SLT PMV in-line MDT Ventilator Guidelines

i) Patient selection criteria/ indications:

1. Patent upper airway.
2. Generally stable medical status and vital signs (HR, RR, BP, SpO2).
3. Alert and responsive (in somnolent patients, the speaking valve can be used to improve alertness but close monitoring is necessary).
4. Minimum 48 hours post tracheostomy placement **case by case digression and agreement with Critical Care Consultant if for sooner assessment*
5. Ideally, patient can tolerate non-invasive ventilation *(*NIV)/assist control (A/C) ventilator support for the trial. **On case-by-case basis it may be trialled in volume control or pressure control modes.*
6. Ideally the patient should be on PS ≤ 15 cmH_2O, PEEP ≤ 10 cm H_2O, $Fi0_2$ ≤ 60% (clinical MDT discretion on case-by-case basis).
7. Patient is able to tolerate cuff deflation.

ii) Patient exclusion criteria/ contraindications:

- Unconscious and/or comatosed patients (RASS score -2 → to -5)
- Medical instability (notably respiratory/cardiac status) or unstable vital signs.
- Airway obstruction.
- History of tracheal stenosis, obstructing lesions or anatomical abnormalities, which may impact upon upper airway patency. These patients require ENT consult prior to trial.
- Vocal cord paralysis in the adducted position.
- Foam-filled cuff (Bivona Tracheostomy).
- Unable to tolerate full cuff deflation.
- Laryngectomy.

iii) Precautions:

- Thick, excessive or otherwise unmanageable secretions at risk of aspiration.
- End stage respiratory disease (e.g. COPD with gas trapping).
- Severe neurological disease.
- Severe anxiety/cognitive dysfunction.

iv) Assessment Protocol:

Action	**Rationale**

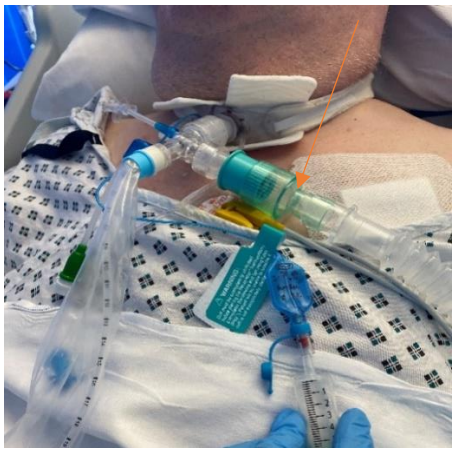
SLT to obtain Critical Care consultant consent prior to commencing initial assessment.	Patient needs to be medically stable and weaning from mechanical ventilation, in order to ensure that patient is safe to tolerate cuff deflation and ventilator adjustments.
Explain the procedure and its steps to the patient and/or family.	To reduce patient anxiety to help facilitate optimum trial performance.
Check ventilator settings pre-assessment including: • mode, • exhaled/expiratory tidal volume (VTe), • respiratory rate (RR), • pressure support (PS) • positive end-expiratory pressure (PEEP), • peak inspiratory pressure (Ppeak/PIP), • fraction of inspired oxygen ($Fi0_2$) Be aware of the patient's current ventilator weaning plan.	To ensure minimum ventilator support is required. Ideally the patient should be on PS ≤ 15 cmH_2O, PEEP ≤ 10 cmH_2O, $Fi0_2$ 60 *clinical MDT discretion on case-by-case basis.
Check the suction record for the amount, consistency and colour of secretions.	To out rule thick, excessive or otherwise unmanageable secretions at risk of aspiration that may contraindicate the trial. Treat with humidity or mucolytics if necessary first.
Position patient comfortably as upright as possible, if lying in bed ensure the head of bed is greater than 30 degrees unless medically contraindicated.	To reduce risk of aspiration and ensure adequate ventilation.

Make sure vent circuit and tracheostomy tube are in proper position.	
Check RR/HR/SpO_2/BP.	To ensure within normal limits for the patient.
Prepare the PMV 007 Aqua Colour, 10cc syringe, suction equipment and a cuff manometer.	
Determine potential changes to ventilation modes and O_2 therapy with support of CNM/CF/PT/Senior physician.	To allow for adequate air leak within the ventilator system and to facilitate sufficient tidal volumes during the trial.

