

# Long Term Ventilation in Children and Young People Clinical Guideline

## Introduction

This guideline has been created to support clinical colleagues in the South Thames Paediatric Network, North Thames Paediatric Network, East of England and Thames Valley and Wessex region with the care of Children and Young People receiving Long Term Ventilation (LTV) who are admitted into hospital.

This guideline covers both Tracheostomy Long Term Ventilation (TrLTV) and Non-Invasive Ventilation (NIV), the document has been designed as one document, but can be further split to NIV & TrLTV, if required separately:

- **Blue sections:** Both TrLTV & NIV
- **Green sections:** NIV
- **Orange sections:** TrLTV

The guideline is designed to support the care of the CYP on LTV and covers safety, staffing, documentation, monitoring, assessment, troubleshooting and escalation. It does not replace the clinical knowledge, expertise and judgement of clinicians at the bedside.

### **The Contents for this Guideline are as follows:**

- Core Guideline (Pages 1-5)
- Appendices (Appendix A- Appendix O)
- Resources

## Change History

Version 1: June 2023

## Content Page

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## Long Term Ventilation

“Long-Term Ventilation (LTV) refers to various types of respiratory support provided every day for a period of at least three months. Ventilation is delivered either via a tracheostomy tube (invasive) or via a face mask or nasal cannula (non-invasive). The aim of LTV is to improve survival and quality of life in people with conditions that have led to respiratory failure.”

(NCEPOD 2020)

Key (including colour code)	
LTV	Long Term Ventilation (both NIV & TrLTV)
Tr-LTV	Tracheostomy Long Term Ventilation
NIV	Non Invasive Ventilation
FFD	Fit for discharge
RAP	Respiratory Action Plan
<b>Pitfall note</b>	Provides additional information that may help prevent pitfalls in care delivery
<b>Dark Red Italics</b>	Reference to an important existing document/ guidance

## Quick Links

NTSP Bedheads and Algorithm	LTV Online Education Resources
<a href="#">Tracheostomy</a> 	<a href="#">Educational Resources   Children's long-term ventilation service (ltv.services)</a> 

## Glossary

For Ventilator terminology see [Appendix C: Ventilator definitions](#)

<b>AVPU</b>	Alert, Voice, Pain, Unconscious	<b>LMA</b>	Laryngeal Mask Airway
<b>Bi Level/ BiPAP</b>	Bi Level/ Bi Level Positive Airway Pressure	<b>LTV</b>	Long Term Ventilation
<b>BP</b>	Blood Pressure	<b>NBM</b>	Nil By Mouth
<b>BVM</b>	Bag Valve Mask	<b>NA</b>	Nursing Associate
<b>CRT</b>	Capillary Refill Time	<b>NIV</b>	Non Invasive Ventilation
<b>CPAP</b>	Continuous Positive Airway Pressure	<b>RR</b>	Respiratory Rate
<b>CYP</b>	Child and Young People	<b>RAP</b>	Respiratory Action Plan
<b>FFD</b>	Fit For Discharge	<b>RN</b>	Registered Nurse
<b>GCS</b>	Glasgow Coma Scale	<b>Tr LTV</b>	Tracheostomy Long Term Ventilation
<b>HCSW</b>	Health Care Support Worker	<b>TTS</b>	Tight To Shaft
<b>HME</b>	Heat Moisture Exchanger	<b>WOB</b>	Work of Breathing

**DOPES for both TrLTV & NIV**

The **DOPES** mnemonic can support rapid identification of an urgent issue relating to airway and ventilation.

- D Displacement**  
Is the Trachea in situ?  
Is there a leak around the trachea or mask?  
Is there a disconnection?
- O Obstruction**  
Is the Trachea blocked?  
Are there upper airway secretions/ blockages?  
Are there any retained secretions or increased pulmonary resistance?  
Is there an underlying medical reason for airway obstruction e.g. seizure activity
- P Pneumothorax**  
Is there good and equal air entry?  
Is there good ventilation?  
Is there hyper resonance on percussion?
- E Equipment**  
Is the tubing intact?  
Is the ventilation tubing blocked, kinked or pinched?  
Is the exhalation/ leak port (an intentional leak) present?  
Is there a ventilator malfunction?  
Is there a disconnection in the circuit?  
Is the interface appropriate?
- S Stomach**  
Is there air in the stomach?  
Is the stomach distended?

**Escalation and Advice**

Respiratory Centre	Retrieval Team
Refer to the Respiratory Action Plan (RAP) for CYP individual escalation plan, and the contact details for the CYP respiratory centre and retrieval service	

**Parent & Carer guidance**

Working in partnership with parents/carers is vital. They will likely:

- Know usual patterns for their CYP
- Have access to the documentation you need, including the Respiratory Action Plan (RAP)
- Be skilled and knowledgeable in LTV
- Know specific care adaptations for their child that will be important to maintain (e.g time of tape changes, dressing use, best approach for mask tolerance)
- Know how to use the ventilator.

You may have a local policy designed to support the use of existing care packages in hospital.

**Respiratory Action Plan (RAP)**

All CYP on LTV should have a Respiratory Action Plan (RAP) provided by their respiratory centre. The RAP will contain:

- LTV requirements
- LTV prescription
- Escalation pathway
- Contact details for respiratory centre and retrieval service

**This should be kept with the patient’s notes for use when undertaking safety checks, in the event of respiratory deterioration and escalation of care.**

Some patients that are less dependent on ventilation may not have a RAP in place depending on the designated respiratory centre. In this instance respiratory centres can be contacted for advice and this guideline should support patient management alongside specialist advice.

**Pitfall Note:** This CYP Respiratory document may have an alternative name to ‘RAP’, this document should be used when ‘RAP’ is referred to in the guideline.

**Assessment**

- Assessment should follow same structured approach as for any patient. Use an **ABCDE systematic approach** with consideration of child’s normal pattern documented in their RAP.
- Frequency of assessment and observations should be as clinically indicated see [‘Staffing, Monitoring and Documentation’](#)
- Do not allow the medical complexity of a child on LTV distract from usual skills of inspection, auscultation, palpation.

*Additional elements to consider for CYP on LTV when completing a systematic assessment :*


- A**
  - Have secretions changed in consistency, colour, and quantity?
  - Tr LTV- When is next Tracheostomy change scheduled?
  - Tr LTV- Has patient required recent unplanned tracheostomy change?
- B**
  - How does the respiratory rate, pattern and WOB compare to patients usual baseline? *See RAP for usual pattern*
  - What is baseline oxygen requirement? And current?
  - Any signs of increased WOB (Ventilated patients will still exhibit signs of increased WOB)
  - Pitfall note:** Underlying condition may impact ability to increase WOB e.g Neuromuscular condition
  - Is physiotherapy referral required?
  - Is patient on usual settings/ unwell settings or other – see RAP
  - Is patients Respiratory team informed of any escalation?
  - NIV – Is the interface suitable for current clinical condition
- C** LTV complexity may distract from other non-respiratory findings.
- D** **Do not stop** systematic approach.
- E**

**Pitfall note:** CYP with complex care needs are **high risk** for missed differentials such as acute abdomen especially where communication difficulties exist.  
[For detailed assessment approach see Appendix B: A-E Assessment](#)

## Non-Invasive Ventilation safety checks and interventions


**NIV Guidance:** This page can be discarded if CYP is Tr LTV

NIV safety checks and interventions	
<b>Every shift</b> <ul style="list-style-type: none"> <li>Check oxygen, suction, BVM are present and working</li> <li>Clinical monitoring- parameters set appropriately</li> <li>Check seal of the mask is adequate</li> <li>Complete a visual inspection of the mask and the ventilator</li> <li>Check that the headgear is applied/ sitting correctly and not too tight</li> </ul>	<i>Further information</i> <ul style="list-style-type: none"> <li><a href="https://ltv.services/education-al-resources/#ltv-resources">https://ltv.services/education-al-resources/#ltv-resources</a></li> <li>See Appendix I: NIV: Mask fitting, safety checks &amp; troubleshooting</li> </ul>
<b>Daily</b> <ul style="list-style-type: none"> <li>Straps: should be able to fit two fingers under the strap when assessing tightness.</li> </ul>	<i>Further information</i> <a href="#">See Appendix I: NIV: Mask fitting, safety checks &amp; troubleshooting</a>
<b>4 Hourly</b> <ul style="list-style-type: none"> <li>Ensure mask integrity before &amp; as required during use.</li> <li>Check and ensure the patency of: <ul style="list-style-type: none"> <li>- Exhalation/ leak port (an intentional leak)</li> <li>- Anti- asphyxiation valve (if applicable)</li> </ul> </li> <li>Ensure pressure areas are assessed and appropriate relief provided</li> <li>Mouth cares</li> </ul>	
<b>Weekly</b> <ul style="list-style-type: none"> <li>Mask cleaning</li> </ul>	
<b>Other</b> <ul style="list-style-type: none"> <li>Nebulisation if appropriate</li> </ul>	<a href="#">Appendix H: Nebulisation via NIV</a>

Ventilator safety checks and interventions	
<b>Ventilator safety checks should be performed in addition to the ward bedside checks, and should be completed:</b> <ul style="list-style-type: none"> <li>At the start of every shift</li> <li>At the handover of patient care</li> <li>When commencing use of the ventilator</li> <li>As part of troubleshooting, in conjunction with an A-E patient assessment</li> </ul> <b>In addition:</b> <ul style="list-style-type: none"> <li>If a CYP has two ventilators, this should be completed on each ventilator.</li> <li>The <b>Respiratory Action Plan (RAP)</b> should be accessible and a copy in the CYP notes.</li> </ul>	
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> LTV Hub  <a href="#">Appendix A</a>  </div>	
<b>Safety checks to be completed:</b>	
<b>Power</b>	<ul style="list-style-type: none"> <li>Plugged in to mains power (<i>and charging if appropriate</i>)</li> <li>External battery on charge (<i>if appropriate</i>)</li> <li>Battery status</li> <li>Ventilator is working</li> </ul>
<b>Settings and Alarms</b>	<ul style="list-style-type: none"> <li>Checked against the prescription/ Respiratory Action Plan</li> <li>Ensure ventilator is locked out of clinical menu so that no changes can be made</li> <li>Correct prescription is running (<i>there may be more than one programme available- see RAP</i>)</li> <li>Test alarms (<i>refer to LTV centre advice</i>)</li> </ul>
<b>Circuit</b>	<ul style="list-style-type: none"> <li>Correct tubing</li> <li>HME or humidifier is set up, working and water chamber is filled.</li> <li>Exhalation/ leak port (an intentional leak) present and patent (<i>Feel for expiratory air flow to ensure leak is patent and working</i>)</li> <li>Oxygen port/ connection is available (<a href="#">Appendix D</a>)</li> <li>Circuit is clean, intact and spare circuit is available (<i>follow manufacturers guidance on cleaning and maintenance</i>)</li> </ul>

# Tracheostomy Long Term Ventilation safety checks and interventions

## Tracheostomy safety checks and interventions

<b>Every shift</b>	<i>Further information</i>
<ul style="list-style-type: none"> <li>Completed bed head sign and emergency algorithms in bed space</li> <li>Tracheostomy emergency box contents checked</li> <li>Suction readily available and correctly assembled</li> <li>Correct size suction catheters</li> <li>Self inflating BVM</li> <li>Working oxygen with mask</li> <li>Clinical monitoring- parameters set appropriately</li> </ul>	<p><a href="https://www.tracheostomy.org.uk/NTSP- Algorithms-and-Bedheads">https://www.tracheostomy.org.uk/NTSP- Algorithms-and-Bedheads</a></p>  <p><a href="#">See Appendix K: Emergency Tracheostomy Box &amp; Additional Bedside Tracheostomy Care Equipment</a></p> <p><a href="#">See Appendix M: Suctioning a Tracheostomy</a></p> <ul style="list-style-type: none"> <li>See local trust guidance</li> </ul>
<b>Daily</b>	<i>Further information</i>
<ul style="list-style-type: none"> <li>Tape changes</li> <li>Skin and stoma check</li> <li>Cuff pressure check (if applicable) or more frequently if indicated</li> </ul>	<p><a href="#">See Appendix K: Emergency Tracheostomy Box &amp; Additional Bedside Tracheostomy Care Equipment</a></p> <p><a href="#">See Appendix L: Routine Tracheostomy Tape Change</a></p>
<b>4 Hourly</b>	
<ul style="list-style-type: none"> <li>Tape tension check</li> </ul>	
<b>Other</b>	<i>Further information</i>
<ul style="list-style-type: none"> <li>Suction as clinically required</li> <li>Tracheostomy change as per manufacturers guidance unless clinical need arises</li> </ul>	<p><a href="#">See Appendix M: Suctioning a Tracheostomy</a></p> <p><a href="#">See Appendix N: Planned Tracheostomy Tube Change</a></p>

## Ventilator safety checks and interventions


**Ventilator safety checks should be performed in addition to the ward bedside checks, and should be completed:**

- At the start of every shift
- At the handover of patient care
- When commencing use of the ventilator
- As part of troubleshooting, in conjunction with an A-E patient assessment

**In addition:**

- If the Child has a Tracheostomy a Tracheostomy checklist should also be completed [see Appendix K Emergency Tracheostomy Box & Additional Bedside Tracheostomy Care Equipment](#)
- If a CYP has two ventilators, these checks should be completed on **each ventilator**.
- The **Respiratory Action Plan (RAP)** should be accessible and a copy in the CYP notes.

