CG018 Mechanical Ventilation

Key Recommendations for operational use		
For use by: EMRS West and North. **Internet:** Yes		
1	F_iO_2	• Aim to maintain SpO_2 94-98%, avoid hyperoxia. • Target SpO_2 88-92% in patients with severe COPD. • Increasing F_iO_2 may not always correct oxygenation (e.g. large shunt).
2	Permissive Hypercapnia	• Consider permitting hypercapnia to allow lung protective ventilation. - contraindicated with raised intracranial pressure. • Aim to ensure pH >7.2 or H^+ <65 nmol/l.
3	Principles of lung protective ventilation	• Use lung protective strategies to prevent damage through atelectatrauma, barotrauma, volutrauma and biotrauma: - use Tidal Volume of 6-8 ml/kg of predicted body weight (PBW). - avoid plateau pressures of >30cmH_2O. - optimise PEEP. - avoid hyperoxia.
4	Predicted Body Weight (PBW)	• Calculate Tidal Volume (Vt) based on predicted body weight (PBW) not actual weight. • Use either: - patient's height and the calculator found in the EMRS app. - the ulnar length tape measure to derive 6ml/kg of PBW. • To use ulnar length: - bend patients arm, palm across chest, with fingers pointing to the opposite shoulder. - measure between the olecranon (point of the elbow) and the styloid process. - use the derived PBW on the laminated ruler.
5	Tidal Volume	• Use Volume Control as the default method of ventilation: - the Oxylog3000+ defaults to Autoflow, a decelerating flow pattern with a waveform similar to conventional pressure control modes. • Target initial Vt of 6ml/kg. • Increase to 8ml/kg or decrease to 4ml/kg as needed.
6	Plateau Pressure	• Plateau (rather than the peak) pressure reflects the pressure in the alveoli. • Measure Pplat in Volume Control: - to do this, turn off Autoflow in the "settings" menu of the Oxylog3000+. - Set Tplat to 10%. • Adjust Vt within the range to achieve plateau pressure <30cm H_2O.

7	Respiratory rate (RR)	• Use an initial respiratory rate (RR) of 14-18 / min. • Low tidal volume strategy may require a higher RR. • Increase RR up to 35/min if needed to maintain $PaCO_2$ within normal range. • With higher respiratory rates, watch for dynamic hyperinflation: - indicated by the end expiratory flow not returning to baseline/zero on the flow curve, or increasing airway pressures.
8	Positive End Expiratory Pressure (PEEP)	• Optimise PEEP with an aim of reducing F_IO_2 below 0.50. • Consider a trial of higher PEEP if a high F_IO_2 is required: - increase in increments up to 15cmH_2O. - this may be especially required with atelectasis and obesity. - may need to reduce if hypotensive or high airway pressures. • Ensure patient is volume resuscitated. • A paradoxical drop in oxygenation can occur with higher PEEP (e.g. large shunt).
9	Recruitment Manoeuvres	• Do not perform recruitment manoeuvres routinely. • Establish intra-arterial BP monitoring. • Consider using the "40 for 30" approach on the Oxylog3000+: - set Pmax above 40 cmH_2O. - change ventilator mode to Pressure Control. - set Inspiratory pressure to 40cmH_2O - Press and hold down the inspiratory hold button for 30 seconds (it will do a partial release at 15 seconds, ignore and keep holding, it will release fully at 30 seconds). - go back to baseline settings and ventilation immediately after. • Desaturation can occur during the recruitment; this should improve after. • Stop the manoeuvre if hypotension develops. • If SpO_2 improvement is transient, consider repeating recruitment and increasing PEEP.
10	Neuromuscular blockade	• Use boluses of muscle relaxant to facilitate safe transfer. • Consider muscle relaxants if having difficulty with mechanical ventilation / oxygenation. • Ensure adequate anaesthesia and consider awareness risk. • Consider administration to correspond with specific at-risk periods of the transfer e.g. unloading, loading and prior to handover.
11	Pressure controlled ventilation	• Default parameters for the Oxylog3000$^+$: - P_{insp} – defaults to 20cmH_2O. - PEEP– defaults to 5cmH_2O. • Subsequently adjust P_{insp} according to measured Vt. • Adjust inspiratory time (T_i) to achieve desired I:E; may affect tidal volume.

