CLINICAL EVIDENCE GUIDE

INTUBATION-RELATED SECRETION MANAGEMENT: CONTROLLING CONTRIBUTORS TO ACUTE RESPIRATORY FAILURE

This guide reviews the clinical evidence supporting the use of products featuring subglottic secretion drainage to improve patients' outcomes and as part of a ventilator-associated pneumonia (VAP) bundle to help reduce the incidence of VAP.

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TABLE OF CONTENTS

INTRODUCTION

The main pathogenic mechanism of intubation-related pneumonia is bacterial translocation from the stomach and/or oropharynx to the lower respiratory tract. Following endotracheal intubation, pathogenic microorganisms has been shown to colonize the oropharyngeal mucosa, dental plaque, stomach, and sinuses. Therefore, contaminated subglottic secretions travel down the trachea and accumulates above the cuff of the endotracheal tube (ETT).[1]

Intensive care unit (ICU) patients with acute respiratory failure who require tracheal intubation and mechanical ventilation (MV) are at risk for intubation-rated pneumonia.[2] Critically ill patients receiving MV may experience impaired airway clearance as a result of ineffective cough and impaired secretion mobilization.[3]

Ineffective cough, impaired mucociliary transport, oropharyngeal pathogens, and air-flow patterns leads to secretion pooling in lower airways, atelectasis, and VAP, all of which may contribute to weaning and extubating failures.[3]

The care of ventilated patients is a top priority because this population experiences high levels of mortality and morbidity.[4] Hospital-reported data from the National Healthcare Safety Network suggests that VAP rates have been declining.[5,6] However, new data from a randomly selected national sample demonstrated that approximately 10% of mechanically ventilated patients were diagnosed with VAP. This rate has not declined over the past decade.[7]

Five elements of care to prevent ventilator-associated events (VAE) were developed to help decrease the incidence of VAP:

- Elevation of the head of the bed to between 30 and 45 degrees
- Use of the ABCDEF bundle
- Peptic ulcer disease prophylaxis
- Venous thromboembolism prophylaxis
- Daily oral care with chlorhexidine

When the hospital team shifted from the all-or-nothing approach, VAP rates decreased dramatically.[8,9] Reducing pneumonia for intubated patients requires research, practice and persistence – often through a coordinated process that is led by small teams to implement a care bundle approach.[10] In many cases, the clinicians confirmed that the new emphasis on working reliably and as a coordinated care team helped decrease VAP rates. Each part of the bundle has to be applied together in order to see a change in outcomes.[4]

PATHOGENESIS

According to the Center for Disease Control (CDC), HAIs affect 5 to 10 percent of hospitalized patients in the U.S. per year. Approximately 1.7 million HAIs occur in U.S. hospitals each year, resulting in 99,000 deaths and an estimated $20 billion in healthcare costs. The most common of these infections at 21.8% is pneumonia.[8]

Through research, practice and persistence many hospitals have been able to reduce their instances of pneumonia for mechanically ventilated patient. This process is a coordinated process often times led by small teams and implementing a care bundle approach.[10] Each consideration is equally important in this effort to reduce pneumonia type events.

- Ventilator bundle inclusions
- Proper handwashing practices
- Head of bed at 30 degrees: Reduces aspiration of the gastric secretions within the oropharangeal space.
- Oral care: Proper oral care to minimize bacterial secretions; proper oral suctioning based upon hospital recommended practices.
- Subglottic suctioning: To remove any secretions that have gathered on top of the tracheal tube cuff.
- Closed suctioning: To reach the space below the airway management product.

