THE UNIVERSITY of EDINBURGH

ROYAL COLLEGE of PHYSICIANS of EDINBURGH

COVID-19 CRITICAL CARE

Understanding and Application

Edinburgh Critical Care Online Handbook

Welcome

This handbook complements the online, open access FutureLearn based COVID-19 CRITICAL CARE: Understanding and Application.

https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1

Recognition and management of the deteriorating patient

01

Graham Nimmo

General Points

- Acutely ill patients require rapid but careful assessment.
- Initiation of treatment often precedes definitive diagnosis but diagnosis should be actively pursued.
- Aim to prevent further deterioration and stabilise the patient.
- Early involvement of experienced assistance is optimal i.e. GET HELP

*** Please apply your local guidelines and protocols with regard to Personal Protective Equipment (PPE).**

- The general principles of emergency management described here can be applied to the majority of acutely ill adults irrespective of underlying diagnosis or admitting speciality.
- When patients are admitted, access the Emergency Care Summary (ECS) and electronic Palliative Care Summary (ePCS) as the information available on these may affect decisions about appropriate management in the event of patient deterioration. Symptomatic care may be more appropriate than escalation of support.
- Sepsis, shock and respiratory failure can occur in any clinical area. There may be life-threatening abnormalities of physiology present e.g. hypoxia or hypovolaemia, or the patient may have a specific condition which is at risk of rapid de-stabilisation e.g. acute coronary syndrome, GI bleed.

The four key domains of emergency management

1	2	3	4
Acute assessment (with targeted examination stabilisation immediate investigations & support	Monitors: Reassess Surface Invasive Real time or delayed Illness severity assessment	Clinical decision making Team work Task Mx Situation awareness Critical thinking	Differential diagnosis/ definitive diagnosis Immediate, medium term and long term treatment

The approach to the acutely ill adult requires these four elements to proceed almost in parallel.

Immediate investigations are those which will influence the acute management of the patient and include;

- Arterial blood gas
- Glucose
- Potassium
- Haemoglobin
- Clotting screen (where indicated).
- Twelve lead ECG.
- CXR (where indicated).
- Remember to take appropriate cultures including venous blood cultures before administering antibiotics (if practical).
- Consider sending blood for screen, group and save or cross-matching.

1 Acute Assessment, Primary Treatment & Investigations

Acute assessment is designed to identify life-threatening physiological abnormalities and diagnoses so that immediate corrective treatment can be instituted (see algorithm). Patient observations and NEWS score are critical to the process. Within NHS UK an early warning scoring system (NEWS) is utilised to alert staff to severely ill patients. It is a decision support tool that compliments clinical judgement and provides a method for prioritising clinical care. An elevated NEWS score correlates with increased mortality and it is recommended that a patient with a NEWS score of 4 or greater requires urgent review and appropriate interventions commenced. Think: Do they need specialist/critical care input **NOW**? If the answer is yes get help immediately.

*** However ill patients may have a NORMAL NEWS score: look at the individual patient critically.**

COVID-19 patients: NEWS is commonly lower than severity of illness would imply Tachypnoea is much less prominent than in other critical illness: the respiratory rate is less than you would expect for degree of respiratory failure and may be falsely reassuring

Primary Assessment & Management: Approach to the Acutely ill Patient

See explanatory notes below
Approach: Hello, how are you?
What is the main problem? Do you have any allergies?
What medicines are you on? PMH?
Get a clear history to assist definitive diagnosis

	CLINICAL ASSESSMENT *GET HELP NOW	ACTION	INVESTIGATIONS IN ASSESSMENT
A	**Airway and Conscious Level** Clear and coping? → **Stridor***	**Chin lift, head tilt** **Call for help early**	
B	**Breathing** Look, listen and feel Rate and volume and symmetry WOB[2]/pattern **RR > 30*** **Paradoxical breathing***	**Auscultate chest** **High concentration 60-100% oxygen[1]** **Monitor ECG, BP, SpO_2** **Ventilate if required**	**ABG[3], PEFR, CXR**
C	**Circulation** **Pulse[4]** Rate/volume Rhythm/character Skin colour and temp **Capillary refill[6] and warm/ cold interface** **Blood pressure (BP)** **HR < 40 >140*** **BP < 90 SBP***	**No pulse: cardiac massage** **IV access[5] and Fluids** **Auscultate Heart**	**12 lead ECG**
D	**CNS and Conscious Level** **GCS/AVPU** **Fall in GCS 2 points*** Pupils, focal neurological signs	**ABC & Consider the cause** **Management of coma**	**Glucose**
E	**Examine & Assess Evidence & Environment** Temperature	**Look at SEWS chart, results, drug & fluid charts**	**Standard bloods[7]**

[1] If not breathing, get help and give two effective rescue breaths.
[2] WOB: work of breathing.
[3] Always record inspired oxygen concentration.
[4] If collapsed carotid, if not start with radial.
[5] Take blood for x-match and immediate tests (see text).
[6] Should be <2 seconds.
[7] COVID-19 patients: presenting haemoglobin is often high or high normal eg 170-190g/L

Notes on Initial Assessment Algorithm

*** If you are called to a sick patient GO AND SEE THEM. Five seconds critically looking at the patient will tell you more than 10 minutes on the phone.**

Airway and Breathing

- See BLS guidelines for cardiac arrest.
- By introducing yourself and saying hello you can rapidly assess the airway, breathing difficulties and the conscious level. If the patient is talking A is clear and B isn't dire.
- AMPLE: ask about allergies, medicines, past history, last food/fluid, events at home or in ward e.g. drug administration.
- If any patient with known or suspected chronic respiratory disease arrives in A&E, CAA or ARAU on high concentration oxygen check ABG immediately and adjust oxygen accordingly.
- When assessing breathing think of it in the same way as you think of the pulse: rate, volume, rhythm, character (work of breathing), symmetry. Look for accessory muscle use, and the ominous sign of paradoxical chest/ abdomen movement: "see-saw".
- As you assess breathing targeted examination of the chest is appropriate.
- High concentration oxygen is best given using a mask with a reservoir bag and at 15l can provide nearly 90% oxygen.

*** The concentration of oxygen the patient breathes in is determined by the type of mask as well as the flow from the wall and the breathing pattern. By using a fixed performance system (Venturi) you can gauge the percentage much more accurately.**

- The clinical state of the patient will determine how much oxygen to give, but the acutely ill should receive at least 60% oxygen initially.
- ABG should always be checked early to assess oxygenation, ventilation ($PaCO_2$) and metabolic state (HCO_3 and base deficit). Always record the FiO_2 (oxygen concentration).
- Oxygen therapy should be adjusted in the light of ABGs: O_2 requirements may increase or decrease as time passes.

Circulation

- As you assess circulation targeted examination of the heart is appropriate.
- IV access is often difficult in sick patients.
- The gauge of cannula needed is dictated by the required use:
  - large bore cannulae are required for volume resuscitation. Ideally insert 2 large bore (at least 16G grey) cannulae, one in each arm in the severely hypovolaemic patient.
  - an 18 gauge green cannula is usually adequate for drug administration.
- Consider Intra-osseous (I-O) access.
- The femoral vein offers an excellent route for large bore access.
- If there is major blood loss speak to the labs & BTS: you may need coagulation factors as well as blood. Consider activating the Major Haemorrhage protocol dial 2222. Call Senior help.
- Use pressure infusors and blood warmers for rapid, high volume fluid resuscitation.

*** If the patient is very peripherally vasoconstricted and hypovolaemic don't struggle to get a 14G (brown) cannula in. Put in two 18G cannulae (green) and start fluid resuscitation through both. Consider I-O access. CALL FOR HELP.**

- Machine derived cuff blood pressure is inaccurate at extremes of BP and in tachycardias (especially AF).
- Manual **sphygmomanometer** BP is more accurate in hypotension.
- In severe hypotension which is not readily corrected with fluid early consideration should be given to arterial line insertion and vasoactive drug therapy: **GET HELP**.

Disability

- Glasgow coma scale (GCS): document all three components accurately with best eye, best verbal and best motor responses.
- Recommended painful stimuli are supraorbital pressure or Trapezius pinch.

Glasgow Coma Scale to record conscious level

Eye Opening (E)	Verbal Response (V)	Motor Response (M)
4 = Spontaneous 3 = To voice 2 = To pain 1 = None	5 = Normal conversation 4 = Disoriented conversation 3 = Words, but not coherent 2 = No words.....only sounds 1 = None T = intubated patients	6 = Normal 5 = Localizes to pain 4 = Withdraws to pain 3 = Decorticate posture 2 = Decerebrate 1 = None
		Total = E+V+M

- Check pupil size, symmetry and reaction to light.
- **A.V.P.U.** can also be used by people less familiar with the calculations of the Glasgow Coma Sale (GCS)

  A = **A**lert
  V = responds to **V**oice stimuli
  P = responds to **P**ainful stimuli
  U = **U**nresponsive

  AVPU is used in the recording of NEWS and carries a weighting appropriate to level of consciousness.

Exposure, evidence and examination

- Further history should be obtained and further examination should be performed. Information should be sought from recent investigations, prescription or monitoring charts.

