

Nursing Care of the Mechanically Ventilated Adult in Intensive Care Full Clinical Guideline

Reference no.:CG-CRITCARE/4513/24

These are nursing guidelines for use within critical care to support best practice. They are not prescriptive and as with all nursing practice should be utilised in conjunction with the registrant's clinical judgement

Introduction

Mechanical ventilation is most commonly required where patients are unable to manage or protect their own airway or where their condition results in impending or existing respiratory failure.

In addition to the undoubted benefits it offers, mechanical ventilation comes with both physiological and psychological consequences which must be acknowledged by those caring for the patient. In order to mitigate or reduce associated risk it is essential to provide an evidence-based guideline to direct and inform key decisions on nursing management and care.

Aim and Purpose

The purpose of this guideline is to ensure the safe, holistic and informed nursing care of critically ill adults requiring invasive mechanical ventilation.

It aims to promote the maintenance of a safe environment for patients, relatives and the multidisciplinary team, to direct the delivery of excellent and informed nursing care and to ensure the nurse acts as patient advocate. (NMC. 2018)

Keywords - Mechanical Ventilation, Critically Ill Adult, Intensive Care Unit

Main Body of Guidelines

Patient Handover and Equipment Safety Checks

1. Ensure that wherever possible a registered nurse is responsible for the patient's care in a 1:1 ratio (FICM / ICS 2022) and that the patient remains under the supervision of a competent registered professional at all times (Newmarch 2006, Couchman et al 2007).
2. Ensure that the verbal nursing handover provides sufficient information for the oncoming nurse to effectively manage the patient's immediate condition and treatment and ensure that any specific infection control instructions are communicated effectively to prevent cross contamination between patients, their families or the health care team.
3. Perform hand hygiene and don apron, or required infection specific Personal Protective Equipment (PPE) prior to patient contact (NHS England 2023).
4. Undertake the following shift change safety checks and sign to confirm completion (UHDB 2024).

- a) Ensure all infused medications are being administered as prescribed, that they are in date and labelled correctly and that the date for line change is documented.
 - b) Ensure that all invasive monitoring lines are transduced using the prescribed fluids and pressurised to 300mmHg. Check that they are labelled correctly and that the date for the line change is documented.
 - c) Ensure that the ventilator settings are checked and within the target parameters, that all ventilator alarms are engaged, that patient appropriate alarm limits are set e.g. 10% above and below the patient specific target range and that the ventilator maintenance number is documented on 24-hour observation chart.
5. Undertake the following bedside safety checks following the verbal handover and ensure that they are documented correctly (Newmarch 2006, UHDB 2024).
- a) Ensure positive patient identification has been undertaken prior to care commencement and that the patient's actual / estimated weight and height are recorded on the 24-hour observation chart.
 - b) Check that all essential equipment is plugged into an appropriate mains supply plug socket and that the bed space is clear from loose lines, cables and clutter that may act as a 'trip hazard' to maintain safe working environment.
 - c) Ensure that all monitoring and equipment has been calibrated (Magder 2006) and that the arterial line blood pressure is comparable to the Non Invasive Blood Pressure (NIBP). Ensure that the invasive monitoring transducers are at the height of the patient's phlebostatic axis / right atrial alignment (Woodrow 2009) and that all monitoring alarms are engaged and set within safe parameters e.g. 10% above or below the patient specific target range.
 - d) Ensure that the appropriate 'Airway' classification card is positioned on the ventilator side of the bed and can be easily visualised (Royal College of Anaesthetists, 2011, Difficult Airway Society 2015).
 - e) Where the patient has a tracheostomy, ensure that a sealed blue 'Tracheostomy Emergency' box is available at the bedside and that all patient specific consumables are stocked up to facilitate required tracheostomy care (ICU tracheostomy Guidelines 2024).
 - f) Check that the oxygen (O₂) supply is attached to the C-Circuit and that it is in full working order and ensure that an AMBU bag and emergency airway adjuncts are available in the bed space for immediate use.
 - g) Check that there is CD oxygen cylinder, that is at least $\frac{3}{4}$ full available in the bed space for immediate emergency use in the event of O₂ supply failure.
 - h) Check that 'open' suction equipment is available at the bedside and in full working order and that there is an adequate stock level of appropriately sized suction catheters and clean gloves (National Tracheostomy Safety Project 2024).
 - i) Check that there is an appropriately sized 'closed' suction catheter attached to the patient with a sticker denoting the date when the next 72-hour catheter change is due. Change the suction receptacle if $> \frac{3}{4}$ full as directed by the ICU closed suction guidelines 2024.
- NB. The diameter of the suction catheter should be \leq half of the diameter of the endotracheal tube or calculated as follows; **FG = (Size of ETT - 2) x 2** (National

Tracheostomy Safety Project 2024), to optimise secretion clearance, to minimize the risk of tracheal trauma and to allow for adequate gas flow around the catheter during the suctioning procedure.