LTV Hub  
[Appendix A](#)



**Safety checks to be completed:**

<b>Power</b>	<ul style="list-style-type: none"> <li>Plugged in to mains power <i>(and charging if applicable)</i></li> <li>External battery on charge <i>(if appropriate)</i></li> <li>Battery status</li> <li>Ventilator is working</li> </ul>
<b>Settings and Alarms</b>	<ul style="list-style-type: none"> <li>Checked against the prescription/ Respiratory Action Plan</li> <li>Ensure ventilator is locked out of clinical menu so that no changes can be made</li> <li>Correct prescription is running <i>(there may be more than one programme available- see RAP)</i></li> <li>Test alarms <i>(refer to LTV centre advice)</i></li> </ul>
<b>Circuit</b>	<ul style="list-style-type: none"> <li>Correct tubing</li> <li>HME or humidifier is set up, working and water chamber is filled.</li> <li>Exhalation/ leak port (an intentional leak) present and patent <i>(Feel for expiratory air flow to ensure leak is patent and working)</i></li> <li>Oxygen port/ connection is available <a href="#">(Appendix D)</a></li> <li>Circuit is clean, intact and spare circuit is available <i>(follow manufacturer/ LTV centre guidance on cleaning and maintenance)</i></li> </ul>

Nurse staffing for CYP needing LTV will be influenced by a number of factors, including patient diagnosis and complexity, severity of presenting illness, age, PEWS and ward layout. This chart provides only a guidance on the level of staffing, monitoring and documentation required. Patient assessment should inform nursing and medical staff as to the dependency of the patient. This should be reviewed, adapted and documented as required. Notes: for patients requiring overnight ventilator support in the night time but not in the day, staffing should be altered per shift as per the stability and supervision required.

Patient status	LTV patient –'well' settings, Fit for Discharge (FFD)		Complex LTV/ 'well' setting but not Fit For Discharge (FFD)		LTV patient 'unwell/ sick' settings	
	LTV CYP, well settings – admitted due to non-respiratory reason / FFD / Awaiting housing etc.	LTV CYP, well settings – admitted due to non-respiratory reason / FFD / Awaiting housing etc.	Complex LTV patient with co-morbidities	Complex LTV patient with co-morbidities	LTV patient on unwell settings – admitted due to respiratory reason and increase secretions	LTV patient on unwell settings – admitted due to respiratory reason and increase secretions
<b>Open Bay or Cubicle</b>	Open Bay	Cubicle	Open Bay	Cubicle	Open Bay	Cubicle
<b>Staffing</b>	1:2 HCSW or NA with appropriate competencies can be allocated with appropriate RN supervision	1:1 HCSW or NA with appropriate competencies can be allocated with appropriate RN supervision	1:2 HCSW and RN working in partnership Or 1:1	1:1 RN or NA with RN allocated to support	1:1 or 1:2 Fluid decision based on clinical findings, trajectory of illness and dependency of other patients.	1:1 RN
<b>Monitoring</b>	Continuous saturation monitoring only when asleep, if concerned or if no parent present/ no staff member directly with the child	Continuous saturation monitoring only when asleep or if concerned	Continuous saturation monitoring only when asleep, if concerned or if no parent present/ no staff member directly with the child	Continuous saturation monitoring only when asleep or if concerned	Continuous saturation monitoring 3 lead ECG monitoring Blood gas frequency as dictated clinically	Continuous saturation monitoring 3 lead ECG monitoring Blood gas frequency as dictated clinically
<b>Documentation</b>	<p><b>Ventilator:</b> <i>Checks:</i> Ventilator settings including mode and pressures, O2 requirement (l/min), Tidal Volume (Vte) and Leak <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Humidifier:</b> <i>Checks:</i> humidifier on, temperature/ setting, water filled <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Vital signs:</b> 4 hourly observations</p> <ul style="list-style-type: none"> <li>RR &amp; WOB</li> <li>Oxygen Saturations</li> <li>Heart Rate</li> <li>BP</li> <li>CRT</li> <li>AVPU/ GCS</li> <li>Temperature</li> <li>PEWS</li> </ul>	<p><b>Ventilator:</b> <i>Checks:</i> Ventilator settings including mode and pressures, O2 requirement (l/min), Tidal Volume (Vte) and Leak <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Humidifier:</b> <i>Checks:</i> humidifier on, temperature/ setting, water filled <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Vital signs:</b> 4 hourly observations</p> <ul style="list-style-type: none"> <li>RR &amp; WOB</li> <li>Oxygen Saturations</li> <li>Heart Rate</li> <li>BP</li> <li>CRT</li> <li>AVPU/ GCS</li> <li>Temperature</li> <li>PEWS</li> </ul>	<p><b>Ventilator:</b> <i>Checks:</i> Ventilator settings including mode and pressures, O2 requirement (l/min), Tidal Volume (Vte) and Leak <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Humidifier:</b> <i>Checks:</i> humidifier on, temperature/ setting, water filled <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Vital signs:</b> 4 hourly or more frequently as condition dictates:</p> <ul style="list-style-type: none"> <li>RR &amp; WOB</li> <li>Oxygen Saturations</li> <li>Heart Rate</li> <li>BP</li> <li>CRT</li> <li>AVPU/ GCS</li> <li>Temperature</li> <li>PEWS</li> </ul>	<p><b>Ventilator:</b> <i>Checks:</i> Ventilator settings including mode and pressures, O2 requirement (l/min), Tidal Volume (Vte) and Leak <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Humidifier:</b> <i>Checks:</i> humidifier on, temperature/ setting, water filled <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Vital signs:</b> 4 hourly or more frequently as condition dictates:</p> <ul style="list-style-type: none"> <li>RR &amp; WOB</li> <li>Oxygen Saturations</li> <li>Heart Rate</li> <li>BP</li> <li>CRT</li> <li>AVPU/ GCS</li> <li>Temperature</li> <li>PEWS</li> </ul>	<p><b>Ventilator:</b> <i>Checks:</i> Ventilator settings including mode and pressures, O2 requirement (l/min), Tidal Volume (Vte) and Leak <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Humidifier:</b> <i>Checks:</i> humidifier on, temperature/ setting, water filled <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Vital signs:</b> 1-2 hourly as condition dictates:</p> <ul style="list-style-type: none"> <li>RR &amp; WOB</li> <li>Oxygen Saturations</li> <li>Heart Rate</li> <li>BP</li> <li>CRT</li> <li>AVPU/ GCS</li> <li>Temperature</li> <li>PEWS</li> </ul>	<p><b>Ventilator:</b> <i>Checks:</i> Ventilator settings including mode and pressures, O2 requirement (l/min), Tidal Volume (Vte) and Leak <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Humidifier:</b> <i>Checks:</i> humidifier on, temperature/ setting, water filled <i>Frequency:</i> start of shift, as a part of troubleshooting and with vital signs</p> <p><b>Vital signs:</b> 1-2 hourly as condition dictates:</p> <ul style="list-style-type: none"> <li>RR &amp; WOB</li> <li>Oxygen Saturations</li> <li>Heart Rate</li> <li>BP</li> <li>CRT</li> <li>AVPU/ GCS</li> <li>Temperature</li> <li>PEWS</li> </ul>

**Pitfall Note:** It should be noted that a CYP on LTV, does not need to be nursed in a cubicle solely because they are on LTV, but this is a decision in conjunction with infection control guidelines.

\* If parents do not wish for staff to check the ventilator hourly due to waking the child, the unit may consider asking the parents to sign a care plan stating this and agree to check the settings once per 12 hour shift or if the CYP has breaks from ventilation throughout the day, complete checks whenever the ventilator is switched on and if there is clinical concern



## Appendices

Appendices	
<i>This guideline when viewed electronically is interactive, follow the links to the relevant pages.</i>	
<a href="#">Appendix A:</a>	<a href="#">LTV Hub</a>
<a href="#">Appendix B:</a>	<a href="#">A-E assessment</a>
<a href="#">Appendix C:</a>	<a href="#">Ventilator definitions</a>
<a href="#">Appendix D:</a>	<a href="#">How to connect oxygen (entrained and into a circuit)</a>
<a href="#">Appendix E:</a>	<a href="#">Humidification</a>
<a href="#">Appendix F:</a>	<a href="#">LTV quick Guide: Unlocking the clinical menu</a>
<a href="#">Appendix G:</a>	<a href="#">NIV troubleshooting</a>
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<a href="#">Appendix I:</a>	<a href="#">NIV: Mask fitting, safety checks &amp; troubleshooting</a>
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<a href="#">Appendix M:</a>	<a href="#">Suctioning a tracheostomy</a>
<a href="#">Appendix N:</a>	<a href="#">Planned tracheostomy tube change</a>
<a href="#">Appendix O:</a>	<a href="#">Nebulisation via tracheostomy LTV</a>

# LTV HUB

V3: October 2022—Information was correct at time of printing.  
For review: April 2023. *Some equipment and policies differ slightly between LTV centres, please contact your local LTV Centre for more information and ensure that you are working to local policy.*

Access more Resources, Videos, E-learning and Competency Documents at LTV Central Team: <https://ltv.services/>

Access Complex Discharge Guidance and Tools (developed in collaboration with WellChild and PPLTVG) <https://www.wellchild.org.uk/10-principles-for-complex-discharge>

## MEDICAL EQUIPMENT USER GUIDES AND TROUBLESHOOTING



Astral 150



Trilogy 100



Nippy Junior +



Stellar 100 & 150



AirSense 10

## CIRCUIT SET UP



Astral 150



Trilogy 100



Nippy Junior +



Stellar 100 & 150



AirSense 10

## EDUCATION RESOURCES - VIDEOS



Respiratory Assessment



Mask fitting for NIV



Pressure sores & NIV



NIV Equipment troubleshooting



Suctioning a tracheostomy



Partially blocked Tracheostomy



Blocked Tracheostomy



BLS Tracheostomy



Nippy 4



Trilogy EVO



**LTV Hub**  
(online and PDF version)

LTV complexity may distract from other non-respiratory findings. Do not stop systematic approach

Considerations, Investigations and Interventions

<p><b>A</b></p>	<ul style="list-style-type: none"> <li>• Check for patent airway</li> </ul>	<p><b>TrLTV</b> Check Tracheostomy is in situ and patent &gt; Refer to <i>'Emergency Paediatric Tracheostomy Management'</i> (NTSP)</p> <p><b>NIV</b> Check interface integrity and position Assess for any leaks around the mask, blocked nostrils</p> <p><b>TrLTV &amp; NIV</b> Have secretions changed in consistency, colour, and quantity? Check for patent exhalation/ leak port (an intentional leak) Check for secretions and/ or vomit</p>
<p><b>B</b></p>	<ul style="list-style-type: none"> <li>• Oxygenation</li> <li>• Carbon dioxide</li> <li>• Respiratory rate</li> <li>• Work of breathing</li> <li>• Auscultation</li> <li>• Ventilator prescription</li> <li>• Humification</li> </ul>	<p>Is there an increased oxygen requirement? Is there an increased respiratory rate? Is there increased work of breathing? Are there any indicators of a respiratory cause? Is the ventilator delivering appropriate ventilation? Check the prescription using the RAP – review the escalation plan Is the CYP on a humidified or dry circuit?</p> <p><b>Pitfall Note:</b> The underlying condition may impact ability to increase WOB e.g neuromuscular condition</p>
<p><b>C</b></p>	<ul style="list-style-type: none"> <li>• Heart rate</li> <li>• Blood pressure</li> <li>• Haemodynamic stability</li> </ul>	<p>Is there a change from usual baseline for heart rate? Is there a change from usual baseline for blood pressure? Does the CYP have a sign of sepsis or cardiac failure – manage as appropriate. Does the CYP have an underlying cardiac condition? Check capillary refill time</p>
<p><b>D</b></p>	<ul style="list-style-type: none"> <li>• AVPU</li> <li>• GCS</li> <li>• Seizure activity</li> </ul>	<p>Is there a change from baseline neurology using GCS/modified GCS? Is this affecting respiratory function ? Is low GCS due to a seizure or adverse effects from anti-epileptic drugs? Is there any change in baseline neurology secondary to respiratory failure ie hypoxia or hypercarbia?</p>
<p><b>E</b></p>	<ul style="list-style-type: none"> <li>• Temperature</li> <li>• Abdominal distension</li> <li>• Equipment</li> </ul>	<p>Does the CYP have a temperature/sign of sepsis or cardiac failure – manage as appropriate. Does the CYP have abdominal distension impacting on respiratory mechanics?</p>

Be aware of baseline- review RAP/ speak to parent/ carer

<p><b>Consider:</b></p> <ul style="list-style-type: none"> <li>• Oxygen</li> <li>• Suction</li> <li>• Nebulisation</li> <li>• Physiotherapy input</li> </ul>
<p><b>Consider:</b></p> <ul style="list-style-type: none"> <li>• Oxygen</li> <li>• Suction</li> <li>• Blood gas</li> <li>• Nebuliser</li> <li>• Escalating to humidified 'wet' circuit</li> <li>• Physiotherapy input</li> <li>• Chest xray</li> <li>• Antibiotics</li> <li>• Stopping feeds</li> <li>• NGT/ gastrostomy on free drainage/ aspiration</li> <li>• Escalation following RAP to unwell settings/ LTV Team +/- retrieval team and inform local ITU/ anaesthetic team</li> </ul>
<p><b>Consider:</b></p> <ul style="list-style-type: none"> <li>• Blood gas</li> <li>• Fluid resuscitation at 10 ml/kg (refer to <b>resus guidelines</b>)</li> <li>• Chest xray</li> <li>• ECG</li> <li>• ECHO</li> <li>• Escalation to retrieval team and local ITU/ anaesthetic team</li> </ul>
<p><b>Consider:</b></p> <ul style="list-style-type: none"> <li>• Neuro-imaging</li> <li>• Blood gas</li> <li>• Escalation to retrieval team and local ITU/ anaesthetic team</li> </ul>
<p><b>Consider</b></p> <ul style="list-style-type: none"> <li>• Antibiotics</li> <li>• Stopping feeds</li> <li>• NGT/ gastrostomy on free drainage/ aspiration</li> </ul>

**Additional considerations:**

- Check **RAP** for prescription, escalation plan and contacts to LTV Clinical Team
- Check if an **Advanced Care Plan** is in place? If not, discuss with parents, LTV centre and local medical teams regarding escalation.