Preventing Deterioration & Cardiac Arrest

- Around 80% of our in-hospital cardiac arrests are in non-shockable rhythms.
- In **ventricular fibrillation**/**pulseless ventricular tachycardia** the onset is abrupt, and an at-risk group with acute coronary syndromes can be identified and monitored. Early defibrillation results in optimal survival.
- In contrast, in-hospital cardiac arrest in **asystole or pulseless electrical activity or PEA** has a survival rate of around 10% and there is no specific treatment. There are usually documented deteriorations in physiology prior to the arrest. These are often treatable and reversible so the aim is to recognise decline early and to provide early corrective management in order to **PREVENT CARDIAC ARREST**. (See NEWS section).

*** Causes of preventable asystole and PEA can also cause VF.**

- **Hypoxaemia** and **hypovolaemia** are common and often co-exist e.g. in sepsis, anaphylaxis, trauma or haemorrhage such as GI bleeding.
- Electrolyte abnormalities, notably **hyperkalaemia**, **hypokalaemia** or **hypocalcaemia** are easily detected and readily correctable.
- **Drug** therapy or poisoning/toxins may contribute to instability.

Physiological abnormalities	How to pick them up
Hypoxaemia, hypercarbia, acidosis	Do an early blood gas
Hypovolaemia, hypervolaemia	Assess circulation (see algorithm)
Hypokalaemia, hyperkalaemia	Early bloods
Hypothermia	Assess context, core temp
Tension pneumothorax	Clinical context and signs: Point of care ultrasound
Toxins*	Clinical context
Cardiac tamponade	Clinical context, early echocardiogram
Thromboembolic	Clinical context, PE/CTPA

*** N.B beta-blockers and calcium channel blockers.**

- **Hypothermia**, **tension pneumothorax**, **cardiac tamponade** (particularly after thrombolysis, cardiac surgery or chest trauma) and thrombo-embolic disease must all be considered (look at the clinical context).

2 Monitoring & Reassessment

- Real-time continuous monitoring is invaluable in the acutely ill.
- Pulse oximetry, ECG and cuff BP monitoring should be instituted immediately in all patients.
- Monitoring is an integral part of the treatment/re assessment/treatment/reassessment loop.
- The place of urgent investigation is detailed previously. Early point of care ultrasound (POCUS) or ecocardiography.
- In order to make a definitive diagnosis specific blood tests or imaging techniques may be required.

*** Do not move unstable patients e.g. to x-ray until stabilised, and then only with adequate support, vascular access, monitoring and appropriate escort.**

Assessment and re-assessment

Assess response to treatment by continuous clinical observation, repeated assessment of airway, breathing, circulation and disability (conscious level) as above with uninterrupted monitoring of ECG and oxygen saturation. Reassess regularly to see the effects of intervention, or to spot deterioration.

*** IF THE PATIENT IS NOT IMPROVING CONSIDER:**

1. **Is the diagnosis correct?**
2. **Is the diagnosis complete?**
3. **Is there more than one diagnosis?**
4. **Are they so ill help is needed now?**
5. **Is there an unrecognised problem or diagnosis?**

2 illness Severity Assessment

- Working out how ill the patient is and what needs to happen to them next underpins the effective, safe management of all adult medical emergencies.

Specific scoring systems are included in specialist sections. The National Early Warning Scoring System is being used in UK.

Illness severity assessment informs four key decisions:

i. What level and speed of intervention is required? e.g. urgent ventilation, immediate surgery.

ii. Is senior help required immediately, and, if so, whom?

iii. Where should the patient be looked after? This is a decision about nursing care, monitoring and treatment level. The choices include:
- General wards
- Intermediate care facility (Coronary Care Unit: CCU or High Dependency Unit: HDU)
- Theatre
- Intensive Care Unit (ICU)

*** Placing the patient in a monitored HDU bed without increasing the level of appropriate medical input and definitive treatment will not improve outcome on it's own. Senior advice should be sought early.**

iv. What co-morbidity is present? (including drugs which blunt compensatory changes in physiology).

*** If the parameters are normal is that appropriate for the clinical state of the patient?**

News Parameters and Scoring System

Parameter	3	2	1	Score 0	1	2	3
Respiratory rate	>36	31-35	21-30	9-20			<8
SpO_2 (%)	<85	85-89	90-92	>93			
Temperature		>39	38-38.9	36-37.9	35-34.9	34-34.9	<33.9
Systolic BP (mm Hg)		>200		100-199	80-99	70-79	<69
HR	>130	110-129	100-109	50-99	40-49	30-39	<29
AVPU Response				Alert	Verbal	Pain	None

Case example

Patient presents in respiratory distress.

RR 32, SpO_2 90%, T° 38.9, Systolic BP 160/70, HR 105, AVPU: Verbal

NEWS score = 6

Patient requires increased frequency of observations and urgent medical review.

Illness Severity and Diagnosis (Risk of Deterioration)

- As the ABCD is secured a specific diagnosis is sought with the 'Targeted
- Examination' and specific treatment can then be instituted.
- Explanation, reassurance and analgesia are integral parts of acute care. Always keep the patient, family and/relevant others informed about progress.
- Objective information on severity of illness may be obtained from blood tests e.g. acidosis and oxygenation, K^+, renal dysfunction, liver failure and DIC.
- If acidosis is due to tissue hypoxia, base deficit can be followed as a guide to response to treatment (unless metabolic acidosis is due to e.g. renal failure).

*** BASE DEFICIT is very important, the more negative the more chance the patient will die.**

+3 to -3	normal
-5 to -10	moderately ill
-10 or worse	severely ill

Arterial blood lactate

- If elevated has prognostic significance – the higher the worse.
  N.B. patients may have tissue hypoxia with a normal lactate.

Addressograph

Name: .....

DOB: .....

CHI: .....

NEWS of 5 or more?

Think Sepsis!

In a patient with a **NEWS** of **5 or more** and a known infection, signs and symptoms of infection, or at risk of infection, think **'Could this be sepsis?'** and **escalate care immediately.**

Special Instructions:
Only to be completed under the direction of a senior member of the medical team

A total NEWS of ..... or individual parameter of .....
is acceptable for this patient because .....

.....

.....

Please escalate if .....

.....

.....

Print ..... Sign ..... Designation .....

Date ..... Time ..... *(only valid if signed and dated)*

***Regardless of NEWS always Escalate if concerned about a patient's condition. Escalate immediately if clinical observations cannot be obtained**

NEWS TOTAL	Monitoring Frequency	Clinical Response Document concerns/decisions in patients clinical notes
0	Minimum 12 hourly/ 4 hourly in admission areas	• continue routine NEWS monitoring
Total 1 - 4	Minimum 4-6 hourly	• inform registered nurse • registered nurse assessment • review frequency of observations • if ongoing concern, escalate to medical team • consider fluid balance chart
3 in single parameter	Minimum 1 hourly	• registered nurse assessment • medical assessment • management plan to be discussed with senior trainee or above • consider fluid balance chart
Total 5 - 6 **Urgent response threshold**	Minimum 1 hourly	• registered nurse assessment • urgent medical assessment • management plan to be discussed with senior trainee or above • consider senior trainee review if NEWS does not improve following initial medical assessment • consider level of monitoring required • consider anticipatory care planning (ACP) • start fluid balance chart
Total 7 or more **Emergency response threshold**	Continuous monitoring of vital signs	• registered nurse to assess immediately • immediate assessment by senior trainee or above • discuss with supervising consultant • if appropriate contact Critical Care for review • consider anticipatory care planning (ACP) • start fluid balance chart

Codes for recording oxygen delivery on the NEWS2 observations chart			
A	breathing air	**RM**	reservoir mask
N	nasal cannula (document in litres)	**TM**	tracheostomy mask
SM	simple mask	**CP**	CPAP mask
V	venturi mask and percentage (e.g device = V, % = 40)	**H**	humidified oxygen and percentage (e.g device = H, L/min or % = 40)
NIV	patient on NIV system	**OTH**	Other specify

NEWS Key 0 1 2 3	Date:
	Time:
A+B Respirations Breaths/min	≥25
	21-24
	18-20
	15-17
	12-14
	9-11
	≤8
A+B SpO_2 Scale 1 Oxygen saturation (%) Use Scale 1 if target range is 94-98%	≥96
	94-95
	92-93
	≤91
SpO_2 Scale 2* Oxygen saturation (%) Use Scale 2 if target range is 88-92% eg. in hypercapnic respiratory failure	≥97 on O_2
	95-96 on O_2
	93-94 on O_2
	≥93 on air
* **ONLY** use Scale 2 under the direction of a qualified clinician	88-92
	86-87
Tick box if using SpO_2 Scale 2	84-85
Sign:	≤83
Air or Oxygen? Oxygen is a drug and prescribed by target range	A = Air
	O^2 L/min or %
	Device
C Blood Pressure mmHg Score uses Systolic BP only If manual BP mark as M	≥220
	201-219
	181-200
	161-180
	141-160
	121-140
	111-120
	101-110
	91-100
	81-90
	71-80
	61-70
	51-60
	≤50
C Pulse Beats/min Manual pulse	≥131
	121-130
	111-120
	101-110
	91-100
	81-90
	71-80
	61-70
	51-60
	41-50
	31-40
	≤30
D Consciousness Score for new onset of confusion (no score if chronic)	Alert
	New Confusion
	V
	P
	U
E Temperature ^0C	≥39.1^0
	38.1-39.0^0
	37.1-38.0^0
	36.1-37.0^0
	35.1-36.0^0
	≤35.0^0
NEWS TOTAL	
Monitoring frequency	
Escalation of care Y/N	
Initials	
Urine output recorded Y/N	
Blood Glucose level or N/A	
Pain score (0-10)	
Nausea score (0-3)	
Motor Block score (0-4) or N/A	

																								Date
																								Time
											3													≥25
											2													21-24
																								18-20
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											2													95-96 on O_2
											1													93-94 on O_2
																								≥93 on air
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																								Initials
																								Urine output
																								Blood Glucose
																								Pain
																								Nausea
																								Motor Block

*** Even in the absence of a specific diagnosis of concern or greatly impaired physiology early ICU involvement may be appropriate: seek senior advice.**

Watch for the development of cardiovascular, respiratory and other organ system failure, particularly in patients known to be at risk because of their illness.

