GUIDE to CARING FOR ACUTELY ILL PATIENTS
for
NON-CRITICAL CARE STAFF
in an
EMERGENCY SITUATION

WEST YORKSHIRE CRITICAL CARE NETWORK
Education Group

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INTRODUCTION

Looking after critically ill patients means you need to respond quickly to the changing clinical environment. In order to do this efficiently you need to have the right information at the right time. The purpose of this book is to provide you with some of the information you may need in order to help you care for your patient. It follows a systematic process of patient assessment.

A = Airway
B = Breathing
C = Circulation
D = Disability
E = Exposure

GENERAL PATIENT ASSESSMENT

For the majority of patients an admission to hospital can be very stressful and this is compounded if they are admitted to a critical care area. It is important to be clear about why they have been admitted to hospital for this may impact on their current and future treatment.

Areas to Consider

Why Has Patient Been Admitted?

- Acutely or Electively
- Medical or Surgical admission
- Step down from ICU or step up from acute ward situation

Circumstances Changed?

- Initial medical problem $\rightarrow$ needs surgical intervention e.g. GI Bleed
- Initial surgical problem $\rightarrow$ needs medical intervention e.g. control of arrthymias

Past Medical History (PMH)

The impact of PMH on a patient's current condition can be very important. They may have a chronic condition that has resulted in an acute exacerbation, or they may be presenting with a totally unrelated complaint. You must consider a patient's PMH in light of whether it has had an effect on their current admission and what impact it may have.

You need to consider:

- Underlying Chronic Conditions e.g. A cardiac or respiratory history, diabetes & cancer
- Previous Surgery: Was it major or minor? How long ago? Totally recovered or ongoing
- Medications: What are they on, do they need to be continued, do you know what they are?
- Are they available in a suitable format that can be administered in the patient's current condition?

Social History

This is relevant for all patients not just the elderly

- Housing circumstances
- Next of Kin / support network / contact details / patient's religion
- Support services – Community nurses, social services
- Mobility – restrictions, include O_2 usage and use of aids
- Smoking – how much, what and for how long
- Alcohol – number of units a week, how long
- Recreational drug usage – type, short v long term use
- Patient wishes about treatment options (e.g. advanced directive)

Safety Equipment

- Gas supply of oxygen & air, suction, electricity, air conditioning, water, manual ventilation, generator, uninterrupted power supply, plug banks. Consider personal protection i.e. gloves, apron, goggles, mask.

Planning

- Crash call, fire, emergency numbers and know local procedures
- 24 hour worth of supplies – patient specific
- Fluids & medications

RESPIRATORY ASSESSMENT

AIRWAY

- Look, listen & feel
- Suction, chin lift, jaw thrust, oropharyngeal & nasopharyngeal airways to consider

BREATHING

Respiratory assessment is one of the most important assessments you can undertake.

It must be stressed that observations should be looked at in relation to each other & must not be considered in isolation; trends give a far better indication of a patient's clinical condition.

Visual Observations

Look at the patient and note:

- Communication - can they hold a conversation or just speak words
- Look at chest movements respiratory rate, depth and pattern
- Look at air entry – is it bilateral
- Are they using accessory muscles, nasal flaring, hunched shoulders
- Colour i.e. pink, cyanosis, mottled, grey
- Sounds – wheezing, strider, rattling, no noise
- Appearance i.e. sweaty, clammy, oedematous, dehydrated,
- Conscious level i.e. are they alert or drowsy, tired, orientated, agitated or confused, AVPU, Glasgow Coma Scale. A deterioration may indicate raised CO_2 - see page 12.
- Position – are they sitting/lying comfortably, is their position suitable for their respiratory status, are they in pain?
- Sputum – if being produced, the volume, colour, consistency, purulence, cough reflex

Auscultation

Breath sounds are created by air turbulence. Sounds may be normal, abnormal, diminished or absent. Chest sounds can be deceptive, it is therefore important to use them in consideration with other clinical observations. Listening for air entry is used to assess:

- Bilateral air entry and whether air is reaching all parts of the lungs
- Secretions
- Effect of suctioning (before and after)
- Bronchial patency/bronchospasm

Stethoscopes should be used for auscultation. The diaphragm of the stethoscope best transmits high pitched sounds (e.g. wheezes) the bell is better for hearing low softer sounds (e.g. the heart).

Technique

- Artefact can interfere with successful auscultation. Ensure the sounds you are listening to are coming from the patient's chest!
- Ensure you have a clear area with direct skin contact, note that hair on chest can imitate crackles
- Water pooling in oxygen tubing will transmit sounds to the chest
  Need to listen:
- On both the right and left, front, back and laterally
- At apices and bases & during inspiration and expiration
- Over any dependant lung areas, where fluid and mucus tend to collect

Suction

- When patients require ventilation via endotracheal tube and sedation they are not always able to cough and clear secretions properly.
- Endotracheal suction is required to remove excess secretions from the respiratory tract and despite this being a relatively simple procedure it can give rise to harmful side effects if not performed correctly and safely.
- Where possible a closed circuit suction catheter should be used to reduce the risk of infection to patient, staff and relatives.
- Once you have carried out your assessment of the patient requiring suction, prior to suctioning you must ensure you have all the equipment ready to use.
- Ensure you inform the patient of the procedure and reassure if necessary.

NB: Suction – See Appendix 1

Abnormal Breath Sounds

Breath Sounds	Sounds Like & Due To
Wheeze	**Low or high pitched sounds. Due to air passing through narrow airways. Obstruction due to secretions, bronchospasm or chronic airway disease**
Crackles	**High pitched noises, occur when disease processes affect the alveoli or terminal airways (i.e. pneumonia & pulmonary oedema). Coarse crackles - bubble like sounds due to excess fluid & exudate**

Pulse Oximetry (SpO_2)

Pulse oximetry is a non-invasive method of monitoring arterial Hb saturation. Although it forms part of the respiratory assessment you must familiarise yourself with problems associated with it.

Pulse oximetry should be used in addition to a thorough respiratory assessment and not taken in isolation

Pulse oximetry measures the peripheral saturation of haemoglobin by oxygen. Peripheral saturation is usually within 2% of arterial blood gas measurement saturation. A normal range of SpO_2 for a patient breathing room air, who doesn't have an underlying respiratory problem such as COPD is between 95 - 99%. Oxygen delivery to the tissues is reduced by Anaemia, Carbon Monoxide Levels CO_2 levels and is not accounted for in the saturation measurements. COPD patients 88-92 SATs as per BTS (British Thoracic Society) Guideline for emergency oxygen use in adult patients (1988).

