Guideline for Prevention of Ventilator associated Pneumonia

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Index

1. List of Abbreviations

- **CDC:** Centers for Disease Control and Prevention
- **CPAP:** Continuous Positive Airway Pressure
- **HAIs:** Healthcare Associated Infections
- **HCP**: Healthcare Personnel
- **ICU:** Intensive care units
- **IVAC:** Infection-related ventilator-associated complication
- **NHSN:** National Healthcare Safety Network
- **NIPPV:** Non-invasive positive pressure ventilation
- **PVAP:** Possible ventilator-associated pneumonia
- **VAC:** ventilator- associated condition
- **VAE:** Ventilator associated events
- **VAP:** Ventilator associated pneumonia
- **WHO:** World Health Organization

2. Glossary

- **Condensate:** The liquid water that forms when warm, humid exhaled air cools and releases its moisture into the ventilator circuit or tubing
- **Ventilator:** A device used to support, assist, or control respiration (inclusive of the weaning period) through the application of positive pressure to the airway when delivered via an artificial airway, specifically oral/nasal endotracheal or tracheostomy tube.
- **Ventilator associated Events (VAEs)**: VAEs are identified by using a combination of objective criteria: deterioration in respiratory status after a period of stability or improvement on the ventilator, evidence of infection or inflammation, and laboratory evidence of respiratory infection, and are categorized into the following 3 tiers: ventilator- associated condition (VAC), infection-related ventilator-associated complication (IVAC), and possible ventilator-associated pneumonia (PVAP).
- **Ventilator-associated pneumonia (VAP):** A pneumonia where the patient is on mechanical ventilation for > 2 consecutive calendar days on the date of event, with day of ventilator placement being Day 1*AND the ventilator was in place on the date of event or the day before.*If the ventilator was in place prior to inpatient admission, the ventilator day count begins with the admission date to the first inpatient location.

3. Executive Summary

Pneumonia is the most common hospital-acquired (nosocomial) infection. Hospital-acquired ventilator-associated pneumonia (VAP) is one of the most frequent infections seen in intensive care units (ICUs). This evidence-based approach aims to reduce rates of VAP, shorten the duration of mechanical ventilation, decrease the length of hospital stays and lower mortality rates.

Recommendations
Recommendations to Prevent Ventilator associated pneumonia (VAP) and/or Ventilator associated events (VAEs) in Adult Patients
Avoid intubation and prevent reintubation. Use high-flow nasal oxygen or non-invasive positive pressure ventilation (NIPPV) as appropriate whenever safe and feasible **(Strong Recommendation)**
Minimize sedation · Avoid benzodiazepines in favour of other agents · Use a protocol to minimize sedation · Implement a ventilator liberation protocol (**Strong Recommendation)**
Maintain and improve physical conditioning (**Strong Recommendation)**
Elevate the head of the bed to 30-45° **(Strong Recommendation)**
Provide oral care with toothbrushing but *without* chlorhexidine **(Strong Recommendation)**
We recommend early enteral nutrition in preference to parenteral nutrition **(Strong Recommendation)**
Change the ventilator circuit only if visibly soiled or malfunctioning (or per manufacturers' instructions) (**Strong Recommendation)**
Consider early tracheostomy **(Conditional Recommendation)**
Consider the use of endotracheal tubes with subglottic secretion drainage ports for patients expected to require >48–72 hours of mechanical ventilation **(Conditional Recommendation)**
Consider post pyloric rather than gastric feeding for patients with gastric intolerance or at high risk for aspiration **(Conditional Recommendation)**
Recommendations to Prevent VAP and/or VAE in Preterm Neonates
Use non-invasive positive pressure ventilation in selected populations (**Strong Recommendation)**

