

# Pneumonia and Ventilator-Associated Pneumonia Surveillance

Last Updated 2017

---

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

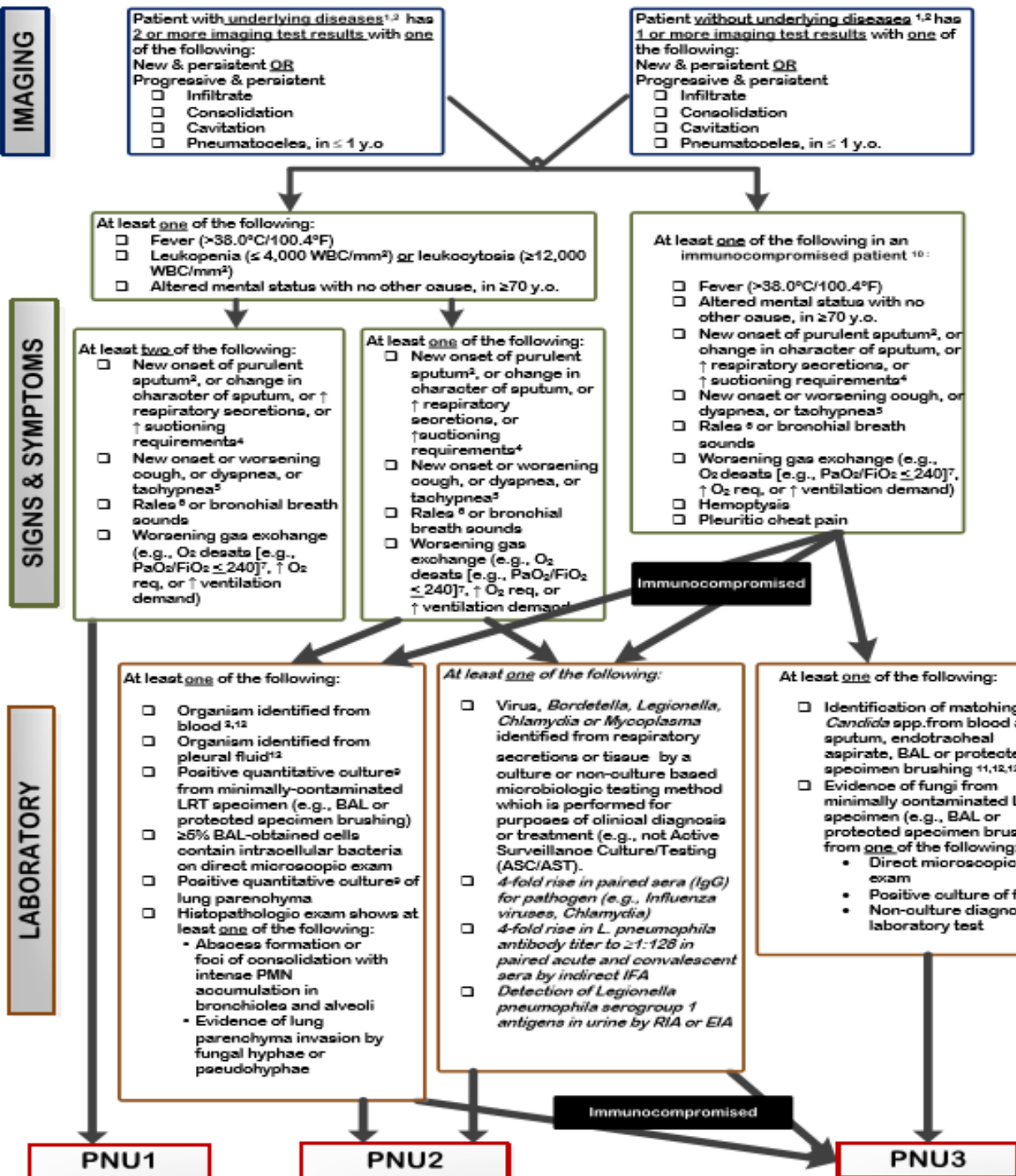


# Objectives

- Describe surveillance definitions for pneumonia (PNEU), ventilator associated events (VAE), and ventilator associated pneumonia (VAP)
- Demonstrate how to use the NHSN VAE Calculator
- Review importance of feedback of HAI results to staff

