

UHL PICU/CICU Guideline

The Prevention of Ventilator Associated Pneumonia

Scope/Introduction/Background

This guideline is relevant to all medical and nursing staff involved in patient care on the paediatric critical care unit and children's intensive care unit at University Hospitals of Leicester NHS Trust.

Aim

To prevent the development of ventilator associated pneumonia (VAP) in the critically ill neonate or child.

Ventilator Associated Pneumonia

VAP remains an important cause of morbidity and mortality in the critically ill and post-operative patients receiving mechanical ventilation. Far less is known about the risk factors, epidemiology, and outcomes of VAP in infants and children than in adults. There is no gold standard definition of VAP in adults or paediatrics¹.

VAP is the second most common hospital acquired infection in paediatric intensive care unit (PICU) patients, accounting for 20% of such infections in this population. In the US National Nosocomial Infection Surveillance (NNIS) hospitals, the mean paediatric VAP rate was 2.9/1000 ventilator days for PICU patients – approximately half of the adult rate. The highest age-specific rates of VAP occurred in the 2-month to 12-month age group, and the most common causative organism was *P aeruginosa*, which accounted for 22% of cases. In both the PICU and NICU, VAP increases the number of days the child spends on mechanical ventilation, length of stay, mortality, and hospital costs²⁻⁴. In the PICU, VAP extends hospital stay by an average of 8.7 days and has been shown in the US to increase hospital cost by \$51,157. One paediatric study demonstrated mortality increasing from 7.2 to 19.1% in those who developed a VAP³.

The risk factors for VAP in infants and children vary somewhat from those in adults, and in many instances are processes of care common in the ICU. VAP in neonates is associated with duration of mechanical ventilation, reintubation, endotracheal suctioning, and treatment with opiates. In older infants and children, VAP is also associated with various conditions (subglottic or tracheal stenosis, trauma, tracheostomy, genetic syndromes) and interventions (presence of a central line, multiple central venous catheters, bronchoscopy, thoracocentesis, burn debridement, and transport out of the ICU).

Definition

Ventilator Associated Pneumonia (VAP) is pneumonia occurring in a patient 48 hours or more after intubation with an endotracheal tube or tracheostomy tube and which was not present before.

Diagnosis

The clinical criteria used to diagnosis VAP in infants and children are different to adults. Although currently in use for diagnosis and surveillance, the clinical criteria for VAP in infants younger than 1 year are not specific for low birth weight infants and have not been validated in neonates. Despite having specific criteria, the recognition of VAP is more challenging in paediatric patients, particularly in ventilated neonates, who usually have coexisting pulmonary disease. These comorbid conditions can confound the diagnosis of VAP as well as VAP surveillance efforts.

The flow diagram (Figure 1.) on the subsequent page has been developed to aid in the diagnosis and categorisation of ventilator associated pneumonia.