- j) Check the suction vacuum pressures are set $\leq 20\text{kPa}$ (National Tracheostomy Safety Project 2024) at between 13 – 20 kPa or 100 – 150mmHg (Royal Marsden 2020) to minimise risk of tracheal damage and suction induced hypoxaemia.
- k) Ensure that the appropriate ventilator circuit is in situ and has a sticker denoting the due change date attached. Record this date on the ICU 24-hour observation chart.

NB. Where a 'dry' ventilator circuit is indicated, ensure that the required Heat Moisture Exchange (HME) filter is changed every 24 hours / prn if excess water vapour has collected. The circuit should be changed after 48 hours to a heated circuit unless the patient's condition is prohibitive or unless extubation is likely within the following 24 hours (ICU humidification guidelines 2024).

Where a heated humidification circuit is indicated, care must be delivered in accordance with the ICU humidification guidelines 2024. The circuit should be changed every 7 days or more frequently if soiled and the humidifier temperature documented hourly on the 24-hour observation chart.

- 6. Undertake daily cleaning of the patient's bed space using appropriate detergent wipes unless patient specific infection control measures state otherwise and change all consumable items as required.

Patient Assessment & Nursing Care of the Invasively Ventilated Patient

- 1. Assess the patient's general appearance and ensure that unless contraindicated they are nursed in a 30 – 45° head-up position as directed by the Ventilator Care Bundle (VCB) (DoH 2007, Muscedere 2008, Hellyer *et al* 2016) in order to prevent ventilator acquired pneumonia (VAP). Position the patient's head so that the endotracheal tube is in alignment with the body, that the neck is not over extended and that the ventilator tubing is secured effectively to prevent 'drag' on the mouth / nose and to ensure condensate flows away from the airway (American Thoracic Society 2005).
- 2. Ensure a minimum of three members of the healthcare team are available to change the patient's position. A competent registered professional must be responsible for the patient's airway and hold the endotracheal / tracheostomy tube while also coordinating the turn.
- 3. Observe the size of the endotracheal tube and the length at which it is secured at the patient's maxilla. Document this on the 24-hour observation chart and compare this with the measurement at intubation. Report changes from baseline immediately.
- 4. Where the endotracheal tube has a subglottic aspiration port, aspirate this as a minimum 4 hourly / prn to prevent accumulated oral secretions from migrating past the cuff on to the lungs (Lorente 2007), to reduce the risk of VAP and to comply with the VCB (DoH 2007, Hellyer *et al* 2016). Record the amount of aspirate on the 24-hour observation chart.
- 5. Secure the endotracheal tube effectively using endotracheal tape and appropriate padding for the first 72 hours post intubation (Branson *et al* 2014) and change with the assistance of a second member of the healthcare team at least once a shift or prn if soiled. Where intubation is required for more than 72 hours consider changing the fixing to

an alternative endotracheal tube fastener i.e. AnchorFast or Insight Medical and change as recommended by manufacturer's instructions.

6. Change the position of the endotracheal tube carefully within the oral cavity and observe the vulnerable pressure points at the lips, behind the ears and corners of the mouth. Complete the appropriate local documentation at least once per shift. Treat, document and report skin breakdown / pressure damage within the UHDB Wound Management Care Pathway (2021).
7. Check the cuff inflation pressure and record this on the 24-hour observation chart at the beginning of each shift and 4 hourly / prn thereafter (Diaz *et al* 2005, DOH 2011 Hellyer *et al* 2016). Ensure that an effective seal is maintained within the trachea to a cuff pressure between 20 – 30 cm's H₂O or 2cm's > peak inspiratory pressure (Higgs *et al* 2018) in order to prevent VAP (Diaz *et al* 2005), to minimise the risk of tracheal pressure damage (Pierce 2006) and to comply with VCB (DOH 2007, Hellyer *et al* 2016).
8. Ensure End -Tidal CO₂ monitoring is in situ within the ventilator circuit from intubation to extubation in order to early identify tube displacement (NAP4 2011) and enable continuous assessment of ventilation.
9. Record all ventilator settings / observations associated with the chosen ventilator mode and where appropriate record the patient's own respiratory effort. Report significant changes and ensure all planned ventilation changes are recorded and highlighted on the 24-hour observation chart.
10. Assess the patient's chest for symmetry of movement and auscultate lung fields for the presence of normal or abnormal breath sounds. Record findings and report the absence of breath sounds OR abnormal breath sounds immediately. (Bohadana *et al* 2014).
11. Continuously monitor oxygen saturations (SpO₂) and Perfusion Index (PI) using pulse oximetry in order to assess the patient's oxygenation (Peate *et al* 2016) and peripheral perfusion status. Record oxygen percentage hourly on 24 - hourly observation chart and report if outside of prescribed target range. Change the position of the probe as a minimum 4 hourly to reduce the risk of pressure / temperature damage (Royal Marsden 2020)