Action	**Rationale**
Suction orally, via tracheostomy tube and via subglottic port if one in situ prior to cuff deflation.	To ensure minimum residual secretions during procedure to reduce aspiration risk.
Initially reduce the PEEP by 3cm H2O before deflating the cuff.	This will reduce the excessive flow and auto-cycling created by the vent trying to maintain the PEEP level with the cuff leak.
Cuff deflation procedure SLT + one other trained person slowly deflates the cuff fully with a 10ml syringe while another person carries out synchronous suction via tracheostomy. Monitor vital signs. Repeat suction if necessary.	To ensure that cuff deflation is tolerated. Stop if: • Increased coughing • Increased respiratory rate/effort • Need for suction increases • SpO_2 levels decrease Re-inflate cuff and do not proceed any further with PMV trial without further reassessment.
Have the patient inhale when the cuff is fully deflated,	There should be a minimum 40%-50% loss of VTe and significant drop in the Ppeak/PIP after cuff

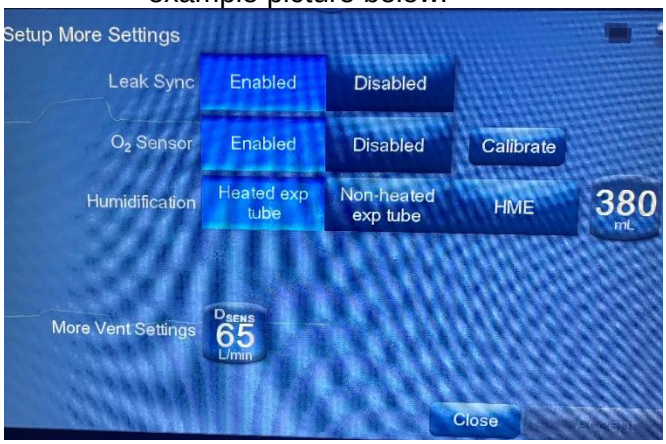
assess for signs of airway patency: • loss of exhaled tidal volume (VTe), • +/- decreased Ppeak/PIP (will not drop if on pressure control mode), and • oral air coming out through mouth/nose.	deflation. This suggests a patent airway. If not, consider the size of the tracheostomy tube for downsizing first or an ENT consult to out rule laryngeal/tracheal pathology if still not successful. Note: on the TUH 'Servo Maquet' ventilators, '***' flashing symbol means value not within range (100ml-4,000ml for adults) suggestive of VTe <100ml post cuff deflation.
Where clinically indicated, adjust the ventilator settings (e.g.: turn off peep, increase the pressure support, increase tidal volume, adjust sensitivity, adjust alarms). SLT must ensure a Senior Physician/CNM/CF or PT is present on initial assessment to manage the ventilator alarms, assist in ventilator adjustment problem solving and monitor ventilation accordingly.	To ensure patient comfort, to ensure adequate alveolar ventilation and to ensure safe and effective ventilator alarms: • Reduce PEEP alarm. • Set the end expiratory pressure alarm to lower than adjusted PEEP. • Reduce minute ventilation alarm accordingly. • Trial further reducing PEEP by 2cm H2O when cuff deflated and trialling PMV. Consider turning off the PEEP (to 0 or 1cm H_2O depending on lowest ventilator setting allowed) on subsequent trials when clinically indicated. This will reduce or eliminate the excessive flow and auto-cycling created by the vent trying to maintain the PEEP level with the cuff leak. • Boost Fi02 by 10% if ARDS patient until patients baseline SaO2 are achieved and maintained (note total limit of 60% Fi02 must not be exceeded).

	• If the patient is on continuous positive airway pressure (CPAP) or synchronized intermittent mandatory ventilation (SIMV) mode, PS may need to be adjusted to maintain adequate spontaneous tidal volume or patient comfort. Observe the patient closely for an increased WOB or negative pressure during inspiration. • Peak flow may need to be increased in conjunction with tidal volume adjustments, increase PS by x2cm H_2O to help with this. <u>*If patient on SIMV mode:</u> • Adjust sensitivity setting to avoid auto-cycling/auto-triggering where the ventilator triggers in the absence of patient effort • Adjust Spontaneous Inspiratory Time (Ti) if applicable to avoid prolonged inhalation time (not available with A/C). • *During volume-oriented ventilation, such as Volume Control modes eg SIMV, if the Ppeak/PIP drops adjust set VTi (inspiratory tidal volume) to compensate for volume lost if needed. This is done by increasing the VTi incrementally (50 ml at a time) to near pre-cuff deflation Ppeak/PIP, patient has good voice, chest rise adequate and RR stable (not necessary with PC or PS ventilation). It is not recommended to add more than 400cc of VTi. In pressure modes of ventilation, such as Pressure Control or Pressure Support, there

