Ventilator Associated Pneumonia – Elimination Through Infection Prevention & Treatment

Dr. Charles Palenik, Indiana University School of Dentistry

A Webber Training Teleclass

Ventilator Associated Pneumonia

Elimination Through Infection Prevention & Treatment

Hosted by Paul Webber
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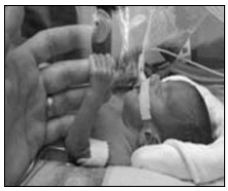
Ventilator Associated Pneumonia



Ventilator Associated Pneumonia

Ventilator Associated Pneumonia

- pneumonia = 11% - 15% of all hospital-associated infection HAIs (#2)
- pneumonia = 27% of all medical intensive care unit infections
- pneumonia = 34% of coronary care unit infections
- #1 risk factor for HAI pneumonia is mechanical ventilation (with its requisite endotracheal intubation)
- VAP occurs in 10% - 25% of patients

Ventilator Associated Pneumonia

- rates in varying ICUs are from 4-16 per 1000 ventilator days (highest in trauma ICUs)
- average increased stay = 4-9 days (mean 6.1 days)
- Attributable mortality in the past ranged from 20% - 50% (five of nine studies)
- VAP has high mortality and morbidity
- VAP can be prevented
- average increased case cost - $10,000 - $40,000, up to $150,000

VAP Infection Prevention/Control Program

An effective facility-wide infection prevention and control program is comprised of many components and tools that can be used for VAP prevention.

Recent quality improvement initiatives suggest that many cases of VAP might be prevented by careful attention to the process of care.

The success management of patients on ventilators is necessary to ensure the best possible outcomes for individual patients while reducing the M&M associated with these infections.

Basic Infection Prevention/Control Stewardship

Although we will focus on infection prevention related to VAP use, it is necessary to look at more global interventions that have an impact on HAIs such as VAP. The basics of infection prevention and control are necessary underpinnings of programs, policies, and protocols that impact HAIs (appropriate hand hygiene, environmental and equipment considerations, compliance with standard and transmission-based precautions, etc.).

Antimicrobial Stewardship

One component of HAI prevention deserves added attention. As highlighted in the Centers for Disease Control and Prevention's (CDC) Campaign to Prevent Antimicrobial Resistance in Healthcare Settings, a program for antimicrobial stewardship in any healthcare setting (acute or long-term care) has potential for positive impact on all HAIs. The combination of effective antimicrobial stewardship with a comprehensive infection control program has been shown to limit the emergence and transmission of antimicrobial-resistant bacteria.

VAP Definition I

HAI - pneumonia in a patient on mechanical ventilatory support (by endotracheal tube or tracheostomy) for greater than or equal to 48 hours

Pneumonia Definitions

Pneumonia is classified as community-acquired (CAP), healthcare-associated (HCAP), HAP, or VAP. VAP is a sub-classification of HAP, if the patient is hospitalized during the period of mechanical ventilation. CAP is defined as pneumonia for which the first positive bacterial culture is obtained within 48 hours of admission to the hospital and the patient does not have risk factors for HAP.

Pneumonia Definitions

HCAP occurs when the patient's first positive bacterial culture is obtained within 48 hours of admission and the patient has any of the following risk factors: admission source indicates a transfer from another healthcare facility; patient has received hemodialysis, wound, or infusion therapy as an outpatient; patient was previously hospitalized for at least 3 days within the past 90 days prior to current admission; or the patient is immunocompromised due to underlying disease or therapy (HIV, chemotherapy).

Pneumonia Definitions

HAP is pneumonia in which the patient's first positive bacterial culture is obtained more than 48 hours after admission to the hospital.

VAP Definition II

VAP is pneumonia that develops in a mechanically ventilated patient with a first positive bacterial culture beyond 48 hours after hospital admission or tracheal intubation, whichever occurred first. It is noted that this definition of VAP differs from the NHSN surveillance definition of VAP, as the NHSN definition does not require a 48-hour period of intubation and ventilation before pneumonia can be considered ventilator-associated.