N.B. The Perfusion Index (PI), where >1 is optimal, 0.3 – 1 is acceptable and < 0.3 indicates inadequate perfusion. PI is an indicator of the pulsatile strength that reflects a numerical non-invasive measure of peripheral perfusion (Lima *et al* 2002, Hasanin *et al* 2017) and can be used fundamentally to assess the quality / reliability of the SpO₂ measurement. (Mindray, 2011)
12. Undertake arterial blood gas analysis as directed by The Royal Marsden Manual of Clinical & Cancer Nursing Procedures (2020) as frequently as the patient's condition directs / minimum 8 hourly in order to assess their ventilation and acid / base status and to ascertain electrolyte, lactate and haemoglobin levels (Keogh 2017). Record results on the 24-hour observation chart and report if outside of the patient specific parameters.
13. Perform endotracheal suction using a 'closed suction catheter' (Branson *et al* 2014, ICU Closed Suction Guidelines 2024) as frequently as patient's condition requires, to maintain airway patency, to optimise secretion removal in those whose cough reflex is impaired (Bersten *et al* 2018) and to promote effective oxygenation (Newmarch 2006). Assess the amount, colour and consistency of chest secretions and send sputum specimens as required. Document and report significant changes.

NB. If the patient is diagnosed with or suspected as having a disease that is known to be transmitted via the respiratory tract OR where they are undergoing an Aerosol Generating Procedure (AGP) care must be delivered whilst adhering to Airborne / Droplet respiratory precautions (NHS England 2023).

14. Record compliance to the Ventilator Care Bundle (DoH 2011, Hellyer *et al* 2016) on the 24 - hour observation chart. Current elements include:
- a) Head Elevation 30-45⁰
 - b) 4 hourly tracheal cuff pressure measurement and maintenance 20-30cm's H₂O
 - c) Minimum 4 hourly / prn subglottic aspiration if port available
 - d) Humidification of oxygen
 - e) Daily sedation hold
 - f) 4 hourly oral hygiene
 - g) DVT prophylaxis
 - h) Gastric ulcer prophylaxis.

N.B All elements of the ventilator care bundle MUST be considered and an informed decision made as to whether contraindications apply. Compliance to the care bundle will be achieved when ALL elements are delivered OR when those elements considered to be contraindicated have been considered but not applied.

15. If the patient requires the introduction of a chest drain to enable the resolution of a pneumothorax, haemothorax, chylothorax, pleural effusion or empyema, deliver nursing care as directed by The Royal Marsden Manual of Clinical & Cancer Nursing Procedures (2020) and complete UHDB chest drain observation chart hourly. Record fluid drainage on the 24-hour observation chart and report changes in activity / drainage, the development of surgical emphysema or any evidence of respiratory distress.
16. Where patients suffering from Acute Respiratory Distress Syndrome (ARDS) require invasive mechanical ventilation, undertake care as directed by ICU ARDS Guidelines (2024).
17. Where severely hypoxic patients require prone positioning to improve their oxygenation, undertake care as directed by Prone ICU Nursing Guideline (2022).