Minimize the duration of mechanical ventilation **(Strong Recommendation)**
Use caffeine therapy to facilitate extubation (**Strong Recommendation)**
Assess readiness to extubate daily **(Strong Recommendation)**
Manage patients without sedation whenever possible **(Strong Recommendation)**
Avoid unplanned extubations and re intubations **(Strong Recommendation)**
Provide regular oral care with sterile water **(Strong Recommendation)**
Change the ventilator circuit only if visibly soiled or malfunctioning (or per manufacturer's instructions) **(Strong Recommendation)**
Apply lateral recumbent positioning **(Conditional Recommendation)**
Apply reverse Trendelenburg positioning **(Conditional Recommendation)**
Consider closed/in-line suctioning systems **(Conditional Recommendation)**
Closed oral care with maternal colostrum **(Conditional Recommendation)**
Recommendations to Prevent VAP and/or PedVAE in Pediatric Patients
Avoid intubation if possible. Use non-invasive positive pressure ventilation for selected populations **(Strong Recommendation)**
Assess readiness to extubate daily in patients without contraindications **(Strong Recommendation)**
Take steps to minimize unplanned extubations and re intubations **(Strong Recommendation)**
Avoid fluid overload **(Strong Recommendation)**
Provide regular oral care (i.e., toothbrushing or gauze if no teeth) **(Strong Recommendation)**
Elevate the head of the bed unless medically contraindicated **(Strong Recommendation)**
Change ventilator circuits only if visibly soiled or malfunctioning (or per manufacturer's instructions) **(Strong Recommendation)**
Prevent condensate from reaching the patient **(Strong Recommendation)**

Use cuffed endotracheal tubes **(Strong Recommendation)**
Maintain cuff pressure and volume at the minimal occlusive settings **(Strong Recommendation)**
Suction of oral secretions should be performed before each position change **(Strong Recommendation)**
Consider interruption of sedation daily **(Conditional Recommendation)**
Consider early tracheostomy **(Conditional Recommendation)**
Consider the use of endotracheal tubes with subglottic secretion drainage ports for older pediatric patients expected to require >48 or 72 hours of mechanical ventilation **(Conditional Recommendation)**

4. Introduction

Hospitalized patients are at high risk for pneumonia and other pulmonary complications, particularly patients on mechanical ventilation. Hospital-acquired pneumonia is one of the most common nosocomial infections.

Ventilator bundle components potentially associated with lower mortality rates include staff education, performance feed-back, and in adults, elevating the head of the bed, minimizing sedation, and assessing readiness for extubation. Additional promising strategies include conservative fluid management, low tidal volume ventilation, and early mobility.

5. Scope and Purpose

The scope of a Ventilator-Associated Pneumonia (VAP) prevention guideline typically encompasses all healthcare settings where patients receive mechanical ventilation.

The **purpose** of a VAP prevention is to:

- **Significantly reduce the incidence of Ventilator-Associated Pneumonia:** This is the primary objective, as VAP is a major cause of morbidity and mortality in critically ill patients requiring mechanical ventilation.
- **Establish and promote the consistent application of evidence-based best practices:** The bundle synthesizes the most effective preventative measures into a practical and standardized approach to care.
- **Improve clinical outcomes for mechanically ventilated patients:** By minimizing VAP, patients experience shorter durations of ventilation, reduced ICU length of stay, decreased risk of complications (like sepsis and acute respiratory distress syndrome), and improved survival rates.
- **Provide a structured and actionable framework for the care of ventilated patients:** The bundle offers clear and specific interventions that can be readily integrated into daily clinical practice.
- **Foster a collaborative and multidisciplinary approach to VAP prevention:** Successful implementation requires the active participation, education, and adherence of all members of the healthcare team involved in the care of ventilated patients.
- **Serve as a critical component of quality improvement initiatives:** The elements of the bundle provide measurable metrics for monitoring compliance, identifying areas for improvement, and evaluating the effectiveness of VAP prevention strategies.

- **Educate healthcare professionals on the importance and implementation of key preventative measures:** The guidelines reinforce the rationale behind each intervention and provide guidance on their proper execution.
- **Promote a culture of proactive prevention in the management of mechanically ventilated patients:** By emphasizing consistent adherence to the bundle, healthcare organizations can cultivate an environment where VAP prevention is a fundamental aspect of patient care.

6. Target Audience

- Infection Prevention and Control Team
- All Healthcare Workers: Including Clinicians, Nurses, Head Nurses
- HAIs Surveillance Officers
- The Treating Physician

7. Methodology

A comprehensive search for guidelines was undertaken to identify the most relevant guidelines to consider for adaptation.