POINTS TO CONSIDER

- Where is the probe, has the site been changed regularly?
- Has the reading increased or decreased?
- If it is a genuine low reading, act upon it

SaO_2 TROUBLESHOOTING GUIDE

Reason	Why
Peripheral Vasoconstriction – Cold extremities	Oximetry relies on perfusion & pulse, so poor perfusion can cause 'noisy' signals
Dysrhythmias – Irregular Heartbeat	Impairs perfusion causing 'noisy' signals
Shivering	Poor readings due to peripheral vasoconstriction
Dark skin, blood, nail varnish	All absorb light which can cause under readings
Jaundice	Affects light absorption
Intravenous Dyes	Affect light absorption
External light (Adapted from Woodrow 2000)	Can over estimate light, especially fluorescent. Hence most probes have light shields

Arterial Blood Gases (ABG's)

ABG's provide essential information about patients, and they form part of the overall patient assessment, and not just considered in isolation.

Arterial Blood Gas Values

MEASURE	NORMAL	NEED ADVICE
pH	7.35 – 7.45	<7.3 or >7.5
PO_2	11.0 – 13.0kPa	<9
PCO_2	4.5 – 6.0kPa	<4 or >7
HCO_3	22- 30mmol/l	<20
Base Excess	-2 – +2mmol/l	<-3
SO_2	96 – 100%	<93%

Normal Venous Blood Gas Values

pH	7.34 – 7.42
PO_2	5.0 – 5.6 kPa
PCO_2	5.6 – 6.7 kPa

ABG Troubleshooting Guide

Look at your gases

pH < 7.35	**ACIDOSIS**
PCO_2 > 6 kPa	Respiratory Acidosis
PCO_2 normal or < 4.5 kPa	Metabolic Acidosis

PH > 7.45	**ALKALOSIS**
PCO_2 < 4.5	Respiratory Alkalosis
PCO_2 normal or > 6 kPa	Metabolic Alkalosis

VENTILATION

- Rate = How fast patient or machine is breathing
- Tidal volume = mls of air going into the patient. Approx 8-10mls/kg = 500 – 700mls
- Minute volume = how much air is going into the patient each minute. Measured in litres =

$$\frac{\text{Rate x Tidal Volume}}{1000} \quad \text{e.g. } \frac{10 \times 500 = 5000\text{mls}}{1000} = 5.0\text{litres/min}$$

Inspiratory minute volume
Expiratory minute volume
} should be about the same to within 50mls

Inspiratory pressure = peak pressure on inspiration

If on pressure control setting observe RATE & VOLUME
On volume control setting observe RATE & PRESSURE

MODES OF VENTILATIONS						
	BiPAP biphasic positive airway pressure ← depending on settings can be anything from CPAP only up to and including pressure control +/- PEEP →					
SPONTANEOUS BREATHING	**CPAP** **Continuous Positive Airway Pressure same as = PEEP** **Helps decrease work of breathing & increase gaseous exchange**	**Pressure Support / Assisted Breathing** **Rate determined by patient, gas helped in to achieve adequate tidal volume.** **No back-up breaths**	**SIMV + Pressure Support / Assisted Breathing (SIMV + PS or SIMVASB)** **Back-up breaths = SIMV** **Gas pushed in to preset level to help patient achieve adequate volume = PS or ASB** **Volume support (VS)** **Set volume and if achieved by patient = pressure support**	**SIMV Synchronished intermittent mandatory ventilation** **Either pressure control or volume control** **BUT** **patient is able to take own breaths**	**Mechanical ventilation** **1) Pressure Control (rate + pressure set watch volumes = PC)** **2) Volume control (rate + volume set watch pressures) = VC** **CMV = controlled mandatory ventilation** **IPPV = intermittent positive pressure ventilation** **Pressure regulated volume control (PRVC) - Benefits of both PC & VC**	**FULL MECHANICAL VENTILATION**
Trigger = how sensitive the machine is to know when the patient is trying to take a breath		**+/- PEEP**	**+/- PEEP**	**+/- PEEP**	**+/- PEEP**	

CIRCULATION

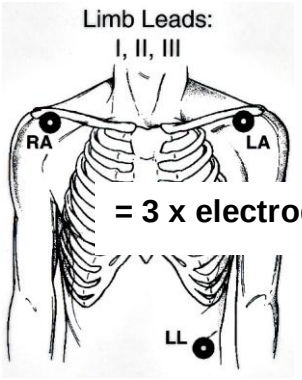
CARDIOVASCULAR ASSESSMENT

- Look, Listen & Feel, Pulse, Colour & Rhythm
- Monitor all patients and be familiar with layout & alarms of the monitor
- Hypotension should be regarded as a medical emergency requiring rapid treatment & a search for the cause.
- Before the BP falls many patients exhibit early warning signs that the cardiovascular system is under stress e.g. rising or high pulse rate.
- Hypotension is often a **late** sign of a compromised circulation.
- Hypotension results in poor perfusion of the major organ systems.

ECG

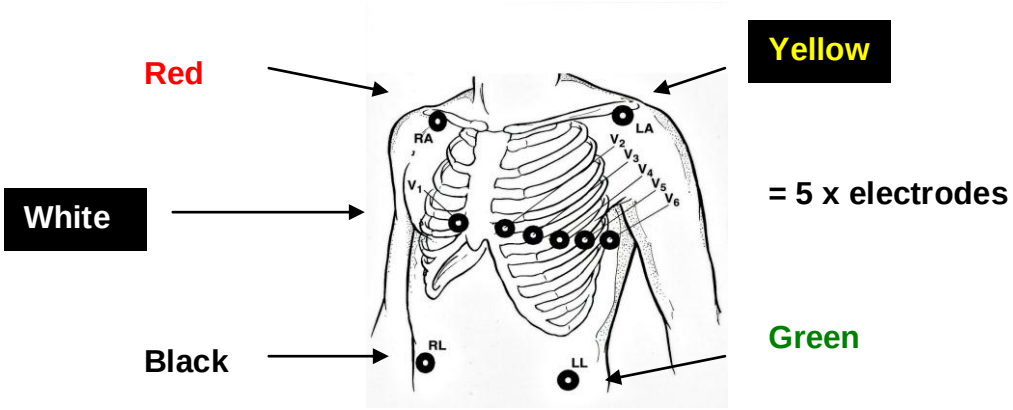
Lead Placement – Continuous Monitoring*

(Usually Lead II on ICU)



Lead Colours

(Aide Memoire: Ride, Your, Green, Bike with White in the middle)

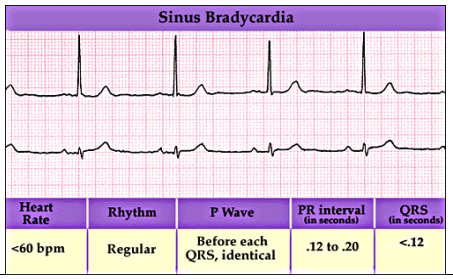


Continuously monitoring the ECG allows you to view the electrical activity of the heart and any associated dysrhythmias.