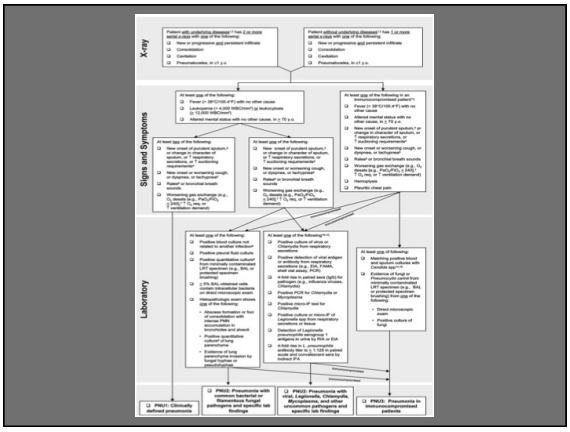
VAP Definition III

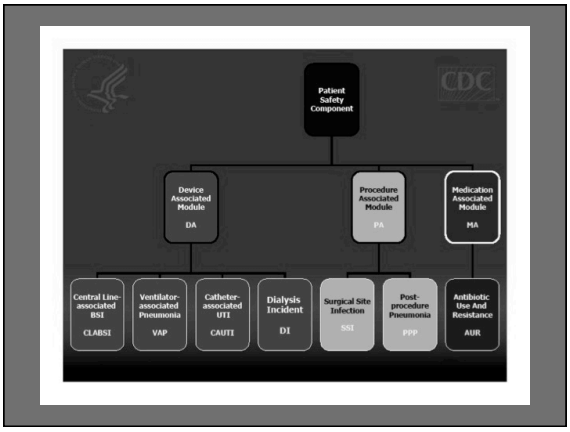
Pneumonia is identified by using a combination of radiologic, clinical and laboratory criteria. Patients with mechanically assisted ventilation have a high risk of developing nosocomial pneumonia. Patients with mechanically assisted ventilation have a high risk of developing nosocomial pneumonia.

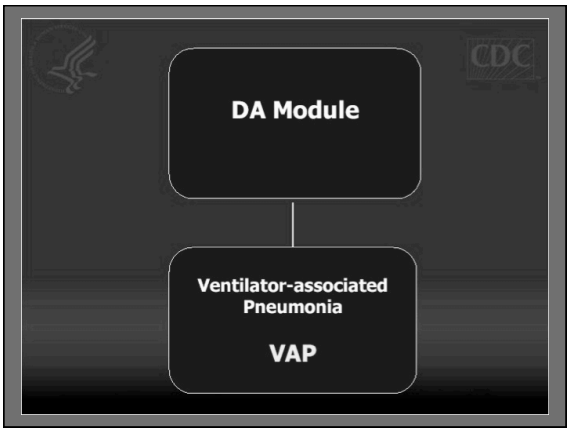
The CDC indicates VAP should be reported to NHSN

NHSN

NHSN definitions utilize three specific types of pneumonia: clinically defined pneumonia (PNU1), pneumonia with specific laboratory findings (PNU2), and pneumonia in immunocompromised patients (PNU3).







VAP Definition IV

***Ventilator associated pneumonia (VAP)**: Patients who need mechanical help to breathe have a high risk of developing hospital-acquired pneumonia. Reporting for VAP will be phased in when a standardized definition is developed. A standardized definition will make sure that hospitals are reporting the exact same event and will allow comparison between hospitals.*

South Carolina Department of Health and Environmental Control

VAP Definition V

Canadian HAP/VAP Guidelines 2008: "Infiltrating" the Data and "Consolidating" the Evidence

Gabriel Loh BSc(Pharm), ACPR, PharmD Clinical Pharmacy Specialist - Critical Care Vancouver General Hospital – VCH

Hospital-acquired pneumonia (HAP)
- Not incubating at hospital admission
- Presentation ≥ 48 hours post-admission
- "Early-onset" within 96 hours of admission
- "Late-onset" > 96 hours from admission
- Ventilator-associated pneumonia (VAP)
- Subset of HAP
- Mechanically ventilated ≥ 48 hours at time of diagnosis

Am J Respir Crit Care Med 2005; 171:388-416

Infection and Immunity

HAP, whether or not associated with mechanical ventilation, is generally a secondary endogenous infection. Although exogenous sources of infectious microorganisms exist, it is typically the patient's own colonizing flora that is implicated in infection.