12	Refractory Hypoxia	• Increase FiO_2. • Sit up if possible. • Confirm bilateral air entry and ET tube position. • Suction ET tube. • Confirm ventilating at expected Vt and that MV is adequate. • Confirm paralysed, sedated and that BP is adequate. • Trial of higher PEEP. • Consider altering I:E towards a 1:1 ratio. • Consider recruitment manoeuvre once adequately fluid resuscitated. • Discuss with ICU team at receiving site or EMRS/ScotSTAR colleague • Consider ECMO referral prior to leaving referring site if hypoxia is not improved with recruitment manoeuvre and optimising cardiac output.
Specific circumstances		
13	Obstructive Airway disease	• High resistance causes high peak airway pressures, expiratory flow is markedly reduced which can result in gas trapping. • Turn off *Autoflow* setting on ventilator: - in the “settings” menu of the Oxylog3000+. • Prolong expiratory time: - decrease I:E ratio (aim for 1:2 to 1:4, perhaps even longer). - decrease respiratory rate. • Check flow curves on ventilator to ensure full expiration before the next inflation. • Initial PEEP range 0-5 cmH_2O. • Consider disconnecting from ventilator to allow expiration if increasingly difficult to ventilate or cardiovascular collapse. • Consider permitting hypercapnia. • High **peak** airway pressures may suggest airflow restriction rather than over-distension: - consider tolerating if adequate ventilation can not otherwise be achieved. - in these circumstances **plateau** airway pressure (during inspiratory hold) should still be acceptable ($<30cmH_2O$).
14	Pregnancy	• Keep $EtCO_2$ in the normal pregnant range (3.7-4.2kPa) • Start initial tidal volume of 8ml/kg: - pregnancy increases minute ventilation mainly through increased Vt. • Remember reduction in FRC and increased oxygen consumption.

15	Trauma	• Start with lung protective ventilation (LPV). • Titrate PEEP carefully in a hypotensive patient. • Consider relaxing LPV strategies if CO_2 outwith normal range and there is concern over head injury and the risk/benefit is in the favour of neuroprotection. • Start by increasing RR and then Vt can be increased if needed. • Refer to **CG005 Head injury**: - PaO_2 >13kPa. - $PaCO_2$ 4.5 - 5kPa or $ETCO_2$ 4.0-4.5kPa. - consider hyperventilation ($PaCO_2$ 4kPa or $ETCO_2$ 3.5kPa) for impending herniation.
16	Children	• Use Pressure control: - consider starting at inspiratory pressure 15-20 cmH_2O, expiratory pressure 5 cmH_2O. • Aim for tidal volume 6-8ml/kg, adjust inspiratory pressures accordingly. • Use normal RR for age (table). • Use paediatric Oxylog circuit for children 10-30Kg. • Use manual ventilation if child <10kg. • Refer to **CG012 Paediatrics.**

Age	Ideal body weight (kg)	Starting RR
Term	3.5	40-60
6 months	5	30-40
1 year	10	25-35
2 years	12	20-30
4 years	16	20
6 years	25	16

2. Document History			
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Writing group (Chair in bold)	Andrew Cadamy	Intensivist	EMRS
	Dan Graham	Emergency Physician	EMRS
	Arran Keir	Anaesthetist	GRI
	Jon McCormack	Anaesthetist	EMRS
	Shaun Mcleod	Anaesthetist	EMRS
	Richard Price	Intensivist	EMRS
	James Ronaldson	**Adv Retrieval Practitioner**	**EMRS**
Associate Medical Director	Andrew Inglis		
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Distribution	BASICS Scotland		X
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	ScotSTAR	EMRS (West)	✓
		EMRS (North)	✓
		Paediatric	X
		Neonatal	X
	Tayside Trauma Team		X

3. Scope and purpose

- Overall objectives:

The aim of this guideline is to provide safe, evidenced based advice regarding ventilation for intubated patients in the care of the Emergency Medical Retrieval Service. Mechanical ventilation can be lifesaving however it also has the potential to aggravate and precipitate lung injury. Lung-protective ventilation has been shown to mitigate against this in both ARDS and non-ARDS patients and has therefore become the standard of critical care worldwide.

This is relevant to our patient population as:

- Several studies have shown that early ventilator settings affect patient outcome.
- Patients can be ventilated with the transfer team for a long time before reaching the definitive ICU.
- Standards of critical care should be relevant to environments providing critical care outside the ICU.

- Statement of intent:

This guideline is not intended to be construed or to serve as a standard of care. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. Clinicians using this guideline should work within their skill sets and usual scope of practice.

- Feedback:

Comments on this guideline can be sent to: sas.cpg@nhs.scot

- Equality Impact Assessment:

Applied to the ScotSTAR Clinical Standards group processes.

