

# Pneumonia and Ventilator-Associated Pneumonia Prevention

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Basics of Infection Prevention  
Healthcare-Associated Infections Program  
Center for Health Care Quality  
California Department of Public Health



# Objectives

- Review the epidemiology and pathogenesis of pneumonia (PNEU) and ventilator-associated pneumonia (VAP)
- Discuss evidence-based prevention practices for PNEU, ventilator associated events (VAE), and VAP
- Describe adherence monitoring of prevention practices

# Hospital-Associated Pneumonia

- Account for 15% of all hospital HAI
  - 25% of medical ICU HAI
- Among patients with HAI pneumonia, mortality as high as 33%

[CDC/HICPAC Guidelines for Preventing Health-Care Associated Pneumonia, 2003](https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm)

(<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm>)

# Common Pneumonia Pathogens

- *Pseudomonas aeruginosa*
- *Proteus* spp
- *Acinetobacter* spp
- *Staphylococcus aureus*

CDC/HICPAC Guidelines for Preventing Health-Care Associated Pneumonia, 2003  
<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm>

# Pathogenesis of HAI Pneumonia

**Bacteria may invade the lower respiratory tract by:**

- Aspiration
  - Persons with abnormal swallowing
    - Depressed consciousness
    - Ventilator patients
    - Postoperative patients
- Inhalation of aerosols containing bacteria
- Hematogenous spread from a distant body site

# Risk Factors for HAI Pneumonia

1. Factors enhancing colonization of oropharynx or stomach
    - Antimicrobials
    - Admission to ICU
    - Underlying chronic lung disease
  2. Patients at risk for aspiration
    - Initial or repeat endotracheal intubation
    - Nasogastric tube insertion
    - Supine position, coma, post-surgery, immobilization
  3. Prolonged mechanical ventilation
  4. Host factor extremes
    - Age, malnutrition, severe underlying conditions
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# Pneumonia and Ventilator-Associated Pneumonia Prevention – What works?

Best sources for **evidence-based pneumonia prevention practice** recommendations

- **CDC/HICPAC** Pneumonia Prevention Guideline, **2003**
- **SHEA/IDSA** Strategies to Prevent Healthcare Associated Pneumonia in Acute Care Hospitals, **2014**

# Preventing Pneumonia

- Educate staff on pneumonia prevention
- Provide pneumococcal vaccination as recommended by the CDC (for healthy adults a series of 2 given 1 year apart  $\geq$  65 years of age)
- Provide annual influenza vaccination to patients and HCP
- Prevent aspiration
- Ensure regular oral care with an antiseptic agent
- Encourage post operative coughing, deep breathing, and early ambulation

[CDC/HICPAC Guidelines for Preventing Health-Care Associated Pneumonia, 2003](https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm)

(<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm>)

[CDC Immunization schedule for adults >19 years](https://www.cdc.gov/vaccines/schedules/easy-to-read/adult.html#schedule)

(<https://www.cdc.gov/vaccines/schedules/easy-to-read/adult.html#schedule>)



## Preventing Pneumonia - 2

- Clean respiratory equipment and devices before sterilization or disinfection
  - Clean shortly after use
  - Ensure appropriate rinsing, drying and packaging

[CDC/HICPAC Guidelines for Preventing Health-Care Associated Pneumonia, 2003](https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm)

(<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm>)

## Preventing Pneumonia - 3

- Use standard precautions – consistently!
  - Hand hygiene before and after patient care
  - Wear gloves when handling respiratory secretions
  - Change gloves and perform hand hygiene between patients and after touching contaminated equipment

[CDC/HICPAC Guidelines for Preventing Health-Care Associated Pneumonia, 2003](https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm)

(<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm>)

# Ventilator-Associated Pneumonia (VAP)

- Up to 46% of patients with VAP die
  - Varies with patient population and organism type
  - Highest mortality occurs in patients with severe illness and infection with non-fermentative gram-negative bacilli (e.g., *Acinetobacter* or *Burkholderia* species)
- Increases ICU length of stay >6 days
  - \$40,000 estimated cost

[Institute for Healthcare Improvement \(IHI\)\(2012\)](http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventVAP.aspx)

(<http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventVAP.aspx>)