**Criteria for further escalation:**

- Consider escalation to LTV/PICU/ Retrieval team in the following circumstances:

**Early discussions with PICU/ retrieval team and tertiary LTV team should be initiated.**

**NIV-** if CYP has:

- An increasing NIV requirement on unwell settings
- and/or FiO<sub>2</sub> is > 50%
- Requires higher pressures beyond prescribed unwell settings.
- If there is very poor respiratory drive requiring a significantly higher backup rate (i.e. almost totally dependent upon the ventilator - which is a change from baseline).
- Deteriorating blood gas, i.e. worsening ventilation, despite being on unwell ventilator settings.
- If there is more than single organ involvement (e.g. respiratory support + requiring hemodynamic support).
- Lack of competent/ skilled staff to manage patient safely locally.

**TrLTV-** if CYP has:

- An increasing requirement for ventilation on unwell settings
- and/or FiO<sub>2</sub> > 50%.
- Requires higher pressures beyond prescribed unwell settings.
- If there is very poor respiratory drive requiring a significantly higher backup rate (i.e. almost totally dependent upon the ventilator - which is a change from baseline).
- Deteriorating blood gas, i.e. worsening ventilation, despite being on unwell ventilator settings.
- If there is more than single organ involvement (e.g. respiratory support + requiring hemodynamic support).
- Lack of competent/ skilled staff to manage patient safely locally.

Modes	
CPAP	<p>Continuous Positive Airway Pressure</p> <ul style="list-style-type: none"> <li>• A continuous flow of positive pressure throughout the respiratory cycle</li> <li>• The aim of CPAP is to keep the alveoli open to maintain gaseous exchange</li> <li>• CYP must be able to breathe spontaneously</li> </ul>
Bi-Level/ BiPAP	<ul style="list-style-type: none"> <li>• Two Pressures are delivered: an Inspiratory Pressure and an Expiratory Pressure</li> <li>• Modes or ways to deliver Bi-Level Ventilation include: S, ST/ Pressure Support, T/ Pressure Control, PC SIMV, IVAPs/ AVAPs</li> <li>• See Bilevel mode definition in ventilator manual for further mode specific information.</li> </ul>

### Ventilator Setting Definitions

Inspiratory Pressure (IPAP)	<p><i>(Inspiratory Positive Airway Pressure)</i></p> <p>The pressure the ventilator will deliver to the patient during inspiration [measured in cmH<sub>2</sub>O]</p>
Expiratory Pressure (EPAP/ PEEP)	<p><i>(Expiratory Positive Airway Pressure/ Positive End Expiratory Pressure)</i></p> <p>The pressure the ventilator will deliver to the patient during expiration [measured in cmH<sub>2</sub>O]</p>
Breath rate/ Back up rate	<p>The minimum number of breaths per minute (bpm) set. Not applicable in CPAP and certain BiLevel modes.</p> <p>See the Bilevel mode definition in the ventilator manual for further mode specific information.</p> <p><b>Pitfall Note:</b> Undertake an A-E assessment, as the CYP respiratory rate, may differ to their 'Breath rate/ Back up rate' setting.</p>
Inspiratory Time (Ti)	The length of the inspiratory phase of a mandatory or assisted breath.
Rise Time	The speed of breath delivered from EPAP to IPAP
Ramp (switch)	<p>On starting ventilation the ventilator initiates at a lower pressure and then gradually increases to the pressures prescribed.</p> <p>The ramp feature can be used for some patients who are not dependent on their ventilator, and can be used as a comfort setting.</p>
Trigger	<p>The ventilator detects patient effort and supports it by providing the set pressure.</p> <p>The trigger type and sensitivity level is set appropriately for the CYP (by the LTV Centre) so the ventilator can detect patient effort and support this.</p>

### Measured and calculated parameters during ventilation

Vt -Tidal Volume	<p>This is the volume of each breath.</p> <p>This is normally aimed at 5-10mls/kg</p>
MV - Minute Ventilation	<p>This is the volume of ventilation being delivered over a minute to the CYP.</p> <p>This can be calculated by:</p> $MV = \frac{RR \times Vt}{1000}$
Leak	<p>Any kind of interruption to the circuit or system which may interfere with the pressure being delivered.</p> <p>Passive single limb circuits have an intentional leak value- this is the exhalation/ leak port. An essential component to allow the child to breathe out safely.</p>
Respiratory Rate	<p>The respiratory rate calculated by the ventilator.</p> <p>A respiratory assessment should always be undertaken, and the respiratory rate of the patient assessed and documented.</p>
PIP- Peak Inspiratory Pressure	The maximum airway pressure achieved during inspiration- should be consistent with the IPAP set
PIF- Peak Inspiratory Flow	The maximum flow achieved during inspiration
I:E	The ratio of the inspiratory period to the expiratory period

Safety Check : ensure that an oxygen port or connection is available at the bed space, this is step is undertaken as part of ventilator safety checks

## Equipment

### Adding oxygen to ventilator with no inbuilt oxygen port:



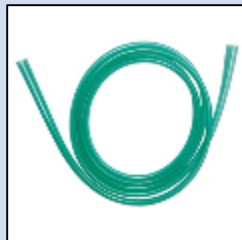
Oxygen connector in ventilator circuit

or

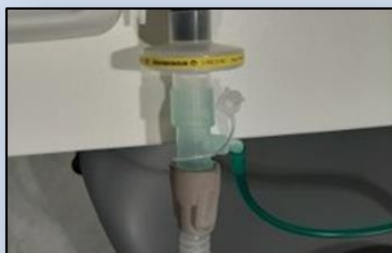


Oxygen port on antibacterial filter

+



Standard Oxygen tubing



### Adding oxygen to ventilator with inbuilt oxygen port:

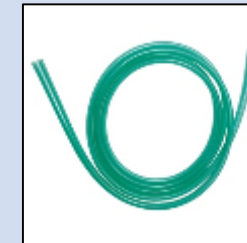


Oxygen nipple/ connector/ port

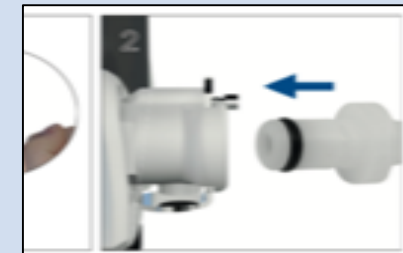
or



+



Oxygen tubing



Usually at the back or side of the ventilator

**Pitfall note:** Some ventilators require the oxygen port to be removed when not in use, or to have oxygen tubing connected and attached to an oxygen delivery device (even if this is turned off). This is to reduce the risk of dust entering the ventilator.

- If the ventilator has an inbuilt oxygen port (usually at the back or side of the ventilator) it is recommended that this is used to deliver oxygen.
- Oxygen is mixed with the air from the ventilator, before leaving the ventilator causing no disruption to ventilator flow. This reduces the risk of inappropriate alarms and less risk of increased condensation
- When a connector is added to the circuit to entrain oxygen into the circuit, the flow from the ventilator can be disrupted, causing alarms to sound inappropriately and increase risk of rainout as the cold oxygen mixes with the air in the tubing

### Examples of LTV ventilators that may require adding oxygen via the circuit:

- Breas Nippy Junior/ Junior+
- Breas Nippy 3/ 3+
- Philips DreamStation
- ResMed Lumis
- ResMed Airsense 10

### Examples of LTV ventilators that allow addition of oxygen via the ventilator:

- Breas Nippy 4/ 4+
- Philips Trilogy 100
- Philips Trilogy Evo
- ResMed Stellar 100/ 150
- ResMed Astral 100/ 150

# Humidification for LTV

## Why?

- TrLTV: The natural humidification (nose and mouth) is bypassed
- High flow of air from ventilation causes increased drying effect
- Leading to:
  - thicker/ sticky secretions
  - Higher risk of infection
  - Plugging in the airway including in tracheostomy tube

## Who?

### NIV:

- If CYP has thick secretions e.g during an unwell episode
- Particular patient groups such as Neuromuscular patients with a weak cough and Cystic Fibrosis patients
- CYP with recurrent chest infections
- Oral/ nasal dryness & discomfort
- 24hr use of NIV
- Patient preference

### TrLTV:

- All CYP ventilated via a tracheostomy

*\*Pitfall Note:* These images used as an example. the type of ventilator, humidifier, circuit and interface will vary across LTV Centres – refer to CYP usual circuit set up

## Humidification Set up NIV\*

### Integrated humidifier:



Ventilator with integrated humidifier

+



Ventilator tubing

+



Vented Interface



### External humidifier:



Ventilator

+



+/- Bacterial Filter

+



Ventilator tubing



Humidifier

+



Ventilator tubing

+



Vented Interface



## Humidification Set up TrLTV\*

### Wet circuit:



Ventilator

+



Bacterial Filter

+



Ventilator tubing

+



Humidifier

+



Ventilator tubing

+



Exhalation port/ leak

+



+/-Swivel elbow



### Dry circuit:



Ventilator

+



Bacterial Filter

+



Ventilator tubing

+



Exhalation port/ leak

+



HME

+



+/-Swivel elbow



## Troubleshooting: Humidification

**Pitfall Note:** A humidifier cannot be used on travel or transferring- swap to a dry circuit. Ensure humidifier is on the same level or below the CYP to reduce risk of water running into the tracheostomy/ NIV interface

Check CYP first : complete an A-E assessment

Issue	Action
<p><b>Humidifier alarming, light flashing</b> (Integrated humidifier: humidification related alert may be visible on ventilator screen)</p>	<ul style="list-style-type: none"> <li>• <b>Check CYP</b></li> <li>• <b>Check humidifier:</b> Is there water in the humidifier chamber? If low/ empty, the temperature will increase; if too much water/ refilled quickly, temperature will decrease while humidifier heats up water</li> <li>• <b>Integrated humidifier:</b> Check this is connected properly and any openings on the humidifier chamber are closed properly</li> <li>• <b>External humidifier:</b> Check temperature probes are connected properly in the circuit and into the humidifier itself. If excess condensation present, remove temperature probes from the circuit and gently wipe with soft tissue. If humidifier continues to alarm, the probes may be faulty and need replacing.</li> </ul>
<p><b>Faulty humidifier/ humidifier does not seem to be working</b></p>	<ul style="list-style-type: none"> <li>• <b>Check CYP</b></li> <li>• <b>Know CYP humidification need:</b> If CYP is acutely unwell humidification is of increased importance, to aid the clearance of secretions. <b>Pitfall note:</b> Some underlying diagnoses are more likely to predispose the CYP to needing humidification e.g. Neuromuscular, Cystic Fibrosis. If TrLTV, do they tolerate any dry circuit time?</li> <li>• <b>Check humidifier:</b> Is it plugged in/ connected correctly and turned on? If integrated humidifier, check ventilator is plugged into mains power. <b>Pitfall note:</b> Integrated humidifiers cannot run off the battery, they must be plugged into mains power to work. Some ventilators require the integrated humidifier to be manually turned back on if mains power is interrupted e.g. if there is a power cut/ the ventilator is unplugged for any reason and runs from the internal battery, the humidifier would need to be turned back on manually in the ventilator menu.</li> <li>• <b>Change humidifier:</b> If dependant on ventilation and humidity, CYP may have a spare humidifier.</li> <li>• <b>Provide alternate humidity:</b> Consider giving extra nebulisers or continuous nebulisers if CYP is dependent on humidification</li> <li>• <b>Replacement:</b> Organise a replacement humidifier by contacting LTV Centre/ equipment supplier as per RAP</li> </ul>
<p><b>Nasal congestion/ irritation/ oral dryness</b></p>	<ul style="list-style-type: none"> <li>• <b>Check CYP</b></li> <li>• <b>Provide alternate/ additional humidity:</b> Consider increasing time on wet circuit, additional nebulisers or continuous nebulisers.</li> <li>• If using integrated humidifier, consider increasing humidity level by 1 to help loosen nasal secretions/ moisten mouth</li> </ul>
<p><b>Rainout: excess water collecting in circuit</b></p>	<ul style="list-style-type: none"> <li>• <b>Check CYP</b></li> <li>• <b>Check circuit at least hourly:</b> if water is collecting in the tubing, tip back into the humidifier</li> <li>• <b>Check Position:</b> Ensure humidifier is on the same level or below the CYP to reduce risk of water running into the tracheostomy/ NIV interface</li> <li>• If using integrated humidifier, reduce humidity level by 1</li> <li>• <b>Environment:</b> Check for any draughts in the room (fan/ open window) and ensure not blowing directly on ventilation equipment</li> </ul>