- Guideline process endorsed by the Scottish Trauma Network Prehospital, Transfer and Retrieval group.

Explanatory Statements		
4.1 F_iO_2	**Authors' recommendation**	**Level [Reference]**
• *Aim to maintain SpO_2 94-98%, avoid hyperoxia.* • *Target SpO_2 88-92% in patients with severe COPD.* • *Increasing F_iO_2 may not always correct oxygenation (e.g. large shunt).* Hyperoxia may cause cellular damage via multimodal mechanisms including oxidative stress and can have multisystem effects. Hypoxaemia is usually defined as SpO_2 <90% and most patients will tolerate SpO_2 of ≥90%. Oxygen saturations decreases quickly below 88% so aiming for oxygen saturations of ≥94% during transfer of a patient on the lowest FiO_2 possible allows avoidance of hyperoxia whilst leaving some room to deal with deteriorations during transfer. In patients with chronic respiratory failure, oxygen saturations can be targeted to 88-92%.	Strong	[6] 1+

4.2 Permissive hypercapnia	**Authors' recommendation**	**Level [Reference]**
• *Consider permitting hypercapnia to allow lung protective ventilation.* - *contraindicated with raised intracranial pressure.* • *Aim to ensure pH >7.2 or H^+ <65 nmol/l.* Balance acceptable pH against lung protective ventilation (11). Generally, do not aim to normalise blood gas values but provide LPV and accept hypercapnia and a mild acidosis. Mild hypercapnia may be protective against lung injury and improves oxygen delivery. (12). Trying to normalise blood gasses in obstructive lung disease may also lead to gas trapping from too high a RR. Aim to keep keep pH >7.2 or H+ <63 nmol/l. In certain scenarios (eg, brain injury) an increased $PaCO_2$ may not be appropriate (12).	Conditional	[11] 3 [12] 4

4.3 Principles of lung protective ventilation	Authors' recommendation	Level [Reference]
• *Use lung protective strategies to prevent damage through atelectatrauma, barotrauma, volutrauma and biotrauma:* - *use Tidal Volume of 6-8 ml/kg of predicted body weight (PBW)* - *avoid plateau pressures of >30cmH_2O* - *optimise PEEP* - *avoid hyperoxia* Mechanical ventilation may aggravate and precipitate lung injury through volutrauma (over distension of alveolar units), barotrauma (from high pressures), atelectatrauma (from repeated alveolar collapse and re-expansion), biotrauma (tissue disruption leading to release of inflammatory mediators). Hyperoxia and oxygen toxicity can be injurious. Following on from the ARDSnet trial [2], lung protective ventilation has become common place in patients with ARDS. Studies in non-ARDS patients generally show benefits [3]. Thus lung protective ventilation using Vt of 4-8ml/kg of predicted body weight (usually with a starting of 6), alongside optimising PEEP, limiting plateau pressures and avoiding hyperoxia have become the standard of care (6).	Strong	[1] Guideline [2,3,4] 1++ [5,6] 1+

4.4 Predicted Body Weight (PBW)	Authors' recommendation	Level [Reference]
• *Calculate Tidal Volume (Vt) based on predicted body weight (PBW) not actual weight.* • *Use either:* - *patient's height and the calculator found in the EMRS app.* - *the ulnar length tape measure to derive 6ml/kg of PBW.* • *To use ulnar length:* - *bend patients arm, palm across chest, with fingers pointing to the opposite shoulder.* - *measure between the olecranon (point of the elbow) and the styloid process.* - *use the derived PBW on the laminated ruler.* Predicted body weight is based on the patient's age, height and gender. This is a better predictor of lung size. Actual body weight can cause excess Vt in obese patients or inadequate Vt in underweight patients. Several equations can be used to calculate predicted body weight, however these need an accurate height which can be difficult to obtain. Ulnar length measuring tapes are quick and easy to use and produce accurate results (8,9) This is based on the NIH National Heart, Lung and Blood Institute ARDS Network PBW equation.	Conditional	[8] 2 – [9,28] Guideline