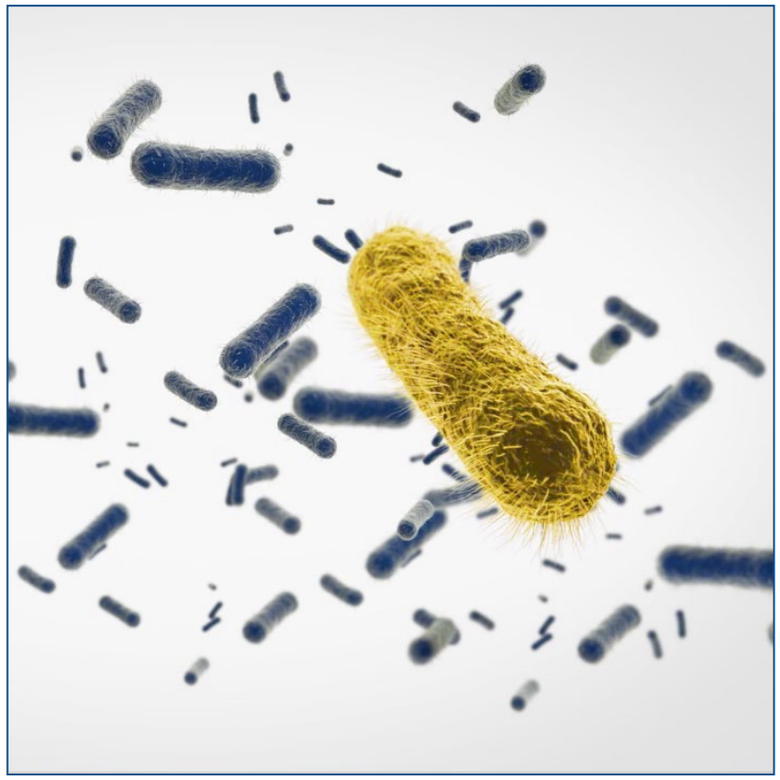
RISK FACTORS

Ventilator-associated pneumonia incidence and mortality

- VAP is the second most common nosocomial infection in the United States. It is estimated to occur in 9% to 27% of ICU patients.[12]
- On average 10-20% of ICU patients ventilated for >2 days experience VAP. [13]
- Mortality that is directly attributable to VAP is estimated to be between 9 -13%.[12]

Pathogenesis and risk factors

- Aspiration of oral and/or gastric secretions is the primary route of bacterial entry into the lungs and is believed to be a primary factor in the development of VAP.[15]
- Each day on mechanical ventilation increases patient risk for VAP by 1% to 3%.[12]
- Independent predictors of VAP include burns, trauma, central nervous system disease, respiratory disease, cardiac disease, mechanical ventilation in the previous 24 hours, witnessed aspiration, and paralytic agents.[16]
- Clinical investigation has shown evidence of aspiration of gastric contents in 88.9% of ICU patients even when head of bed elevation was monitored regularly.[16]



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SECRETION MANAGEMENT: LITERATURE REVIEW

Proper patient secretion management and the prevention of pneumonia should target the main pathogenic origins, which is bacterial translocation from stomach and oropharynx to the lower respiratory tract. Within hours following endotracheal intubation, pathogenic microorganisms colonize the oropharyngeal mucosal surfaces, dental plaque, sinuses, and stomach. Accumulation of oropharyngeal secretions colonized with these pathogens occurs above the endotracheal tube (ETT) cuff. Microaspiration of these subglottic secretions might occur through an underinflated tracheal cuff or through longitudinal folds in high volume-low pressure cuffs.[13]

To reduce the VAP rate, a hospital in Belgium systematically introduced evidence-based measures supported by the Plan-Do-Check-Act (PDCA) cycle methodology. Some of the improvements included:[20]

- Cuff pressure control and ETT with polyurethane cuff (2008)
- ETT with PVC taper-shaped cuff and subglottic suctioning (2009)

The 2008 results were ineffective, but in 2009 the introduction of three new technologies reduced the VAP rate by half.[19]

Despite the clinical importance of VAP, the ability to conduct accurate VAP surveillance is very limited.[17] In 2011-2012, the Centers for Disease Control and Prevention convened a group of healthcare providers to develop a new approach to surveillance. This group represented professional societies for critical and respiratory care, infectious disease, healthcare epidemiology, and infection prevention. They recommended broadening the focus of surveillance from pneumonia alone to complications of mechanical ventilation in general to help prevent all complications.

To help prevent further complications, it was recommended that interventions such as a VAP bundle improve objective outcomes with little risk of harm.[18] A Belgian study showed that improving education of healthcare providers and staff and checklist implementation resulted in increased compliance for the VAP bundle and a decrease in the VAP incidence. They also saw an increase in the use of endotracheal tubes (ETTs) with subglottic aspiration.[19]

One study showed a significant decrease in VAP (by half) when the VAP bundle was incorporated. It also showed improved outcome with a decreased mortality and a significant decrease in ICU length of stay (by 2 days), which reduced the cost for those on the VAP bundle.[20] Another study showed that implementing each element of the VAP bundle can reduce morbidity, mortality, and healthcare costs.[10]

The application of a VAP bundle can produce improvements in microbiological measures and nosocomal infection rates resulting in lowering mortality, shortened lengths of hospitalization, and decreased medical care costs. However, education and periodic training remain a fundamental process of improving health services. VAPs were reduced by improving bundle compliance and ensuring the same standard of care to all ICU patients.[33]

GUIDELINES

Since 2001, only minor updates have been made to the guidelines. The 2016 American Thoracic Society guideline for hospital-acquired pneumonia (HAP) and VAP defines HAP as an episode of pneumonia not associated with mechanical ventilation. As a result, there are two distinct groups but no update to the 2005 guideline.[21]

National guidelines in the United States, Canada, and parts of Europe recommend ETTs with subglottic secretion drainage (SSD) based on randomized controlled trails and meta-analyses, suggesting that SSD can reduce VAP rates.[22] Tracheal tubes with SSD were developed to prevent VAP; however, they cannot fully prevent microaspiration of sputum and vomitus.