In the healthy individual, the lower respiratory tract is a sterile site and the body possesses many defense mechanisms to maintain that state. Mechanical barriers, humoral and cell-mediated immunity, and phagocyte activity act to defend against bacterial invasion of lung tissue. Human saliva contains components that demonstrate antimicrobial properties and helps to regulate the composition of oral flora.

Infection and Immunity

Factors that may interfere with the host's defenses and predispose to respiratory infection include alterations in level of consciousness, cigarette smoke, alcohol intake, viral infections, sepsis, endotracheal tubes, nasogastric tubes, respiratory therapy devices, hypoxemia, acidosis, toxic inhalations, pulmonary edema, uremia, malnutrition, immunosuppressive agents, and mechanical obstruction. Inadequate salivary flow in intubated patients causes xerostomia, which may contribute to mucositis and colonization of the oropharynx with Gram-negative bacteria

Infection and Immunity

Advanced age predisposes the individual to development of pneumonia due to a less efficient cough reflex and changes in humoral immunity and cell-mediated immune function. The patient who is immunosuppressed due to disease state or treatment modality is also at increased risk for development of infection.

The intubated patient is often a critically ill individual with many risk factors that contribute to the development of pneumonia. Risk factors for VAP can be classified as modifiable or nonmodifiable, as well as patient-related and treatment-related.

Early- and Late-Onset

VAP is divided into early- and late-onset disease. Early-onset VAP occurs during the first 4 days of the patient's admission and is often caused by *Streptococcus pneumonia, Haemophilus influenza, or Moraxella catarrhalis. By comparison,* late-onset VAP occurs beyond 4 days after admission and is more commonly caused by *Pseudomonas aeruginosa, Acinetobacter or Enterobacter spp., or methicillin-resistant Staphylococcus aureus (MRSA). Many of the organisms* associated with late-onset VAP are resistant to multiple antibiotics or have MDR strains. *Staphylococcus aureus is isolated* in 20% to 40% of cases and is especially common in persons taking drugs by injection; in patients with neurological

Early- and Late-Onset

disease, thermal injury, or wound infection; and in patients who have received prior antibiotic therapy or have had a prolonged stay in the ICU. Compared with patients with VAP caused by methicillin-susceptible *Staphylococcus aureus* (MSSA), those in whom the causative organism is MRSA are often older and are significantly more likely to have had previous chronic lung disease, antibiotic therapy, steroid therapy, and greater than 6 days of mechanical ventilation.

Microbiology

The following organisms were identified as causing VAP (in order of most to least frequent with percentage of isolates in parentheses):

- *Staphylococcus aureus (24.4%)*
- *Pseudomonas aeruginosa (16.3%)*
- *Enterobacter spp. (8.4%)*
- *Acinetobacter baumannii (8.4%)*
- *Klebsiella pneumonia (7.5%)*
- *Escherichia coli (4.6%)*
- *Candida spp. (2.7%)*
- *Klebsiella oxytoca (2.2%)*
- Coagulase-negative *Staphylococcus (1.3%*

Microorganisms Associated with VAP

Early-Onset VAP (within first 4 days of admission)	Late-Onset VAP (after day 4)	CDC NHSN 2006–2007 Summary Data
Streptococcus pneumonia	*Pseudomonas aeruginosa*	*Staphylococcus aureus* (24.4%)
Haemophilus influenza	*Acinetobacter* spp.	*Pseudomonas aeruginosa* (16.3%)
Moraxella catarrhalis	*Enterobacter* spp.	*Enterobacter* spp. (8.4%)
	Methicillin-resistant *Staphylococcus aureus*	*Acinetobacter baumannii* (8.4%)
		Klebsiella pneumonia (7.5%)
		Escherichia coli (4.6%)
		Candida spp. (2.7%)
		Klebsiella oxytoca (2.2%)
		Coagulase-negative *Staphylococcus* (1.3%)
		Other (23.1%)