4.5 Tidal Volume	Authors' recommendation	Level [Reference]
• *Use Volume Control as the default method of ventilation:* - *the Oxylog3000+ defaults to Autoflow, a decelerating flow pattern with a waveform similar to conventional pressure control modes.* Autoflow[R] (on the Oxylog 3000+) regulates inspiratory flow and pressure with a decelerating flow pattern usually associated with pressure-controlled ventilation. This delivers a set tidal volume at the lowest possible inspiratory pressure and reduces peak airway pressures. On the Oxylog3000+, Autoflow is automatically on with Volume control ventilation. It can be turned off in the settings menu, this is required to measure an accurate plateau pressure. Consider de-selecting Autoflow with bronchospasm.	Information	[7] Guideline
• *Target initial Vt of 6ml/kg.* • *Increase to 8ml/kg or decrease to 4ml/kg as needed.* Low tidal volume ventilation protects lungs by: - preventing "volutrauma" (over distension of some alveoli areas and under distension in other areas) - preventing barotrauma - preventing development of acute respiratory distress syndrome (ARDS) - suppressing activation of chemical inflammatory mediators	Strong	[4] 1++ [28] Guideline

4.6 Plateau pressure	Authors' recommendation	Level [Reference]
- *Plateau (rather than the peak) pressure reflects the pressure in the alveoli.* - *Measure Pplat in Volume Control:* - *to do this, turn off Autoflow in the "settings" menu of the Oxylog3000+.* - *Set Tplat to 10%.* - *Adjust Vt within the range to achieve plateau pressure <30cm H_2O.* Plateau pressure is a pressure measured in the lungs at the end of inspiration, when the lungs have come to a static, inflated state. It represents the alveolar pressure rather than the peak pressure (5). Peak pressure is a combination of the alveolar pressure, flow and airway resistance and can also be high due to eg, bronchospasm and ETT occlusion. Keeping plateau pressure below 30 cmH_2O is standard practice (1). At the end of the flow delivery phase, the expiratory valve remains closed until the end of the inspiratory time. This phase, the inspiratory pause, can be identified as the plateau **Tplat** and is defined as a percentage of the inspiratory time	Strong	[5] 1+ [1,28] Guideline

4.7 Respiratory rate	Authors' recommendation	Level [Reference]
• *Use an initial respiratory rate (RR) of 14-18 / min.* • *Low tidal volume strategy may require a higher RR.* • *Increase RR up to 35/min if needed to maintain $PaCO_2$ within normal range.* • *With higher respiratory rates, watch for dynamic hyperinflation:* - *indicated by the end expiratory flow not returning to baseline/zero on the flow curve, or increasing airway pressures.* If RR is too low, it may lead to alveolar hypoventilation, hypercarbia and worsening acidosis. RR may need to be increased to maintain minute ventilation in lung protective ventilation due to the lower Vt. This can be increased up to 35/min if needed. Monitor expiratory flow curves to avoid breath stacking secondary reduced expiratory time. This is more likely to occur in patients with obstructive lung disease. Available data do not allow a recommendation to be made regarding respirator settings based solely on limitation of driving pressure (29).	Conditional	[6] 1+ [28] Guideline

4.8 PEEP	Authors' recommendation	Level [Reference]

• *Optimise PEEP with an aim of reducing F_IO_2 below 0.50.*
• *Consider a trial of higher PEEP if a high F_IO_2 is required:*
  - *increase in increments up to 15cmH_2O.*
  - *this may be especially required with atelectasis and obesity.*
  - *may need to reduce if hypotensive or high airway pressures*
• *Ensure patient is volume resuscitated.*
• *A paradoxical drop in oxygenation can occur with higher PEEP (e.g. large shunt).*
Positive End-Expiratory Pressure (PEEP) can prevent airway and alveolar collapse and increase functional residual capacity (11). It therefore can improve V/Q matching, improve distribution of inspired gas and increase arterial oxygen tension. It can also reduce left ventricular afterload. PEEP should therefore be optimised; this may also allow the F_IO_2 to be reduced, avoiding the risks of hyperoxia. PEEP goals should be reassessed if vasopressor or fluid requirements increase after increasing PEEP, plateau pressure is greater than 30 to 35 cmH_2O or there is evidence of worsening tissue oxygen delivery or worsening oxygen saturation. PEEP may increase ICP however this needs to be balanced against any improvement in oxygenation. Unilateral or very focal lung diseases (pneumonia, mucous plugging, pulmonary contusions) may have a paradoxical response to increasing levels of PEEP.
	Strong	[10]
		1+