- Need to recognise what is the patients 'normal' rhythm and any treatment they have for this
- Ensure that the monitor alarms are set appropriately to pick up any changes associated with bradycardia, tachycardia, ectopic and asystole
- Ectopic beats (that is an impulse generated outside the sinoatrial node) and other dysrhythmias may have underlying causes e.g. electrolyte imbalances so check regularly and treat as clinically indicated with potassium, magnesium and calcium.

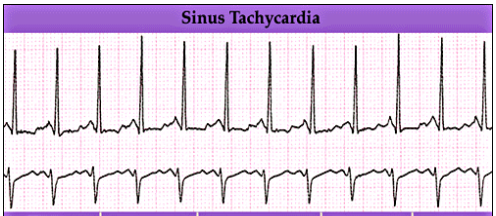
SINUS RHYTHM

SINUS BRADYCARDIA



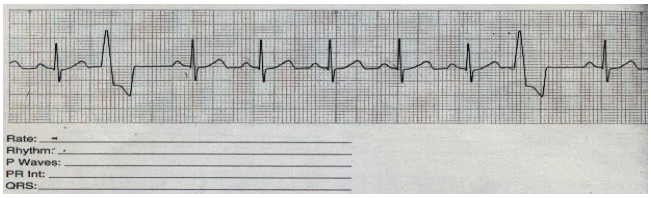
Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
<60 bpm	Regular	Before each QRS, identical	.12 to .20	<.12

SINUS TACHYCARDIA

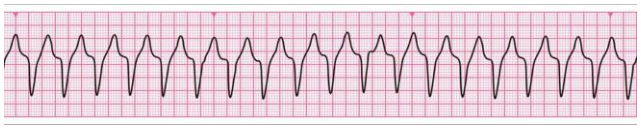


Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
> 100 bpm	Regular	Before each QRS, identical	.12 to .20	<.12

ECTOPICS



PULSELESS VT



VENTRICULAR FIBRILATION

- Need to familiarise yourself with local treatments for other common dysrhythmias e.g. atrial flutter for example

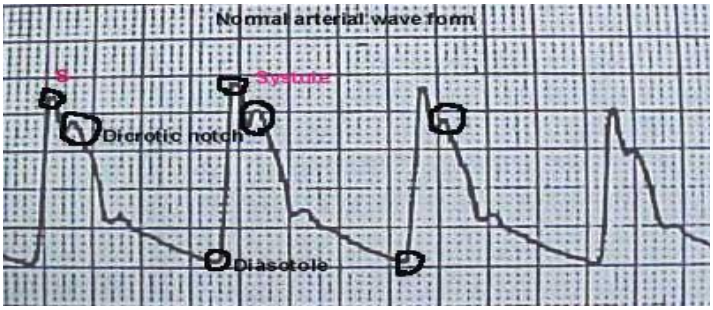
How to Read A Rhythm Strip (Resus Council 2010)

1. Is there any electrical activity?
2. What is the ventricular (QRS) rate?
3. Is the QRS rhythm regular or irregular?
4. Is the QRS width normal (narrow) or prolonged (wide)?
5. Is atrial activity present? (If so, what is it? Is there a normal P wave or some other atrial activity?)
6. How is the atrial activity related to ventricular activity?

Blood Pressure

Can be monitored invasively (via an arterial line) or non-invasively via a cuff.

Invasive Blood Pressure Monitoring



Normal Arterial Waveform

Direct arterial monitoring is a continuous visual measurement that has a greater degree of accuracy in comparison to non-invasive monitoring. When assessing a blood pressure derived from this type of monitoring you need to ensure:

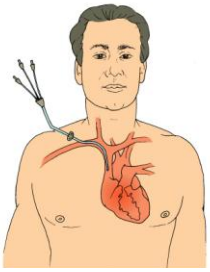
- That you look at the trends, waveform and pattern
- The transducer is at the level of the heart and zeroed to atmospheric pressure with no air bubbles present in the arterial line giving set.
- The alarm limits are set appropriately and compare to a non- invasive reading for accuracy

Blood pressure is the pressure of blood against the walls of the main arteries it comprises:

- systolic (when ventricles are contracting) and
- diastolic (when ventricles are relaxing and refilling)
  but these are momentary figures therefore Mean Arterial Pressure (MAP) (calculated using the systolic and diastolic figures) gives a better indication of perfusion and should therefore be routinely included in any observations.
- Care & safety aspects of the arterial line – must be visible & frequently observed as a risk of disconnection, haemorrhage, haematoma and infection.
- Semi-oclusive dressing for security.
- Arterial lines need to be labelled to prevent risk of injection of drugs.
- Pressure bags must be inflated to a pressure of 300mmHg to ensure no air is flushed through the arterial line system.

Detecting hypo or hypertension identifies a symptom NOT a cause so other haemodynamic and clinical information will be needed.

Central Venous Pressure (CVP)



This is the pressure within the right atrium of the heart, and allows an estimate of circulatory function.

- Where possible it is important that the trace is continuously monitored and you are aware of the different types of waveforms that can occur.
- Ensure that the transducer is in line with the heart and zeroed to atmospheric pressure without air bubbles
- Fluid balance is essential in assessing CVP readings

The CVP measurement in conjunction with Blood Pressure, Pulse, urine output and conscious level give a very accurate indication of a patients haemodynamic state. By having all the relevant information to hand it is easier to make an accurate clinical assessment.