Summary of Epi & Pathogenic Points

- The incidence of VAP is 3- to 10-fold greater than pneumonia in nonventilated patients.
- VAP occurs in 8% to 28% of patients undergoing mechanical ventilation.
- In the healthy individual, the lower respiratory tract is a sterile body site.
- The body possesses several defense mechanisms to prevent contamination of the lungs.
- Disease processes, treatment modalities and personal habits or practices (i.e., cigarette smoke, alcohol intake) can impair the body's natural defense mechanisms, predisposing the individual to lower respiratory infection.

Summary of Epi & Pathogenic Points

- Mechanical ventilation is the primary risk factor for development of VAP for several reasons:
  - The endotracheal tube itself acts as a conduit from the upper respiratory tract to the lower respiratory tract.
  - Secretions collect on and around the endotracheal cuff; leakage of this fluid is the primary mechanism of infection of the lower respiratory tract.
  - Sedation of patients who are mechanically ventilated inhibits the natural ability to clear secretions.
  - Patients undergoing mechanical ventilation are frequently fed via the nasogastric route, providing a ventilation. providing a source of fluid for aspiration and micro-aspiration

Summary of Epi & Pathogenic Points

- Critically ill patients, especially those who are unstable with regard to neurologic or cardiac status, are often maintained in a supine position.
- Activity is frequently limited during the period of mechanical ventilation.
- VAP risk is greatest early on in ventilation, and diminishes over time.
- VAP is frequently bacteriological in origin, especially in the immunocompromised patient.

Colonization of the oropharynx and dental surfaces act as a reservoir of bacteria that ultimately gain access to the lower respiratory tract in patients undergoing mechanical ventilation.

FAQ #1

If the patient is intubated pre-admission, how should we determine the VAP?

If the patient was symptom-free at the time of the intubation by the paramedic or emergency department and meets the NHSN criteria/algorithm for VAP, it is a positive device-associated pneumonia. However, if the patient was intubated and received care at another hospital and subsequently transferred to your facility, then you need to apply the 48-hour rule. Only pneumonias appearing 48 hours post-admission would be considered a VAP.

FAQ #2 - #4

Question II: If a VAP occurs within 48 hours of intubation, is it considered hospital-acquired?
Yes, the development of a VAP can occur within 48 hours of intubation.
Question III: What is the minimum time frame?
There is no minimum period of time that the ventilator must be in place in order for the pneumonia to be ventilator-associated except for the transferred patient in example in Question I.
Question IV: Do we call it a VAP if the patient aspirated on intubation?
If the patient was symptom-free and had obvious aspiration at the time of the intubation, it is a hospital-associated event. If the patient met VAP criteria, the answer is yes.

FAQ #5 - #6

Question V: What is the definition of a VAP?
It is a pneumonia that occurs in a patient who was intubated ***and ventilated at the time of, or within 48 hours*** before, the onset of pneumonia.
Question VI: I rarely have a VAP defined as a PNU2 or PNU3. What am I doing wrong?
You are not doing anything wrong. In general, the majority of VAPs identified through surveillance fall into PNU1. This is because most VAPs are clinically diagnosed without specific lab findings to confirm the exact etiology that would place them into the PNU2 category.

FAQ #7

Question VII: Why do we use PNU1, PNU2, and PNU3?
PNU1 is the domain where all "clinically" defined pneumonias are tracked; clinically defined meaning the use of chest x-rays along with the patient's signs and symptoms. PNU2 tracks the pneumonias with specific lab confirmation (positive blood or pleural cultures, quantitative cultures, polymerase chain reaction, antibodies, etc.) and PNU3 tracks the pneumonias in immunocompromised patients.

FAQ #8

Question VIII: Is it correct that the first step is a chest x-ray finding?
Correct. You are looking for a new or progressive and persistent infiltrate, consolidation, cavitation, or pneumatoceles. The other clarification comes with determining if the patient is with or without underlying disease. If the patient does not have underlying disease, one or more serial x-rays with one of the findings is enough. If the patient does have underlying disease, two or more serial x-rays with findings are necessary.
In patients with pulmonary or cardiac disease, the diagnosis of pneumonia may be difficult. Again, in these difficult cases with underlying disease, serial chest x-rays must be examined to help separate infectious from noninfectious causes (e.g., pulmonary edema).