Inclusion/ exclusion criteria followed in the search and retrieval of guidelines to be adapted:

- Selecting only evidence-based guidelines (guideline must include a report on systematic literature searches and explicit links between individual recommendations and their supporting evidence)
- Selecting only national and/or international guidelines
- Specific range of dates for publication (using Guidelines published or updated in 2020 and later)
- Selecting peer reviewed publications only
- Selecting guidelines written in English language
- Excluding guidelines written by a single author, not on behalf of an organization to be valid and comprehensive, a guideline ideally requires multidisciplinary input.
- Excluding guidelines published without references as the panel needs to know whether a thorough literature review was conducted and whether current evidence was used in the preparation of the recommendations.

The following characteristics of the retrieved guidelines were summarized in:

- Developing organization/authors
- Date of publication, posting, and release

- Country/language of publication
- Date of posting and/or release
- Dates of the search used by the source guideline developers.

All retrieved Guidelines were screened and appraised using AGREE II instrument (www.agreetrust.org) by at least three members. The panel decided on a cut-off point or ranked the guidelines (any guideline scoring above 50% on the rigor dimension was retained). The committee decided to adapt from:

1. Rosenthal VD, Memish ZA, Bearman G. Preventing ventilator-associated pneumonia: A position paper of the International Society for Infectious Diseases, 2024 update. Int J Infect Dis. 2025; 151:107305.
2. Klompas M, Branson R, Cawcutt K, Crist M, Eichenwald EC, Greene LR, et al. SHEA/IDSA/APIC Practice Recommendation Strategies to prevent ventilator-associated pneumonia, ventilator-associated events, and nonventilator hospital-acquired pneumonia in acute-care hospitals: 2022 Update. Infect Control Hosp Epidemiol. 2022;43(6):687-713.

Evidence assessment

According to World Health Organization (WHO) Handbook for Guidelines, we used the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) approach to assess the quality of a body of evidence, develop and report recommendations. GRADE methods are used by WHO because these represent internationally agreed standards for making transparent recommendations. Detailed GRADE information is available on the following sites:

- GRADE working group: http://www.gradeworkinggroup.org
- GRADE online training modules: http://cebgrade.mcmaster.ca/
- GRADE profile software: http://ims.cochrane.org/revman/gradepro

Table (1) Quality and Significance of the four levels of evidence in GRADE

Quality	Definition	Implications
High	The guideline development group is very confident that the true effect lies close to that of the estimate of the effect	Further research is very unlikely to change confidence in the estimate effect
Moderate	The guideline development group is moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibly that it is substantially different	Further research is likely to have an important impact on confidence in the estimate of the effect and may change the estimate

Low	Confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the true effect	Further research is very likely to have an important on confidence in the estimate of effect and is unlikely to change the estimate
Very low	The group has very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of the effect	Any estimate of the effect is very uncertain

Table (2) Factors that determine How to upgrade or downgrade the quality of evidence.

Downgrade in presence of	Upgrade in presence of
Study limitations. **1-** Serious limitations **2-** Very serious limitations	Dose- response gradient. +1 Evidence of a dose-response gradient
Consistency **1-** Important inconsistency	Direction of plausible bias + All plausible confounders would have reduced the effect
Directness **1-** Some uncertainty **2-** Major uncertainty	Magnitude of the effect +1 Strong, no plausible Confounder, consistent and direct evidence
Precision **1-** Imprecise data	+2 very strong, no major threats to validity and direct evidence
Reporting bias **1.** High probability of reporting bias	

The strength of the recommendations

The strength of a recommendation communicates the importance of adherence to the recommendation.

- **Strong recommendations**

With strong recommendations, the guideline communicates the message that the desirable effects of adherence to the recommendation outweigh the undesirable effects. This means that in most situations the recommendation can be adopted as policy.

- **Conditional recommendations**

These are made when there is greater uncertainty about the four factors above or if local adaptation has to account for a greater variety in values and preferences, or when resource use makes the intervention suitable for some, but not for other locations. This means that there is a need for substantial debate and involvement of stakeholders before this recommendation can be adopted as policy.

When not to make recommendations?

When there is lack of evidence on the effectiveness of an intervention, it may be appropriate not to make a recommendation.