	CVP Reading	Possible Causes
CALL FOR HELP	Low <4mmHg	• Loss of fluids due to haemorrhage, excessive diuresis, extravasation (e.g. burns) • Disconnected transducer • Not given enough fluids • Transducer in wrong place
	NORMAL 4 – 10mmHg	
	High >10mmHg	• Hypervolaemia • Cardiac failure – R ventricular failure, pulmonary embolism • Lumen occlusion/obstruction – due to cannula against vein wall • Transducer switched off/fluids infusing through • Transducer in wrong place

Consider these in relation to BiPAP & CPAP

INOTROPES (drug therapy)

NB:

- **These MUST NOT be stopped or altered except by an experienced ICU/HDU professional**
- **Please ensure they DO NOT run out**
- **If an alarm on an infusion device sounds, identify cause and act appropriately**

Some patients require inotropic support. It is important to ensure that they have received adequate fluid to optimise their haemodynamic status. This can be in the form of colloids or crystalloids, and will be dependant on Hb, CVP, Pulse, and urine output.

Background information

The main receptors are:

- α (alpha) agonists produce vasoconstriction.
- **β1** (beta) agonists increase myocardial contractility and heart rate
- **β2** agonists produce peripheral vasodilatation, increased myocardial contractility and reflex tachycardia
- **DA** (Dopaminergic) agonists . At low doses there is improvement in renal, gut and liver blood flow

Drug	Receptor	Actions
Adrenaline	β1 β2 α	↑ Heart rate & stroke volume (peripheral vasoconstriction)
Dobutamine	β1 (β2)	↑Heart rate & stroke volume (peripheral vasodilatation)
Dopexamine	β2 DA	Peripheral & splanchnic vasodilatation(↑ heart rate)
Dopamine	DA	Increased renal perfusion (actions of dopamine dose dependant)
Noradrenaline	α β1	Arteriole vasoconstriction

Inotropes are used regularly in critical care areas. It is important to be familiar with the following terms so you can appreciate how inotropes work.

Invasive Cardiac Output Monitoring

Measurement	Average Range
Central Venous Pressure	4 – 10mmHg
Pulmonary Artery Occlusion Pressure (PAOP)	5 – 15mmHg
Cardiac Output (CO)	4 – 6L/Min
Cardiac Index (CI)*	2.5 – 3.5l/min/m^2
Stroke Volume (SV)	60 – 90ml/beat
Stroke Volume Index (SVI)	33 – 47ml/beat
Systemic Vascular Resistance (SVR)	900 – 1200
Systemic Vascular Resistance Index (SVRI)	1700 - 2400
* CI=CO/BSA Other indices (SVRI) calculated using CI	

Reference: Whiteley, Bodenham & Bellamy(1998)

NEUROLOGICAL ASSESSMENT

Disability

Neurological assessments are essential in the acutely ill patient.
Some patient's may already have a degree of neurological impairment due to an underlying medical condition for example an infection or a stroke. But there may be other reasons for causing a decreased conscious level such as hypoxia or hypoglycaemia.

Look at your Patient

- Are they alert and orientated?
- Are they confused or agitated?
- Are they drowsy or anxious?

Clinical Assessment

You need to utilise the Glasgow Coma Scale, AVPU, Pain Score and Sedation Scores to assist you with systematic neurological assessment.

What do you need to do to improve the score?

Glasgow Coma Score

Eye Opening	
Spontaneously	4
To Speech	3
To Pain	2
None	1
Best Verbal Response	
Orientated	5
Confused	4
Inappropriate Words	3
Incomprehensible Sounds	2
None	1
Best Motor Response (Arms)	
Obeys Commands	6
Localization to Pain	5
Normal Flexion to Pain	4
Spastic Flexion to Pain	3
Extension to Pain	2
None	1

(Maximum Score 15 Minimum Score 3)

AVPU

A = Alert and Orientated
V= Responds to Verbal Stimulus
P= Responds to Pain
U = Unresponsive

Sedation Score for ICU Patients

(Based on ICS Guidelines – also refer to local guidelines)

3	Agitated and restless
2	Awake and uncomfortable
1	Awake but calm
0	Roused by voice
-1	Roused by touch
-2	Roused by painful stimuli
-3	Un-rousable
A	In natural sleep
P	Paralysed

Acute Pain Intensity Score

Assess Pain Intensity on Movement – as per local guidelines

EXPOSURE

RENAL ASSESSMENT

Monitoring renal function is an essential aspect of the assessment of the critically ill patient. Outcome and prognosis of acute renal failure (ARF) is greatly improved by early recognition, and may even be prevented. Renal function can also reflect the function of the cardiovascular system where a low cardiac output results in a low urine output (Jeven & Ewens, 2002).

Patients that are critically ill require a self retaining catheter inserted and require hourly observations or less, if otherwise instructed.

Monitoring

Urinalysis

- **colour:** pale is dilute, dark is concentrated, pink/red may indicate haematuria,
- **odour:** infected urine has a 'fishy' smell,
- **cloudy or debris:** may indicate infection,
- **frothy:** may indicate significant proteinuria (infection) – please test
- **dipstick test:** a quick and useful test that aids diagnosis

Urine output

- **average:** ½ml/Kg/hr, approx 1000 – 1500mls/24 hours

NB. The use of diuretics, overall fluid balance and the possibility of a blocked urinary catheter must be considered when assessing urine output.

Fluid balance & CVP

Observation of these parameters is essential for the early recognition and/or prevention of acute renal failure. (Please see relevant sections)

- Anuria – is generally applied to the production of <100mls of urine per day
- Oliguria – is defined as the production of between 100 – 400mls of urine per day.

ACUTE RENAL FAILURE

Classified into three groups:

- **Pre-renal** is the most common cause of ARF (Barry 1998) and is the result of reduced renal perfusion caused by hypovolaemia, severe hypotension caused by low cardiac output and/or systemic vasodilatation.
- **Intrinsic** renal failure is usually acute tubular necrosis caused by renal ischaemia and toxins, which includes rhabdomyolysis and sepsis.
- **Post-renal** is caused by physical obstruction of the urinary tract for example: bladder tumours, large prostates & pelvic masses and blocked catheters!