VAP Risk Assessment

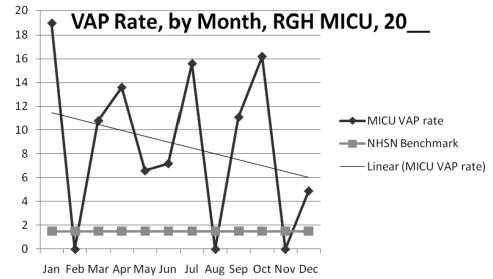
VAP Risk Assessment

1. Does the organization routinely collect data on process measures related to VAP? Process measures may include: • *Hand hygiene compliance* • *Sedation interruption* • *Assessment of readiness to wean* • *Maintenance of semirecumbent positioning* • *Oral care*	Yes	No
2. If so, do the results of these data demonstrate compliance to recommended practices?	Yes	No
3. Are results of the measures reported to senior leadership, nursing leadership, and care providers?	Yes	No
4. Are there written policies, protocols, or pathways that describe the recommended practices for prevention of VAP?	Yes	No

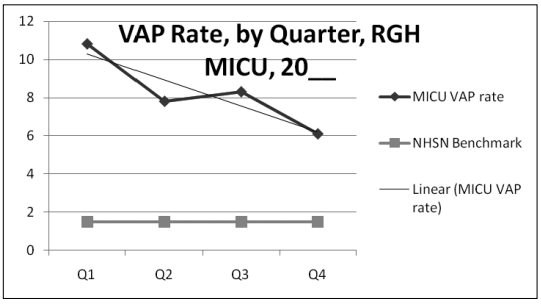
Surveillance

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
VAP cases	2	0	1	1	2	1	1	0	1	2	0	1
Vent days	105	78	92	73	300	139	64	85	90	123	167	201
VAP rate	19.0	0	10.8	13.6	6.6	7.2	15.6	0	11.1	16.2	0	4.9
Quarterly VAP rate	10.9			7.8			8.4			6.1		

Surveillance



Surveillance

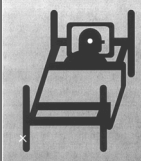


Prevention Strategies

- reduction of bacteria colonization
- the endotracheal tube
- role of contamination
- decreasing the duration of intubation
- positioning
- nutrition
- mobility
- technology
- gastric juices
- sedation level
- oral hygiene

Bundle

Head of bed elevated at least 30 degrees at all times



If unable to bend at the hip, use reverse Trendelenburg

University of Rochester Medical Center Strong Health

700 bed tertiary care medical center. Strong Health is a Trauma Center, Transplant Center (bone marrow, kidney, liver & heart). 4 adult ICU's: MICU (17 beds), SICU (14 beds), Burn/Trauma (17 beds), and Cardiovascular ICU (14 beds)

arry Evans, RN, MSN, Adult Critical Care Project Manager

VENTILATOR BUNDLE

- Elevate HOB 30 degrees unless contraindicated
- Sedation Vacation
  - Turn off sedation until patient is able to follow commands or is fully awake.
- DVT Prophylaxis
- PUD Prophylaxis
- Daily assessment for readiness to wean
- Structured Oral Care and Mobility were added as adjunct therapies to enhance effectiveness of bundle

IHI.org 2003, Ricart, Lorente, Diaz et al. 2003

Our Ventilator Bundle Challenges

- Resistance to practice change
  - Physicians
    - Lack of buy-in
    - Daily Goal Sheets time consuming
    - Individual practice preferences
    - Skepticism about results of research and evidence provided to support the initiative
  - Staff
    - Need to learn new protocols
    - Concern about compromised patient safety with sedation vacation
    - Practice boundary issues between Respiratory Therapy and Nursing when RT- Driven Weaning Protocol was implemented