INVOLVE CRITICAL CARE EARLY

3 Clinical Decision Making

Decision making underpins all aspects of clinical and professional behaviour and is one of the commonest activities in which we engage. You should understand:

- the factors involved in clinical decision making such as knowledge, experience, biases, emotions, uncertainty, context
- the critical relationship between CDM and patient safety
- the ways in which we process decision making: system 1 and system 2 (link to evidence)
- the place of algorithms, guidelines, protocols in supporting decision making and potential pitfalls in their use
- the pivotal decisions in diagnosis, differential diagnosis, handing over and receiving diagnoses and the need to review evidence for diagnosis at these times

4 Definitive Diagnosis & Treatment

- Immediate life-saving treatment often prevents further decline or effects improvement while the diagnosis is made and specific therapy applied e.g. percutaneous coronary intervention in MI, endoscopic treatment of an upper GI bleeding source. Outcome is better in patients where a definite diagnosis has been made and definitive therapy started.

Full Examination & Specialist Investigations

- Get a good history: useful information is always available.
- Relatives, GP, neighbours, ambulance staff may all be helpful.

*** If the patient is not improving consider:**
1. Is the diagnosis secure?
2. Is the illness severity so great help is needed?
3. Is there something else going on?

Daily Practice of Critical Care

Gilly Fleming, Elise Hindle, Graham Nimmo, Emma Scahill

What makes a unit a Critical Care Unit?

It is more than just a location within the hospital.

Critical care is an active treatment process which is delivered to patients with immediate life-threatening illnesses or injuries in whom vital organ systems are failing, or at risk of failure, wherever they are situated.

Care within the unit is provided by a consultant-led specialist team, which works around the clock to offer advanced therapeutics, diagnostics and monitoring.

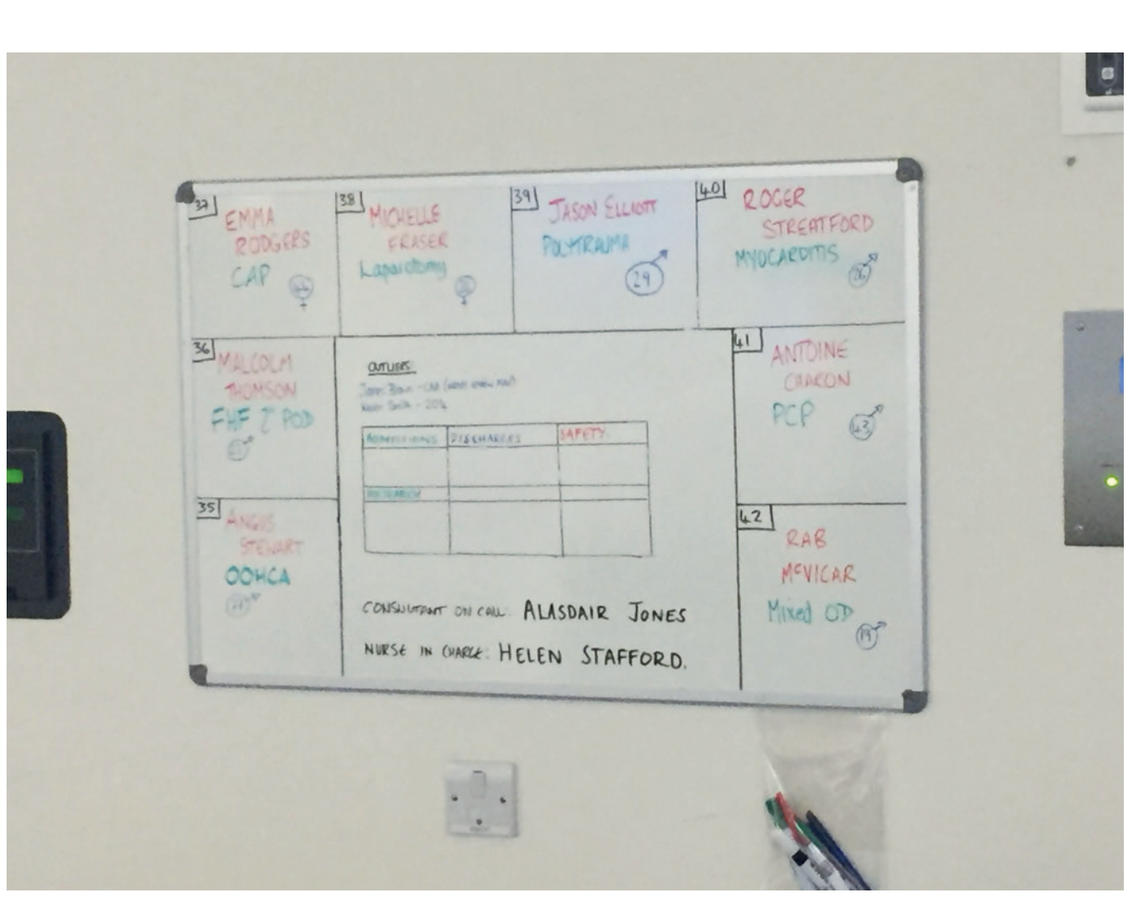
Image courtesy of Judith Roberts, North Dakota, US

What are the different levels of Care offered within Critical Care?

Not all patients within Critical Care require the same degree of monitoring and intervention. The Intensive Care Society (UK)1 defines the levels of care as follows:

- Level 0 care is care which is appropriate for patients who need to be in hospital but require observations to be monitored less than four hourly. These patients are most often managed on a general ward.
- Level 1 care is either for patients who have recently been discharged from a higher level of care, or for patients in need of additional monitoring or intervention. Some hospitals may have critical care outreach teams that allows patients like this to remain in a ward level environment.
- Patients who require single organ support (e.g. vasopressors) may be suitable for level 2 care unless it is advanced respiratory support that is required which necessitates level 3 care.
- Level 3 care is provided for patients requiring advanced respiratory support or for patients who require > 2 organs to be supported.

The level of care assigned to a patient will influence, but not determine, staffing requirements although in general patients receiving level 3 care should be expected to require 1:1 nursing care around the clock.



The Critical Care Bedspace

It is of vital importance that the patient bed space is organised in such a way to promote ease of clinical care, optimise patient dignity and comfort and limit the capacity for infectious pathogens to thrive.

Below is bedspace 39 within the Critical Care Unit. **Have a look around the bedspace and familiarise yourself with the labels.**

How does the bedspace compare to the units in which you work?

Patient Monitoring in Critical Illness

Adequate monitoring is a core standard of care for patients in Intensive Care Units. When used in addition to vigilance by medical and nursing staff, then unfavourable clinical events can be detected quickly and acted upon. Importantly, the use of monitoring within intensive care does not negate the risk of adverse events, but should make them more readily detectable.

ANZICS (The Australian College of Intensive Care Medicine) published the following recommendations as their minimum standards of monitoring for patients within an Intensive Care Environment:

- Patient monitoring equipment should be modular, with trending capability, be clearly visible, and have audible alarms.
- Clinical monitoring by a vigilant nurse is the basis of good patient monitoring
- There should be a continuous ECG display and measurement of the arterial blood pressure either through invasive or non-invasive measures.
- Respiratory function should be assessed at frequent and clinically appropriate intervals by observation and supported by pressure monitoring and blood gas analysis.
- End tidal CO_2 monitoring - capnography must be available at each bed in the Intensive Care Unit and must be used to confirm tracheal placement of the endotracheal or tracheostomy tube immediately after insertion, and continuously in patients who are ventilator dependent.
- Endotracheal cuff monitoring – equipment to measure cuff pressure intermittently.
- Temperature monitoring through non-invasive or minimally invasive techniques
- Other equipment - when clinically indicated, equipment must be available to measure other physiological variables such as cardiac output and derived variables, neuromuscular transmission etc.

Ventilators in the Critically ill

In Ventilation and Organ Support page of the resource hub you can learn about ventilators and modes of ventilation. Below is a brief overview to get you started on the unit.