Treatment
- Aggressive fluid resuscitation (pre-renal)
- Support of cardiovascular system
- Avoidance of nephrotoxic drugs (e.g. NSAIDs, gentamicin)
- Maintenance of adequate oxygenation
- Renal replacement therapy e.g. haemodialysis, haemodiafiltration

Reference: Barry. B (1998) and Jeven and Ewens (2002))

FLUID BALANCE

Accurate fluid balance calculation is essential in the acutely unwell patient. It is important to be aware of not only the daily fluid balance, but also the accumulative balance since admission. This gives you valuable information concerning whether a patient is over or under filled in relation to their condition. Things to consider when calculating fluid balance

Input

- Crystalloid : maintenance, continuous infusions, transducer fluid, drug/antibiotic boluses
- Colloids : Blood and Albumin (4.5% and 20%),
- Other blood products : FFP, Platelets
- Gelatins: Haemacel and Gelofusin
- Synthetic Colloids
- Nutrition – TPN or NG/NJ feeds
- Oral fluids

Fluid restrictions are a very important consideration. Where possible any additional volume in a fluid restricted patient should be made up with nutrition

Output

- Urine – amount (should be ½ml/kg in adults) and is it supported by anything e.g. diuretics, dopamine, renal regime
- NG losses – amount and consistency (↑Na and K loss), due to ileus, abdominal distention
- Diarrhoea – type consistency need to estimate volume, large losses can be significant
- Abdominal drains – type, consistency and amount
- Wound leakage – approximate loss if excessive
- Insensible losses : approx 500-900ml/day depending on whether mouth breathing, temperature, sweating, shivering
- Chest drains

Temperature

A patient's temperature can give you valuable information.

- Pyrexia – think about insensible losses, infections, antibiotics, cooling measures
- Hypothermia - warming, extra fluids (especially if immediately post operative)

The difference between a central/core temperature and a peripheral temperature gives a good indication of a patient's perfusion.

Things to consider:

- Feeding for the patients - enteral or parental (see local guidelines)
- Skin integrity (use local guidelines)
- All hygiene care – mouth, eyes, hair, nails

OUTREACH TEAM

MEWS (Modified Early Warning Score) is a set of physiological parameters against which a patients observations can be scored. A MEWS score greater than 3 on the wards triggers a call out using an algorithm which uses both the patients own team and a call to the Outreach Team.

INFECTION CONTROL

The key to universal precautions is risk assessment to protect **patients** and **staff** from the spread of blood borne viruses (HIV/Hepatitis) or other harmful micro-organisms that may be present in blood or body fluids.
It is not always possible to tell who has an infection, so **blood** and **body fluids** from ALL patients should be treated as **infected.**

Key Points

- Treat all blood and body fluid as infected
- Use good hand hygiene & cover any broken skin
- Wear protective clothing (gloves, apron, masks) when dealing with body fluids
- Use and dispose of sharps appropriately
- Disinfect body fluid spillages correctly
- Dispose of waste and excreta carefully
- Correct signage on doors

When Should I Wear Protective Clothing & What Should I Wear?

No Contact with body fluids	➔	No protective clothing
Contact with body fluid LOW risk of splashing	➔	Gloves &/or apron
Contact with body fluid HIGH risk splashing	➔	Gloves, mask, goggles water resistant gown
Consider Flu PPE availability		

Critical care areas, that is all ICU's and HDU's patients are high risk so particular care needs to be paid to universal precautions

SEPTICAEMIA

Definitions

Bacteraemia	The presence of bacteria in the bloodstream
Septicaemia	The presence of bacteria within the blood stream with systemic features e.g low BP
Sepsis	The clinical response to infection
Severe Sepsis	The response to infection with organ dysfunction
Septic Shock	Sepsis with hypotension despite adequate fluid replacement
SIRS (Systemic Inflammatory Response Syndrome)	Clinical features of sepsis, not necessarily due to infection (e.g. trauma, burns)
Toxic Shock Syndrome	Profound shock medicated by staphylococcal and streptococcal toxins

Aetiology

Source of Infection	**Likely Organism**
Respiratory	*Strep Pneumoniae*
Urine	Gram-negative bacilli e.g. *Coli*
Gallbladder	Gram-negative bacilli, enterococci
Bowel	Gram-negative bacilli, anaerobes
Pelvic	*Neisseria gonnorrhoea,* anaerobes
Skin	Staphylococci, *Strep pyogenes*
Nasopharynx	*Neisseria meningitidis*

Predisposing Factors

- immunosuppression
- neutropenia e.g. after chemotherapy for malignancy
- wounds, burns
- anatomical abnormalities e.g. stones
- indwelling catheters - urinary, intravascular
- extremes of age
- diabetes mellitus, renal failure, chronic liver disease

Symptoms and Signs

- Acute circulatory failure (shock)
- Hypotension (BP<90mmHg)
- Tachycardia
- Cold, clammy skin
- Rapid, shallow respiration
- Drowsiness, confusion, irritability
- Oliguria
- ± multi-organ failure
- ± features of specific infection e.g. pneumonia, meningococcal rash

BLOOD RESULTS

.

Blood Levels	Symbol	Values	Unit
Activated Partial Thrombin Time	APTT	25 – 40	Secs
Albumin		28 – 38	G/l
Alanine Transaminase	ALT	0 – 35	Iu/l
Alkaline Phosphate	Alk Phos	70 – 300	Iu/l
Amylase		19 – 45	Iu/l
Bicarbonate	HCO_3	20 – 28	Mmol/l
Bilirubin		3 – 15	Umol/l
Calcium (adjusted)	Ca	2.20 – 2.60	Mmol.l
Chloride	Cl	98 – 107	Mmol/l
C-reactive Protein	CRP	<10	Mg/l
Creatinine		50 – 140	Umol/l
Fibrinogen		1.6 – 4.6	G/l
Fibrinogen degradation products	FDP	<10	Mcg/l
Glucose		3.4 – 5.7	Mmol/l
Haemoglobin	Hb	12.0 – 15	G/dl
International normalised ratio	INR	1.0	
Lactate		0.6 – 1.2	Mmol/l
Magnesium (adjusted)	Mg	0.7 – 1.0	Mmol/l
Myoglobin (blood & urine)		< 100	mcg
Neutrophils		2 – 7.5	
Osmolarity		280 – 300	mOsm/kg
Packed Cell Volume	PCV	0.37 – 0.47	
Phosphate	PO_4	0.80 – 1.30	Mmol/l
Platelets	Plts	140 – 400	$X10^9$/l
Potassium	K	3.6 – 5.0	Mmol/l
Prothrombin Time	PT	9 – 13	Secs
Sodium	Na	135 – 145	Mmol/l
Thrombin Time	TT	13 – 18	Secs
Troponin		< 0.03	
Urea		2.2 – 7.7	Mmol/l
White Cell Count	WCC	4 – 11	$X10^9$/l

URINE RESULTS

Urine Levels	Normal Level
Potassium (K)	35 – 90mmols per day
Urea	250 – 900mmols per day
Sodium (Na)	130 – 260mmols per day

DRUG CALCULATIONS

STANDARD IV BOLUS

Formula

*What you want x Volume of diluent = Amount to give
*What you have in Vial/ampoule

*Must be in the same unit of measure i.e.: mg, mcg, g
e.g. Need to give 150mg Phenytoin (comes as 250mg/5ml)

$\frac{150}{250} \times 5 =$ **3mls**

MCG/KG/MIN

Formula

$\frac{\text{Mg of Drug}}{\text{Volume (ml)}} \times 1000 =$ micrograms/ml of drug (mcg/ml)

∴ mcg/ml ÷kg ÷60 minutes x rate infusion is running = mcg/kg/min

E.g. Start Adrenaline (10mg in 100mls) running at 4mls/hr on 70kg person, how many mcg/kg/min?