## LTV Quick Guide: Unlocking the Clinical Menu

Ventilators are usually in 'non-clinical/ limited access' mode. They will require unlocking to the 'clinical/ full access' mode to make any alterations to the prescription/ settings. Full details of how to complete this can be found in the ventilator manual. **This guidance has been provided for use by health care professionals only.** Refer to the CYP Respiratory Action Plan (RAP) for their escalation plan & contact details for tertiary LTV team or retrieval team

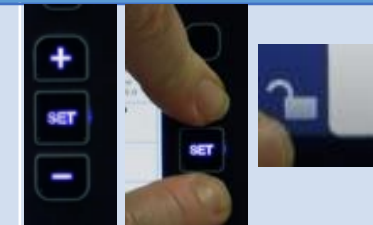
## Breas Ventilators

**Nippy Junior + and Nippy 3+:**

- Press and hold the – and + buttons together at the same time and hold for 2 seconds
- Always ensure it is relocked - to relock press and hold the – and + buttons together at the same time and hold again for 2 seconds

**Nippy 4 and Nippy 4+:**

- Press and hold the + and - buttons together at the same time and hold for 2 seconds
- Always ensure it is relocked- to relock following settings being changes, press and hold the + and - buttons at the same time and hold for 2 seconds



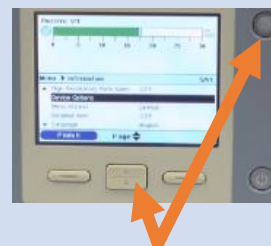
## Philips Ventilators

**DreamStation:****CPAP/ BiPAP/ ST/ AVAPS:**

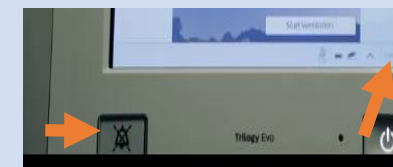
- Press and hold down the ramp button on the top of the machine and the dial at the same time and hold for a few seconds
- Always ensure it is relocked in the same way once settings have been changed

**Trilogy 100:**

- Press and hold the 'down' arrow and the alarm silence button at the same time and hold for a few seconds
- Always ensure it is relocked and 'limited' access is selected from the option menu

**Trilogy Evo:**

- Press and hold the digital clock in the bottom right of the screen and the alarm silence button - keep holding both together for 5 seconds
- A confirmation pop-up will appear. Release the button and clock, and confirm entering 'full access' mode
- Press the 'arrow' icon in the bottom right of the screen and press the padlock symbol to return back to 'limited' access following setting changes



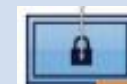
## ResMed Ventilators

**Stellar 100/ 150:**

- Press and hold down the double ticks button on the top of the machine and the dial at the same time and hold for a few seconds
- Always ensure it is relocked in the same way once settings have been changed

**Astral 100/ 150:**

- On the touch screen in the top left corner, press and hold the padlock icon for a few seconds
- A confirmation pop-up will appear asking if you would like to access the clinical menu for 20 minutes or unlimited. For safety select "20 minutes" to confirm
- Padlock icon at top left of screen should now be open
- Always ensure it is relocked by tapping the padlock icon in top left corner of the screen

**AirSense 10 and Lumis:**

- Press and hold down the home button at the front of the machine and the dial at the same time and hold for a few seconds
- Always ensure it is relocked in the same way once settings have been changed



## Troubleshooting: NIV

## Check CYP first : complete an A-E assessment

Issue	Action
<b>Desaturation</b>	<ul style="list-style-type: none"> <li>➤ Check Airway and then continue to undertake a systematic A-E assessment. Consider applying mnemonic <a href="#">DOPES</a> when troubleshooting (Displacement, Obstruction, Pneumothorax, Equipment and Stomach)               <ul style="list-style-type: none"> <li>• Check for patent airway and the interface for disconnections, leaks and blockages</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt (<a href="#">Appendix I</a>)</li> <li>• Assess breathing; auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• Add/ increase oxygen via ventilator (either into the circuit using an extra connector or at the back/ side of the ventilator via the oxygen port). <a href="#">See Appendix D: How to connect Oxygen to a portable Ventilator</a></li> <li>• Refer to CYP RAP and review their escalation plan</li> <li>• Ensure “Ramp” setting is turned off if the CYP is acutely unwell</li> </ul> </li> </ul>
<b>Machine failure</b>	<ul style="list-style-type: none"> <li>• Know CYP dependency: if ventilation only required when asleep, wake child while escalating</li> <li>• Change ventilator: CYP usually has a backup machine if they are dependent on ventilation</li> <li>• Hand-ventilate CYP immediately if asleep or unable to tolerate any time off ventilation</li> <li>• Organise a replacement ventilator (See RAP for technical ventilator contacts)</li> </ul>
<b>High leak/ High flow/ Low pressure alarm</b>	<ul style="list-style-type: none"> <li>• Check for patent airway and the interface for disconnections, leaks and blockages: adjust to minimise leak, remove and re-apply mask if needed to obtain a good mask fit</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt (<a href="#">Appendix I</a>)</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports</li> <li>• Feel for mouth leak if using a nasal interface by putting back of hand just in front of mouth. If air coming out of mouth, consider changing to a mask that also covers the mouth or consider use of dummy/ pacifier or chin strap (contact LTV centre for advice)</li> <li>• Perform a learn circuit/ circuit test/ calibration (if applicable for ventilator in use)</li> <li>• Check ventilator: is it working correctly? Support CYPs breathing if required &amp; change ventilator</li> </ul>
<b>Blocked tube/ NV mask/ High pressure alarm</b>	<ul style="list-style-type: none"> <li>• Check for patent airway and the interface for blockages: secretions/ vomit in the mouth &amp; nose</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt (<a href="#">Appendix I</a>)</li> <li>• Assess breathing; auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check interface fitted properly: not occluding nostrils, remove and re-apply mask if needed to obtain a good mask fit</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• Perform a Learn circuit/ Circuit Test/ Calibration (if applicable for ventilator in use)</li> <li>• Check ventilator: is it working correctly? Support CYPs breathing if required &amp; change ventilator</li> </ul>

## Troubleshooting: NIV

## Check CYP first : complete an A-E assessment

Issue	Action
<p><b>High-Vte/ High Mve</b> - The CYP minute ventilation/ or tidal volume is higher than or equal to the alarm level set.</p>	<ul style="list-style-type: none"> <li>➤ Check Airway and then continue to undertake a systematic A-E assessment, consider applying mnemonic <a href="#">DOPES</a> when troubleshooting (Displacement, Obstruction, Pneumothorax, Equipment and Stomach)               <ul style="list-style-type: none"> <li>• Check for patent airway and the interface for disconnections, leaks and blockages</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt (<a href="#">Appendix I</a>)</li> <li>• Assess breathing, auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• Refer to CYP RAP and review their escalation plan</li> <li>• Consider alternative causes for increased tidal volume or minute ventilation e.g. CYP taking bigger/ more frequent breaths such as during increased level of activity- laughing, crying or hiccups.</li> <li>• Contact LTV centre: if CYP stable and no issues with ventilator circuit, consider if the CYP may have outgrown the current alarm parameters set. They may require alarm parameters to be changed</li> </ul> </li> </ul>
<p><b>Low Vte/ Low Mve</b> - The CYP minute ventilation/ or tidal volume is less than or equal to the alarm level set. (e.g. interface leak/ disconnection or blockage)</p>	<ul style="list-style-type: none"> <li>➤ Check Airway and then continue to undertake a systematic A-E assessment, consider applying mnemonic <a href="#">DOPES</a> when troubleshooting (Displacement, Obstruction, Pneumothorax, Equipment and Stomach)               <ul style="list-style-type: none"> <li>• Check for patent airway and the interface for disconnections, leaks and blockages</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt (<a href="#">Appendix I</a>)</li> <li>• Assess breathing, auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports (refer to <a href="#">High leak/ High flow/ Low pressure alarm troubleshooting</a>)</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• Refer to CYP RAP and review their escalation plan</li> </ul> </li> </ul>
<p><b>Aerophagia:</b> Bloating caused by excessive &amp; repetitive air swallowing. Can cause splinting of the diaphragm, poor gas exchange &amp; pain</p>	<ul style="list-style-type: none"> <li>• Check CYP is not auto-triggering (ventilator tries to deliver a breath when CYP is not ready)</li> <li>• Aspirate gastrostomy/ NGT (if applicable) or consider inserting an NGT aspirate every 4 hours or leave on free drainage at times if appropriate</li> <li>• Refer to RAP/ escalate to LTV Centre for advice, to consider:               <ul style="list-style-type: none"> <li>• Switching mask: changing interface from nasal to full face or vice versa can reduce gulping air</li> <li>• Reduce pressure- if required in severe cases</li> </ul> </li> </ul>
<p><b>Failed circuit test</b> (if applicable for ventilator in use)</p>	<ul style="list-style-type: none"> <li>• Repeat the circuit test, following instructions on the ventilator screen and keeping tubing as straight as possible</li> <li>• If it fails a second time, contact the servicing provider, LTV team or ventilator company and use spare ventilator if CYP dependent on ventilation- see RAP for technical support contact details.</li> </ul>
<p><b>Humidifier alarming</b></p>	<ul style="list-style-type: none"> <li>• <a href="#">See Appendix E: Humidifier Troubleshooting</a></li> </ul>

## Troubleshooting: NIV

### Check CYP first : complete an A-E assessment

Issue	Action
<p><b>Poor Synchrony/ Asynchrony:</b> <i>(A mismatch between the CYP and the Ventilator, e.g. CYP receiving a ventilator breath at a different time to when they are trying to inhale. The CYP looking uncomfortable when on the ventilator)</i></p>	<p><b>Pitfall Note:</b> Poor synchrony is applicable to bilevel modes only.</p> <ul style="list-style-type: none"> <li>• Check for patent airway and the interface for disconnections, leaks and blockages: Secretions in the airway can cause asynchrony- suction &amp; consider physiotherapy input</li> <li>• Check for a leak: excessive leak can cause asynchrony as it can be interpreted by the ventilator as spontaneous breath, triggering the ventilator to deliver a breath: (refer to <a href="#">High leak/ High flow/ Low pressure alarm troubleshooting</a>)</li> <li>• Check for 'Rainout' (build-up of water in tubing) which generates circuit air turbulence &amp; can cause Auto-triggering: remove excess water &amp; assess humidity level (decrease humidity)</li> <li>• Escalate to LTV Centre: Trigger sensitivity may need adjusting. If it is too sensitive, ventilator may deliver a breath when the CYP is not ready</li> </ul>
<p><b>Poor compliance/ CYP uncomfortable on NIV</b></p>	<ul style="list-style-type: none"> <li>• Check CYP while on ventilation</li> <li>• Check if "Ramp" enabled: If no other apparent cause for being uncomfortable or CYP reports the ventilator is "blowing too hard"</li> <li>• If enabled, increase Ramp time so that pressure builds up slowly over a set time to help acclimatise CYP to the pressure</li> <li>• Escalate to LTV Centre: to discuss cause, troubleshoot and review</li> </ul>
<p><b>Nasal congestion/ irritation</b></p>	<ul style="list-style-type: none"> <li>• Circuit type: Consider changing to a wet circuit and/ or nebuliser/s</li> <li>• Check Humidifier: Is it on?, does it require water to be topped up. <b>Pitfall Note:</b> A wet humidified circuit cannot be used during travel or transport- ensure CYP is on a dry circuit for this.</li> <li>• If using integrated humidifier, increase humidity level by 1 to help loosen nasal secretions</li> </ul>
<p><b>Rainout</b> (excess water collecting in circuit)</p>	<ul style="list-style-type: none"> <li>• Check circuit hourly: if water is collecting in the tubing, tip back into the humidifier</li> <li>• Ensure humidifier is on the same level or below the CYP to reduce risk of water running into the NIV interface</li> <li>• If using integrated humidifier, reduce humidity level by 1</li> <li>• Check for any draughts in the room (fan/ open window) and ensure not blowing directly on ventilation equipment</li> </ul>
<p><b>Pressure sores</b></p>	<ul style="list-style-type: none"> <li>• Prevention: Review size/type of NIV mask, consider cycling between two masks every 4 hours, consult with tissue viability and contact LTV centre regarding: protective creams, dressings and +/- mask review</li> <li>• Remove the route cause – consider swapping mask or does CYP dependency allow increased breaks from ventilation – see RAP</li> <li>• Escalate to LTV Centre for advice</li> <li>• Severe cases, remove mask &amp; use alternative ventilator support if applicable</li> </ul>

## Non-Invasive Ventilation (NIV) nebuliser delivery: Flow generated/ jet nebuliser

**Pitfall Note:** Where possible only use nebulisers via an NIV circuit if the patient is dependant. A better nebuliser deposition is achieved directly to the patient, rather than via the ventilator circuit, nebuliser medication can enter the ventilator risking damage to the ventilator