Many patients within critical care require advanced respiratory support from a ventilator. The ventilator interfaces with the patients lungs via an endotracheal or tracheostomy tube.

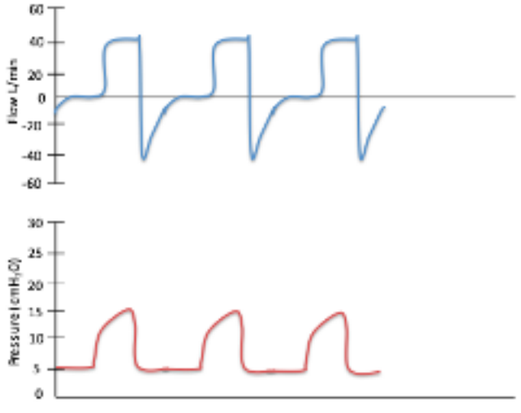
Positive pressure ventilators have four main components:

1. A source of pressurised gas including an oxygen / air blender
2. An inspiratory valve, expiratory valve and ventilator circuit.
3. A control system, including a control panel, monitoring and alarms
4. A system to sense when the patient is trying to take a breath

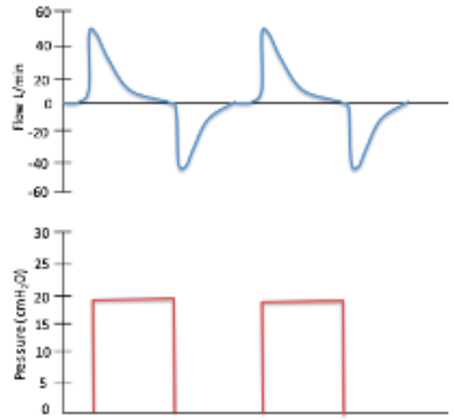
The most commonly employed modes are as follows:

- **Volume control ventilation (VCV) also known as continuous mandatory ventilation, or intermittent positive pressure ventilation.**
  - In this mode the user selects the volume of gas to be delivered with each breath (V_T) and the rate at which those breaths are to be delivered (RR). Each ventilation breath is delivered with a constant inspiratory flow. To maintain this fixed rate of gas flow the pressure must increase throughout inspiration. To avoid lung injury it is important to set a pressure limitation (usually 30 – 35 cm H_2O). When this pressure is reached, inspiratory flow will cease or slow, which may result in a lower V_T being delivered

The flow and pressure curves for volume control ventilation can be seen below. Compare it to the flow and pressure curves for pressure control ventilation. In which groups of patients that you have come across might each be useful and why?



- **Pressure control ventilation (PCV).**
  - In this mode the user directs the ventilator to deliver gas at a set pressure for a certain period of time and at a set frequency.
  - The V_T will depend upon the compliance of the lungs. Close attention must be paid to the V_T to avoid under-ventilation or volutrauma secondary to over-ventilation.



- **Pressure support ventilation (PSV) also known as assisted spontaneous breathing (ASB).**
  - The ventilator senses a patient's spontaneous breathing effort and supports this by delivering gas flow at a set pressure. The inspiratory time and frequency are determined by the duration of the patient's spontaneous effort. If the patient stops breathing, no breaths will be delivered, however, most ventilators have an apnoea alarm and the option to set an emergency back-up ventilation mode such as VCV or PCV.
- **Synchronous intermittent mandatory ventilation (SIMV).**
  - This is a mixed mode which offers the patient pressure supported breaths when they are generating spontaneous breaths, or mandated PCV or VCV breaths if the spontaneous rate falls below a stated frequency.

Whichever mode of ventilation you choose, it is recommended that you aim to deliver a V_T of ≤ 6ml/kg ideal body weight, and plateau pressures of ≤ 30 cmH_2O, as per the **ARDSnet study**.

Before you complete the invasive ventilation electure in week one, have a play with the Interactive Hamilton Ventilator Simulator. Try to set up each mode of ventilation as described above.

You can access the simulator at **https://www.hamilton-medical.com/.static/HAMILTON-T1/start.html**

Handover and Safety Brief

"Handover" is the accurate, reliable and safe transfer of information across shift changes or between teams and is recognised to be a high risk clinical event. It is well recognised that failure of communication during handover of information may lead to unnecessary diagnostic delays, patients not receiving required treatment, and medication errors.

You learnt about effective handover and the use of structured aids such as the SBAR tool during your fundamentals of critical care course.

Within your virtual critical care unit, formal handover occurs twice a day.

In 2007 the Joint Commission International (JCI) and the World Health Organization suggested implementation of a standardised approach to handover communication by using the SBAR (Situation, Background, Assessment, Recommendation) technique.

You should attend morning handover during week one of your placement on the virtual intensive care unit at
https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1/todo/72869

Daily Assessment of a Critically ill patient

The daily assessment is a systems-based approach to assessing a critical care inpatient. This assessment should allow recognition of clinical trends and to inform the short- and long-term management plan. We would recommend using standardised patient assessment documentation such as the proforma document which is available on your learning page. This will prompt you to examine all body systems and will make it simpler to compare to previous days assessments.

Before commencing the daily assessment, it is important to familiarize yourself with the patient's clinical history.

- It is useful to note the day of their ICU admission.
- Try to formulate a list of their current clinical issues.
- Is there any relevant past medical history?
- Does the patient have any planned interventions today or outstanding investigations to chase?

Having the above information to hand will make the interpretation of your clinical findings easier.

Remember to follow good infection control practices when approaching the patient and to maintain patient privacy.

You can watch the daily assessment of a patient at
https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1/todo/72869

Daily Review Checklist

AIRWAY

- How is the airway secure? ETT, SACETT, Trache. Size of airway. Position of airway.
- Grade of intubation.
- Head up?
- Tie vs tapes for securing airway – how is it secured
- Suctioning – any difficulties – what is coming up
- Mouth care – any issues with sores/oral thrush

BREATHING

- Expansion, air entry, added sounds
- Ventilation - settings
- CXR
- ABG analysis
- Weaning
- Oxygen and $PaCO_2$ targets
- Positioning of patient

CIRCULATION

- Support
- Lines
- Monitoring
- Transfusion target
- Fluid management/fluid balance
- IV access – central/peripheral/IO (when and why)
- Renal function
- Microbiology – temp, WCC

DISABILITY

- Devices review
- Drugs review (Med Rec) and Drug Levels e.g. gentamicin; Anti-microbials
- Analgesia/sedation
- Delirium
- Suitability for sedation hold
- GCS for neuro patients

EVERYTHING ELSE

- Bloods
- ECG; CXR; other imaging required?
- TPN
- Pressure areas/wounds/drains
- Mobilization

THE F's

- Feed
- Fluids

GI ULCER PROPHYLAXIS

- Bowels
- Glycaemic control

COMMUNICATIONS

- Family
- Incapacity form
- DNACPR
- Escalation of support decisions
- Anticipatory care planning for discharge

FINAL HOUSEKEEPING CHECK LIST

FASTHUGS BID

Feed/fluids/family
Analgesia
Sedation
Thromboprophylaxis
Head up
Ulcer prophylaxis
Glucose control
Spontaneous breathing trial
Bowels
Indwelling catheter review
Drugs: Medicines Reconciliation and de-escalation

WGH DAILY COVID-19 WARD ROUND CHECKLIST (adapted from Cardiff COVID-19 Checklist: K Nunn, R Baruah, A Morgan)