$\frac{10}{100} \times 1000 = 100$ (mcg/ml)

∴ $100 \div 70 \div 60 \times 4 =$ **0.09mcg/kg/min**

TO SET MLS PER HOUR

Formula

Amount of drug required x KG x 60 Minutes ÷ MCG per ML of Drug = Mls per Hour

E.G Start Adrenaline (10 mg in 100 mls) at 0.2mcg/kg/min in a 70kg patient, how many mls do you start it at?

$0.2 \times 70 \times 60 \div 100 = 8.4$ **Start infusion at 8.4mls/hr**

PERCENTAGES INTO MGS

Formula

% = gms per 100mls
e.g. 20% = 20gms per 100mls

$\frac{\%\text{ of solution}}{100} \times 1000 =$ mg/ml **OR** % of solution x 10

e.g. How many mg/ml are there in 20% Mannitol ?

$\frac{20}{100} \times 1000 = 200$mg/ml OR 20% x 10 = **200mg/ml**

e.g. How many mg/ml are there in 8.4% $NaHCO_3$?

$\frac{8.4}{100} \times 1000 = 84$mg/ml OR 8.4% x 10 = **84mg/ml**

INFUSION RATES

Depending on where you work you might chart infusions according to how many mls/hr they are running, or according to the dose. Below are some of the common infusions we run in the Trust and what formula we should use to calculate the dose.

Drug	Infusion Rate	Infusion Rate
Adrenaline	Micrograms/Kilogram/Minute	
Alfentanil		Milligrams/Hour
Atracurium		Milligrams/Hour
Dobutamine	Micrograms/Kilogram/Minute	
Dopamine	Micrograms/Kilogram/Minute	
Dopexamine	Micrograms/Kilogram/Minute	
Fentanyl		Milligrams/Hour
Midazolam		Milligrams/Hour
Morphine		Milligrams/Hour (or amount if PCA)
Noradrenaline	Micrograms/Kilogram/Minute	
Phenylephrine	Micrograms/Kilogram/Minute	
Propofol		Milligrams/Hour
Vecuronium		Milligrams/Hour

Nursing & Midwifery Council

CODE OF PROFESSIONAL CONDUCT (2002)

SUMMARY

As a registered nurse, midwife or health visitor, you must:

- Respect the patient or client as an individual
- Obtain consent before you give any treatment or care
- Cooperate with others in the team
- Protect confidential information
- Maintain your professional knowledge and competence
- Be trustworthy
- Confidentiality – media enquiries
- Act to identify and minimise risk to the patients

These are the shared values of all the United Kingdom health care regulatory bodies

ADDITIONAL READING:

- Code of Professional Conduct
- Ventilator Care Bundle
- Sepsis Care Bundle
- Renal Care Bundle
- Saving Lives – High Impact Interventions

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Appendix 1

SUCTION GUIDELINES

When patients require ventilation via endotracheal tube and sedation they aren't always able to cough and clear secretions properly.

Endotracheal suctioning is required to remove excess secretions from the respiratory tract and despite this being a relatively simple procedure it can give rise to harmful side effects if not performed correctly and safely.

Some simple questions to ask yourself:

1. Which patients will require suctioning?
    - Patients who are intubated
    - Patients who have a poor cough reflex, whether due to being sedated or unconscious
    - Patients with tracheotomies
    - Patients with neurological deficit, e.g. multiple sclerosis, Guillain-Barré Syndrome

2. How will I know when a patient requires suctioning?
    - If they are visibly coughing or you can see secretions in the tube
    - Can you feel secretions by placing a hand on the patients chest, does if feel bubbly, crackles?
    - Is the patient's oxygen saturations falling or are lower than what they have been?
    - Has there been any fall in the patients volumes on the ventilator, looking at the tidal volume and minute volume

Once you have carried out your assessment of the patient requiring suctioning, prior to suctioning you must ensure you have all the equipment ready to use.

Equipment required

- Apron, gloves and visors
- Correct size single use suction catheter (less than half the diameter of the airway)
- Visibly clean bubble tubing
- Sterile water for flushing tubing following suctioning

Procedure for open endotracheal suctioning

- Provide a full explanation of the procedure, this should be provided irrespective of the patients conscious level, if the patient is awake you should gain consent for the procedure
- Wash hands, put a apron on and wear protective facial wear
- Position the patient so the patient is comfortable and accessible
- If the patient is on high amount of oxygen (Over 50%) it is advisable to pre oxygenate at 100% for 2-3 mins (Sherwood 1994)
- Oxygen saturations and heart rate should be continuously monitored
- Ensure suction unit is functional and set to the correct pressure (60-100mmhg) may be used for adults, if secretions are excessively thick a slightly higher pressure may be required
- Place on clean non sterile gloves on both hands

- Expose the flow controlled end of the catheter to the suction tubing, ensuring that only this end is exposed and the tip of the catheter is still concealed within the packet
- Remove the suction catheter just as you are about to disconnect the patient from the breathing system
- Gently insert the suction catheter into the endotracheal tube, guiding it down the tube until a resistance is felt, pull back about 1cm and before applying suctioning. Gently place pressure on the suction catheter control, do not rotate the catheter, and just gently withdraw. All this should be performed within 15 seconds so that the patient isn't disconnected for too long to prevent hypoxia
- Ensure the patient is connected back to the ventilator and that the patients chest is moving
- On completion wash suction tubing through with sterile water
- Remove catheter and wrap around gloved hand, and remove the glove and dispose into a yellow bag
- Wash hands
- Document in the relevant nursing paperwork, how often suction has been required, what the secretions were like and any adverse reactions to suctioning

Where possible a closed circuit suction catheter should be used, to reduce the risk of infection to patient, staff and relatives