References

- | | |
|--|--|
| American Thoracic Society (2005) | Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated and Healthcare-associated Pneumonia. <u>American Journal of Respiratory Care Medicine</u> Vol.171. pp.388 – 416. |
| Bersten. A.D., Handy. J.M (2018) | <u>OH's Intensive Care Manual</u> 8 th Edition. Elsevier. |
| Bohadana. A., Izbicki. G., Kramer. S. (2014) | Fundamentals of Lung Auscultation. <u>The New England Journal of Medicine</u> 370.8. pp.744 -51 |
| Branson. R. Gomaa. D. | Management of the Artificial Airway. <u>Respiratory Care</u> June 2014. Vol. 59. N ^o .6. pp. 974-990 |
| Rodriquez. D. (2014) | |

- Couchman. B.A., Wetzig. S.A.
Coyer. F.M. *et al* (2007) Nursing care of the mechanically ventilated patient: What does the evidence say? Part one. Intensive and Critical Care Nursing 23. pp.4-14.
- Department of Health (2007) High Impact Intervention N^o 5. Care Bundle for Ventilated Patients (or tracheostomy where appropriate) www.clean-safe-care.nhs.uk
- Department of Health (2011) High Impact Intervention Care Bundle to reduce ventilation-associated pneumonia. HCAI High Impact Interventions
- Diaz. E., Rodriquez. A.H., Rello. J. (2005) Ventilator-associated pneumonia: issues related to the artificial airway. Respiratory Care 50. pp. 900-906
- Difficult Airway Society (2015) DAS guideline for the management of unanticipated difficult intubation in adults. <http://das.uk.com>guidelines>
- Faculty of Intensive Care Medicine
Intensive Care Society (2022) Guidelines for the Provision of Intensive Care Services (GPICS) version 2.1 <http://www.ficm.ac.uk>guidelines-for-the-provision-of-intensive-care-services>.
- Hasanin. A., Mukhtar. A.,
Nassar. H. (2017) Perfusion indices revisited Journal of Intensive Care 5.24
<https://doi.org/10.1186/s40560-017-0220-5>
- Hellyer. T., Ewan. V., Wilson.,
Simpson A. (2016) The Intensive Care Society bundle of interventions for the prevention ventilator-associated pneumonia. Journal of the Intensive Care Society Vol. 17.(3) pp. 238-243.
- Hollister Incorporated UK (2013) AnchorFast Guard Oral Endotracheal Tube Fastener www.hollister.co.uk
- Keogh. J. (2017) Nursing Laboratory & Diagnostic Tests. 2nd Edition. New York. McGraw-Hill
- Lima. A., Beelen. P.,
Bakker. J. (2002) Use of a peripheral perfusion index derived from the pulse oximetry signal as a non-invasive indicator of perfusion. Critical Care Medicine 30 (6), pp. 1210-1213
- Lorente. L. (2008) Influence of an endotracheal tube with polyurethane cuff and subglottic secretion drainage on pneumonia. American Journal of

- Respiratory and Critical Care Medicine 176. pp. 1079-1783
- Magder. S. (2006) Current Opinion in Critical Care Manuscript 65
- Mindray (2011) Patient Monitor Operator's Manual
- Muscedere. J. (2008) Comprehensive evidence-based clinical practice guidelines for ventilator-associated pneumonia. Journal of Critical Care 23: pp. 126-37
- National Tracheostomy Safety Project (2024) National Tracheostomy Safety Project. <http://tracheostomy.org.uk>.
- Newmarch. C J (2006) Caring for the mechanically ventilated Patient: part one. Nursing Standard Vol. 20. N°. 17. pp.55-64.
- NHS England (2023) National infection prevention and control manual for England. 24 April 2023. V2.5.
- NMC (2018) The Code. Professional standards of practice and behaviour for nurses, midwives and nursing associates. <http://www.nmc.org.uk/code>.
- Peate. I., Wild. K. (2018) Nursing Practice: Knowledge and Care. Second Edition. Oxford: Wiley Blackwell.
- Pierce. L. (2006) Management of the Mechanically Ventilated Patient Second Edition. Saunders Elsevier pp.91
- Royal College of Anaesthetists Difficult Airway Society (2011) 4th National Audit Project (NAP4) Major complications of airway management in the UK
- Royal Marsden (2020) Chest Drains The Royal Marsden Manual of Clinical and Cancer Nursing Procedures. Chapter 12
- Royal Marsden (2020) Tracheostomy and laryngeal care. The Royal Marsden Manual of Clinical and Cancer Nursing Procedures. Chapter 12
- Royal Marsden (2020) Arterial Blood Gas. The Royal Marsden Manual of Clinical and Cancer Nursing Procedures. Chapter 13