4.9 Recruitment Manoeuvres	Authors' recommendation	Level [Reference]
• *Do not perform recruitment manoeuvres routinely.* • *Consider using the "40 for 30" approach on the Oxylog3000+:* - *set Pmax above 40 cmH_2O.* - *change ventilator mode to Pressure Control.* - *set Inspiratory pressure to 40cmH_2O* - *Press and hold down the inspiratory hold button for 30 seconds (it will do a partial release at 15 seconds, ignore and keep holding, it will release fully at 30 seconds).* - *go back to baseline settings and ventilation immediately after.* • *Desaturation can occur during the recruitment; this should improve after.* • *Stop the manoeuvre if hypotension develops.* • *If SpO_2 improvement is transient, consider repeating recruitment and increasing PEEP.* Recruitment manoeuvres are transient increases in alveolar pressure above normal tidal volume designed to open up collapsed alveoli, this can then be maintained using PEEP. The role of recruitment manoeuvres and how they should be performed is controversial and it should not be considered part of routine practice. Potential pitfalls including haemodynamic instability and barotrauma. Recent RCTs have failed to show any benefit with one recently published RCT even showing potential harm (13,14,15). However there is still potential benefit in selected patients. The described method of "40 for 30" is one approach.	Strong	[13,14] 3 [15] 1+

4.10 Neuromuscular blockade	Authors' recommendation	Level [Reference]
• *Use boluses of muscle relaxant to facilitate safe transfer.* • *Consider if having difficulty with mechanical ventilation / oxygenation.* • *Ensure adequate anaesthesia and consider awareness risk.* • *Consider administration to correspond with specific at-risk periods of the transfer e.g. unloading, loading and prior to handover.* The movement of critically ill patients is not without risks. Aside from the environment, a patient who is 'fighting' the ventilator can be exposed to barotrauma, volutrauma from breathe stacking, and other complications (e.g., tube dislodgment). Pharmacological paralysis of the patient facilitates ventilator synchrony and optimises patient safety. The use of neuromuscular blockade (NMB) in ITU patients has steadily decreased. Long term consequences of NMB are increased rates of ventilator acquired pneumonia (VAP) and increased incidence of critical illness polyneuropathy. Recent evidence may suggest using NMBs in early, severe ARDS for 48 hours appears to be an acceptable, safe and possibly beneficial approach. (16,17,18).	Strong	[16] 1- [17] 1+ [18] 4

4.11 Pressure controlled ventilation	Authors' recommendation	Level [Reference]
• *Default parameters for the Oxylog3000⁺:* - *P_{insp} – defaults to 20cmH_2O.* - *PEEP– defaults to 5cmH_2O.* • *Subsequently adjust P_{insp} according to measured Vt.* • *Adjust inspiratory time (T_i) to achieve desired I:E; may affect tidal volume.* A disadvantage of PCV is that Vt delivery will increase and decrease with changes with patient compliance and volumes are not guaranteed. Constant vigilance is necessary to prevent under or over ventilating patients whose compliance changes. These compliance changes may occur due to underlying disease. PCV may however also provide advantages over VCV: • Lower peak airway pressures to deliver the same volume • Better volume distribution within the lungs • Less risk of barotrauma Volume controlled ventilation may not be the ideal mode for paediatrics. In children, the combination of small airways and small ET tubes causes high airway resistance. This may produce high inspiratory pressures.	Conditional	[20] 1- [21] 2+ [22] 4

4.12 Refractory hypoxaemia	Authors' recommendation	Level [Reference]
• *Increase FiO_2.* • *Sit up if possible.* • *Confirm bilateral air entry and ET tube position.* • *Suction ET tube.* • *Confirm ventilating at expected Vt and that MV is adequate.* • *Confirm paralysed, sedated and that BP is adequate.* • *Trial of higher PEEP.* • *Consider altering I:E towards a 1:1 ratio.* • *Consider recruitment manoeuvre once adequately fluid resuscitated.* • *Discuss with ICU team at receiving site or EMRS/ScotSTAR colleague* • *Consider ECMO referral prior to leaving referring site if hypoxia is not improved with recruitment manoeuvre and optimising cardiac output.*	Conditional	[1] Guideline [19] 4

