

NTI News Section B

Featuring CE Article and Exhibit Guide

Implementing Evidence-Based Practice Guidelines to Minimize Ventilator-Associated Pneumonia

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Learning Objectives

At the end of this learning activity, the participant will be able to:

1. Discuss the pathogenesis of ventilator-associated pneumonia
2. List the risk factors associated with the development of VAP
3. Describe the clinical practice measures that reduce the incidence of VAP

Ventilator-associated pneumonia (VAP) typically begins between 48 and 72 hours after endotracheal intubation, and it is estimated to occur in 9% to 27% of all intubated patients. Mortality rates are significant, ranging between 33% and 50% in affected patients.¹

VAP may be caused by a wide spectrum of bacterial pathogens or multiple organisms and is rarely due to viral or fungal sources in patients with intact immune systems.² Aerobic gram-negative bacilli (eg, *Pseudomonas aeruginosa*), gram-positive cocci (eg, *Staphylococcus aureus*), and particularly methicillin-resistant *Staphylococcus aureus* (MRSA) have been rapidly emerging in the United States. More than 50% of *Staphylococcus aureus* isolates in cultures from intensive care patients are resistant to methicillin. VAP due to multidrug-resistant organisms has also increased dramatically in the United States.¹

The primary source of bacterial entry into the respiratory tract is colonization of the oral cavity, trachea, stomach, and sinuses with pathogenic bacteria (see Figure). Within 48 hours of hospital admission, the oropharyngeal flora changes from the usual gram-positive streptococci and dental pathogens, to predominantly gram-negative organisms, which constitute a more virulent flora.³ Additionally, the stomach contents can become colonized, particularly when stress ulcer prophylaxis alters the pH balance. Gross aspiration or microaspiration carries these bacteria-rich secretions into the lower respiratory tract. Colonies of bacteria

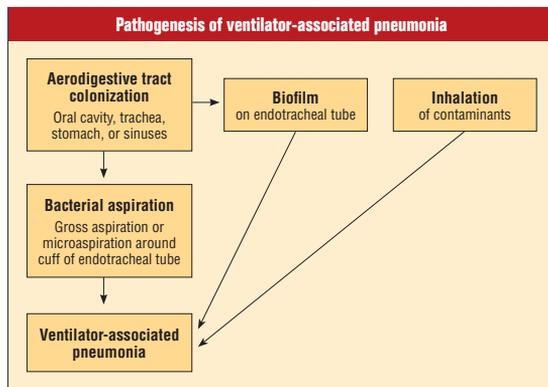
on the endotracheal tube, known as biofilms, are thought to contribute to VAP in some cases. Additionally, although less common, bacteria can gain entry through direct inhalation.^{4,6}

was developed in 1970 to monitor the incidence of healthcare-associated (nosocomial) infections and their associated risk factors and pathogens. This voluntary reporting system today includes approximately 300 hospitals that report their data to the Centers for Disease Control and Prevention (CDC).¹⁰

An NNIS report published in 2004 in the *American Journal of Infection Control* indicated that the

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Risk factors can be modifiable or nonmodifiable. Nonmodifiable factors that increase risk of acquiring VAP include chronic obstructive pulmonary disease, coma, patient's age greater than 60 years, male sex, transport out of the ICU, and reintubation. Modifiable risk factors that affect the occurrence of VAP include ventilator circuit changes every 24 hours, supine positioning of patients, and endotracheal cuff pressures less than 20 cm H₂O.¹²



VAP results in increased lengths of stay, reported to be as much as 22 days with a cost of more than \$40,000 per patient, per infection.⁷ With approximately 5 to 10 cases per 1000 admissions, the estimated 300,000 annual cases of VAP could cost healthcare systems more than \$12 billion annually.^{8,9}

RISK FACTORS AND RATES OF INFECTION

The National Nosocomial Infection Surveillance (NNIS) system

highest rates of VAP were most likely to be seen in the trauma, burn, neurosurgical, and surgical intensive care units (ICUs).¹¹ Infection rates were calculated by taking the number of ventilator patients with pneumonia, multiplying by 1000, and then dividing by the number of ventilator days. For example:

$$\frac{2 \text{ patients with VAP} \times 1000}{500 \text{ ventilator days}} = 4 \text{ (VAP infection rate)}$$

CLINICAL PRACTICE GUIDELINES TO REDUCE VAP

Multiple organizations have issued evidence-based guidelines to reduce and prevent VAP. In 2004, the American Association of Critical-Care Nurses (AACN) issued the VAP Practice Alert. These measures include head-of-bed (HOB) elevation between 30° and 45°, continuous aspiration of subglottic secretions (CASS), and the elimination of routine changes of the patient's ventilator circuit.¹³ These guidelines are also supported by the American Thoracic Society (ATS)¹ and the CDC¹⁴ (see Table on page 2).