# Pneumonia (PNEU) Surveillance Definition

- PNEU definition used for non-ventilated patients
- Surveillance definition can be met by 3 different criteria using combinations of imaging, signs/ symptoms of infection, and laboratory results
  - Clinically defined pneumonia (PNU1)
  - Pneumonia with specific laboratory findings (PNU2)
  - Pneumonia in immuno-compromised patients (PNU3)
- Used frequently for CLABSI surveillance to determine if BSI is primary or secondary to pneumonia
  - Candida and other yeast are not considered causative pathogens of pneumonia



# Identifying Ventilator-Associated Events (VAE) and Pneumonia (VAP)

- Follow NHSN surveillance protocols
- Work with ICU and respiratory therapy staff to develop alerting process
- Monitor ventilated patient for
  - Positive cultures
  - Changes in WBC
  - Patient temperature chart/log
  - Pharmacy reports of antimicrobial use
  - Change in respiratory secretions



# Defining VAE and VAP

- Pneumonia definition is subjective and complex
- Surveillance definition algorithm detects a broad range of conditions/complications that occur in mechanically ventilated patients
- Ventilator-associated event (VAE) defines
  - Ventilator-associated conditions (VAC)
  - Infection-related ventilator-associated complications (IVAC)
  - Possible ventilator-associated pneumonia (PVAP)

NHSN Patient Safety Module: Chapter 10

# Applying VAE and Pneumonia Surveillance Definitions

- VAE definition is used for all ventilated patients in adult locations regardless of age (excludes high frequency ventilated and extracorporeal life support patients)
  - IVAC is an infection-related VAE
  - IVAC/PVAP is pneumonia that occurs in patients intubated and on mechanical ventilation
- VAP/PNEU definition is used for pediatric locations
  - Includes pediatric locations (e.g., PICU)
  - Excludes NICU

# VAE/VAP Surveillance Definition

- Patient must be ventilated >2 calendar days
- Patient must have  $\geq 3$  calendar days of stability or improvement of oxygenation followed by  $\geq 2$  calendar days of worsening oxygenation
- Earliest date of event for VAE is mechanical ventilation day 3 (first day of worsening oxygenation)
- First possible day that VAC criteria can be fulfilled is mechanical ventilation day 4
- For VAE surveillance, PEEP values between 0 - 5 cmH<sub>2</sub>O will be considered equivalent

NHSN Patient Safety Module: Chapter 10



# Ventilator Associated Event (VAE)

- Daily minimum PEEP and  $\text{FiO}_2$  values are defined as the lowest value set on the ventilator during a calendar day (and maintained for at least 1 hour)
  - If there is no value documented to have been maintained for at least 1 hour, the daily minimum value is the lowest value set on the ventilator during the calendar day
- VAE optional denominator – episodes of mechanical ventilation (EMV)
  - An episode of mechanical ventilation is a period of days during which the patient was mechanically ventilated for some portion of each consecutive day

## VAC Criteria

- A baseline period of stability or improvement on the ventilator, defined by  $\geq 2$  calendar days of stable or decreasing daily minimum  $\text{FiO}_2$  or PEEP
  - The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or  $\text{FiO}_2$
- AND**
- After the period of stability – At least 1 of the following 2 criteria sustained for  $\geq 2$  calendar days:
    - ☐ 1. Increase in daily minimum  $\text{FiO}_2$  of  $\geq 20$  points over the daily minimum  $\text{FiO}_2$  in the baseline period
    - ☐ 2. Increase in daily minimum PEEP of  $\geq 3$   $\text{cmH}_2\text{O}$