Prevention of VAP

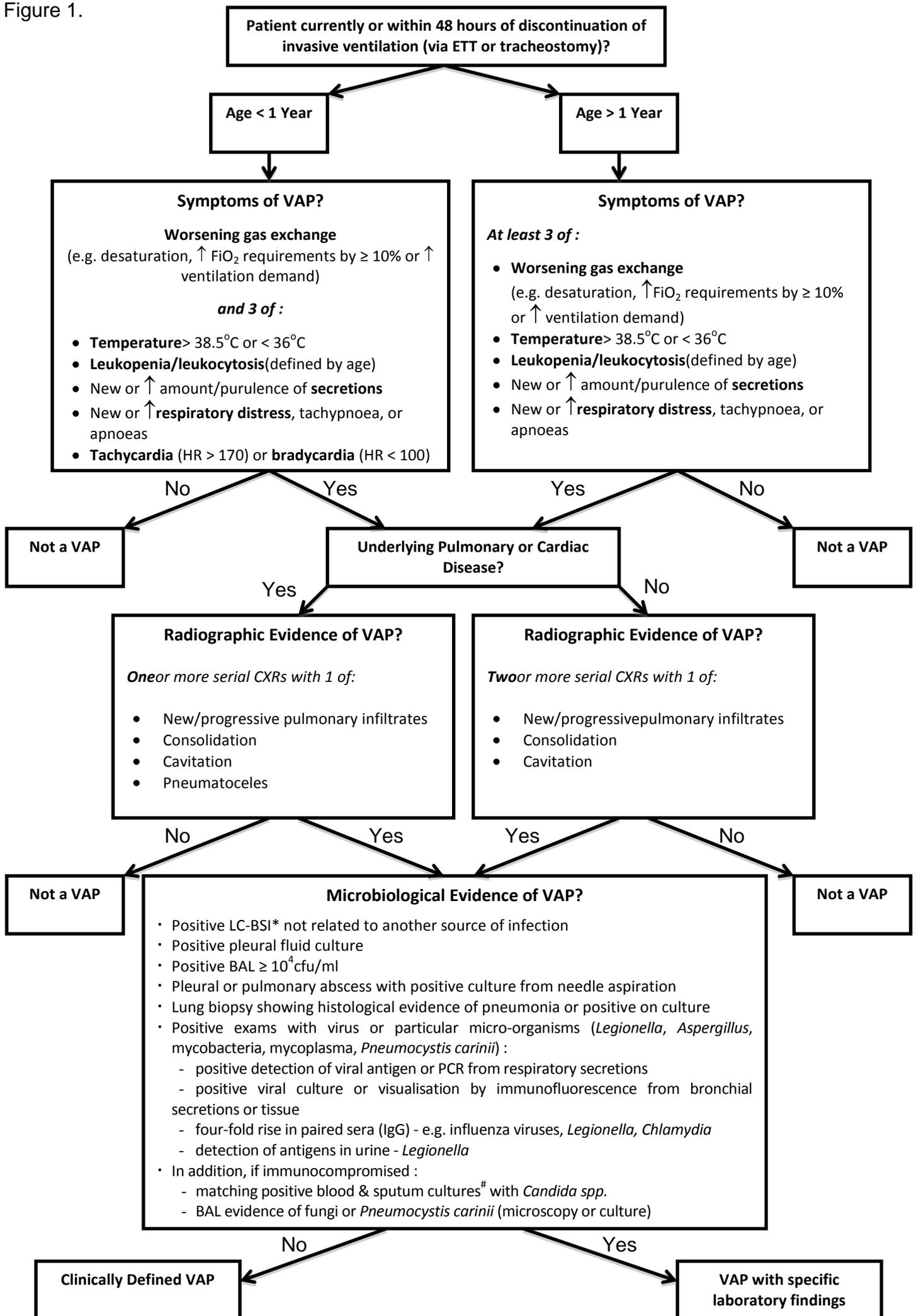
In adult intensive care patients, VAP is believed to be caused by aspiration of oropharyngeal secretions, inhalation of contaminated aerosols, or bacterial translocation from a contaminated gastrointestinal tract. It is not known whether these same mechanisms operate in mechanically ventilated infants and children, but in the absence of definitive data, they are used as the basis for VAP prevention interventions.

Recommended adult VAP care bundle (currently in practice as per the Glenfield Adult ITU Guideline)

- Elevation of head of bed to 35-40 degrees
- Sedation holds
- Deep vein prophylaxis
- Gastric ulcer prophylaxis
- Glucose control
- Appropriate humidification of inspired gas
- Appropriate tubing management
- Suction of respiratory secretions as per local policy
- Routine oral hygiene as per local policy

Practices to prevent VAP, initially developed for the adult population, have often been modified for neonatal and paediatric application, but few of these recommendations have been formally studied. Because the epidemiology of VAP in infants and children is not as well understood as it is in adults, many currently recommended prevention measures not extrapolated from adult guidelines are based on biological plausibility and common sense.

Figure 1.



Recommended prevention measures in PICU

1. Reducing the duration of ventilation

The principle of continuous assessment for readiness to wean - and extubation as soon as possible - to reduce the duration of intubation is very important in paediatric and neonatal patients. While daily sedation holidays are not yet validated in paediatric patients and not recommended due to the risk of unplanned extubation, it is important to have a sedation guideline (COMFORT Scoring in the Leicester PICUs) that prevents over-sedation. Unplanned extubation and reintubation has been shown to be a contributing factor to VAP⁴. Heavy sedation and decreased respiratory drive precludes ventilator weaning and clinical practice should include a daily assessment of readiness for extubation.

2. Preventing micro-aspiration of contaminated secretions

In adults, most cases of VAP are thought to be preceded by micro-aspiration of contaminated oropharyngeal secretions. In infants and children, in the absence of a cuffed tube, it is theoretically easier for secretions to be aspirated into the lung. In the presence of cuffed tubes, secretions pool above the cuff and become a source of contamination. Naso and oropharyngeal secretions should always be removed in intubated patients and the mouth should always be suctioned before the nose using an uncontaminated suction device. Where multi-use suction devices are used they should be placed in a clean non-sealed plastic bag when not in use.