Date: / / Consultant: Previous 24 hours/chart reviewed? Y □ N □

AIRWAY	Yes	No	AIMS	Considered?
Tube size appropriate? Subglottic suction			Suction passing freely and secure for nursing care/airway sampling If more than 3 days ventilated consider repeat deep tracheal aspirate for COVID-19 PCR and screen for other infections/VAP/supra-infection From 10 days consideration of tracheostomy (team discussion, organise early family discussion to broach subject)	
Position at teeth/lips?				
Cuff leak (audible or measurable)?				
Appropriately secure (change AnchorFast for tape/ties if due proning patient)?				
>3 days ventilated?				
>10 days ventilated?				
BREATHING	**YES**	**NO**	**AIMS** **SpO2 88%-92% pre-existing lung disease, or 92%-96%, H+ <60 or pH>7.2, PaO2 >8kPa, 6mls/kg PBW Vt**	**Considered?**
Ventilator safety? (Lung Protective Ventilation)			6 mls/kg tidal volume PBW using our ulnar measuring chart	
			PEEP 8-20cmH20, Pplat ≤30 cmH_2O, driving pressure ≤14 (COVID patients likely to need high PEEP levels)	
FiO_2 ≤ 40%?			• Wean to supported spontaneous mode then CPAP • Stable (usually 12+ hours)? Consider staffing & expert advice for extubation to HFNO/facemask (consider staff/other patient PPE)	
FiO_2 40% - 60%?			ALWAYS AIM FiO_2 < 60% CONSIDER: Mucus plugging, pneumothorax, 2° bacterial infection, PEEP trial, repeat chest ultrasound +/- CXR	
FiO_2 ≥ 60%?			• Haemodynamics acceptable for trial of diuresis? • Atracurium and TOF ≤2 • Recruitment (**NOT** staircase) • Prone early (PF≤20) • No improvement? Expert input ECMO, APRV	
CIRCULATION	**YES**	**NO**	**AIMS** **MAP > 60 mmHg, neutral or negative fluid balance**	
Noradrenaline 1st line vasopressor ≥20mls/hr 8mg% commence hydrocortisone ≥13mls/hr 16mg% commence vasopressin Dobutamine for cardiogenic shock			Search for septic source, review fluid balance, consider small fluid boluses (100mls)	
			Add cardiac output monitoring and FICE scan, fluid boluses must be guided by additional monitoring	
			Consider milrinone if RV impairment	
Positive fluid balance and either static or reducing vasopressor requirements?			Frusemide 20 mg BD IV, increase current dose or start infusion (may reduce nursing PPE/proximity exposure and haemodynamic effect). Avoid maintenance fluids, minimise drug/infusion volumes	
			RRT, early evidence poor outcome in this COVID-19 group (depending upon patient, regional and national picture it would be appropriate to discuss this with another/experienced intensivist)	
CPR/escalation decisions?			Family discussion, local + regional + national picture	
SEDATION	**YES**	**NO**	**AIMS** **Calm and safe**	
FiO_2 ≤ 50%, PEEP ≤ 12			Daily sedation hold	
			RASS and CAM-ICU assessment and wean as able	
			Risk of PRIS (>4mls/kg/hr propofol, new acidosis, ECG changes)? Check CK and lipids, stop propofol and change to midazolam/clonidine	
EXPOSURE **(is external cooling required?)**	**YES**	**NO**	**AIMS** **Minimise procedures and lines, esp. minimise no. of contacts nurse has to have e.g. rationalise admin times with pharmacist**	
Feed?			NG and/or TPN, check BM +/- ketones	
Bowels?			Bowel protocol, intranet, critical care	
Bloods reviewed?			Any need to check CRP/Troponin/CK/ferritin/D-dimers?	
Medicines rationalised?			Minimise admin times, GI protection, LMWH. Any adjustments required for renal function?	
Samples?			Including COVID-19 clearance	
Family update?			Sensitive to reduced visiting	
Now, give the patient a FLAT HUG, summarise and plan with the team, especially bedside nurse				

Routine elements of care in the daily assessment

As part of your daily assessment, it is important to spend a few minutes ensuring the appropriate elements of routine care are in place for your patient. Routine elements of care can be broadly defined as elements of supportive and preventative care for a critically ill patient which are standardised, regardless of the presenting pathology. This aims to reduce the burden of ICU acquired complications for patients.

The origins of the FASTHUG mnemonic are attributed to JL Vincent, who published an article describing it in 2005. It is meant to serve as a mental checklist to ensure that elements of routine care are checked daily for every patient.

The FASTHUGS BID approach

Component	Consideration for Intensive Care Unit (ICU) Team
Feeding	Can the patient be fed orally, if not enterally? If not, should we start parenteral feeding?
Fluids	Check 24 hour fluid balance and plan for next 24 hours
Family	Are family, friends, carers up to date. Do we need to plan a meeting with them?
Analgesia	The patient should not suffer pain, but excessive analgesia should be avoided
Sedation	The patient should not experience discomfort but excessive sedation should be avoided; “calm, comfortable, collaborative” is typically the best
Thromboembolic prevention	Should we give low-molecular-weight heparin or use mechanical adjuncts?
Head of the bed elevated	Optimally, 30° to 45°, unless contraindications (e.g. threatened cerebral perfusion pressure)
Stress Ulcer prophylaxis	Establishing enteral feed is ideal. Proton pump inhibitors are used.
Glucose control	Within limits defined in each ICU
Bowels	Are they moving? Often enough? Too much? Assess and plan using local protocol.
Indwelling catheter review	Look at all tubes and lines. How long have they been in? Are they still required? Do they need to be changed?
Drugs: Medicines Reconciliation and de-escalation	Medicines reconciliation and de-escalation

Documentation and provisional plans

When documenting the daily assessment you must begin with a brief summary outlining the patient’s duration of stay, main diagnoses, and details of injuries, procedures or interventions. Ensure that all of your documentation includes the patient’s name, date of birth, unique hospital number, and the name of the consultant or consultants responsible for their care. Record the details of your examination findings and then summarize with a current problem list and short-term plan. If you have any queries or concerns, then discuss with other members of the medical team. The patient’s management plan will be reviewed on the consultant ward round.

The Consultant Ward Round

Once the daily assessments are complete, a consultant led ward round takes place. This is an opportunity for multi-disciplinary input into the patient's care plan

On the ward round in our virtual care unit you will hear input from a critical care consultant, one or more team doctors, the bedside nurse, the nurse in charge of the floor, the pharmacist, and possibly a physiotherapist, respiratory therapist or some medical students.

The doctor who has performed that patient's daily assessment should present to the team a brief clinical background and the pertinent findings from the clinical assessment. The bedside nurse is then given the opportunity to list the patient's current concerns. With all of the data presented before them, and the opportunity to call on the expertise within the team, the consultant is then able to create an immediate and longer term management plan for that patient.

As part of the ward round the Consultant will also ensure that elements of routine care as described above are in place.

Join the Consultant led ward round at
https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1/todo/72869

Goal Setting

At the end of every Consultant-led ward round, we always set daily goals for every patient. This allows the team to set goals for every organ system, in and order to move the patient forwards and to progress their care. The goals must be clear, documented either in the notes or via a checklist, and clearly communicated to the whole team caring for the patient.

The goals set for each patient includes (if appropriate):

- **Respiratory goal setting** – This might include targets for gas exchange, weaning goals and plans for extubation
- **CVS** – Weaning of vasopressors, target MAP setting eg "MAP 65-70mmHg"
- **GI** – Bowel protocol, plans for nutritional intake, weight
- **Renal** – Fluid balance goal eg "minus 1500ml in next 24 hours"
- **Neurological** – Sedation goals (RASS), CPP targets
- **Other** – Physiotherapy and mobilisation goals. Plans for updating families

REMEMBER APPROPRIATE PPE

Critical Care Management of COVID-19

Alastair Morgan, Andy Boyle

NHS Lothian

AIRWAY

- Use the COVID intubation checklist
- Assign roles and prepare in advance
- COETT with subglottic suction essential
- Minimise aerosolisation risk

VENTILATION

Initial mode = SIMV (Ward 20) or SIMV PCV-VG
Tidal volume 6mls/kg according to ulnar charts
RR: start at 20-25
PEEP: 12-20cmH_2O but beware of CVS collapse
Plateau pressure ≤ 30cmH_2O
Target $SpO_2 \geq 92\%$, $PaO_2 \geq 8kPa$, $H^+ \leq 65$
Paralysis if high FiO_2 requirement or dysynchrony
Proning - FiO2 ≥ 0.6, PaO_2/FiO_2 ratio <20

HAEMODYNAMICS

- Noradrenaline targeting MAP 60-65mmHg
- Hydrocortisone 50mg 6hrly (≥20mls 8mg%NA)
- Vasopressin (≥13mls 16mg% NA)
- Cardiac output monitoring – add dobutamine if cardiogenic shock/myocarditis
- Aim for neutral-negative fluid balance

INVESTIGATIONS

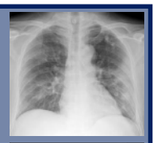
- Routine ICU panel
  - Lymphopenia common
  - Transaminitis
  - Low albumin
  - Deranged PT
  - CRP often elevated
- Nasal/Pharyngeal viral swabs
- Deep tracheal aspirate
- Blood cultures, sputum
- ECG and troponin

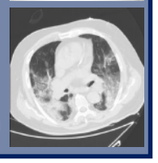
PRONING – use the checklist

- Ensure that all lines are inserted and imaged
- Check PaO_2/FiO_2 ratio 60 minutes after proning – if improved then keep patient prone ≥ 16 hours
- May require 5-7 days of proning
- VV ECMO: refractory hypoxaemia – follow national referral pathway

DIAGNOSTICS AND IMAGING

- CXR post line insertion or if clinical deterioration
- CT: avoid if possible unless considering alternative diagnoses/complications
- Lung Ultrasound:
  - Diffuse B-profile may respond to increased **PEEP (Pattern 1)**
  - Atelectasis/consolidation may respond to **PRONING (Pattern 2)**
- FICE – reduced LV function due to sepsis, viral cardiomyopathy or myocarditis





SEDATION

(AIM: safe patient whilst minimising secondary effects)

- Propofol ≤ 4mg/kg/hr – monitor for PRIS
- Avoid benzodiazepines if possible
- Add clonidine for agitation if haemodynamically stable
- Daily sedation holds when oxygenation improving (FiO_2 ≤0.5, PEEP ≤ 12)

ADDITIONAL TREATMENTS

- Antibiotics according to LUHT guidelines if secondary infection suspected
- Anti-virals: local guidance will be based on emerging evidence & research trials
- HLH suspected – check ferritin level and discuss with haematology team
- Late onset viral myocarditis – stabilise with inotropes, refer for VA ECMO