# Etiology of VAP

## Early onset

- Occurs in first four days of hospitalization
- More likely associated with non-multidrug-resistant organisms such as *E. coli*, *Klebsiella spp.*, *Proteus spp.*, *S. pneumoniae*, *H. influenzae*, and *S. aureus*

## Late onset

- Occurs five or more days into hospitalization
- More often associated with gram-negative bacilli, multidrug resistant *Pseudomonas aeruginosa*, MRSA, *Acinetobacter spp*

[Guideline for the Prevention of Healthcare Associated Pneumonia, 2003](https://www.cdc.gov/infectioncontrol/pdf/guidelines/healthcare-associated-pneumonia-H.pdf)

<https://www.cdc.gov/infectioncontrol/pdf/guidelines/healthcare-associated-pneumonia-H.pdf>

## Common VAP Pathogens

- *Staphylococcus aureus* - 25%
- *Pseudomonas aeruginosa* - 16%
- *Klebsiella pneumoniae/oxy* - 10%
- *Enterobacter* spp. - 8%
- *Acinetobacter* spp. - 6%



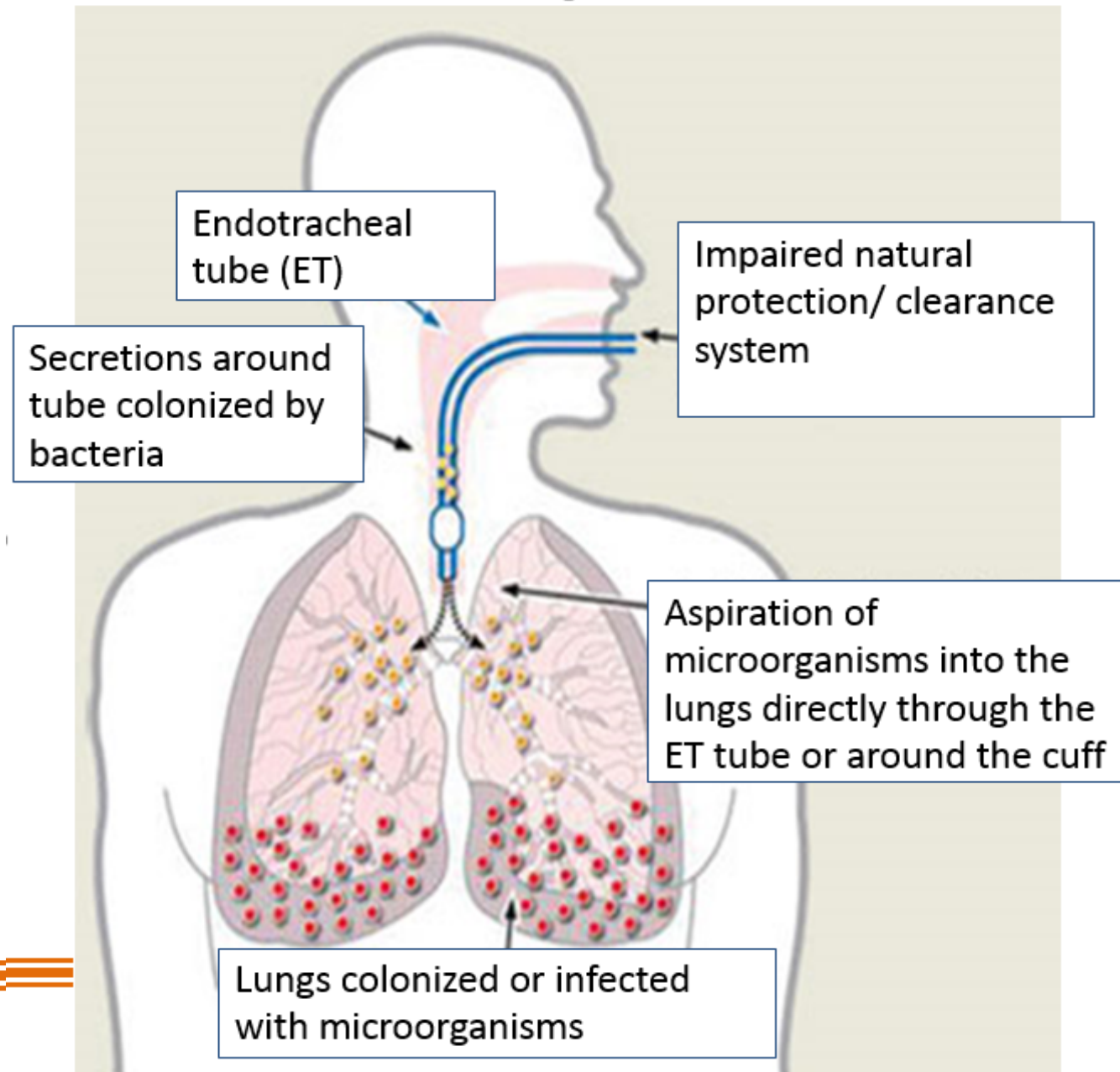
*Pseudomonas aeruginosa*

[NHSN Antimicrobial Resistance Report: Distribution of all Pathogens Reported by HAI Type, Appendix to Table 4, 2011-2014](https://www.cdc.gov/nhsn/xls/reportdatatables/2014-appendix-pathogens.xlsx)

(<https://www.cdc.gov/nhsn/xls/reportdatatables/2014-appendix-pathogens.xlsx>)

# VAP

## Pathogenesis



# VAP Prevention Challenges

Pre-existing conditions (**non**-modifiable risk factors):

- Head trauma
- Coma
- Nutritional deficiencies
- Immunocompromised
- Multi organ system failure
- Acidosis
- History of smoking or pulmonary disease

# VAP Prevention: Modifiable Risk Factors

1. Prevent aspiration of secretions
2. Reduce duration of ventilation
3. Reduce colonization of airway and digestive tract
4. Prevent exposure to contaminated equip



# Prevent Aspiration of Secretions

- Maintain elevation of head of bed (HOB) 30-45 degrees
- Avoid gastric over-distention
- Avoid unplanned extubation and re-intubation
- Use cuffed endotracheal tube with in-line or subglottic suctioning
- Encourage early mobilization of patients with physical/occupational therapy