### Wet circuit or Dry circuit:



- Administered as close to the CYP as possible
- A T-Piece is placed into the circuit between the NIV interface and patient end of ventilator tubing
- The exhalation port/ leak in the interface can become blocked due to crystallisation from the nebuliser e.g. Salt
  - Action:** monitor for signs of obstruction, check exhalation/ leak port and clean mask if concerned
- The nebuliser should remain upright while running- hold nebuliser pot during nebulisation
- A jet nebuliser is delivered using a flow of air or oxygen into the circuit-. This can disrupt ventilator flow causing alarms to sound
  - Action:** check CYP if alarms are sounding, undertake an A-E assessment

## Non-Invasive Ventilation (NIV) nebuliser delivery: Aerogen nebuliser

### Wet/ dry or integrated humidifier (nearest the CYP):



### Wet circuit with an external humidifier:



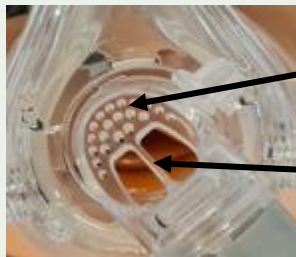
- In a wet/ dry or an integrated humidifier: Place the aerogen as close to the CYP as possible in the circuit between the NIV interface and patient end of ventilator tubing
- In a wet circuit with an external humidifier, the areogen can also be place on the dry side of the humidifier.
- The alarms should not sound unless there is a problem, as the aerogen is not driven by high flow air or oxygen, and does not add an extra air flow into the ventilator circuit. The aerogen uses a vibrating mesh to generate tiny particles, which does not interrupt the ventilator flow
- The aerogen should remain upright while running
- The exhalation port/ leak in the interface can become blocked with salt from the nebuliser causing the ventilator to alarm
  - Action:** monitor for signs of salt build up- check exhalation port and clean mask if concerned

## NIV Interfaces Guide and optimal mask fit for Long Term Ventilation

### Safety and Fitting Guidance

#### Vented Interface

- Exhalation port/ leak (an intentional leak) is built into the interface – this allows the CYP to safely expire in the single limb circuit
- Most CYP on ventilators at home have **vented** interfaces



- **Exhalation port/ leak** - Feel for expiratory air flow to ensure leak is patent and working
- **Anti asphyxiation valve** reduces risk of rebreathing of CO<sub>2</sub> if ventilation stopped and the mask still attached to CYP (e.g. power failure)

#### Non-vented Interface



- There is **no** exhalation port/ leak
- Often used for acute NIV in a PICU/ HDU setting and not in LTV
- Should **not** be used in a single limb circuit due to the lack of an exhalation port/ leak- requires a dual limb circuit or additional exhalation port/ leak (*ensure advice is sought from the CYP respiratory centre*)

#### Fitting Guidance



- Fit mask first, with no tubing attached- ensure head gear straps are not too tight or loose.
- Use a two finger technique when checking head strap tension
- Once mask fitted, connect tubing and then start ventilation
- Check for leaks anywhere around the interface by feeling with your hands for air escaping.
- Exhalation port/ leak - Feel for expiratory air flow to ensure leak is patent and working

### Interface Type

#### Nasal Pillow



### Good Interface fit

- Sits inside nostrils creating a seal around the inside of the nostrils
- Ensure that the inner walls of one or both pillows are not out of shape, compressed or collapsed

#### Nasal Mask



- Sits on top of the bridge of the nose
- Ensure mask not occluding nostrils
- Ensure top lip is not in the nasal mask
- Ensure there is no leak into the eyes as this can cause dryness and discomfort

#### Full Face Mask



- Sits on top of the bridge of the nose
- Sits on the chin, under the bottom lip
- Ensure eyes not covered/ no leak into eyes

#### Oral-Nasal Mask



- Nasal pillows sit in nostrils
- Oral mask section sits on the chin, under the bottom lip

#### Total Face Mask



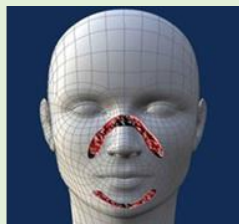
- Sits on the forehead
- Comfortably covers eyes, nose & mouth
- Sits on the chin, under the bottom lip

## NIV Bedside Care

### Tissue Viability: NIV

#### Common pressure areas:

- Bony prominences: bridge of nose, chin, forehead
- Behind the ears and earlobes
- Nasal septum/ nostrils



#### Causes of pressure sores:

- Increased NIV usage
- Increase in ventilation pressure resulting in mask tightening to reduce leaks
- Incorrect mask/ headgear size or type
- Unclean mask
- Lack of regular oral cares and skin care
- Wet mask or increase in humidity
- CYP age and weight affecting skin integrity and tissue depth
- Poor nutrition

#### Prevention:

- Barrier products are used to reduce friction, shear and protect the skin
- Do not apply too many layers or overlap the edges of dressings as this can:
  - Increase pressure over the area causing more damage
  - Cause more leak as straps get pulled tighter increasing pressure over the area and leak through the layers of dressings
- It can be trial and error to find the right solution
- Discuss with parent/ carer usual pressure care routine, escalating to tissue viability as required. The use of Duoderm is not routinely recommended due to the risk of removing the top layer of healing skin.
- Some dressings can be reused. These should be removed with the NIV mask and cleaned in warm soapy water then left to air dry

**Pitfall note:** Where possible avoid placing dressings on chin or between nose and mouth as there is a risk that this could occlude the airway if it slips, a risk assessment should be undertaken.

### Prevention: Oral Care, skin care and Equipment Care

#### Importance of mouth care:

Children who are on NIV for prolonged periods and those receiving high oxygen flows, can experience a dry mouth

- The CYP can develop a thick coating over the tongue and lining of the mouth
- Gentle but regular mouth care including dental hygiene can prevent coatings and debris from the lips, tongue and lining of the mouth

#### Importance of skin care and equipment care:

- Ensure skin is cleaned regularly and is thoroughly dry before replacing NIV interface
- Ensure NIV interface is cleaned daily in warm soapy water, rinsed and thoroughly air dried before reuse (If CYP is dependant on ventilation, they usually have two interfaces to alternate between)

## Troubleshooting: TrLTV

### Check CYP first : complete an A-E assessment

Issue	Action
<b>CYP Desaturating</b>	<ul style="list-style-type: none"> <li>➤ Check Airway and then continue to undertake a systematic A-E assessment. Consider applying mnemonic <a href="#">DOPES</a> when troubleshooting (Displacement, Obstruction, Pneumothorax, Equipment and Stomach to assessment)               <ul style="list-style-type: none"> <li>• Check for patent airway: disconnections, decannulation, leaks and blockages (<b>Refer to</b> 'Emergency Paediatric Tracheostomy Management' NTSP)</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt</li> <li>• Assess breathing: auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• If not on ventilation, either provide oxygen via tracheostomy or connect CYP to their ventilator.</li> <li>• If on ventilation add/ increase oxygen via ventilator (either into the circuit using an extra connector or at the back/ side of the ventilator via the oxygen port). <a href="#">See Appendix D: How to connect Oxygen to a portable Ventilator</a></li> <li>• Refer to CYP RAP and review their escalation plan</li> <li>• CYP struggling to achieve acceptable oxygen saturations with increasing oxygen via ventilator, remove ventilator and commence BLS</li> </ul> </li> </ul>
<b>Machine failure</b>	<ul style="list-style-type: none"> <li>• Know CYP dependency: if ventilation only required when asleep, wake child while escalating</li> <li>• Change ventilator: CYP usually has a backup machine if they are dependent on ventilation</li> <li>• Hand-ventilate CYP immediately if asleep or unable to tolerate any time off ventilation</li> <li>• Organise a replacement ventilator (including to replace back up ventilator) See RAP for technical advise</li> </ul>
<b>High leak/ High flow/ Low pressure alarm</b>	<ul style="list-style-type: none"> <li>➤ Check Airway and then continue to undertake a systematic A-E assessment. Consider applying mnemonic <a href="#">DOPES</a> when troubleshooting (Displacement, Obstruction, Pneumothorax, Equipment and Stomach to assessment)               <ul style="list-style-type: none"> <li>• Check for patent airway: disconnections, decannulation, leaks and blockages (<b>Refer to</b> 'Emergency Paediatric Tracheostomy Management' NTSP)</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt</li> <li>• Check CYP: Feel for mouth leak by putting back of hand just in front of mouth/ listening for vocal sounds</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports</li> <li>• Check ventilator: is it working correctly? Support CYPs breathing if required &amp; change ventilator</li> <li>• Perform a Learn circuit/ Circuit Test/ Calibration (if applicable for ventilator in use)</li> <li>• Refer to CYP RAP and review their escalation plan</li> <li>• Contact LTV centre: if CYP stable and no issues with ventilator circuit, consider if CYP tracheostomy size may need increasing</li> </ul> </li> </ul>



## Troubleshooting: TrLTV

### Check CYP first : complete an A-E assessment

Issue	Action
<p><b>Blocked tube/ NV mask/ High pressure alarm</b></p>	<ul style="list-style-type: none"> <li>• Check for patent airway: secretions/ vomit in the tracheostomy (<b>Refer to</b> 'Emergency Paediatric Tracheostomy Management' NTSP)</li> <li>• Check tracheostomy is in situ: lift dressing and check tracheostomy is correctly in stoma</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt</li> <li>• Assess breathing: auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• Perform a Leak circuit/ Circuit Test/ Calibration (if applicable for ventilator in use)</li> <li>• Check ventilator: is it working correctly? Support CYPs breathing if required &amp; change ventilator</li> </ul>
<p><b>High-Vte/ High Mve</b> - The CYP minute ventilation/ or tidal volume is higher than or equal to the alarm level set.</p>	<ul style="list-style-type: none"> <li>➤ Check Airway and then continue to undertake a systematic A-E assessment. Consider applying mnemonic <a href="#">DOPES</a> when troubleshooting (Displacement, Obstruction, Pneumothorax, Equipment and Stomach to assessment)</li> <li>• Check for patent airway: disconnections, decannulation, leaks and blockages (<b>Refer to</b> 'Emergency Paediatric Tracheostomy Management' NTSP)</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt</li> <li>• Assess breathing, auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• Refer to CYP RAP and review their escalation plan</li> <li>• Consider alternative causes for increased tidal volume or minute ventilation e.g. CYP taking bigger/ more frequent breaths such as during increased level of activity- laughing, crying or hiccupping.</li> <li>• Contact LTV centre: if CYP stable and no issues with ventilator circuit, consider if the CYP may have outgrown the current alarm parameters set. They may require alarm parameters to be changed</li> </ul>
<p><b>Low Vte/ Low Mve</b> - The CYP minute ventilation/ or tidal volume is less than or equal to the alarm level set. (e.g. a leak/ disconnection or blockage)</p>	<ul style="list-style-type: none"> <li>➤ Check Airway and then continue to undertake a systematic A-E assessment. Consider applying mnemonic <a href="#">DOPES</a> when troubleshooting (Displacement, Obstruction, Pneumothorax, Equipment and Stomach to assessment)</li> <li>• Check for patent airway: disconnections, decannulation, leaks and blockages (<b>Refer to</b> 'Emergency Paediatric Tracheostomy Management' NTSP)</li> <li>• Check that the exhalation/ leak port is patent and flow can be felt</li> <li>• Assess breathing: auscultate &amp; suction if secretions indicated, consider physiotherapy input</li> <li>• Check circuit for any disconnections or leaks: splits, holes or disconnected ports (<a href="#">refer to High leak/ High flow/ Low pressure alarm troubleshooting</a>)</li> <li>• Check circuit for blockages: kinks in tubing/ trapped somewhere e.g. side of bed, water in tubing</li> <li>• Refer to CYP RAP and review their escalation plan</li> </ul>