8. Recommendations

Recommendations
Recommendations to Prevent VAP and/or VAE in Adult Patients
Avoid intubation and prevent reintubation. Use high-flow nasal oxygen or non-invasive positive pressure ventilation (NIPPV) as appropriate whenever safe and feasible **(Strong Recommendation, High Evidence Grade)**
Minimize sedation • Avoid benzodiazepines in favour of other agents • Use a protocol to minimize sedation • Implement a ventilator liberation protocol (**Strong Recommendation, Moderate Evidence Grade)**
Maintain and improve physical conditioning (**Strong Recommendation, Moderate Evidence Grade)**
Elevate the head of the bed to 30–45° **(Strong Recommendation, Low Evidence Grade)**
Provide oral care with toothbrushing but *without* chlorhexidine **(Strong Recommendation, Moderate Evidence Grade)**
We recommend early enteral nutrition in preference to parenteral nutrition **(Strong Recommendation, High Evidence Grade)**
Change the ventilator circuit only if visibly soiled or malfunctioning (or per manufacturers' instructions) (**Strong Recommendation, High Evidence Grade)**
Consider early tracheostomy **(Conditional Recommendation, Moderate Evidence Grade)**
Consider the use of endotracheal tubes with subglottic secretion drainage ports for patients expected to require >48–72 hours of mechanical ventilation **(Conditional Recommendation, Moderate Evidence Grade)**
Consider post pyloric rather than gastric feeding for patients with gastric intolerance or at high risk for aspiration **(Conditional Recommendation, Moderate Evidence Grade)**
Recommendations to Prevent VAP and/or VAE in Preterm Neonates

Use non-invasive positive pressure ventilation in selected populations (**Strong Recommendation, High Evidence Grade)**
Minimize the duration of mechanical ventilation **(Strong Recommendation, High Evidence Grade)**
Use caffeine therapy to facilitate extubating (**Strong Recommendation, High Evidence Grade)**
Assess readiness to extubate daily **(Strong Recommendation, Low Evidence Grade)**
Manage patients without sedation whenever possible **(Strong Recommendation, Low Evidence Grade)**
Avoid unplanned extubations and reintubations **(Strong Recommendation, Low Evidence Grade)**
Provide regular oral care with sterile water **(Strong Recommendation, Low Evidence Grade)**
Change the ventilator circuit only if visibly soiled or malfunctioning (or per manufacturer's instructions) **(Strong Recommendation, Low Evidence Grade)**
Apply lateral recumbent positioning **(Conditional Recommendation, Low Evidence Grade)**
Apply reverse Trendelenburg positioning **(Conditional Recommendation, Low Evidence Grade)**
Consider the use of closed/in-line suctioning systems **(Conditional Recommendation, Low Evidence Grade)**
Consider oral care with maternal colostrum **(Conditional Recommendation, Moderate Evidence Grade)**
Recommendations to Prevent VAP and/or PedVAE in Pediatric Patients
Avoid intubation if possible. Use non-invasive positive pressure ventilation for selected populations **(Strong Recommendation, Moderate Evidence Grade)**
Assess readiness to extubate daily in patients without contraindications **(Strong Recommendation, Moderate Evidence Grade)**
Take steps to minimize unplanned extubations and reintubations **(Strong Recommendation, Low Evidence Grade)**
Avoid fluid overload **(Strong Recommendation, Moderate Evidence Grade)**
Provide regular oral care (i.e., toothbrushing or gauze if no teeth) **(Strong Recommendation, Low Evidence Grade)**
Elevate the head of the bed unless medically contraindicated **(Strong Recommendation, Low Evidence Grade)**

Change ventilator circuits only if visibly soiled or malfunctioning (or per manufacturer's instructions) **(Strong Recommendation, Moderate Evidence Grade)**
Prevent condensate from reaching the patient **(Strong Recommendation, Low Evidence Grade)**
Use cuffed endotracheal tubes **(Strong Recommendation, Low Evidence Grade)**
Maintain cuff pressure and volume at the minimal occlusive settings **(Strong Recommendation, Low Evidence Grade)**
Suction of oral secretions should be performed before each position change **(Strong Recommendation, Low Evidence Grade)**
Interrupt sedation daily **(Conditional Recommendation, Moderate Evidence Grade)**
Consider early tracheostomy **(Conditional Recommendation, Low Evidence Grade)**
Consider the use of endotracheal tubes with subglottic secretion drainage ports for older pediatric patients expected to require >48 or 72 hours of mechanical ventilation **(Conditional Recommendation, Low Evidence Grade)**

Rationale

Hospitalized patients are at high risk for pneumonia and other pulmonary complications, particularly patients on mechanical ventilation. Hospital-acquired pneumonia is one of the most common nosocomial infections.