# Reduce Duration of Ventilation

- Conduct “sedation vacations”
- Assess readiness to wean from vent daily
- Conduct spontaneous breathing trials

**May not be feasible for patients on long term ventilator support**

# Reduce Colonization of Airway and Digestive Tract

- Use cuffed Endotracheal Tube (ETT) with inline or subglottic suctioning
  - Minimizes secretions above cuff; prevents contamination of lower airway
- Avoid acid suppressive therapy for patients not at high risk for stress ulcer or stress gastritis
  - Increases colonization of the digestive tract

# Reduce Colonization of Airway and Digestive Tract - 2

- Perform regular oral care with an antiseptic agent
- Reduce the opportunities to introduce pathogens into the airway
  - Perform good hand hygiene
  - Use gloves for contact with respiratory secretions or contaminated objects; follow with hand hygiene
  - Educate staff to avoid contaminating the ETT from patient's mouth, HCP hands, introducing pathogens from patient's other body sites or the environment

# Prevent Exposure to Contaminated Equipment

- Use sterile water to rinse reusable respiratory equipment
- Remove condensate from ventilatory circuits
- Change ventilatory circuit only when malfunctioning or visibly soiled
- Store and disinfect respiratory equipment effectively

# Hospital Role in Pneumonia Prevention

- Ensure policies reflect current evidence based practices
  - CDC guidelines
- Ensure staff competency upon hire and at least annually
  - New hire orientation
  - Annual skills fair
  - Return demonstration to ensure competency
- Establish an adherence monitoring program for measuring prevention care practices
  - Use tools to measure adherence
- Provide feedback to frontline staff and leaders
  - Present adherence results to each unit

# Measure Adherence to VAP Prevention Practices

- California HAI public reporting and prevention laws do not require reporting VAP/VAE to CDPH
- Reporting laws do require hospitals to implement VAP prevention guidelines and process measures (HSC 1288.9)