HOB Elevation

VAP Practice Alert: All patients receiving mechanical ventilation, as well as those at high risk for aspiration (eg, decreased level of consciousness, with
Implementing, continued on page 2)

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(Implementing, continued from page 1) *enteral tube in place), should have the head of the bed (HOB) elevated at an angle of 30°–45° unless medically contraindicated.*¹³

HOB elevation reduces the risk of aspiration and the incidence of VAP. In a study by Drakulovic et al,¹⁵ clinical evidence indicated dramatic reductions in VAP rates with HOB elevation to between 30° and 45°. ATS and CDC also recommend this intervention on the basis of their review of clinical evidence. However, despite multiple evidence-based guidelines supporting HOB elevation, a recent study by Grap et al¹⁶ has shown that the mean HOB elevation in patients receiving mechanical ventilation was consistently lower than the recommendations of 30° to 45°.

Why are patients being kept with the HOB elevated less than 30° to 45°, despite clinical evidence to support elevation? One reason may be conflicting recommendations for the prevention of skin shearing or breakdown. The Agency for Healthcare Research and Quality recommends maintaining the elevation at the lowest degree consistent with

the medical condition or restrictions to prevent pressure ulcers.¹⁷ Another reason may be a simple misjudgment of the angle. Most critical care beds now come with angle devices in the bed rail, but elevation can also be measured with a separate angle device or protractor, to ensure compliance with the AACN guidelines. Additionally, HOB elevation may be below recommended guidelines because of a patient's hemodynamic instability. However, researchers in several studies found that decreased HOB elevation was not related to lower or unstable blood pressure in ICU patients receiving mechanical ventilation.^{16,18}

Continuous Aspiration of Subglottic Secretions

*VAP Practice Alert: Use an endotracheal tube with a dorsal lumen above the endotracheal cuff to allow drainage by continuous suctioning of tracheal secretions that accumulate in the subglottic area.*¹³

First described in 1992, subglottic suction involves the use of a specialized endotracheal tube, sometimes known as a CASS tube, which has a dorsal lumen opening above the cuff in the subglottic region. The

Guidelines for prevention of ventilator-associated pneumonia		
American Association of Critical-Care Nurses (2004)	American Thoracic Society (2005)	Centers for Disease Control and Prevention (2003)
Elevate head of bed 30°–45° (expected practice)	Elevate head of bed 30°–45° (Level I)	Elevate head of bed 30°–45° (Level II)
Continuous subglottic suctioning tube (expected practice)	Continuous aspiration of subglottic secretions (Level I)	If feasible, use of an endotracheal tube with a dorsal lumen (Level II)
Do not routinely change the patient's ventilator circuit (expected practice)	Contaminated condensate should be emptied and prevented from entering the endotracheal tube or inline nebulizers (Level II)	Do not change routinely, change the circuit when it is visibly soiled or malfunctioning (Level IA)

suction lumen can be attached to low continuous suction at -20 mm Hg or intermittent suction at -100 to -150 mm Hg.

In a meta-analysis of 110 different randomized controlled trials comparing standard care of endotracheal tubes with drainage of subglottic secretions, Dezfulian et al¹⁹ reported that draining subglottic

secretions reduced the incidence of VAP by nearly half. Additionally, drainage of subglottic secretions reduced length of stay in the ICU by 3.1 days compared with standard endotracheal care.

In addition to the AACN, the CDC and ATS also currently support use of an endotracheal tube with subglottic secretion drainage.

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Minimal Changes of Ventilator Circuit

*VAP Practice Alert: Do not routinely change, on the basis of duration of use, the patient's ventilator circuit.*¹³

Historically, ventilator circuits were changed as frequently as every 8 hours. This recommendation was based on early studies showing a relationship between respiratory equipment and VAP. Practices were changed in the 1980s after a landmark study by Craven et al²⁰ showed that rates of VAP did not change when circuits were changed every 48 hours rather than every 24 hours. In 1995, Kollef et al²¹ extended the body of evidence to recommend circuit changes on an as-needed basis by demonstrating no differences in VAP rates with or without 7-day circuit changes in a randomized controlled trial of 300 patients.

Current guidelines indicate that circuits should be changed only when visibly soiled or malfunctioning. The American Association of Respiratory Care (AARC) joins the AACN, ATS, and CDC in support of this guideline.²²

Oral Care

In a recent study of critically ill long-term-care residents, El-Solh et al²³ investigated the association

between dental plaque colonization and the lower respiratory tract. Their findings suggested that dental plaque can serve as a reservoir for microorganisms; regimens that improve oral health should reduce the risk of VAP.

The *AACN Procedure Manual for Critical Care*²⁴ includes the following procedure: brush teeth with a pediatric or soft toothbrush twice daily; use oral swabs and apply mouth moisturizer to the oral mucosa and lips every 2 to 4 hours; and suction the oral cavity and pharynx frequently, changing oral suction equipment and tubing every 24 hours.

In a 2005 study, Hanneman and Gusick²⁵ found that nurses self-report more frequent oral care than is documented. The mean documented frequency of oral care in intubated patients was 3.3 episodes during a 24-hour period; the self-reported frequency was 4.2 episodes. The most recent statement by the CDC recommends implementation of a comprehensive oral hygiene program for patients who are at high risk for healthcare-associated pneumonia, although specific practices such as chlorhexidine rinses or oral decontamination with topical antimicrobials are not recommended for routine use. The current AACN and ATS

guidelines do not address oral care strategies to prevent or reduce the risk of VAP, and additional research is needed.