Patients on mechanical ventilation are at risk for a variety of serious complications in addition to pneumonia as acute respiratory distress syndrome, fluid overload, atelectasis, pneumothorax, barotrauma, and pulmonary embolism.

Implementation of VAP prevention strategies

Multidimensional approach includes six components: (a) bundle, (b) education, (c) surveillance of VAP, (d) monitoring compliance with recommendations to prevent VAP, (e) internal reports of VAP rates, and (f) performance feedback have been conducted, achieving a significant reduction in rates of VAP and mortality in numerous studies.

1. **Bundles:** Care "bundles" in infection prevention and safety are simple sets of evidence-based practices that, when implemented collectively, improve the reliability of their delivery and improve patient outcomes. Prevention

bundles are widespread in critical care and have been associated with decreases in VAP, VAE, Non-Ventilator Hospital-Acquired Pneumonia, and in some cases, length of stay and mortality. Ventilator bundle components potentially associated with lower mortality rates include staff education, performance feedback, and in adults, elevating the head of the bed, minimizing sedation, and assessing readiness for extubation. Additional promising strategies include conservative fluid management, low tidal volume ventilation, and early mobility. In addition to oral and hand hygiene, subglottic suctioning, and cuff pressure control. Head-of-bed elevation and oral hygiene were among the most widely used interventions.

2. **Education:** Healthcare professionals, patients, and caregivers participating in the care of a MV should receive training and demonstrate competence, commensurate with their roles, in understanding the recommendations to prevent VAP
3. **Surveillance of VAP:** Employ uniform surveillance methods and definitions to facilitate the comparison of data with benchmark standards. As the one published by the CDC/ National Healthcare Safety Network (NHSN).
4. **Internal reporting of VAP rates:** These measures are crafted to enhance internal hospital quality improvement initiatives, and it is important to convey these measures to senior hospital leadership, nursing leadership, and clinicians engaged in the care of patients at risk for VAP. When providing internal reporting as a benchmark, compare the VAP rates of the given hospital against data from the CDC/NHSN.
5. **Monitoring compliance with recommendations to prevent VAP:** Assess compliance with mechanical ventilator (MV) connection and maintenance guidelines by employing a documented paper, assigning knowledgeable healthcare personnel (HCP) to this task. Document MV connection procedures, encompassing all relevant measures.
6. **Performance feedback:** For the performance feedback, infection control practitioners present charts, showcasing data related to attending HCPs' monthly degree of compliance with infection prevention practices. The infection control tool plays a crucial role, enabling HCPs to identify areas for improvement in cases of low degree of compliance with infection prevention practices.

Practices **for preventing VAP and/or VAEs in Adult Patients**

1. Using high-flow nasal oxygen may help avert intubation in patients with hypoxemic respiratory failure and prevent reintubation after extubation of critically ill patients and postoperative patients compared to conventional oxygen

therapy. High-flow nasal oxygen has also been associated with a trend toward less nosocomial pneumonia in patients with hypoxemic respiratory failure.