# Adherence Monitoring Tool - VAP Prevention

Ventilator Pneumonia Prevention Observations	Pt 1		Pt 2		Adherence by Task	
					#Yes	# Obs
Head of bed 30-45 degrees	Yes	No	Yes	No		
Sedation vacation documented	Yes	No	Yes	No		
Readiness to wean documented	Yes	No	Yes	No		
Oral care with an antiseptic agent is performed regularly (per policy)	Yes	No	Yes	No		
Hand hygiene performed before providing care	Yes	No	Yes	No		
Sterile water used to rinse reusable respiratory equipment	Yes	No	Yes	No		
Condensate in ventilatory circuit is removed	Yes	No	Yes	No		
Ventilatory circuit is changed only when malfunctioning or soiled	Yes	No	Yes	No		
# Yes _____ # Observed _____	#Yes/#Observed = % Adherence				_____ %	



# Legionnaires Disease

- Caused by Gram negative aerobic bacilli, *Legionella pneumophila*
- More than 60 species
  - Most disease *Legionella pneumophila* serogroup 1
- Found naturally in freshwater and man made environments, including drinking water
- Transmitted by
  - Inhalation of contaminated aerosols
  - Aspiration or ingested of contaminated water
  - **Not spread from person to person**

[CDC Legionnaires' Disease](https://www.cdc.gov/vitalsigns/legionella/)

(<https://www.cdc.gov/vitalsigns/legionella/>)

## *Legionella* Sources

- Legionnaires' disease outbreaks often associated with **large or complex water systems** such as those found in
  - Hospitals
  - Long-term care facilities
  - Hotels
  - Cruise ships
- The most likely sources of infection
  - Water used for showering (potable water)
  - Cooling towers (parts of large air conditioning systems)
  - Decorative fountains
  - Hot tubs

[CDC Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings](http://www.cdc.gov/legionella/downloads/toolkit.pdf) (PDF)

(<http://www.cdc.gov/legionella/downloads/toolkit.pdf>)

## Suspect Legionnaires Disease

- Patient failed outpatient antibiotic treatment for community-acquired pneumonia
- Severe pneumonia
- Immunocompromised patient with pneumonia
- Recent traveled away from their home within 10 days before the onset of illness
- Patient with pneumonia in the setting of a Legionnaires' disease outbreak
- Patient at risk for Legionnaires' disease who acquires healthcare-associated pneumonia  $\geq$  48 hours after admission

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[CDC Legionella Diagnosis, Treatment and Prevention](https://www.cdc.gov/legionella/clinicians/diagnostic-testing.html)

([cdc.gov/legionella/clinicians/diagnostic-testing.html](https://www.cdc.gov/legionella/clinicians/diagnostic-testing.html))

## Preventing Pneumonia: The MOST Important Things

### *Prevent Pneumonia and Ventilator Associated Events*

- Maintain HOB 30-45 degrees
- Avoid gastric distention
- Encourage early mobilization
- Conduct “sedation vacations”
- Assess readiness to wean
- Use cuffed ETT with inline suctioning
- Avoid acid suppressive therapy if possible
- Perform regular oral care
- Perform hand hygiene
- Prevent exposure to contaminated equipment

# Pneumonia Prevention Summary

- HAI pneumonia common, especially among ventilated patients, but many are preventable
- Focus on pneumonia prevention care practices
- Regularly monitor adherence of prevention care practices and provide feedback to frontline staff

# References and Resources

- Coffin, S, et al. Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals. *Infect Control Hosp Epidemiol* ,29:S31-S40, 2008
- Greene LR, Sposato K, Farber MR, Fulton TM, Garcia RA. Guide to the Elimination of Ventilator – Associated Pneumonia, APIC, 2009
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- [Institute for Healthcare Improvement \(IHI\)](http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventVAP.aspx)  
(<http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventVAP.aspx>)
- [NHSN Patient Safety Module: Chapter 6 \(PNEU/VAP\), 2019](http://www.cdc.gov/nhsn/PDFs/pscManual/6pscVAPcurrent.pdf) (PDF)  
<http://www.cdc.gov/nhsn/PDFs/pscManual/6pscVAPcurrent.pdf>
- [NHSN Patient Safety Module: Chapter 10\(VAE\), 2019](http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf) (PDF)  
[http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE\\_FINAL.pdf](http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf)
- [SHEA Compendium: Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals: 2014 Update](https://www.shea-online.org/index.php/practice-resources/priority-topics/compendium-of-strategies-to-prevent-hais)  
(<https://www.shea-online.org/index.php/practice-resources/priority-topics/compendium-of-strategies-to-prevent-hais>)

# Questions?

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