DAILY HOUSEKEEPING

F Feeding – refer to dieticians
L Lines
A Analgesia and Sedation
T Thromboprophylaxis
H Head up Position
U Ulcer prophylaxis – Pantoprazole 40mg IV
G Glycaemic Control – check ketones
S Spontaneous Breathing Trial

Self-Care and Staff Well-being

03

Dorothy Armstrong and Graham Nimmo

Introduction

This sections provides useful information and the links to FutureLearn to enable you to appreciate the importance of caring for yourself.

https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1/todo/72869

Experiencing adversity, suffering or trauma takes its toll so be kind to yourself – Kristin Neff suggests we should treat ourselves like a good friend: gently with acceptance, compassion and kindness.
Key to self-care is to acknowledge and accept the rollercoaster of emotions you may be feeling

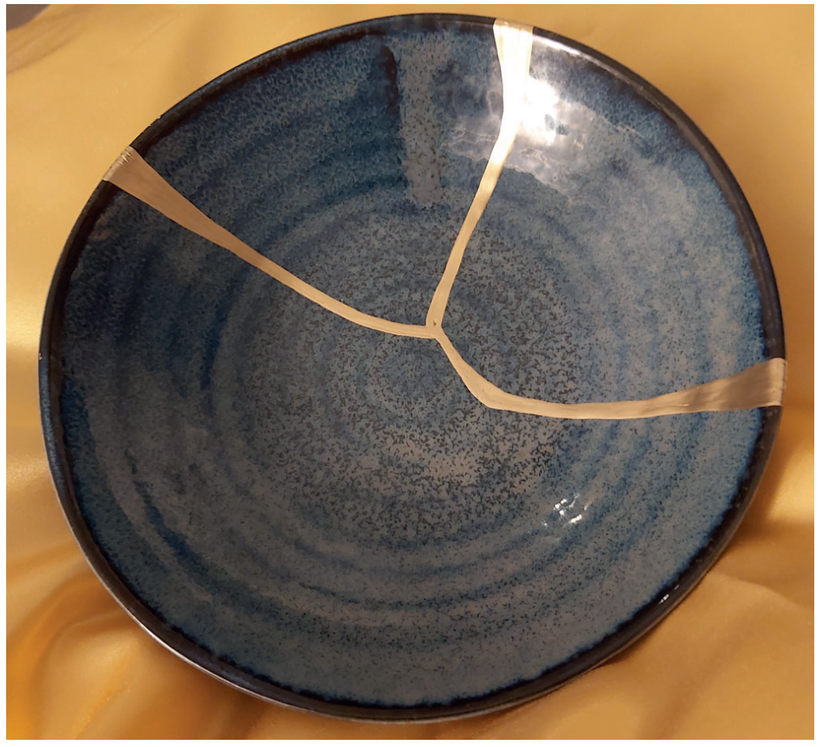
Managing our emotions begins with self-awareness and this graphic may be useful to focus on when you are feeling vulnerable

Being able to pause and breathe – being truly present in the moment. Being aware of what is within your gift and what is outwith your control as described by Covey's circle of concern. Letting-go is about recognising where you can use your energy and let go of the more trivial thoughts or irritations. Finally you are encouraged to experience and savour life at it's best. Often thinking of our senses can be powerful and refocus on what matters in our lives.

This model demonstrates how in order for us to be most effective we should be in a safe place or perhaps somewhat challenged. If we are overwhelmed, we begin to feel anxious or afraid or stressed and our ability to think is impaired.

*** We are all perfectly imperfect and giving our best is enough.**

The Japanese art of Kintsugi repairs broken pottery using gold as a metaphor for our lives and embracing our imperfections as strengths adding to our unique beauty.



Self-compassion

"We can learn to embrace our lives, despite our imperfections and provide ourselves with the strength needed to thrive" **Kristin Neff**

We are all aware of the safety brief on a plane and understand "Put your own oxygen mask on first before helping others" It's the same with caring for ourselves: in order to be at our best and most effective at work you need self-compassion.

*** Put your own oxygen mask on first before helping others**

Facts

More people are struggling with keeping well –increasing mental ill-health in young people and suicide and rates of absenteeism and presenteeism.

We cannot escape suffering in our lives and at work but we can change the way we respond.

"Between stimulus and response there is a space. In that space is our power to choose our response. In our response lies our growth and our freedom." **Viktor Frankl**

What is Self-Compassion?

Treating yourself like you would a friend – be an inner ally rather than a critic! There are three elements:

- **Self kindness** – supporting and encouraging, accepting our imperfections and celebrating our strengths
- **Common humanity** – we are all human and all experience struggles and hardship in our lives and at work
- **Being present (or mindful) in a balanced way** – noticing and accepting in the here and now. Being present – starts with you

Treat yourself like a good friend

Think of a close friend who was struggling in some way – what did you say / do? Now think of a time you were struggling. How did you respond? What did you notice?

Try the self-compassion exercises at home.

What's the kindest things I can do for myself right now?

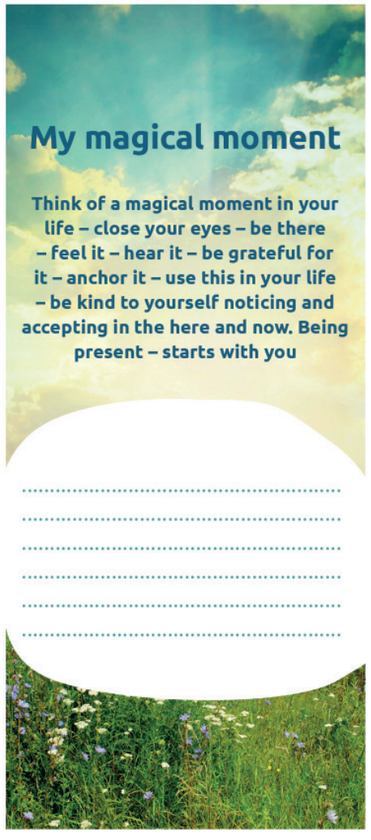
Meeting our emotions

Kristin Neff describes the importance of meeting our emotions rather than resisting. Meeting difficult emotions

- Resisting
- Exploring
- Tolerating
- Allowing
- Accepting

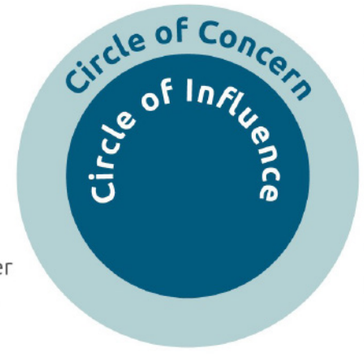
Check out your own self-compassion – visit Kristen Neff's website at **www.self-compassion.org** – and test how self compassionate you are.

*** Name it you tame it - if you resist it persists**



Focus on your Circle of Influence

Spend your energy on what you can affect directly rather than what you have little control.



Bounce back

Recognising stress and calm

CALM

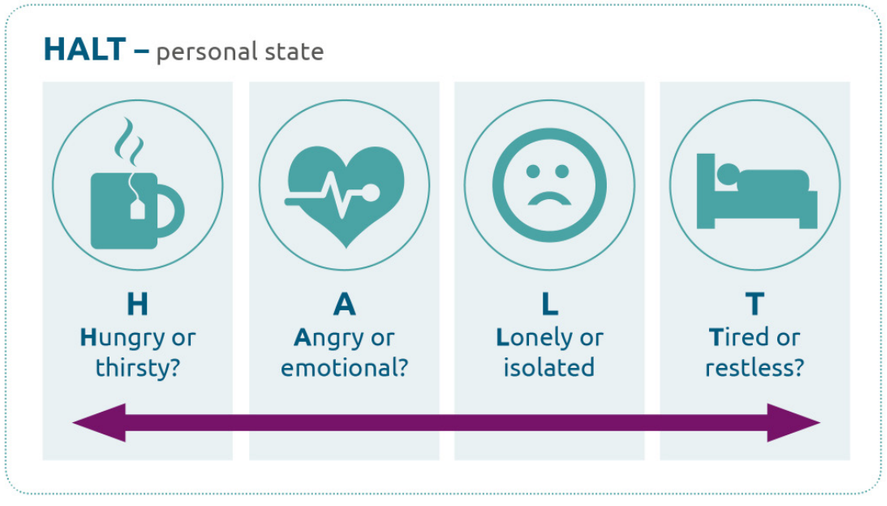
Compose yourself – take a deep breath and press the pause button

Attention – notice your own feelings and give the other person your full attention

Listen – identify the key words and emotions

Mindful – be truly present in the moment

At this time more than ever you are invited to notice, without judgement, the triggers that may add to your stress and what steps you can put in place to shift to a state of calm. Find your own strategies outlined here in this HALT diagram



Reaching out

Please take care of yourself and if you have feelings of overwhelming distress or suicidal thoughts, ask for help. Use the local support available to you at work and at home, Charities such as Samaritans in the UK or speak to your own doctor.