IMPROVING OUTCOMES

Education is a critical factor in the decrease of VAP rates. The implementation of educational programs reduced one facility's VAP rate by more than 57%,²⁶ and a multidisciplinary performance improvement team in another institution was able to decrease their VAP rate by 95% over a period of 6 years.²⁷

A recent report by Lawson²⁸ highlighted the efforts of one hospital to reduce VAP rates through evidence-based medicine. The 6 steps of the program are detailed below.

Data Comparison

The project began with a comparison of that hospital's VAP rates against similar units in other hospitals, as reported through the NNIS system. The hospital's VAP rates were higher than the national threshold.

Assembling a Team

A multidisciplinary team was assembled, including the critical care director, nursing director, director of respiratory therapy, infectious disease nurse, progressive unit care

manager, and critical care educator. Additionally, the hospital librarian contributed by doing extensive literature research for the project.

Developing an Action Plan

After a careful review of the literature, the team developed a list of multiple changes, including the following procedures:

- HOB elevation 30° to 45°
- CASS endotracheal tube
- Oral care
- Draining ventilator circuits away from the patient
- Additional changes, including hand washing, appropriate use of gowns and gloves, ventilator protocols, eliminating saline lavage, and continuous lateral rotation therapy.

Implementation

The implementation process was incremental, involving staff development sessions, formal and videotaped lectures, self-learning packets, e-mails, flyers, and colorful storyboards, all reinforcing the importance of VAP prevention and the methods for reducing the risk of infections.

Evaluation

The results of the program were quickly evident, with an immediate

(Implementing, continued on page 4)

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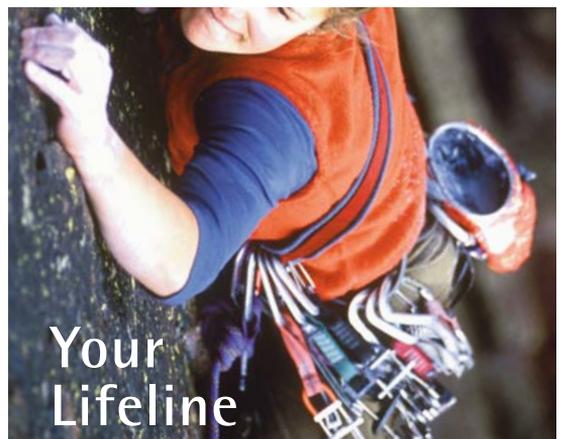


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(Implementing, continued from page 3)
and drastic reduction in VAP rates. Compliance with individual elements of the program was tracked (HOB elevation, documentation of oral care) through records and nursing interviews.

Dissemination of Results

The results of the project were disseminated to all ICU nurses, as well as administrative, medical, and nursing committees. The results were celebrated and highlighted as an example of how working together could help to achieve positive results.

Using Evidence-Based Guidelines to Decrease VAP

As healthcare providers, we work hard to give our patients the best care we can give; as direct care givers at the bedside, our impact can be huge. The statistics on VAP are staggering. Pneumonia remains the sixth leading cause of death in the United States²⁹ and VAP, as a hospital-acquired infection, has a 33% to 50% mortality rate.^{1,14} We know from solid research and the publication of evidence-based guidelines that there are steps we can take for our patients that will decrease the risk of this deadly infection.

The AACN Practice Alert of fers succinct information, provides tools and education to guide bedside care, and is readily available at the AACN Web site. Yet we know from research that despite published guidelines, practice lags behind the evidence, and HOB elevation below 30° can still be found.

You can make a difference and affect your patients' outcomes. Read the evidence, bring the guidelines to work, and discuss them with your peers, nurse manager, or unit director. Find out what your unit's VAP rate is so that you can measure your success. Use a monitoring tool to measure your ICU's compliance with the guidelines for HOB elevation.

In 2004, I was part of a team that developed and implemented a clinical practice guideline for VAP at my hospital. The team measured HOB compliance in our 12-bed medical intensive care unit and saw that we improved over time. The VAP rate for our unit was posted in the break room; barriers and successes were discussed as a standing agenda item for the medical ICU staff meetings. The VAP rate in the medical ICU has steadily decreased from 8.4 infections per 1000 ventilator days at the start of the clinical practice guideline to zero infections in the last two quarters of 2005. The process was driven by

persistence, patience, teamwork, and a united goal to improve patients' outcomes. After all, it really is all about the patient!

Author Disclosure

Maureen Seckel is a critical care medicine/pulmonary clinical nurse specialist at Christiana Care Health Services, Newark, Del. This article was written with the support of Nellcor Puritan Bennett, as part of a course in development for their continuing education Web site: www.nellcor.com/CEExcellence.

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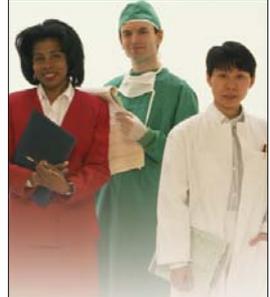
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