Procedure for closed circuit suctioning

- Pre–oxygenate on 100% for minimum of 2 minutes with oxygen concentration greater than 50%
- Explain the procedure to the patient and aim to gain consent from them
- Position the patient
- Check the suction is in full working order and suction pressures are within normal limits
- Wash hands
- Put on an apron and facial protection
- Lift and turn the thumb piece 180^{o} to unlock the suction
- Grip the T piece with one hand and advance the catheter with thumb and forefinger of the opposite hand
- When a resistance is felt pull back 1cm before commencing suction
- Apply intermittent suction by depressing the control valve as needed
- While maintaining grip on the T-piece and control valve, gently withdraw the suction catheter to extend the length of the catheter sleeve until the black marking on the catheter is visible at the back of the T piece
- On completion of suction flush the irrigation port with sterile water
- Lift and turn thumb piece 180^{o} to lock position on control valve to ensure it is safely off

Appendix 1

Side effects of airway suction

- Hypoxia – due to interruption of the patient's ventilation pattern and the removal of gas from the airways and alveoli
- Anxiety, Thompson (2000)
- Cardiac arrhythmias – bradycardia (slow heart rate) can be causes by stimulation of the vagus nerve
- Pain and discomfort – particularly in the surgical patient who has a surgical wound.
- Excessive coughing
- Atelectasis – collapse of the alveoli due to inclusion of the airway
- Mucosal trauma – haemorrhage, ulceration
- Aspiration – of stomach contents
- Introduction of infection

You must remember to ensure the patient is allowed to gain there breathe back between suctioning.

Care of the Seriously Ill Child in an Adult ICU in an Emergency Situation

Appendix 2

Children are different

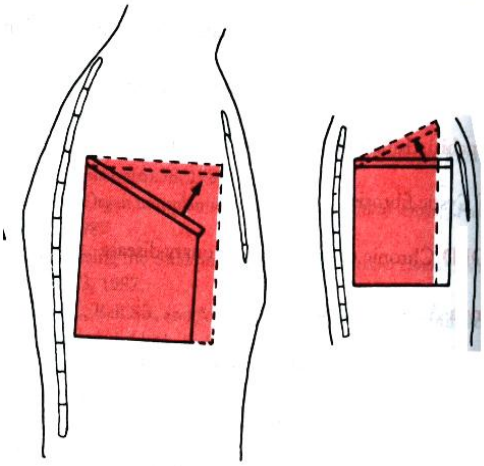
Recently ALSG have adapted a new formula for weight calculations as it is now felt that the old formula underestimated many children over 5years.

Estimating Weight		**Normal Values**			
Age	**Weight (kg)**	**Age**	**Respiratory Rate**	**HR**	**Systolic BP**
Newborn Term infant	3.5kg	Neonate	60	160	70
Infant < 1 year	7kg (6 months) 10kg (1 year) Or (Age mths X 0.5) + 4	<1 yr.	35-45	110-160	75
Child 1 - 5 year	(age in years +4) x 2	1-5yr	23-35	95- 140	80 – 90
Child 5 to puberty	(Age X 3) +7	5-12 yr	20-25	80 – 120	90 – 110
Young adult	Approx 50kg & over	> 12yr	adult	adult	100 - 120

- The most common cause of illness in infancy and childhood is acute disease of the respiratory tract.
- The younger the child / infant the more susceptible they are to respiratory difficulties due to anatomical differences
- Adopting a systematic approach to the stabilisation of seriously ill children will allow practitioners to approach their care with confidence.

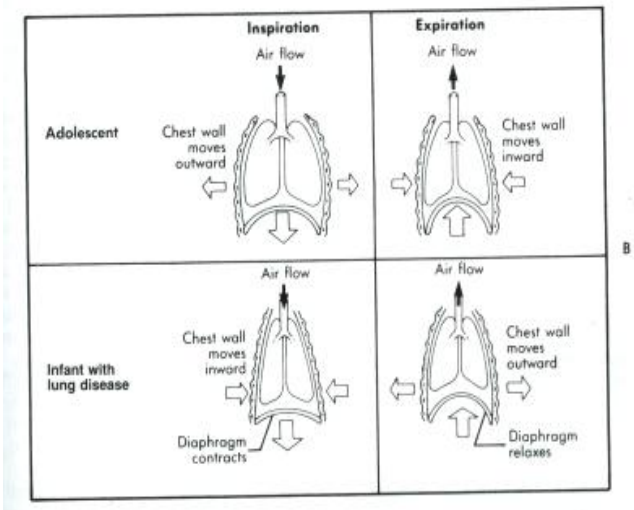
Infants are dependent on good diaphragmatic function

The infants diaphragm inserts more horizontally in conjunction with their ribs, which causes lower rib retraction especially when supine.