Keys to Success, Barriers and Lessons Learned

- Involve key front line staff
- Ongoing education….why are we doing this?
- Participation by senior leaders
- Medical Director and Nurse Manager must be fully supportive
- Administrative assistance
- Resistance to change
- Perceived increased workload
- Another QI project which will go away

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Oral Hygiene

Mouth Care Assessment and Documentation

Patient Name:
Medical Record Number:
Date:

Assessment	Scale 1–4	Comments
Teeth	Clean **1** Plaque/debris in localized area **2** Plaque/debris along gum line **3** Ill-fitting dentures/caries **4**	
Tongue	Pink and moist **1** Coated **2** Shiny/red **3** Blistered/cracked **4**	
Lips	Smooth/moist **1** Dry/cracked **2** Bleeding **3** Ulcerated **4**	
Mucous membranes	Pink and moist **1** Reddened/coated **2** White areas **3** Ulcerated/bleeding **4**	
Total score		

8 or below: Mouth care every 4 hours
9 and above: Mouth care every 2 hours

Oral Hygiene

Activity	Monday Date ____	Tuesday Date ____	Wednesday Date ____	Thursday Date ____	Friday Date ____	Saturday Date ____	Sunday Date ____
Brush teeth Q 12	Initials 0800____ 2000____	Initials 0800____ 2000____	Initials 0800____ 2000____	Initials 0800____ 2000____	Initials 0800____ 2000____	Initials 0800____ 2000____	Initials 0800____ 2000____
Provide oral care every 2 to 4 hours with antiseptic Apply mouth moisturizer to oral mucosa and lips	Time and initials	Time and initials	Time and initials	Time and initials	Time and initials	Time and initials	Time and initials
Suction orally as necessary							
Comments and daily assessment score							

Figure 7-3. Mouth care assessment and documentation form. (From Linda R. Greene, RN, MPS, CIC, Rochester General Health System, Rochester, NY.)

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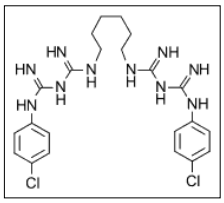
Oral Hygiene - Chlorlexidine



Key Prevention Strategies

- pay strict attention to hand hygiene and basic infection prevention strategies
- avoid unnecessary antibiotics
- perform routine antiseptic mouth care
- prevent aspiration of contaminated secretions: maintain semirecumbent positioning
- shorten duration of mechanical ventilation: apply weaning protocols and optimal use of sedation
- avoid routine ventilator changes
- remove condensate from ventilatory circuits. Keep the ventilatory circuit closed during condensate removal
- disinfect and store respiratory therapy equipment properly
- minimize gastric distensiontracheal tube

Key Prevention Strategies

- educate healthcare personnel who care for patients undergoing ventilation about VAP
- perform direct observation of compliance with VAP-specific process measures
- conduct regular surveillance for outcomes measures. reduction of bacteria colonization the endotracheal tube

Target: ZERO

Prevention, Not Control

The Next Few Teleclasses

9 Feb. 10	(British Teleclass) Post-Discharge SSI Surveillance Made Easy Speaker: Dr. Judith Tanner, Dr Montfort University
11 Feb. 10	International Trends in Sharpes Injury Prevention Speaker: Dr. Terry Grimmond, Grimmond & Associates
17 Feb. 10	(South Pacific Teleclass) Influenza H1N1 – The Southern Hemisphere Experience Speaker: Dr. Lance Jennings, Christchurch School of Medicine
18 Feb. 10	Stopping URI's and Flu in the Family Speaker: Dr. Elaine Larson, Columbia University
25 Feb. 10	Influenza in the Hospital – Who Gets it From Whom Speaker: Dr. Alison McGeer, Mount Sinai Hospital, Toronto
4 Mar. 10	(Novice) An Introduction to Infection Prevention and Control in Healthcare Speaker: Gail Bennett, ICP Associates Inc.
11 Mar. 10	(Novice) MRSA Prevention Basics Speaker: Dr. Bill Jarvis, Jason & Jarvis Associates

www.webbertraining.com.schedulep1.php