2. NIPPV is associated with lower rates of intubation, reintubation, VAP, and mortality compared to conventional oxygen therapy in patients with acute hypercapnic or hypoxemic respiratory failure.
3. Potential strategies to minimize sedation include protocols for targeted light sedation and daily sedative interruptions (ie, spontaneous awakening trials) for patients without contraindications were associated with significantly shorter ICU length of stay in meta-analysis studies.
4. Maintain and improve physical conditioning by initiating exercise and mobilization programs at an early stage could potentially decrease the duration of MV, shorten the LOS in the ICU, decrease the incidence of VAP, and enhance the likelihood of patients returning to independent function.
5. Early enteral nutrition is associated with a lower risk of nosocomial pneumonia, shorter ICU length of stay, and shorter hospital length of stay compared to early parenteral nutrition.
6. Changing the ventilator circuit as needed rather than on a fixed schedule has no impact on VAP rates or patient outcomes but decreases costs so, follow manufacturers' instructions for use if they differ from this recommendation.
7. Reductions in duration of mechanical ventilation with subglottic secretion drainage appear to be limited to patients expected to require >48–72 hours of mechanical ventilation. Endotracheal tubes with subglottic secretion drainage ports should therefore be reserved for patients likely to require >48–72 hours of intubation. Patients requiring emergency intubation in the hospital and preoperative patients at risk for prolonged mechanical ventilation are reasonable candidates. followed by immediate reintubation to exchange a conventional endotracheal tube for a subglottic secretion drainage endotracheal tube is not recommended.
8. Meta-analysis studies suggests that early tracheostomy (within 7 days of intubation) may be associated with a 40% decrease in VAP rates, less time on mechanical ventilation, and fewer ICU days but no difference in mortality.
9. Postpyloric feeding is associated with less aspiration and less pneumonia compared to gastric-tube feeding. Postpyloric tube placement requires special expertise that is not available in all centers and may incur delay in placement. Postpyloric feeding should therefore be reserved for patients with gastric feeding intolerance and for patients at high risk for aspiration as detailed in nutrition society.

Practices **for preventing VAP and/or VAEs in neonatal Patients**

1. Nasal CPAP ventilation (with or without nasal intermittent mechanical ventilation) and high-flow oxygen via nasal cannula are viable alternatives to intubation in most preterm infants, but success rates are greatest for those delivered at >28 weeks gestation. Many premature neonates (especially those with a gestational age >28 weeks) can be successfully supported with non-invasive positive pressure ventilation in the delivery room and subsequently in the NICU.
2. Minimize duration of mechanical ventilation
    a. Manage patients without sedation whenever possible.
    b. Use caffeine therapy for apnea of prematurity within 72 hours after birth to facilitate extubation.
    c. Assess readiness to extubate daily.
    d. Take steps to minimize unplanned extubations and reintubations: Use nasal CPAP or nasal NIPPV in the postextubation period to help prevent the need for reintubation.
    e. Provide regular oral care with sterile water (extrapolated from practice in infants and children, no data in preterm neonates)
    f. Change the ventilator circuit only if visibly soiled or malfunctioning or per manufacturers' instructions for use (extrapolated from studies in adults and children, no data in preterm neonates)

3. Additional approaches for preterm neonates
   These interventions have minimal risks of harm, but their impact on VAE and VAP rates is unknown.

    - Lateral recumbent positioning
    - Reverse Trendelenburg positioning
    - Closed/in-line suctioning
    - Oral care with maternal colostrum

Practices **for preventing VAP and/or VAEs in Pediatric Patients**

1. Avoid intubation if possible:
    a. Risks of NIPPV in pediatric patients mirror those for adults with the added issue that pediatric patients often need sedation to tolerate NIPPV.
    b. CPAP may be superior to high flow oxygen by nasal cannula to avoid intubation in infants with bronchiolitis.

2. Minimize duration of mechanical ventilation
    a. Assess readiness to extubate daily in patients without contraindications through daily spontaneous breathing trials can decrease mean duration of ventilation and Pediatric ICU length of stay in postoperative cardiac surgery
    b. Steps to minimize unplanned extubations and reintubations to reduce unplanned extubations.
    c. Meta-analysis studies found fluid overload is associated with increased risk for prolonged mechanical ventilation (>48 hours).
3. Studies of VAP bundles that emphasized on regular oral care reported significant decreases in VAP rates following bundle implementation. The American Dental Association recommends beginning oral hygiene a few days after birth in term infants. Wipe the gums with a gauze pad after each feeding to remove plaque and residual formula that could harm erupting teeth. After oral hygiene, rinse and suction the mouth. Keep the oral mucosa and lips clean, moist, and intact using sponge-tipped applicators dipped in non-alcohol, nonperoxide mouth rinse.
4. Elevate the head of the bed unless medically contraindicated
5. Changing the ventilator circuit as needed rather than on a fixed schedule has no impact on VAP rates or patient outcomes but decreases costs so, follow manufacturers' instructions for use if they differ from this recommendation.
6. Remove condensate from the ventilator circuit frequently to avoid draining the condensate toward the patient.
7. Endotracheal tube selection and management
    a. Use cuffed endotracheal tubes: Paediatric intensivists have historically favoured uncuffed tubes due to concern that cuffs may induce subglottic stenosis in pediatric airways. Cuffing has proven safe, however, and may decrease the risk of microaspiration. Cuffed tubes are now recommended for term newborns and children.
    b. Maintain cuff pressure and volume at the minimal occlusive settings to prevent clinically significant air leaks around the endotracheal tube, typically 20–25 cm H2O. This "minimal leak" approach is associated with lower rates of post-extubation stridor.
8. Daily sedative interruptions decreased duration of mechanical ventilation and ICU length of stay without increases in adverse event rates.