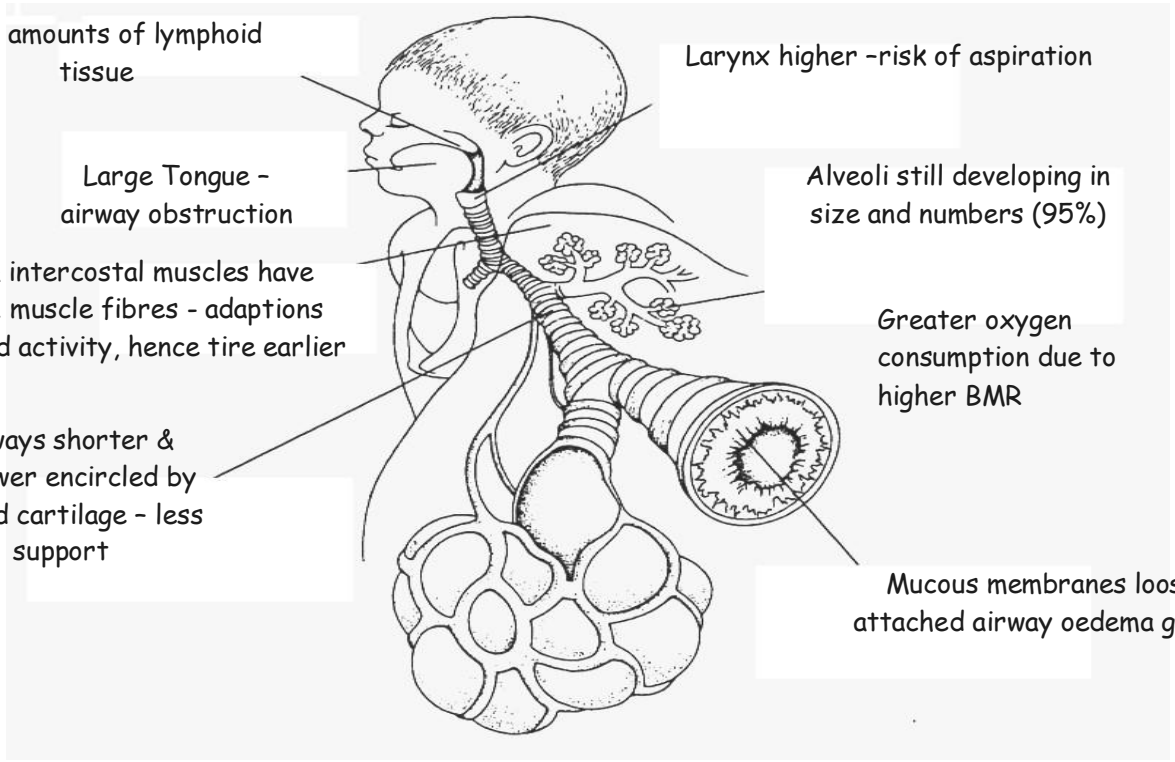


Anatomical factors which impact upon the child's spontaneous ventilation

- The infant's chest wall is more compliant / less rigid due to cartilaginous sternum and ribs.
- The inter-costal muscles do not assist the infant in elevating the rib cage but act a a stabiliser.

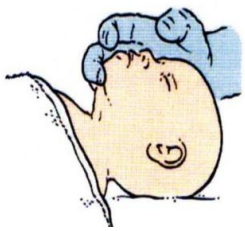


Differences in the infants respiratory system compared to adults

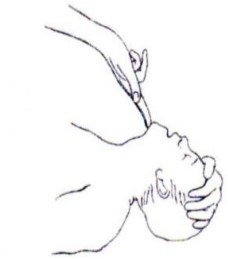


Assessment of Airway

- Stridor suggests upper airway obstruction - croup
- Grunting is exhalation against a partially closed glottis to increase end expiratory pressure
- Opening manoeuvres should be used in a child with a compromised airway – consider use of adjuncts (Guedal, nasopharngeal or intubation)

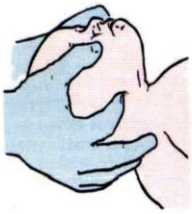


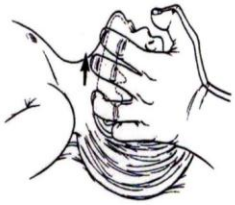
Neutral position



Head tilt-chin lift manoeuvre

Jaw thrust



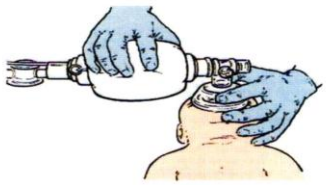


Neutral position Sniffing the morning air

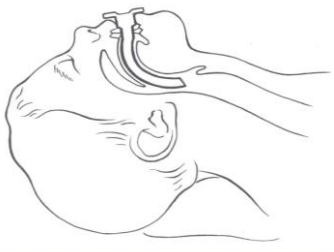
N.B. A child with a compromised airway may quickly become obstructed if distressed

Bag Valve – Mask Ventilation

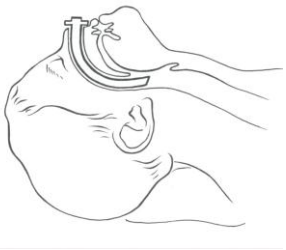
- If hypoventilating with slow respiratory rate or weak effort support is required via bag-valve mask device
- The mask should extend from bridge of nose to cleft of chin, enveloping nose & mouth but avoiding compression of eyes.
- Face mask application with one hand as head tilt-chin lift manoeuvre is performed ensuring the position is either in the neutral for the infant or "sniffing the morning air" for the child.



Airway Adjuncts & Sizing



From the incisors to the angle of the mandible.
When placing oral airway do not rotate as this will cause trauma to the soft palate



Measure from the tip of the nose to the tragus of the ear

Endotracheal Tube Sizing

Endotracheal tubes diameter size:

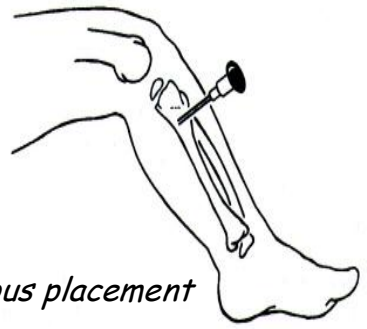
- <1 year = 3.0, 3.5, 4.0
- >1 year = age / 4+4; i.e. 4 years / 4+4=5.0 plus 4.5 & 5.5
- Oral length = Age / 2 + 12

Ventilation

- Respiratory rates – 20-30bpm
- Inspiratory time –
  - Usually starting at 0.7sec for infants to 1sec
- Inspiration pressure –
  - Normal healthy lungs = 16-18cmH_2O
  - Stiff non-compliant lungs = 30-40cmH_2O to generate similar tidal volumes
- Start at 20-25 cmH20

- Pre-set positive end expiratory pressure (PEEP) = 3-5cmH_2O
- Tidal volumes (TV)
  - 5-7ml/kg neonates
  - 7-10ml/kg children
- Use adult ventilation circuit > 15kg

Assessment Circulation



Intraosseous placement

- If signs of shock – fluid bolus 10-20 ml/kg 0.9% saline
- Start inotropes 50-60ml/kg administered in conjunction with volume replacement
- Warm shock
  - Start with dopamine
  - Add adrenaline or noradrenaline
- Cold shock
  - Start with dobutamine
  - Add adrenaline or noradrenaline

Assessment

- Disability: Conscious level, behaviour
  - Normal, lively, irritable, lethargic
  - AVPU / GCS pupillary signs & posture
- A child who only responds to PAIN has GCS of 8 or less and
- THE AIRWAY IS AT RISK
- Exposure:
  - Keep normothermic
  - Rash, fever, consider anaphylaxis

Calculations: Fluids / Feeds

	Method 1	Method 2
First 10kg	100ml/kg	4ml/kg/hr
Second 10kg	50ml/kg	2ml/kg/hr
Subsequent kg	20ml/kg	1ml/kg/hr

Calculations Enteral Feeds:

- 3-6 months old 120ml/kg/day
- > 6 months old use above IV fluid calculation
-

Example: 35kg child:

- Method 1 = (10 x 100) + (10 x 50) + (15 x 20) = 1800ml/day = 75ml/hr
- Method 2 = (10 x 4) + (10 x 2) + (15 x 1) = 75ml/hr
- Dextrose 5% 0.45% saline (KCL 10mmol/500ml)