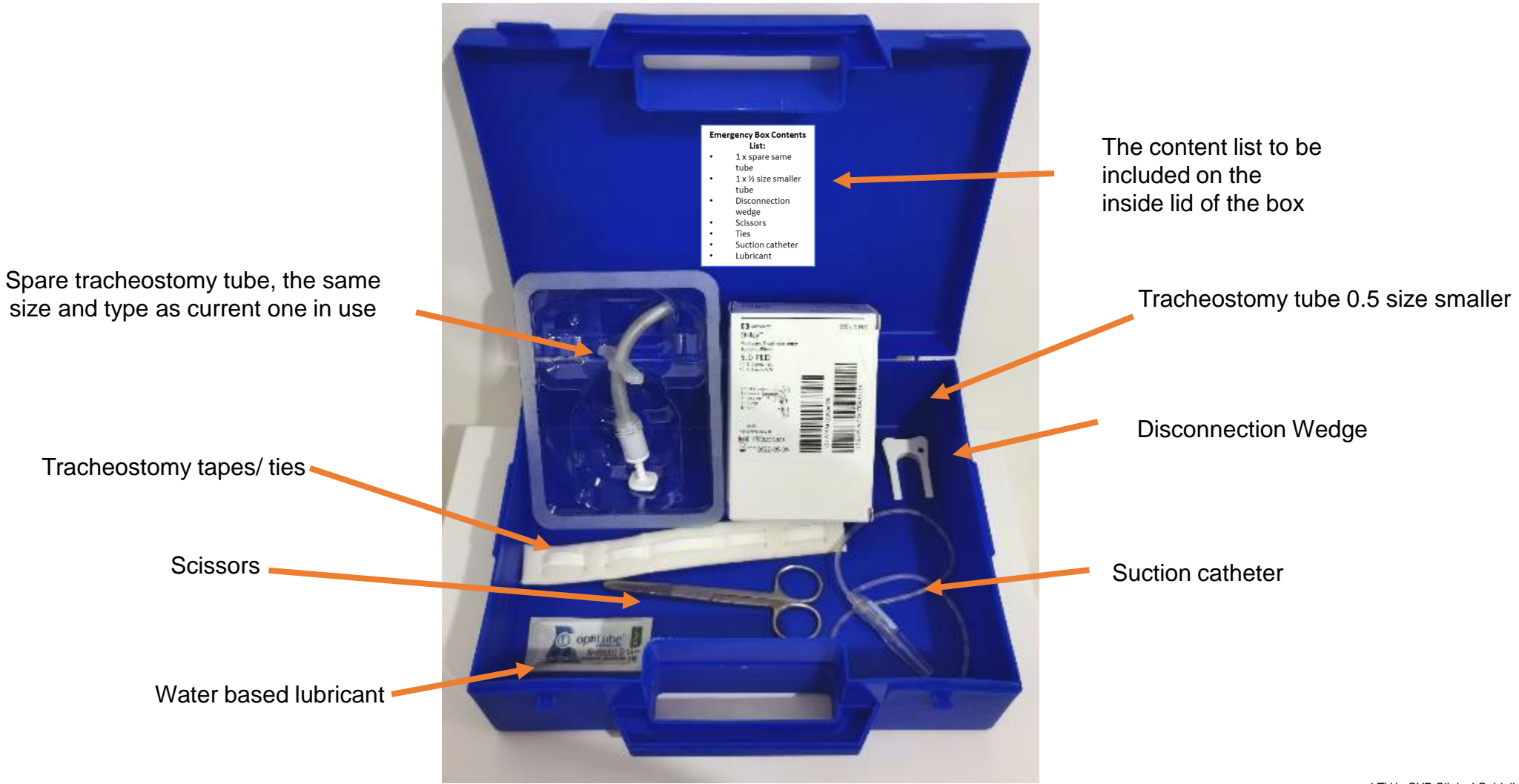
## Troubleshooting: TrLTV

## Check CYP first : complete an A-E assessment

Issue	Action
<p><b>Poor Synchrony</b> (A mismatch between the CYP and the Ventilator, e.g. CYP receiving a ventilator breath at a different time to when they are trying to inhale. The CYP looking uncomfortable when on the ventilator)</p>	<p><b>Pitfall Note:</b> Poor synchrony is applicable in Bilevel modes only.</p> <ul style="list-style-type: none"> <li>• Check for patent airway: disconnections, decannulation, leaks and blockages (<b>Refer to</b> 'Emergency Paediatric Tracheostomy Management' NTSP)</li> <li>• Secretions in the airway can cause asynchrony- suction &amp; consider physiotherapy input</li> <li>• Check for a leak: check for leaks tracheostomy site/ circuit. An excessive leak can cause asynchrony, as it can be interpreted by the ventilator as a spontaneous breath, triggering the ventilator to deliver another breath-</li> <li>• Check for 'Rainout' (build-up of water in tubing) which generates circuit air turbulence &amp; can cause auto triggering- remove excess water &amp; ensure no draughts blowing on tubing</li> <li>• Escalate to LTV centre: Trigger sensitivity may need adjusting. If it is too sensitive, ventilator may deliver a breath when the CYP is not ready</li> </ul>
<p><b>Rainout</b> (excess water collecting in circuit)</p>	<ul style="list-style-type: none"> <li>• Check circuit hourly: if water is collecting in the tubing, tip back into the humidifier</li> <li>• Ensure humidifier is on the same level or below the CYP to reduce risk of water running into the tracheostomy</li> <li>• Check for any draughts in the room (fan/ open window) and ensure not blowing directly on ventilation equipment</li> </ul>
<p><b>Failed circuit test</b> (if applicable for ventilator in use)</p>	<ul style="list-style-type: none"> <li>• Repeat the circuit test, following instructions on the ventilator screen and keeping tubing as straight as possible</li> <li>• If it fails a second time, contact the servicing provider, LTV team or ventilator company and use spare ventilator if CYP dependent on ventilation- see RAP for technical support contact details.</li> </ul>
<p><b>Pressure sores</b></p>	<ul style="list-style-type: none"> <li>• Usually unable to remove the route cause (tracheostomy tapes/ tracheostomy): ensure tapes are secure but not too tight</li> <li>• Prevention: Liaise with tissue viability and LTV centre regarding best protective creams, dressings and tracheostomy tapes to use</li> <li>• Escalate to LTV centre (and/ or retrieval team as clinically indicated).</li> </ul>
<p><b>Humidifier alarming</b></p>	<ul style="list-style-type: none"> <li>• Check humidifier for further information on what/ and where the fault is</li> <li>• Check temperature probe is properly plugged in at base of humidifier- if plugged in correctly, there may be a fault &amp; need replacing</li> <li>• Condensation on temperature probes causes alarm: remove probe, cover hole in circuit and gently wipe probe with soft dry gauze before replacing probe back into hole in circuit</li> <li>• Frequent disconnections: increase in cold air entry will increase heater activity</li> <li>• Check the room is not too cold/ draughty, may also alarm with high flows of air in the circuit e.g. nebuliser or oxygen</li> <li>• Check water level in chamber &amp; water supply- if water in humidifier chamber low, temperature will go up; if too much/ refilled quickly, temperature will go down while humidifier heats up water</li> <li>• For further guidance see: <a href="#">See Appendix E: Humidifier Troubleshooting</a></li> </ul>

## Emergency Tracheostomy Box

- The contents of a tracheostomy emergency box may vary slightly between each CYP and each LTV Centre.
- This document advises on the essential **minimum requirements** for a tracheostomy emergency box in order for the CYP to be safe in an emergency.
- An emergency constitutes a decannulation, a partially blocked tracheostomy tube or a blocked tracheostomy tube i.e. unable to pass a suction catheter easily to the end of the tracheostomy tube (to the usual length required to suction that tracheostomy tube).
- Please refer to the CYP Lead LTV centre for further information and patient specific information.



Core Contents List	Further Guidance
<b>Spare tracheostomy tube: same size and type as current one in use</b>	For inserting in an emergency
<b>Tracheostomy tube 0.5 size smaller</b>	For inserting if unable to get usual sized tube into stoma in an emergency. Usually advised to be a Shiley tube as if required to use Seldinger/ railroading technique, this is more rigid when introducer is removed. Some larger tubes such as the double lumen do not have half sizes so in this instance it may be one size smaller
<b>Scissors</b>	For cutting tracheostomy tapes/ ties. Round ended to minimise the risk of a cut to the neck/ flange of tracheostomy
<b>Disconnection Wedge</b>	For safely removing ventilator tubing/ HME Swedish Nose from Bivona tracheostomy to reduce risk of decannulation (wedge does not usually work on Shiley tracheostomy tubes)
<b>Tracheostomy tapes/ ties</b>	For securing the tracheostomy in an emergency- this can be done as a single handed tube change if required. Velcro tapes are often used in an emergency until help arrives and the CYP is stable enough to change back to their usual ties (CYP may use Velcro tapes as their usual method of securing the tracheostomy). Some centres may suggest one side of the tube has the tape pre attached for ease during an emergency particularly if single person tube change. Check individual care plan and discuss with LTV centre.
<b>Water based lubricant</b>	To lubricate the bend in the arch of the tracheostomy tube ready for insertion- be careful not to put lubricant on the end of the tracheostomy tube as this could block the tube
<b>Suction catheter</b>	Used for the seldinger/ railroading technique if unable to get the 0.5 size smaller tracheostomy tube with the introducer. Size: Suction catheter size should be the size usually used by the CYP

Additional items that may be found in an emergency tracheostomy box:

*(discuss with parents/carers and LTV Centre, as minimum requirements for tracheostomy box can vary dependant on each CYP and each LTV Centre)*

Additional item	Further Guidance
<b>Bed head information and emergency algorithm</b>	Some centres suggest a small (A6) sized copy of the emergency algorithm to be stuck next to the contents list
<b>Swivel Elbow</b>	If Bag Valve Mask (BVM) ventilation is required with a Shiley tracheostomy tube in place, the elbow acts as an extension if the BVM does not securely stay on the tracheostomy due to proximity of tracheostomy hub to the neck
<b>1ml syringe and Sodium Chloride 0.9% ampule</b>	Instillation of Sodium Chloride 0.9% may be advocated to aid suction of particularly thick, sticky secretions – this should only be undertaken by those who have been trained to undertake this procedure
<b>One way valve</b>	For mouth to tracheostomy breaths (usually for parent/ carers due to infection control risks). Mostly used in the community instead of a BVM if CYP does not require ventilation via tracheostomy
<b>Gauze</b>	As per the NTSP algorithm, for covering the tracheostomy stoma while performing BVM ventilation via nose and mouth (some centres may use a gloved finger/hand instead)

## Additional Bedside Tracheostomy Care equipment





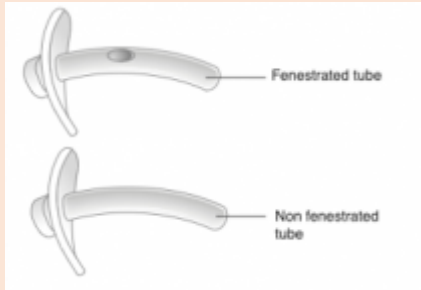
- In addition to the Emergency Tracheostomy Box and usual bedside emergency equipment, there are some additional items that should be present at the bedside to safely manage situations that may occur requiring prompt response to avoid an emergency.
- Please refer to your Lead LTV Centre for further, patient specific information.

Additional items	Further Guidance
<b>NTSP Bedside safety poster</b>	The National Tracheostomy Safety Project (NTSP) emergency algorithm visible at the bedside and completed with CYP specific details (scan QR Code to take you to the NTSP online resources)
<b>Bag Valve Mask</b>	For manual ventilation during an emergency
<b>Oxygen</b>	Either portable oxygen cylinder or wall mounted oxygen. High flow for use in an emergency. If CYP requires regular oxygen there may be additional high or low flow oxygen available depending on amount prescribed. If leaving the bedside, ensure oxygen cylinder is at least half full if CYP (or as per local policy) does not require regular oxygen. If CYP requires regular oxygen, calculate enough for the journey: Journey time X prescribed O2 requirement = Total amount needed for journey, double the amount for safety e.g. CYP requires 2L/min O2 & is going out for 60mins: 60mins x 2L/min =120L O2. Double for safety: 120x2 =240L total
<b>Oxygen connection available</b>	Either tracheostomy mask or appropriate swedish nose HME with oxygen connector if not on a ventilator. Appropriate connection for ventilator also required if the CYP also has LTV
<b>2x High Flow Reservoir Oxygen Mask</b>	For use to deliver high flow oxygen via tracheostomy and face in an emergency
<b>Stethoscope</b>	For auscultating CYPs chest, listening for bilateral air entry to lungs and other lung sounds
<b>One way valve</b>	For mouth to tracheostomy breaths (usually for parent/ carers due to infection control risks). Mostly used in the community instead of a BVM if CYP does not require ventilation via tracheostomy
<b>Swivel Elbow</b>	If BVM ventilation is required with a Shiley tracheostomy tube in place, the elbow acts as an extension if the BVM does not securely stay on the tracheostomy due to proximity of tracheostomy hub to the neck. Also used as replacement for swivel elbow in ventilated patients if this becomes soiled or damaged
<b>Working suction</b>	Portable suction machine or wall mounted suction. For routine suction of tracheostomy tube to keep airway patent. Portable suction machines should be charging when not in use. Refer to local policy regarding suction pressures See <a href="#">Appendix M: Suctioning a Tracheostomy</a>
<b>Box of appropriately sized suction catheters</b>	For suction of tracheostomy tube (double the size of the tracheostomy tube e.g. Tracheostomy tube size 4.0ID= Size 8 suction catheter; where odd numbered catheters are not available, use the closest size down e.g. tracheostomy size 4.5ID= size 9 however no size 9 suction catheter so use size 8)
<b>Yankaur</b>	For oral suction as required
<b>1ml syringe and Sodium Chloride 0.9% ampules</b>	Instillation of Sodium Chloride 0.9% may be advocated to aid suction of particularly thick, sticky secretions – this should only be undertaken by those who have been trained to undertake this procedure