3. Eliminate *routine* use of saline to clear secretions

Whilst common practice as it is believed to prevent blockage of the ET tube and lower airways, there is no evidence to support its practice^{5,6}. There is however evidence that flushing the ET tube may deposit the biofilm coating on the tube into the lung and therefore contribute to VAP^{7,8}.

The change of practice relating to this recommendation has proved challenging to many units as it has been ingrained in routine care.

4. ET tube care

An endotracheal tube increases the risk for bacterial colonization and infection and limits the defence mechanisms of the upper airway by interfering with the normal actions -coughing, mucociliary clearance and swallowing.

All Aspects of ETT tube care, including intubation should include good habits and practice that minimises risk of contamination (Wash Hands, Wear Apron and Gloves, Single use laryngoscope blades, protect ETT tube if problems inserting etc)

5. Elevating head of bed

Elevation of the head of the head has been shown to be beneficial in adults and positioning has been shown to be beneficial in neonates at reducing VAP⁹. The supine position is believed to contribute to micro-aspiration of both gastrointestinal contents and oral secretions¹⁰.

Consequently, a primary VAP prevention recommendation for adults is to keep the patient in a semi-recumbent position. As in adult patients, the head of bed (HOB) of paediatric patients should be elevated to a 30 to 45-degree angle unless contraindicated by the patient's condition.

In neonates, a similar effect is achieved by positioning the incubator or radiant warmer mattresses in the reverse Trendelenburg position at an angle of 15-30 degrees (rather than 30-45 degrees) because the greater angle is difficult to maintain in very small patients.

6. Prevent contamination of equipment

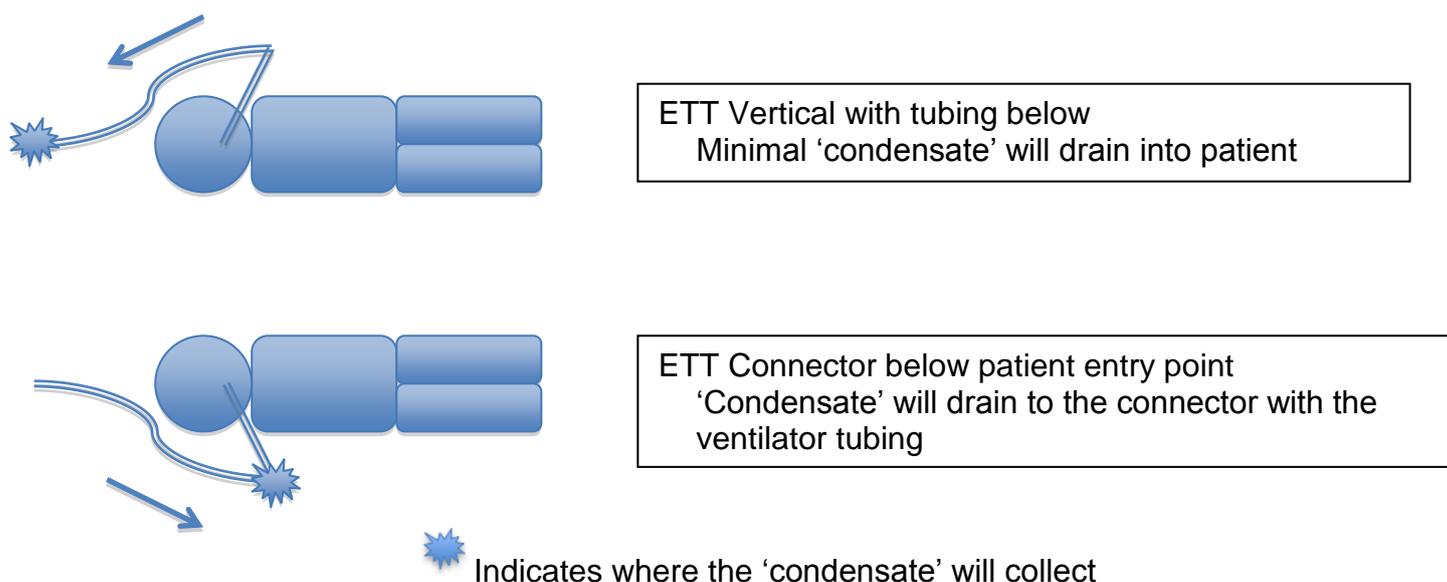
NICU and PICU staff should follow all of the same general infection control measures related to respiratory equipment, ventilator circuits, suction systems, hand washing, and environmental decontamination that are observed when caring for adults. Hand hygiene must be meticulous before handling respiratory equipment or performing any type of airway care.

