 1).
- Administration of sympathetic medications. Adrenaline, atropines eye drops, and tricyclic antidepressants can cause pupillary dilation (Figure 1). Opioids can cause pin point pupils (Figure 2).
- Compression of the third cranial nerve which can occur due to raised intracranial pressure (ICP). This can result in unequal pupils (Figure 3).[3]

Figure 1. Bilateral pupillary dilation

Figure 2. Bilateral pin point pupils

Figure 3. Unequal pupils

Disability

3. **Monitor blood glucose level (BGL).** Exclude hypoglycaemia (BGL < 4.0 mmol/L) in any patient with confusion or decreased level of consciousness. Prompt treatment is required to correct hypoglycaemia to prevent brain damage. The treatments include:

- Follow the 15/15 rule - serve 15 gram of carbohydrates (3 teaspoons of sugar or 150ml of juice).[4] Check BGL in 15 minutes.
- Administer 30-50ml of 50% dextrose (Figure 4) intravenously, this requires a medical order.[5] Check BGL in 15 minutes.

Figure 4. Dextrose 50%

Disability

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Expose & Examine

1. **Expose body for physical examination.** The examination should be thorough using inspection, palpation, percussion and auscultation (IPPA). It should focus on the specific body system that is most likely to be contributing to the patient's deteriorating condition, e.g. examine the skin for urticaria if anaphylaxis is suspected. Patient's dignity and body warmness should be maintained throughout the examination.

2. **Examine invasive catheters / tubes / lines / drainages** for any signs of infection, bleeding, leakages or blockage to find out the possible source of patient's deterioration.

3. **Examine pain** using appropriate pain assessment tool (e.g. PQRST) (Table 1) which should provide the following information:

PQRST Pain Assessment Tool	
P = Provokes	"What causes pain?"
Q = Quality	"How does it feel like? Sharp, dull, stabbing, crushing ..."
R = Radiates	"Does it go anywhere else?"
S = Severe	"How severe is the pain on a scale of 1 – 10?"
T = Time	"How long did it last?"

Table 1. PQRST Pain Assessment Tool

4. **Examine patient's notes / charts.** These include:
   - medical records to obtain full clinical history;
   - clinical charts to determine the baseline and trend of recorded vital signs;
   - fluid balance chart to identify negative and positive fluid balance.

Expose & Examine

5. **Examine prescribed medications** to:

- administer any prescribed medication that can alleviate and treat patient's conditions e.g. Salbutamol (bronchodilator) and Glyceryl Trinitrate (vasodilator);
- check for possible medication served that can cause side effects e.g. opioids cause depressed respiration and level of consciousness.[3]

6. **Examine investigation results.**[2] These include full blood count (FBC) (Table 2), urea and electrolytes, glucose (Table 3), coagulation screen (Table 4) to detect the cause of deterioration and this is also to guide responses to treatment.

Full Blood Count	**Reference Range**
Haemoglobin (Hb)	12.9 – 17.0 g/dL
White blood count (WBC)	3.40 – 9.60 x 10^9/L
Platelet count (PLTCS)	132 – 372 x 10^9/L
Haematocrit / Packed Cell Volume (HCT)	37.5 – 49.3 %

Table 2

Urea, Electrolytes & Creatinine	**Reference Range**
Sodium	135 – 145 mmol/L
Potassium	3.5 – 5.0 mmol/L
Chloride	95 – 110 mmol/L
Urea	2.5 – 7.5 mmol/L
Creatinine	65 – 125 Umol/L
Glucose	4.5 – 5.6 mmol/L

Table 3

Expose & Examine

Coagulation Test	Reference Range
APTT (Activated Partial Thromboplastin Time)	27 – 35.6 seconds
PT (Prothrombin Time Test)	12 – 14.5 seconds
INR	1.0

Table 4

Expose & Examine

REFERENCES

1. Steen, C. (2010). Prevention of deterioration in acutely ill patients in hospital. *Nursing Standard, 24* (49), 49-57.
2. Frost, P., & Wise, M. P. (2007). Recognition and early management of the critically ill ward patient. *British Journal of Hospital Medicine, 68* (10), M180-M183.