	will be no need to increase the VT or set pressure. Since inspiratory pressure remains an accurate indicator after cuff deflation and valve placement, the ventilator will deliver appropriately the set pressure regardless of the leak.
Once the patient is tolerating cuff deflation, SLT to insert the Passy Muir in-line aqua valve with connector into the ventilator circuit as close to the tracheostomy as possible (e.g. between omniflex (CSS *closed suction system) and ventilator circuit). See diagram below for example. 	Benefits of the PMV include: 1. restoration of physiological PEEP 2. restoration of voice 3. improved sense of smell and taste 4. improved swallowing 5. improved secretion management 6. improved quality of life
SLT to assess patients ability to phonate	To ensure supraglottic airflow.
If the patient's voice sounds "wet" or "gurgly" ask them to cough and clear secretions.	Any secretions present may adversely affect voice clarity.
Continue to monitor patient for "Stop" criteria.	"Stop" criteria indicating removal of PMV required: • HR change by 20bpm • RR greater than 35

	• SpO2 less than 90% or specified acceptable parameters • FiO2 ≥60% • Pt reports difficulty breathing • Accessory muscle use • Inspiratory/ expiratory stridor • Violent, persistent coughing • Fatigue • Patient experiences distress / discomfort • The patient requests PMV removal *This is on a case-by-case basis.
Remove the speaking valve at the end of the trial period, re-adjust to pre-ventilator settings, re-inflate the tracheostomy tube cuff and then check the cuff pressure with a manometer.	To limit respiratory fatigue.
SLT to determine if the trial was successful or not with support of assisting PT/CNM/CF/senior medical team member.	Appropriate Outcomes: 1. Patient able to tolerate the PMV without breathing compromise. 2. Patient able to use verbal output for functional communication.
Clean and dry the speaking valve daily according to manufacturer's guidelines and store in the box provided by manufacturer with the patients name and date opened on it. Note PMV should not be worn during nebulisation or while sleeping.	To ensure valve safe for use.

If the initial trial is successful and it is agreed to continue with its use place the warning sticker provided in the speaking valve pack onto the tracheostomy pilot balloon line which states that when this valve is used the cuff must be deflated first.	To warn of potential asphyxiation if PMV placed when tracheostomy cuff is inflated.
SLT to document all actions and parameters monitored on ICCA including; • Secretions: Amount, Consistency and colour. • Vent Settings: mode, tidal volume, RR, pressure support, PEEP, $Fi0_2$, any changes to vent settings during the trial. • Baseline Vital Signs pre & post PMV including HR, RR, Sp02 and BP. • Air flow/cuff leak: tidal volume changes when cuff is fully deflated. • Patient voice quality and ability to cough/clear secretions. • Length and tolerance/outcome of trial. • Patient/Family education and training	To ensure effective communication amongst the multidisciplinary team.
If the patient tolerates the initial trial, SLT to develop PMV schedule documented on ICCA and on 'SLT cuff deflation & speaking valve regime' bedside guidelines for length & frequency of PMV trials. Passy	To ensure effective communication amongst the multidisciplinary team. Some patients may only tolerate short periods of time initially and tolerance may vary from one day to the next.

Muir in-Line Speaking Valve on Ventilator Bedside Guidelines to be stuck up at bedside (Appendix __). If patient does not tolerate initial trial, SLT to document next steps and timeframe for repeat attempt on ICCA as agreed with Critical Care Consultant.	MDT members (Physicians, Nursing Staff & Physio colleagues) jointly contribute to the monitoring and feedback of cuff deflation & PMV tolerance with SLT. SLT will take MDT feedback into their clinical decision making and recommendations for appropriate length/fq of trials until weaned. It is important that appropriately trained staff are present to manage the ventilator alarms, assist in ventilator adjustment problem solving and monitor ventilation accordingly on daily cuff deflation & PMV trials recommended. (Note after initial ax is passed, to stop the alarms bleeping every 2 minutes to account for the cuff deflation/PMV leak on subsequent trials: • <u>On Puritan Bennett ventilators</u>: 1. go into setup -> more settings -> enable the leak sync setting option as per example picture below:  2. Adjust alarms by lowering the $V_{E\ TOT}$ and $V_{TE\ SPONT}$ as per picture below

- <u>On the Servo Marquet ventilator:</u>
  1. Switch the ventilator into NIV mode once the pt is settled & vitally stable.
  2. Re-adjust vent and alarm settings accordingly when you switch to this NIV mode during the period of the recommended cuff deflation & PMV trial.
  3. Reduce minute ventilation alarm @least 2cm below observed mve (l/min).
  4. Once patient finished cuff deflation & PMV trial, re-set the vent settings to invasive mode as per previous settings.