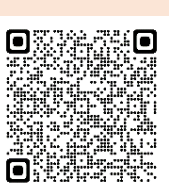


Additional items	Further Guidance
<b>Oximeter</b> (oxygen saturation monitor)	With appropriate saturation probe. To monitor oxygen saturations and pulse
<b>Appropriate PPE</b>	e.g. gloves, apron, goggles/ visor, facemask (refer to local policy)
<b>Nebuliser</b> (Aerogen/ flow driven nebuliser)	Including appropriate T-piece connections for the nebuliser in use to connect to the ventilator circuit (if required) or tracheostomy mask to deliver nebuliser while off ventilation
<b>Sterile Water</b>	To clean suction tubing following use. Also, often used to clean inner cannula of double lumen tracheostomy tube if this is in use. Refer to local policy
<b>Spare tracheostomy tubes:</b> same type & size as current one in use	In order that there is enough stock to account for routine and emergency tube changes and cleaning time for reusable tubes. Usually a minimum of 4 tracheostomy tubes is advised (1 in CYP, 1 in emergency box, 1 being cleaned & 1 spare). Liaise with LTV centre/ local team for further information
<a href="#">For Cuffed tracheostomy tubes:</a> Spare 10ml IV syringes	For inflation/ deflation of cuffed tracheostomy tube and water for injection ampules (if appropriate, e.g. for TTS cuffed tracheostomy tube) and three-way tap (if appropriate, e.g. for Fome cuffed tracheostomy tube only to maintain cuff deflation)
<b>Tracheostomy dressings</b>	Usual dressing used by the CYP for routine tape changes or if the dressing becomes dislodged or soiled
<b>Spare tracheostomy tapes/ ties</b>	Usual tapes/ ties used by the CYP for routine and additional changes as required, e.g. changing if tapes tension needs adjusting and unable to reuse existing tapes and if additional tapes are required following an emergency
<b>Gauze</b>	For cleaning during tracheostomy cares/ tape changes and used to occlude the tracheostomy stoma if unable to get either spare tubes in and having to perform BLS via nose and mouth in CYP with intact upper airway)
<b>Appropriate skin cleaning solution</b>	e.g. Sodium Chloride 0.9% or Prontosan. For use during tracheostomy cares/ tape changes. See CYP RAP or contact LTV centre for more information. Adhere to local Tissue Viability Policy.
<b>Patient specific barrier cream(s)</b>	For use during tapes change to protect skin. See CYP RAP or contact LTV Centre for more information. Adhere to local Tissue Viability Policy.
<b>2x Towel/ blanket</b> (if required)	<ol style="list-style-type: none"> <li>1. To swaddle CYP during tube/ tape changes if required</li> <li>2. To use rolled up under shoulders to help extend neck during tube/ tape changes</li> </ol>
<b>Spare swedish nose HME</b>	For replacement if too wet or soiled. This will be used if CYP has any time off ventilation. Not required if CYP is 24hr ventilated
<b>Tracheal dilators</b> (may be available in the emergency box of patients from some LTV centres or may be in the crash trolley in some areas)	If present, they are only for use in an emergency, this should only be undertaken by those who have been trained to undertake this procedure

Additional Items for Cuffed, double lumen and fenestrated Tracheostomy Tubes

TTS (Tight To Shaft)	Aire Cuff	Fome Cuffed Tube	Double lumen Tube	Fenestrated Tube
 <ul style="list-style-type: none"> <li>• 2 x 10ml IV Syringe (to use pre-determined amount of water, as advised by ENT/ LTV centre)</li> <li>• 1 x 5ml ampule water for injection</li> </ul>	 <ul style="list-style-type: none"> <li>• 1 x 10ml IV Syringe for deflation and inflation (to use pre-determined amount of air as advised by ENT/ LTV centre)</li> <li>• Manometer (to check cuff pressure)</li> </ul>	 <ul style="list-style-type: none"> <li>• Spare Tube of the same size is usually TTS tracheostomy tube (this is easier to insert in an emergency than a Fome cuffed tube)</li> <li>• 1 x 10ml IV Syringe</li> <li>• 1 x three-way tap (to maintain deflation of cuff while tracheostomy tube is removed/ inserted)</li> <li>• 1 x filtered needle (to be used to deflate cuff if the cuff line has been cut)</li> </ul>	 <ul style="list-style-type: none"> <li>• Some double lumen tubes do not come in half sizes, so the 2nd emergency tube maybe one size smaller rather than 0.5 size smaller</li> <li>• Spare innertubes (for tube changes)</li> <li>• Cleaning solution (often sterile water)</li> <li>• Foam cleaning swabs (to clean innertubes between use)</li> <li>• Clean tray/ box (to store spare innertubes)</li> <li>• If cuffed: 1 x 10ml syringe &amp; manometer (to use pre-determined amount of air, as advised by ENT/ LTV centre)</li> </ul>	 <ul style="list-style-type: none"> <li>• Spare fenestrated innertubes (for tube changes)</li> <li>• Non fenestrated innertube(s) (to be placed when suction required or if BVM required to ventilate CYP in an emergency)</li> <li>• Cleaning solution (often sterile water)</li> <li>• Foam cleaning swabs (to clean innertubes between use)</li> <li>• Clean tray/ box (to store spare innertubes)</li> <li>• If cuffed: 1 x 10ml syringe &amp; manometer (to use pre-determined amount of air, as advised by ENT/ LTV centre)</li> </ul>
<p><b>Pitfall Note:</b> In emergencies, for double lumen tubes, the 1st line tube change is to change the innertube.</p>				

Additional items for patients without a patent upper airway (see NTSP Algorithm and video for Tracheostomy stoma ventilation)



LMA (Larvnaeal Mask Airway)



or



Appropriately Sized Paediatric face mask/ Bell Mask



## Safety

- **Staffing:** Two members of staff should be present (At least one should be tracheostomy competent)
- **Roles:** Person 1 secures the Tracheostomy  
Person 2 undertakes the tape change
- **Environment:** Tracheostomy Emergency Equipment should be in easy reach and the Nurse in Charge is aware of the Tape Change
- **Nil by Mouth:** CYP should be NBM for approximately 1 hour prior to tape change (refer to CYP normal regime)
- **Suctioning:** You can suction CYP at any stage of the below process, as long as one person is always securing tracheostomy if the tapes are not secure
- **Tape Tension:** Follow local guidance for technique used for testing tape tension, as this can differ across centres

## Equipment

- [Emergency Tracheostomy Box](#)
- BVM
- Working oxygen and suction
- Correct size suction catheters
- Rolled up towel/blanket (to use rolled up under shoulders to help extend neck)
- Blanket to swaddle (if applicable)
- Sodium Chloride 0.9% ampoules
- 2 x gauze packs (one wet, one dry)
- Tracheostomy tapes
- Tracheostomy dressing
- Round ended Scissors
- Any necessary creams for neck

## Technique (Two Person)

Person 1	Person 2
Secure Tracheostomy tube (e.g. with first and middle finger resting on each wing of the tracheostomy)	Cut tracheostomy tapes on either side (scissors pointing away from CYP neck and remove tape)
	Remove the dressing, easing it from under one wing and then the other
	Fold one piece of wet gauze and clean stoma area, wipe away from stoma in one direction only
	Continue to clean stoma using a fresh piece of wet gauze for each area of stoma e.g. top, bottom, both sides as well as back of neck moving away from the stoma in one direction
	Once cleaned, dry each area of stoma e.g. top, bottom, both sides as well as back of neck moving away from the stoma in one direction
	Check the skin integrity around the neck and the stoma (seek advice after the procedure if signs of infection, granuloma or breakdown)
	Apply any creams if indicated
	Apply dressing, easing it under one wing and then the next wing ensuring it meets in the middle and is well positioned
Person 1 can only stop securing tracheostomy once both individuals are happy with tracheostomy tape tension	Secure the tapes appropriately (if you need to sit the patient up to do this you MUST ensure that the patient's back is fully supported)
	Check tape tension (see local policy for technique) between the patient's neck and the tapes. If the CYP are moving/upset you may need to re check tension once CYP is calm
	If tapes are too loose or too tight, adjust accordingly
Make sure CYP is comfortable	
<b>Equipment:</b> Replace all used supplies	<b>Documentation:</b> Record appearance of stoma, skin condition and tape change in CYP Clinical Notes



## Safety

- **Environment:** Emergency tracheostomy equipment should be in easy reach
- Completed bed head available at the bed space

## Equipment

- [Emergency Tracheostomy Box](#)
- BVM Bag
- Working oxygen and suction
- Correct size suction catheters
- Appropriate monitoring
- Appropriate PPE
- Sterile water for cleaning suction tubing

## Suctioning Pressures

Age	MMHG	KPA
Neonate (0-4weeks)	60- 80	8-10
Infant (4 weeks – 1 yr)	80-100	10-13
Child (1-11yrs)	100-150	13-20
Adolescent (11yrs+)	150-200	13-26.5

Source: RMCH Tracheostomy Care Bundle available on the NTSP website

## Indications & Precautions

### Indications:

- Clinical signs of obstruction
- When patient is unable to clear their own secretions
- Audible/visible secretions
- Signs of increased work of breathing
- Signs of respiratory distress
- Coughing
- Deterioration of oxygen saturation levels or arterial blood gases/cardiovascular changes
- Increased ventilator pressures or oxygen requirement.
- Suspected aspiration of gastric contents
- To maintain airway patency and prevent tracheostomy tube blockage
- Patient request

### Precautions:

- Hypoxia unless due to sputum retention
- Cardiac instability
- Cerebral oedema
- Clotting disorders

### Video



## Suctioning Procedure

Connect appropriate size suction catheter to suction tubing, ensure the tip remains sterile

Turn on suction, and ensure correct suction pressure for CYP age

Remove ventilator tubing, HME or Tracheostomy mask in preparation for the next step

Gently insert suction catheter into the tracheostomy (without applying suction) to the appropriate pre measure length

Apply suction pressure by occluding the suction port, whilst slowly withdrawing the catheter.

**Pitfall Note:** The period of suction should not exceed 5 seconds for an infant and 5-10 seconds for a child and adolescent

Re-attach ventilator tubing, HME or tracheostomy mask

Disconnect and dispose of catheter

Reassess, and repeat procedure using a clean catheter as required.

## Safety

- **Staffing:** Two members of staff should be present (At least one should be tracheostomy competent)
- **Roles:** There are two techniques widely used- it is important to clearly discuss and confirm which method will be used, the roles allocated as Person 1 and Person 2 and to confirm and agree the terms spoken to indicate at which point the tube is to be removed- as these terms can differ across centres. Two methods are discussed here.
- **Environment:** Tracheostomy Equipment should be in easy reach and the Nurse in Charge and other ward staff are aware of the planned tube change
- **Nil by Mouth:** CYP should be NBM for at least 1 hour prior to planned tube change (refer to CYP normal regime)
- **Suctioning:** You can suction CYP at any stage of the below process, as long as one person is always securing tracheostomy if the tapes are not secure.
- **New Tube:** Measure new length if a new tube size or length is being inserted. **Tape Tension:** Follow local guidance for technique used for testing tape tension, as this can differ across centres
- **Cuffed and or Double Lumen:** See [Page 3 of Appendix H](#) for steps marked \* if using these tubes

## Equipment

Two Person Technique, Version 1 (one person removes and second person inserts tracheostomy tube )

- [Emergency Tracheostomy Box](#)

- BVM
- Working oxygen and suction
- Correct size suction catheters
- Rolled up towel/ blanket (to use rolled up under shoulders to help extend neck)
- Blanket to swaddle (if applicable)
- Sodium Chloride 0.9% ampoules
- 2 x gauze packs (one wet, one dry)
- Tracheostomy tapes
- Tracheostomy dressing
- Round ended scissors
- Any necessary creams for neck

## Person 1- Secures and then removes old tracheostomy

## Person 2 – Inserts and then secures new tracheostomy

Confirm technique, CYP positioning, roles and terms spoken to indicate removal of tube.

\*New tracheostomy should be in a clean box/ plastic tray close to person 1, prepared and ready to insert e.g. packaging removed, introducer inserted, small amount of water based lubricant on top side of tube shaft only if required

\*All equipment for routine tapes/ ties and dressing change including any required barrier creams should be ready and close to person 2.

Secures the tracheostomy tube e.g. with first and middle finger resting on each wing of the tracheostomy

Cut tracheostomy tapes on either side (scissors pointing away from the CYP neck) and remove

Remove dressing, easing it from under one wing and then the other

Remove Swedish nose/ ventilation, suction patient, reconnect ventilator and reconnect new catheter to suction tubing

Ensure CYP is still well wrapped and neck is positioned appropriately

Move positioning of fingers to the base of the nose of the tracheostomy.

\*Hold new tracheostomy ready. Ensure person 1 is ready and say '123 OUT'

\*On 'OUT' person 1 removes the old tracheostomy

\*Person 2 inserts new tracheostomy immediately and removes introducer,

\*On removal of introducer, make sure CYP is comfortable and tracheostomy tube is patent. Person 1 attaches ventilation tubing to new tracheostomy

\*Person 2 then secures tracheostomy tube e.g. with first and middle finger resting on each wing

Person 1 undertakes the cleaning of the neck and stoma following the steps in [Appendix L: Routine Tracheostomy Tape Change](#)

Secure tracheostomy tube e.g. with first and middle finger resting on each wing of the tracheostomy

Check tape tension (see local policy for technique) between the patient's neck and the tapes. If they are moving/upset you may need to re check tension once CYP is calm

Person 2 can stop securing tracheostomy once both individuals are happy with tracheostomy tape tension

If tapes are too loose or too tight, adjust accordingly

Make sure CYP is comfortable and tracheostomy tube is patent. **Equipment:** Replace all used supplies

**Documentation:** Record appearance of stoma, skin condition and tracheostomy tube change in CYP Clinical Note. Update Bed Head with new tracheostomy details

**Two Person Technique, Version 2 (one person removes and inserts the tracheostomy tube and the other cleans and secures tapes)**

**Person 1- Removes old tracheostomy tube and inserts the new one**

**Person 2- Person 2: Cleans, checks site/ skin and secure tapes**

**Equipment**

- [Emergency Tracheostomy Box](#)
- BVM
- Working oxygen and suction
- Correct size suction catheters
- Rolled up towel/ blanket (to use rolled up under shoulders to help extend neck)
- Blanket to swaddle (if applicable)
- Sodium Chloride 0.9% ampoules
- 2 x gauze packs (one wet, one dry)
- Tracheostomy tapes
- Tracheostomy dressing
- Round ended scissors
- Any necessary creams for neck

*Confirm technique, CYP positioning, roles and terms spoken to indicate removal of tube.*

\*New tracheostomy should be in a clean box/ plastic tray close to person 1, prepared and ready to insert e.g. packaging removed, introducer inserted, small amount of water based lubricant on top side of tube shaft only if required

\*All equipment for routine tapes/ ties and dressing change including any required barrier creams should be ready and close to person 2.