| | |
|----------------------|--|
| Royal Marsden (2020) | Respiration and Pulse Oximetry. <u>The Royal Marsden Manual of Clinical and Cancer Nursing Procedures.</u> Chapter 14. |
| UHDB (2024) | ICU ARDS Guidelines |
| UHDB (2024) | ICU Closed Suction Guideline |
| UHDB (2024) | ICU Nursing Handover & Bedside Safety Checks |
| UHDB (2024) | ICU Humidification Guidelines |
| UHDB (2024) | ICU Tracheostomy Guidelines |
| UHDB (2023) | Prevention & Management of Pressure Ulcers Care Pathway |
| UHDB (2022) | Trust Policy and Guideline for the Care and Proning – ICU Nursing Guidelines COVID–19-ICU/2020/3608 |
| UHDB (2021) | Wound Management Care Pathway |
| Woodrow. P. (2009) | <u>Intensive Care Nursing : a Framework for Practice.</u> Routledge |

Documentation Controls (these go at the end of the document but before any appendices)

| | | | | |
|--|------------------|-------------|---|----------------------|
| Reference Number CG- CRITCARE/4513/2 4 | Version:1 | | Status Final | |
| Version / Amendment History | Version | Date | Author | Reason |
| | 1 | Nov 24 | Cath Rowe | Review - new to Koha |
| | | | | |
| Intended Recipients: ICU Nurses, Doctors and Consultants | | | | |
| Training and Dissemination: Cascaded electronically through lead sisters/nurses/doctors/outreach. Published on Intranet, Article in ICU newsletter; emailed via NHS.net | | | | |
| Development of Guideline: Cath Rowe Job Title: Senior Clinical Educator ICU | | | | |
| Consultation with: | | | | |
| Linked Documents: State the name(s) of any other relevant documents | | | | |
| Keywords: Mechanical Ventilation, Critically Ill Adult, Intensive Care Unit | | | | |
| Business Unit Sign Off | | | Group: Critical Care Governance Date:TBC | |
| Divisional Sign Off | | | Group:Surgery DQRG Date:November 2024 | |
| Date of Upload | | | November 2024 | |
| Review Date | | | November 2027 | |
| Contact for Review | | | Cath Rowe – Senior Clinical Educator ICU | |

APPENDIX 1

Abbreviations

AGP – Aerosol Generating Procedure

ARDS - Acute Respiratory Distress syndrome

CO₂ – Carbon-Dioxide

FG – French Gauge

HME – Heat Moisture Exchange Filter

kPa – Kilopascals

MAP - Mean Arterial

mmHg – Millimetres of Mercury

O₂ – Oxygen

PaCO₂ – Partial Pressure of Carbon-Dioxide in Arterial Blood

PaO₂ – Partial Pressure of Oxygen in Arterial Blood

PI - Perfusion Index

PPE – Personal Protective Equipment

PRHA - Personal Handling Risk Assessment

SpO₂ - Saturation of oxygen as measured by a pulse oximetry probe

VAP - Ventilator Acquired Pneumonia

VCB - Ventilator Care Bundle

APPENDIX 2

Definitions

Aerosol Generating Procedure – (AGP) – Is a procedure, practice or technique that enables transmission of aerosols from one person to another.

ARDS - Acute Respiratory Distress Syndrome is the most severe form of acute lung injury.

Auscultation- The action of listening to the internal sounds transmitted by the heart, lungs and gut by means of a stethoscope.

C-Circuit - Mapleson C Waters Circuit OR Anaesthetic breathing circuit.

Closed Suction – Is a suction technique that uses a sterile suction catheter enclosed within a protective sheath which allows the catheter to be used multiple times without the need to disconnect the patient from their breathing circuit.

End-Tidal CO₂ Monitoring - End Tidal CO₂ monitoring or capnography depicts the partial pressure of carbon-dioxide detected at the end of exhalation as a number or waveform.

Open Suction – Is a suction technique that uses a single use sterile suction catheter and requires the patient to be disconnected from their breathing circuit.

Perfusion Index - Is an indicator of pulsatile strength and represents the ratio between the pulsatile to non-pulsatile portions of blood in the peripheral tissues. It provides a numerical non-invasive measure of peripheral perfusion that can be used to assess the quality of the SpO₂ measurement.

Prone Positioning - A manoeuvre whereby patients are placed onto their front and has been shown to improve the oxygenation and survival of severely sick patients suffering from ARDS.

Subglottic Aspiration Port - A drainage port on the endotracheal / tracheostomy tube that allows for removal of the subglottic secretions that may accumulate on the cuff.

Surgical Emphysema - Occurs where there is free passage of air that collects in the subcutaneous tissues.