Changing ventilator circuits and in-line suction catheters on a routine schedule is not currently recommended - instead, they should be changed when visibly soiled. However, research regarding the effectiveness of these practices in paediatric and neonatal populations is lacking.

Care of the ventilator includes clearing the circuit of condensate and preventing condensate from draining into the patient's airway and washing the biofilm into the patient's lungs⁹ – see Figure 2 below. Clearing the tubing and checking tube positioning should take place on a routine basis (eg, every 2 hours) and before a patient is repositioned or moved for transport. This should occur without disconnecting the circuit. Heated ventilator circuits are preferred in infants and children.

Figure 2.

Positioning of Endotracheal tube and Ventilator Tubing
- To minimise water from vent circuit entering the patient



7. Correct NG or OG tube placement and care

The proper placement of a nasal or oral gastric tube decreases the chance of stomach contents being aspirated. By both noting what length the NG tube is inserted and aspirating it every 4 hours, the risk of misplacement can be minimised and feed tolerance can be assessed^{11, 12}. High residual volumes of gastric contents have been shown to increase the likelihood of regurgitation and aspiration¹³.

Please also refer to the UHL Paediatric NG tube policy.

8. Oral Hygiene

Oral hygiene in children is essential for the development of strong, healthy teeth and to minimize the risk of infection (Thomson, Ayers, & Broughton, 2003). In the critical care setting, poor oral hygiene has been associated with increased dental plaque accumulation, bacterial colonization of the oropharynx, and higher nosocomial infection rates, particularly ventilator-associated pneumonia¹⁴⁻¹⁶.

The Institutue for Health Improvement (IHI)'s VAP prevention paediatric supplement recommends "comprehensive mouth care appropriate to the age of the patient".

Please also refer to the UHL Paediatric Oral Hygiene Guideline

9. Peptic Ulcer Prophylaxis

Whilst a routine part of adult VAP prevention bundles, there is no evidence to suggest its use prevents VAP in the paediatric population^{17, 18}. However, it may be used as part of routine PICU care and increasing the gastric pH may theoretically decrease the pulmonary inflammatory response if aspiration occurs.

UHL PICU/CICU VAP Care Bundle Summary

- **Elevate the head of the bed to**
 - 15-30% for neonates
 - 30-45% for infants and older
- Daily assessment and documentation in rounds of '**Readiness to Extubate**'
 - Ensure sedation optimal and COMFORT Score target set
- Perform **Mouth Care** every 2 hrs appropriate to age of patient
 - Refer to the PICU/CICU oral hygiene policy
- Keep ventilator **circuit free of condensate** by draining every 2-4hrs
 - Without disconnection if possible
- **Dependent tubing**
 - Keep the ventilator tubing below the level of the patient so any condensate does not drain into the lungs
- **Stop routine saline flushing** of the endotracheal tube
 - Currently used to clear or loosen secretions
- Change ventilator circuits and in line suction devices only when visibly soiled. Use **meticulous hand hygiene** before and after contact with ventilator circuits.
- Keep end of ventilator circuit, suction devices and manual bagging circuits and masks **off the bed**. Store in clean, non sealed plastic bags when not in use
- Correct **positioning of Nasogastric Tube**
- **Peptic Ulcer Prophylaxis**
 - Appropriate to the age and clinical condition of the child
- **DVT Prophylaxis**
 - Appropriate to the age and clinical condition of the child

Surveillance

Surveillance is standardised across both adults and paediatric intensive care with the rate calculated per 1000 ventilator days. All suspected cases of VAP should be reviewed and strictly determined in agreement with the defined criteria to ensure consistency of the data. Any suspected VAP should have a datix reporting form completed and will be reviewed both as part of the datix review system and by the PICU Clinical Risk Committee. This will ensure it meets the standardised criteria and will maintain a record VAPs to correlate with the number of ventilator days.

The action of surveillance and implementation of a VAP bundle has been shown to reduce the rate of VAP occurrence. Target rates of adherence to the VAP bundle and reduction in the rate of VAPs occurring will be set out through the PICU Clinical Risk Committee and Clinical Practice Meetings. The recording and any reduction in rate of VAP would be a suitable CQUIN.

Monitoring

- VAP Bundle Compliance
- VAP Rate per 1000 ventilator days

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