Secure tracheostomy tube e.g. with thumb and index finger either side or the tracheostomy tube close to the flange

Ensure Person 1 has the tracheostomy tube secured and is happy for tapes to be cut

Cut tracheostomy tapes on either side (scissors pointing away from CYP neck) and remove tapes

Remove dressing, easing it from under one wing and then the other

Remove swedish nose/ ventilation, suction patient, reconnect ventilator/ swedish nose and reconnect new catheter to suction tubing

Ensure CYP is still well wrapped and neck is positioned appropriately

\*Ensure communication that tube change is about to take place so that Person 2 is aware and ready to assist in case of emergency. Ensure new tube is in your dominant hand. Communicate by saying: **"Ready, Steady Out"**

\*On 'OUT' Person 1 removes the old tracheostomy, discards this in the tray, immediately inserts the new tube into the stoma, swiftly removing the introducer

\*Following removal of introducer, make sure CYP is comfortable and tracheostomy tube is patent. Person 2 attaches ventilation tubing/ swedish nose to new tracheostomy

Person 1 continues to secure tracheostomy tube by holding it in place while the neck and stoma are cleaned, dried, any dressings and creams are applied, and tapes are secured

Person 2 undertakes the cleaning of the neck and stoma following the steps in [Appendix L: Routine Tracheostomy Tape Change](#)

Person 1 can stop securing tracheostomy once both individuals are happy with tracheostomy tape tension

Check tape tension (see local policy for technique) between the CYP neck and the tapes. If the CYP is are moving/ upset, you may need to recheck tension once CYP is calm. If tapes are too loose or too tight, adjust accordingly

Make sure CYP is comfortable and tracheostomy tube is patent

**Equipment:** Replace all used supplies **Documentation:** Record appearance of stoma, skin condition and tracheostomy tube change in CYP Clinical Note. Update Bed Head with new tracheostomy details

## Additional Guidance & equipment for Cuffed planned Tracheostomy Tube Change

### TTS (Tight To Shaft) ○

**Additional Equipment:**

- 2 x 10ml IV Syringe
- 1 x 5ml ampoule water for injection



### Aire Cuff ●

**Additional Equipment:**

- 1 x 10ml IV syringe
- Manometer



### Fome Cuffed Tube ●

**Additional Equipment:**

- 1x 10ml IV Syringes
- 1x three-way tap
- (to maintain deflation of cuff while tracheostomy tube is removed/ inserted)
- 1 x filtered needle (use to deflate cuff if cuff line has been cut)



For Routine changes: Follow advice from specialist centre as this can be CYP specific

**Pitfall Note:** Do not attempt to remove or insert without deflating the cuff, as this can cause trauma and/or bleeding

**Prior to insertion:**

Check the cuff is intact and inflates adequately by testing with the correct amount of water (pre-determined amount by ENT Team).  
Deflate the tube and have correct amount of water in the IV syringe ready. Lubricate the outer curve of the tube

**Prior to insertion:**

Check the cuff is intact and inflates adequately using the manometer.  
Deflate the cuff using the IV syringe. Lubricate the outer curve of the tube

**Prior to insertion:**

If you are carrying out a routine Fome cuff tube change, pre-deflate the new tube with an IV syringe and three-way tap (keeping the 3 way tap connected and turning the tap off to stop the cuff reinflating) and lubricate on the outer curve.  
**For Routine changes: Follow advice from specialist centre**

**Method for deflation and inflation during routine tube change:**

One person holds the tracheostomy in place whilst the 2nd person uses one 10ml IV syringe to remove the water from the cuff. Remove the trache tube and replace with a new TTS tube, remove the introducer immediately. Hold the tube in place while the 2nd person inflates the cuff with the pre-filled water syringe. Hold the tracheostomy tube in place whilst the 2nd person secures the tapes/ties.  
Suction and check patency once tube is secured.


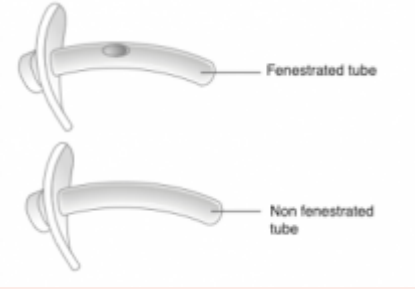
**Method for deflation and inflation during routine tube change:**

One person holds the tube in place whilst the 2nd person uses one 10ml IV syringe to remove the air from the cuff (check the amount of air removed). Remove the tube and replace with a new aire cuff tube, remove introducer immediately. Hold the tube in place while the 2nd person inflates the cuff using a 10ml syringe with the correct amount of air or as much as tolerated (or if tolerated, leave deflated until ties are secured and then inflate). Hold the tracheostomy tube in place whilst the 2nd person secures the tapes/ties. Once tube is secured using tapes/ties, check the pressure using manometer.  
Suction and check patency once tube is secured.

**Method for deflation and inflation during routine tube change:**

One person holds the tube in place whilst the 2nd person deflates the cuff using a 10ml IV syringe with a three-way tap connected to the cuff line (turn the tap off to stop the cuff reinflating) before removal of the Fome cuff tube.  
Remove the tube and immediately replace with a pre-deflated Fome cuffed tube (with three-way tap attached to the cuff line and tap turned off to keep the cuff deflated), remove the introducer immediately. Hold the tube in place while the 2nd person removes the three way tap to inflate the Fome Cuff tube (leaving the bung on the end of the cuff line open). Hold the tracheostomy tube in place whilst the 2nd person secures the tapes/ties. Once the tube is secured using tapes/ties suction and check patency.

## Additional Guidance & equipment for Double lumen and Fenestrated planned Tracheostomy Tube Change

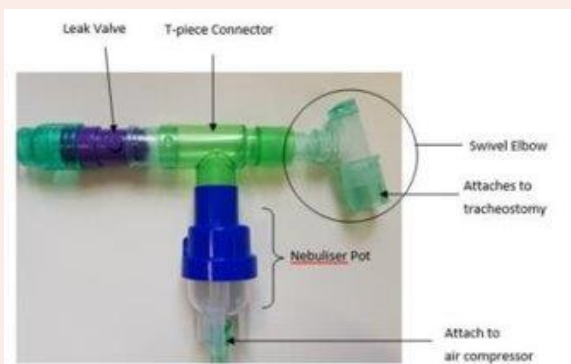
Double lumen Tube	Fenestrated Tube
<p><b>Additional Equipment:</b></p> <ul style="list-style-type: none"> <li>Spare inner tube</li> <li>If cuffed: 1 x 10ml syringe and manometer</li> </ul>  <p><b>If cuffed tube, do not attempt to remove or insert without deflating the cuff, as this can cause trauma and/or bleeding</b></p>	<p><b>Additional Equipment:</b></p> <ul style="list-style-type: none"> <li>Spare fenestrated inner tubes (for tube changes)</li> <li>Non fenestrated innertube(s) (to be placed when suction required or if BVM ventilation required)</li> <li>Cleaning solution (often sterile water)</li> <li>If cuffed: 1 x 10ml syringe &amp; manometer</li> </ul>  <p><b>If cuffed tube, do not attempt to remove or insert without deflating the cuff, as this can cause trauma and/or bleeding</b></p>
<p><b>Prior to insertion:</b> If cuffed tube, check the cuff is intact and inflates adequately.</p> <p>Check inner cannula is intact and operating effectively</p> <p>Note: the inner cannula needs to be changed frequently (usually at a minimum of 4 hourly to prevent the need for emergency tube changes due to secretions/blockage)</p>	<p><b>Prior to insertion:</b> If cuffed tube, check the cuff is intact and inflates adequately.</p> <p>Check inner cannula is intact and operating effectively</p> <p>Note: the inner cannula needs to be changed frequently (usually at a minimum of 4 hourly to prevent the need for emergency tube changes due to secretions/blockage)</p>
<p><b>Method for deflation and inflation during routine tube change:</b> <b>If cuffed:</b> One person holds the tube in place whilst the 2nd person uses one 10ml IV syringe to remove the air from the cuff (check the amount of air removed). Remove the tube and replace with a new tube, remove introducer immediately. Hold the tube in place while the 2nd person inflates the cuff using a 10ml syringe with the correct amount of air or as much as tolerated (or if tolerated, leave deflated until ties are secured and then inflate). Hold the tracheostomy tube in place whilst the 2nd person secures the tapes/ties. Once tube is secured using tapes/ties, check the pressure using manometer. Insert the inner cannula. Suction and check patency once tube is secured.</p>	<p><b>Method for deflation and inflation during routine tube change:</b> <b>If cuffed:</b> One person holds the tube in place whilst the 2nd person uses one 10ml IV syringe to remove the air from the cuff (check the amount of air removed). Remove the tube and replace with a new tube, remove introducer immediately. Hold the tube in place while the 2nd person inflates the cuff using a 10ml syringe with the correct amount of air or as much as tolerated (or if tolerated, leave deflated until ties are secured and then inflate). Hold the tracheostomy tube in place whilst the 2nd person secures the tapes/ties. Once tube is secured using tapes/ties, check the pressure using manometer. Insert the non-fenestrated inner cannula. Suction and check patency once tube is secured. Replace inner cannula with fenestrated tube if required following suction.</p>

## Wet circuit:



- Administered as close to the CYP as possible
- T-Piece placed in the circuit between the exhalation port/ leak and patient end of circuit
  - Action:** Check correct size T-piece in use: 15mm for 15mm circuit & 22mm for 22mm circuit
- Exhalation port/ leak in the circuit can become blocked due to crystallisation from the nebuliser e.g. Salt
  - Action:** monitor for signs of obstruction, change exhalation port/ leak more frequently as required
- Nebuliser should remain upright while running
- Jet nebuliser is delivered using a flow of air/ oxygen into the circuit. This can disrupt ventilator flow causing alarms to sound
  - Action:** check CYP if alarms are sounding, undertake an A-E assessment

## Dry circuit:



- Usually advisable to remove the HME from the dry circuit while delivering a nebuliser as it could become saturated with the nebuliser solution, increasing resistance in the circuit or if the nebuliser is not in the right place (closest to the CYP) could prevent the CYP from receiving the nebulised medication/ Sodium Chloride 0.9%
  - Action:** If HME left in the circuit during a nebuliser, check HME for excess liquid following nebuliser and consider changing HME
  - Action:** If HME is removed from the circuit, return the HME into the circuit following completion of the nebuliser

# Tracheostomy Ventilation (TrLTV) nebuliser delivery: Aerogen nebuliser

## Wet or dry circuit:



## Wet circuit at the humidifier:



- Administered as close to the CYP as possible
- Wet circuit: Can also be attached to the dry side of the humidifier or nearest the CYP.
- Alarms should not sound unless there is a problem as it is not driven by high flow air/ oxygen so does not add extra air flow to the ventilator circuit. It uses a vibrating mesh to generate tiny particles. This does not interrupt the ventilator flow
- Aerogen should remain upright while running
- Usually advisable to remove the HME from the dry circuit while delivering a nebuliser as it could become saturated with the nebuliser solution, increasing resistance in the circuit or if the nebuliser is not in the right place (closest to the CYP) could prevent the CYP from receiving the nebulised medication/ Sodium Chloride 0.9%
  - Action:** If HME left in the circuit during a nebuliser, check HME for excess liquid following nebuliser and consider changing HME
  - Action:** If HME is removed from the circuit, return the HME into the circuit following completion of the nebuliser

## Resources

- NTSP – online resources Available at [www.tracheostomy.org.uk](http://www.tracheostomy.org.uk)
- NCEPOD (2020) Balancing the Pressures A review of the quality of care provided to children and young people aged 0-24 years who were receiving long-term ventilation. Available at: <https://www.ncepod.org.uk/2020ltv.html>
- Paediatric Innovation Education and Research Network (PIER) online resources. Available at: [Paediatric Long Term Ventilation Education - PAEDIATRIC INNOVATION, EDUCATION & RESEARCH NETWORK \(piernetwork.org\)](https://www.piernetwork.org/)
- LTV Services online resources. Available at <https://ltv.services/>

## With Thanks

With thanks to South Thames Paediatric Network, North Thames Paediatric Network, East of England ODN and Thames Valley and Wessex ODN and the affiliated acute trusts sharing their current guidelines for reference, and the LTV Teams within these regions for the reviewing of this guideline.