"Our human compassion binds us the one to the other – not in pity but as human beings who have learnt how to urn our common suffering into hope" **Nelson Mandela**

Resources

You will find a number of resources including videos, audios and graphics here
https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1/todo/72869

Emergencies and practical resources toolkit

04

Emergency equipment

You can watch the video of the airway trolley at
https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1

Airway and tracheostomy emergencies

The 4th National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society; major complications of airway management in the UK (NAP4) reported high rates of airway related complications within the Intensive care Unit[7]. Airway-related complications were more likely to occur within critical care than in theatre and were significantly more likely to result in major morbidity and mortality. NAP 4 reported rates of airway-related complications within critical care that was more than 50 times that during anaesthesia, with a mortality of almost 50% of patients who suffered a major airway event within critical care. Whereas most airway complications during anaesthesia arose at intubation, the majority of life-threatening airway events on ICU involved accidental airway dislodgement, especially of tracheostomies.

Human factor errors were described in 40% of the cases reported within NAP 4, although subsequent analyses have suggested this figure is much higher.

The NAP 4 report highlighted both organisational failings and individual errors in contributing towards these airway disasters.

In response to the NAP 4 report, critical care teams have been preparing for emergencies within the critical care environment making use of simulated emergency drills and cognitive aids. In addition, there has been a big push to train staff and to standardise responses to tracheostomy management with the national tracheostomy patient safety programme.

Failed Intubation

Difficulty with intubating the trachea occurs in approximately 1-3% of intubation attempts. In approximately half of all cases it is not predicted.

Whilst there are some predictors of difficult intubation including thyromental distance and the Mallampati test, these anatomical hallmarks are not reliable at predicting difficult intubation.

Within a critical care unit patients requiring intubation and ventilation are also physiologically difficult, often hypoxic, and may be shocked. The period of apnoea tolerated may be considerably shortened in comparison to patients undergoing anaesthesia for elective surgery. There also tends not to be the option to wake patients up if unanticipated difficult intubation is encountered.

If an anaesthetised patient cannot breathe spontaneously or the lungs cannot be otherwise ventilated via the use of a bag valve mask, then the patient will be said to be in a “can’t oxygenate, can’t ventilate scenario” and direct front of neck access to the trachea may have to be obtained.

In 2017, the difficult airway society (DAS) published their guidelines for the management of unanticipated difficult intubation in critically ill adults[10]. This standardised the approach to this crisis and encourages teams to verbalise a plan A-D prior to the RSI attempt.

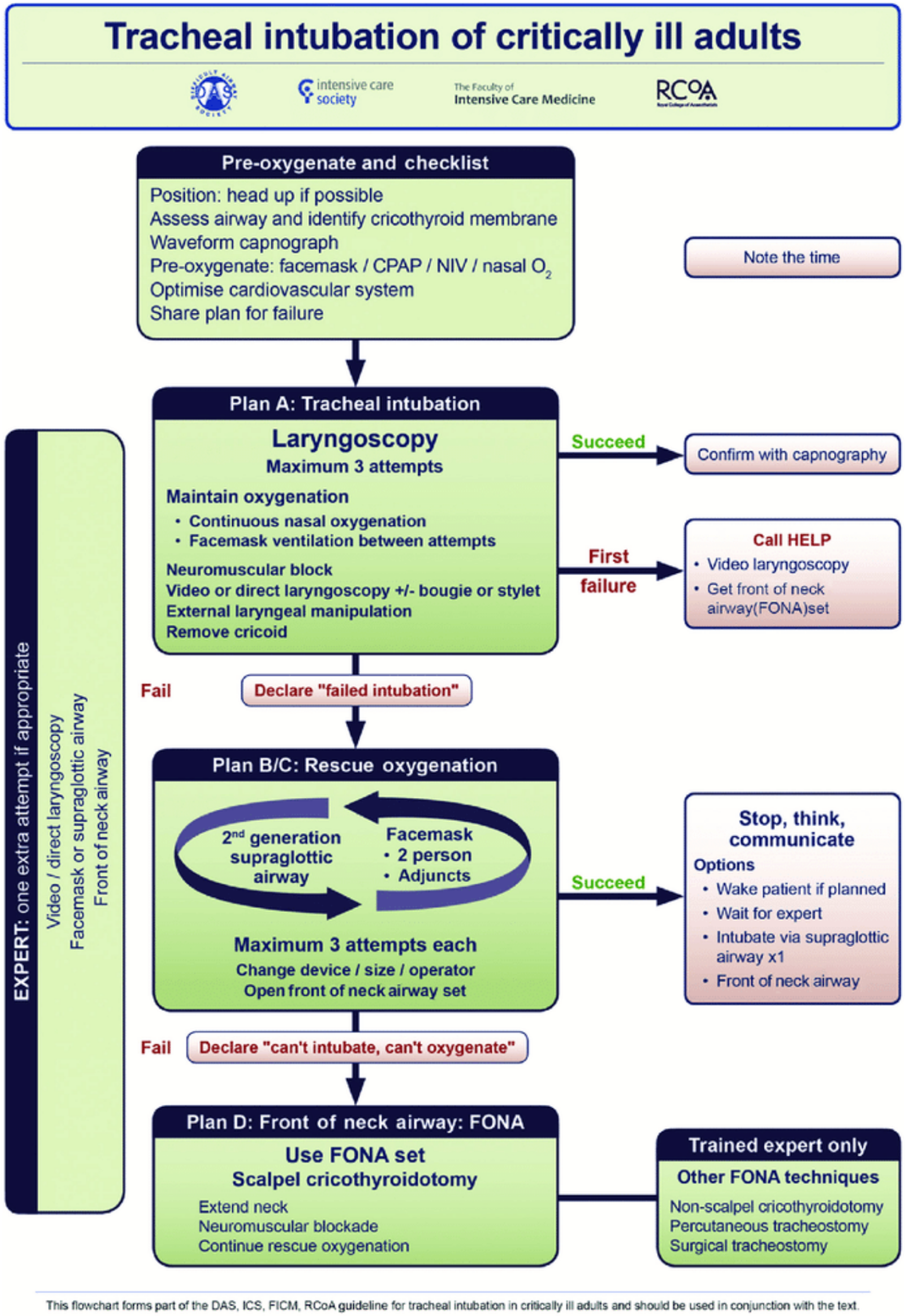
Prior to the commencement of an intubation attempt in the critically ill adult the whole team should complete a pre-procedure checklist. The DAS/ RCOA/ FICM RSI checklist is shown below.

Intubation Checklist: critically ill adults - to be done with the whole team present

Difficult Airway Society; Intensive Care Society; Faculty of Intensive Care Medicine; Royal College of Anaesthetists

Prepare the patient	Prepare the equipment	Prepare the team	Prepare for difficulty
☐ **Reliable IV/IO access** ☐ **Optimise position** ☐ Sit-up? ☐ Mattress hard ☐ **Airway assessment** ☐ identify cricothyroid membrane ☐ Awake intubation option? ☐ **Optimal preoxygenation** ☐ 3 mins of ETO_2 >85% ☐ Consider CPAP/NIV ☐ Nasal 0_2 ☐ **Optimise patient state** ☐ Fluid/pressor/inotrope ☐ Aspirate NG tube ☐ Delayed sequence induction ☐ **Allergies?** ☐ ↑Potassium risk? - avoid suxamethonium	☐ **Apply monitors** ☐ SpO_2/waveform $ETCO_2$/ ECG/BP ☐ **Check equipment** ☐ Tracheal tubes x2 -cuffs checked ☐ Direct laryngoscopes x2 ☐ Videolaryngoscope ☐ Bougie/stylet ☐ Working suction ☐ Supraglottic airways ☐ Guedel/nasal airways ☐ Flexible scope/Aintree ☐ FONA set ☐ **Check drugs** ☐ Consider ketamine ☐ Relaxant ☐ Pressor/inotrope ☐ Maintenance sedation	☐ **Allocate roles** One person may have more than one role ☐ Team Leader ☐ 1st Intubator ☐ 2nd Intubator ☐ Cricoid force ☐ Intubator’s assistant ☐ Drugs ☐ Monitoring patient ☐ Runner ☐ MILS (if indicated) ☐ Who will perform FONA? ☐ **Who do we call for help?** ☐ **Who is noting the time?**	☐ **Can we wake the patient if intubation fails?** ☐ **Verbalise** “Airway Plan is:” ☐ **Plan A:** Drugs & laryngoscopy ☐ **Plan B/C:** Supraglottic airway Face-mask Fibreoptic intubation via supraglottic airway ☐ **Plan D:** FONA Scalpel-bougie-tube ☐ **Does anyone have questions concerns?**

Following the completion of the checklist and the verbalisation of the A-E plan, the Emergency Intubation can then proceed with the following steps occurring in the case of an unanticipated difficult airway.



This flowchart forms part of the DAS, ICS, FICM, RCoA guideline for tracheal intubation in critically ill adults and should be used in conjunction with the text.