9. Indicators for Monitoring

To ensure the appropriate prevention of ventilator associated pneumonia in hospitals and reduce the risk of VAP, specific indicators should be monitored regularly. These are some indicators which can provide measurable data to assess compliance, identify areas for improvement, and guide interventions. Here are some key indicators that can be included in hospital guidelines for prevention of VAP.

a) Process Measures:

- Process-measure definitions and measurement strategies vary widely.
- For organizations that collect and report process measures:
    - Clearly define measures including data sources, inclusion and exclusion criteria, frequency of monitoring, and numerator and denominator criteria.
    - Develop a formal system to document compliance.
    - Compliance can be measured via direct observations or via audits of patient charts, bedside checklists, and/or electronic medical records. Periodically validate the accuracy of paper and/or electronic documentation.
    - Perform assessments regularly.
        i. The optimal frequency of assessments (eg, once daily, twice daily, or weekly) is not known but can likely be adjusted based on compliance rates and unit size.
        ii. An analysis of a large collaborative quality improvement effort suggests that the following approach can be used to determine the frequency of process measure assessments.
- Start by measuring processes daily. If compliance is consistently high for a given process, then decrease the frequency of measures (ie, once every 2–3 days or once per week, and if compliance continues to be high, then decrease to once per month). If compliance is low or variable, then continue with daily measurements.
- For units with at least 30 ventilator days per month, measuring compliance on 7 consecutive days per month provides accurate performance estimates
- For units with <30 ventilator days per month, daily data collection is required to achieve accurate performance estimates.
- There is no consensus on how best to define adherence to different process measures and definitions for measuring adherence vary widely.

1. Compliance with Prevention Bundles

Compliance can be reported for each process measure individually and/or as ‘all or none’ compliance with a bundle of process measures. For ‘all or none’ compliance, credit is given only if all components have been accomplished and documented; if any components were not performed and/or were not documented, no credit is given.

Calculate compliance of adherence to recommendation

- **Numerator:** compliance of each certain recommendation (i.e. Number of documented daily assessments for the necessity of continuing MV access
- **Denominator:** total number of MV connections
- **Standardization factor:** 100 (i.e., multiply by 100 so that measure is expressed as a percentage)

b) Outcome Measures:

1. **Rates of VAP (Number of VAP using CDC/NHSN per 1000 MV-days)**
Measurement of rates allows an individual facility to gauge the longitudinal impact of implementation of prevention strategies:

- **Numerator:** number of VAPs in each location monitored
- **Denominator:** total number of MV-days for all patients that have a MV in each location monitored
- **Standardization factor:** Multiply by 1000 so that the measure is expressed as cases per 1000 MV-days.

2. **Device Utilization Ratio (DUR)** can be monitored longitudinally to identify any variations, allowing for comparisons at both hospital and unit levels, and serving as a surrogate for assessing patient exposure risk.
The catheter utilization ratio is the number of MV-days per number of patient-days in a given period. This is a measure of the total patient-days in which a MV was used and can be used as a marker for risk of infection.
   - **Numerator:** Number of MV Days for a location
   - **Denominator:** Number of Patient Days for a location

According to the approved CDC criteria,

**Device days are the total number of days of exposure to urinary catheter for all the patients during the selected time period.*

**Patient days are the total number of days patients are in the ICU during the selected time period*

10. Plan to Update this National Clinical Guideline

This guideline will be reviewed and updated when new evidence emerges that is likely to influence the recommendations.

References

1. Centers for Disease Control and Prevention (CDC). Pneumonia (Ventilator-Associated [VAP] and non-Ventilator-Associated Pneumonia [PNEU]) Event. Atlanta (GA): CDC; 2025 [cited 2025 Jun 11]. Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf
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