One way to address this issue is by improving cuff shape. A taper-shaped cuff prevents fluid leakage more effectively than conventional cuffs and suppresses the fluid leakage. Aspiration of oropharyngeal pathogens and leakage of contaminated fluid around the ETT cuff into the lower respiratory tract are possible primary causes of VAP. The Shiley™ evac endotracheal tube with TaperGuard™ cuff has been shown to reduce VAP due to its taper-shaped cuff with subglottic secretion drainage.[23,24,25] Patients who had intermittent subglottic suctioning had a statistically lower incidence of VAP than patients intubated with the conventional ETT.[32]

VAE prevention is complex and requires a high rate of compliance to recommended bundle elements. It also requires a multidisciplinary approach, with the unit and facility leadership working together. A key to success is ongoing monitoring of compliance to bundles for data-driven decision-making, using data to drive practice and process changes, and communication of supporting process performance to staff.

RECOMMENDATIONS

American Thoracic Society/Infectious Diseases Society of America Evidence Levels[26]	
Evidence level	Definition
Level I (high)	Evidence comes from well-conducted, randomized controlled trials
Level II (moderate)	Evidence comes from well-designed, controlled trials without randomization or large case series with systematic analysis of disease patterns and/or microbial etiology
Level III (low)	Evidence comes from case studies and expert opinion

Centers for Disease Control and Prevention Guidelines[27]	
Category IA	Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies
Category IB	Strongly recommended for implementation and supported by some clinical or epidemiologic studies and by strong theoretical rationale
Category IC	Required for implementation, as mandated by federal or state regulation or standard
Category II	Required for implementation, as mandated by federal or state regulation or standard
No Recommendation; Unresolved	Practices for which insufficient issue evidence or no consensus exists about efficacy

Summary of published guidelines: prevention of ventilator-associated pneumonia

Guidelines can be a valuable evidence-based resource for facilities seeking to improve their practices to reduce ventilator-associated pneumonia (VAP). Following is a summary of selected guidelines, recommendations, bundles, and practice alerts for the prevention of healthcare-associated or ventilator-associated pneumonia.

This summary includes guidelines from the American Thoracic Society (ATS) and Infectious Diseases Society of America (IDSA),[26] the Centers for Disease Control and Prevention (CDC),[27] the Canadian Critical Care Society (CCCS),[28] the Agency for Healthcare Research and Quality (AHRQ),[29] the Institute for Healthcare Improvement (IHI),[30] the American Association of Critical Care Nurses (AACN),[31] Safer Healthcare Now (SHN),[28] and the Society for Healthcare Epidemiology of America (SHEA/IDSA).[32]

For the complete recommendations and supporting documentation from each organization, please refer to the published guideline or document.

RECOMMENDATIONS (cont'd.)

Intervention	ATS/IDSA	CDC	CCCS	AHRQ	IHI	AACN	SHN	SHEA/IDSA
Staff education and involvement	I	IA						✓
Appropriate hand disinfection	I	IA						✓
Surveillance of ICU infections	II	IB						✓
Avoid intubation and reintubation when possible	I	II						✓
Noninvasive ventilation when possible	I	II						✓
Oral vs. nasal intubation and gastric tube placement	II	IB	✓				✓	✓
Continuous aspiration of subglottic secretions	I	II	✓ (Consider)	✓		✓	✓	✓
Maintain endotracheal cuff pressures >20 cm H_2O	II							✓
Prevent circuit condensate from entering ETT or nebulizers	II	IB						✓
Adequate staffing levels in ICU	II							
Semirecumbent positioning	I	II	✓	✓	✓	✓	✓	✓
Enteral vs. parenteral nutrition	I	Unresolved						
Routine use of selective digestive decontamination	Not recommended	Unresolved						
Routine use of oral chlorhexidine	Not recommended	Unresolved						
Daily interruption or lightening of sedation	II				✓		✓	✓
Stress bleeding prophylaxis with either H_2 antagonists or sucralfate	Either	Preference unresolved	Sucralfate not recommended	H_2 antagonists	✓		✓	
Change ventilator circuits only when visibly soiled; no regular changes		IA	✓			✓		✓
Use of heat and moisture exchangers (HMEs)	Unresolved	Unresolved	✓					
Recommendation for closed suction or single-use open suction	No preference	Closed suction						
Kinetic beds			✓ (Consider)					
Oral hygiene program for high-risk patients		II						✓
Tight glycemic control	I							
Deep vein thrombosis (DVT) prophylaxis					✓		✓	
Avoid gastric overdistention								✓

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