Unintentional Extubation

Immediate Actions

1. **Call for help**
2. **Use self-inflating bag with reservoir and facemask to support breathing. If muscle relaxed insert oropharyngeal airway and hand ventilate using a two person technique. Check that chest is moving.**
3. **Check that bag is attached to oxygen source set at 15L/min.**
4. **Keep capnography in the circuit and observe for trace with ventilation.**
5. **Maintain until advanced airway provider arrives.**

Graham Nimmo April 2020 Based on ACCP Transfer Action Cards NHS Lothian

Sudden Drop in SpO_2 in the Intubated Patient

Immediate Actions

1. **Call for help**
2. **Turn up oxygen to 100% and ensure it is getting there**
   - **a.** Cylinder
   - **b.** Wall supply
   - **c.** Ventilator tubing connections
3. **Assess airway**
   - **a.** Check ET tube position and patency: length at teeth; sounds of cuff leak; pass suction catheter
   - **b.** Review $ETCO_2$ trace
   - **c.** Check ventilator function
4. **Assess breathing**
   - **a.** Observe and palpate chest bilaterally for movement
   - **b.** Auscultate bilaterally
   - **c.** Check ventilator function
5. **Assess circulation**
   - **a.** Palpate carotid or femoral pulse
   - **b.** Assess HR and BP
   - **c.** Atropine or glycopyrronium for severe bradycardia
6. **Check SpO_2 probe position**

If there is any doubt about ventilator function, disconnect the tubing from the tube and manually bag the patient with self-inflating bag with reservoir, and connected to 15 L/min oxygen.

Consider and rule out:

- **Disattachment of the circuit**
- **Displacement of airway**
- **Airway obstruction**
- **Pneumothorax**
- **Cardiac arrest**
- **Failure of capnography monitoring**
- **Failure of ventilator equipment**

Graham Nimmo April 2020 Based on ACCP Transfer Action Cards NHS Lothian

Sudden high airway pressures

Immediate Actions

1. **Call for help immediately**
2. **Turn up oxygen to 100%**
3. **Assess airway**
   - **a.** Check ET tube position and patency: length at teeth; pass suction catheter
   - **b.** Difficulty passing suction catheter: consider tube obstruction or migration down a main bronchus
4. **Assess chest: inspect, palpate, auscultate**
   - **a.** Consider pneumothorax
   - **b.** Consider endo-bronchial intubation
   - **c.** Identify bronchospasm: administer salbutamol
5. **Is the patient 'fighting the ventilator'?**
   - **a.** Consider sedation bolus
6. **Check ventilator and settings**
7. **Check connections and tubing for any obstruction or kinks**
8. **Disconnect patient from ventilator and bag manually with 100% oxygen**
9. **If SpO_2 falling go to Falling SpO2 Action Card**

Consider and rule out:

- **Displacement of airway**
- **Obstruction of circuit or ETT**
- **Tension pneumothorax**
- **Bronchospasm**
- **Cardiac arrest**
- **Ventilator dys-synchrony**

Graham Nimmo April 2020 Based on ACCP Transfer Action Cards NHS Lothian

Falling and loss of End Tidal CO_2

Immediate Actions

1 Call for help immediately

2 Turn up oxygen to 100%

3 Assess airway

a. Check ET tube position and patency: length at teeth; sounds of cuff leak; pass suction catheter

b. Review ETCO2 trace and look at the chest to assess adequacy of ventilation

c. If ET tube displaced but patient still ventilating hold on to tube until advanced airway help arrives

d. If ET tube displaced but patient not ventilating refer to Extubation Action Card.

4 Check ventilator, circuit connections and alarms

a. If low airway pressure disconnection or extubation is likely cause

5 Assess breathing and circulation

a. Listen to the chest and look at SpO2 monitor

b. Palpate carotid pulse

c. Check blood pressure

6 Check CO_2 monitor

a. Ensure capnograph monitoring line in circuit

b. Ensure capnograph not obstructed

Consider and rule out:

- **Disattachment of the circuit**
- **Displacement of airway**
- **Airway obstruction**
- **Pneumothorax**
- **Cardiac arrest**
- **Failure of capnography monitoring**
- **Ventilator failure**

Graham Nimmo April 2020 Based on ACCP Transfer Action Cards NHS Lothian

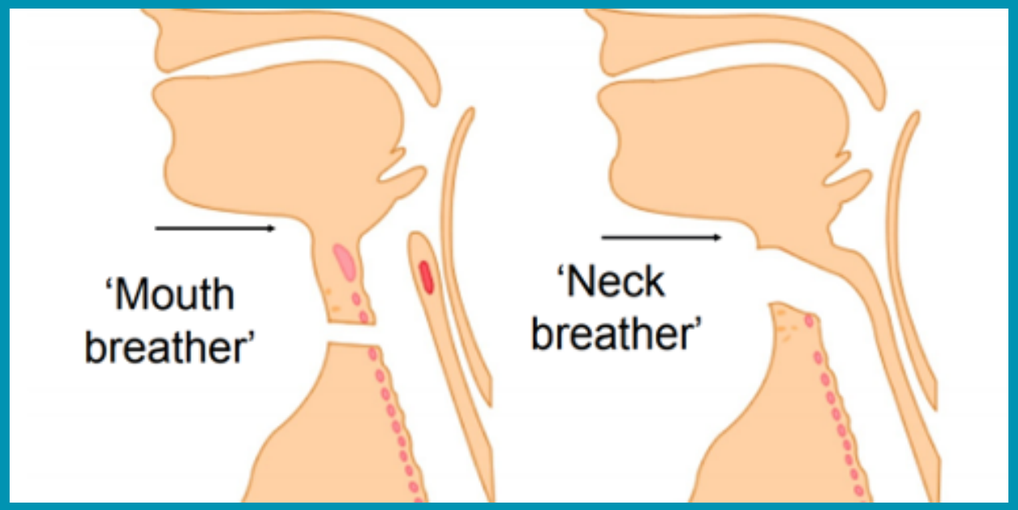
Tracheostomy Emergencies

The NAP 4 report highlighted that 70% of all reported airway events, and 60% of deaths, involved complications with tracheostomies. Disproportionally, dislodged or blocked tracheostomies were the major causes of mortality and morbidity on ICU. Movement of patients including turning was cited as a major risk period for patients with tracheostomies. In addition, many units did not have standardised guidelines or approaches to dealing with tracheostomy emergencies.

Following NAP 4, the National Tracheostomy safety project published guidelines for management of tracheostomy and laryngectomy management.

Are you clear on the difference between a Tracheostomy and a Laryngectomy ?

- A Tracheostomy is a semi permanent or permanent opening to the trachea. There is a patent upper airway and the patient may be oxygenated via the mouth or the tracheostomy stoma. They may also be called a “mouth breather”
- A Laryngectomy is the surgical removal of the larynx, usually completely and permanently. The remnants of the trachea are stitched to the anterior neck. There is no connection from the nose or mouth to the lungs. The patient cannot be oxygenated from the top end. They may also be called a “neck breather”



Tracheostomy emergencies are managed in a standardised way, as set out by the national tracheostomy safety project.

The emergency management algorithm is available on the next page.

You can attend our teaching session on the management of tracheostomy emergencies at https://www.futurelearn.com/courses/covid-19-critical-care-education-resource/1

Emergency tracheostomy management - Patent upper airway

Call for airway expert help
Look, listen & feel at the mouth and tracheostomy
A Mapleson C system (e.g. 'Waters circuit') may help assessment if available
Use **waveform capnography** when available: exhaled carbon dioxide indicates a patent or partially patent airway

Is the patient breathing?

No → Call Resuscitation Team **CPR if no pulse / signs of life**

Yes → Apply high flow oxygen to **BOTH** the face and the tracheostomy

Assess tracheostomy patency

Remove **speaking valve** or **cap** (if present)
Remove **inner tube**
Some inner tubes need re-inserting to connect to breathing circuits

Can you pass a suction catheter?

Yes → **The tracheostomy tube is patent**
Perform tracheal suction
Consider partial obstruction
Ventilate (via tracheostomy) if not breathing
Continue ABCDE assessment

No → Deflate the **cuff** (if present)
Look, listen & feel at the mouth and tracheostomy
Use waveform capnography or Mapleson C if available

Is the patient stable or improving?

Yes → **Tracheostomy tube partially obstructed or displaced**
Continue ABCDE assessment

No → **REMOVE THE TRACHEOSTOMY TUBE**
Look, listen & feel at the mouth and tracheostomy. Ensure oxygen re-applied to face and stoma
Use waveform capnography or Mapleson C if available

Is the patient breathing?

No → Call Resuscitation team **CPR if no pulse / signs of life**

Yes → Continue ABCDE assessment

Primary emergency oxygenation

Standard **ORAL airway** manoeuvres
Cover the stoma (swabs / hand). Use:
- Bag-valve-mask
- Oral or nasal airway adjuncts
- Supraglottic airway device e.g. LMA

Tracheostomy STOMA ventilation
- Paediatric face mask applied to stoma
- LMA applied to stoma

Secondary emergency oxygenation

Attempt **ORAL intubation**
Prepare for difficult intubation
Uncut tube, advanced beyond stoma

Attempt **intubation of STOMA**
Small tracheostomy tube / 6.0 cuffed ETT
Consider Aintree catheter and fibreoptic 'scope / Bougie / Airway exchange catheter

National Tracheostomy Safety Project. Review date 1/4/16. Feedback & resources at **www.tracheostomy.org.uk**

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Front cover image: Lou and Kirsty in Ward 20 Critical Care, Western General Hospital, Edinburgh by Dr Rosie Baruah