4.13 Obstructive Airway disease	Authors' recommendation	Level [Reference]
• *High resistance causes high peak airway pressures, expiratory flow is markedly reduced which can result in gas trapping.* • *Turn off Autoflow setting on ventilator:* - *in the "settings" menu of the Oxylog3000+.* • *Prolong expiratory time:* - *decrease I:E ratio (aim for 1:2 to 1:4, perhaps even longer).* - *decrease respiratory rate.* • *Check flow curves on ventilator to ensure full expiration before the next inflation.* • *Initial PEEP range 0-5 cmH_2O.* • *Consider disconnecting from ventilator to allow expiration if increasingly difficult to ventilate or cardiovascular collapse.* • *Consider permitting hypercapnia.* • *High **peak** airway pressures may suggest airflow restriction rather than over-distension:* - *consider tolerating if adequate ventilation can not otherwise be achieved.* - *in these circumstances **plateau** airway pressure (during inspiratory hold) should still be acceptable (<30cmH_2O).* High resistance causes high peak airway pressures, reduced expiratory flow which can result in hyperinflation leading to cardiovascular compromise. The aim is to prolong expiratory time to allow complete exhalation. This can be done by reducing respiratory rate and/or decreasing the I:E ratio. Check the expiratory flow curve on the Oxylog to ensure full expiration before next inspiration. Gas trapping leads to intrinsic PEEP which will counter the tendency alveoli have to collapse without the application of external PEEP. However low levels of PEEP may stent airways open and reduce obstruction. If hyperinflation remains an issue then a further option is to disconnect the patient from the ventilator and manually decompress the chest. High peak airway pressures in these conditions are due mainly to airway resistance and should not cause as great a risk of barotrauma. Plateau pressure is the pressure at zero flow, with the effect of resistance eliminated, and so represents lung distension. The relative safety of peak airway pressures here however assumes lung homogeneity which may not be the case. If required higher peak airway pressures can be tolerated in order to achieve acceptable gas exchange, and as long as the plateau pressure remains <30cmH_2O.	Conditional	[23] 2++ [24] Guideline
Autoflow should be turned off as although peak insp pressure will be reduced, the mean pressures tend to be increased. Autoflow also precludes measurement of an accurate plateau pressure which is useful in this patient group.		

4.14 Pregnancy	Authors' recommendation	Level [Reference]
• *Keep $EtCO_2$ in the normal pregnant range (3.7-4.2kPa)* • *Start initial tidal volume of 8ml/kg:* - *pregnancy increases minute ventilation mainly through increased Vt* • *Remember reduction in FRC and increased oxygen consumption.* Pregnancy causes an increase in minute ventilation, mainly through an increase in tidal volumes, leading to a lower resting $PaCO_2$ of 3.7 – 4.2kPa which should be maintained. Therefore start with a Vt of 8ml/kg in these patients. Pregnant patients have a higher incidence of difficult intubation, a lower FRC and higher oxygen consumption causing faster desaturation.	Conditional	[29] 4 [30] Guideline

4.15 Trauma	Authors' recommendation	Level [Reference]
• *Start with lung protective ventilation (LPV).* • *Titrate PEEP carefully in a hypotensive patient.* • *Consider relaxing LPV strategies if CO_2 outwith normal range and there is concern over head injury and the risk/benefit is in the favour of neuroprotection.* • *Start by increasing RR and then Vt can be increased if needed.* • *Refer to **CG005 Head injury**:* - *PaO_2 >13kPa.* - *$PaCO_2$ 4.5 - 5kPa or $ETCO_2$ 4.0-4.5kPa.* - *consider hyperventilation ($PaCO_2$ 4kPa or $ETCO_2$ 3.5kPa) for impending herniation.* This is a balance between lung protective ventilation and neuroprotective measures, specifically maintaining CO_2. Start with lung protective measures and if CO_2 is outwith normal parameters and concerns over head injury then lung protective strategies can be relaxed if the risk/benefit favour neuroprotection. Start by increasing RR then Vt can be increased if needed. Take care with the use of PEEP in hypotensive shocked patients, it can also increase ICP. However this needs to be balanced against the negative effects of hypoxia in a head injured patient. Make sure the patient has an adequate preload if significantly increasing PEEP.	Conditional	[25] 2++ [26,27] Guideline

4.16 Children	Authors' recommendation	Level [Reference]
• *Use Pressure control:* - *consider starting at inspiratory pressure 15-20 cmH_2O, expiratory pressure 5 cmH_2O* • *Aim for tidal volume 6-8ml/kg, adjust inspiratory pressures accordingly* • *Use normal RR for age (table)* • *Use paediatric Oxylog circuit for children 10-30Kg.* • *Use manual ventilation if child <10kg* • ***Refer to CG012 Paediatrics.*** For children intubated pressure controlled strategy is preferred, with inspiratory pressure 15-20 cm$H_2$0 and expiratory pressure 5 cm$H_2$0 aiming for a tidal volume (Vt) of 6-8 ml/kg of ideal body weight. Use an age-appropriate respiratory rate.	GPP	

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