# IVAC Criteria

- Meets VAE criteria for VAC

AND

- On or after calendar day 3 on ventilator and within 2 calendar days before or after onset worsening oxygenation:
- BOTH of the following 2 criteria are met:
  - ☐ 1. Temp  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$   
OR  
WBC  $>12,000$  cells/mm<sup>3</sup> or  $<4,000$  cells/mm<sup>3</sup>
  - ☐ 2. A new antimicrobial agent(s) is started, and is continued for  $>4$  calendar days

NHSN Patient Safety Module: Chapter 10

## PVAP Criteria

- Meets VAE criteria for IVAC
- AND**
- On or after calendar day 3 on ventilator and within 2 calendar days before or after onset of worsening oxygenation:  
**One** of the following three criteria is met:
    - ☐ 1. Positive culture (see list) without requirement for purulent respiratory secretions\*
    - ☐ 2. Purulent respiratory secretions plus specified positive respiratory culture\*
    - ☐ 3. Positive pleural culture, lung histopathology, or diagnostic test for Legionella, or specified virus\*

\*Consult VAE protocol for organism exclusions

NHSN Patient Safety Module: Chapter 10



# NHSN VAE Calculator

## Version 4.0

1. Enter ventilator data, follow instructions

**Ventilator Associated Condition (VAC)** , based on FIO<sub>2</sub> values occurred on 9/10/2017

Click on the **Go to IVAC** button to move to the next part of the protocol

Calculate VAC

Start Over

Go to IVAC

Explain...

MV Day	Date	Min. PEEP (cmH <sub>2</sub> O)	Min. FiO <sub>2</sub> (20 - 100)	VAE
1	9/7/2017	5	80	
2	9/8/2017	5	80	
3	9/9/2017	5	80	
4	9/10/2017	5	100	± VAC
5	9/11/2017	8	100	
6	9/12/2017	8	100	
7	9/13/2017	8	80	
8	9/14/2017			
9	9/15/2017			

Meets VAC Criteria. "Go to IVAC"

Legend: † - VAE Window ± - VAE Date ‡ - Qualifying Antimicrobial Day (QAD)

NHSN VAE Calculator Version 4.0

<https://www.cdc.gov/nhsn/vae-calculator/index.html>

2. Enter temperature, WBC count, antibiotics
3. Click "Calculate IVAC"

An IVAC was found for this patient. Click on the "Go To PVAP" button to go to the next part of the definition or click on the "Explain..." button for an explanation of how this determination was made.

Start Over Calculate IVAC Explain... Go to PVAP

MV Day	Date	Hide... (cmH <sub>2</sub> O)	Min. PEEP (cmH <sub>2</sub> O)	Hide... (20 - 100)	Min. FiO <sub>2</sub>	VAE	T<36° or T>38°	WBC ≤ 4,000 or WBC ≥ 12,000 cells/mm <sup>3</sup>	Choose a Drug: AMPICILLIN	QAD
1	9/7/2017	5		80						
2	9/8/2017	5		80						
† 3	9/9/2017	5		80			✓	✓	✓	† yes
† 4	9/10/2017	5		100		‡ IVAC	✓	✓	✓	† yes
† 5	9/11/2017	8		100			✓	✓	✓	† yes
† 6	9/12/2017	8		100			✓	✓	✓	† yes
7	9/13/2017	8		80						
8	9/14/2017									
9	9/15/2017									

Legend: † - VAE Window ‡ - VAE Date †† - Qualifying Antimicrobial Day (QAD)

Meets IVAC Criteria. "Go to PVAP"

# NHSN PVAP

1. Check off criteria in table, then "Calculate PVAP"

The event on 9/10/2017 conforms to a Possible Ventilator-Associated Pneumonia (PVAP) definition. For a discussion of why, click on the Explain button.

**PVAP Determination**

For the IVAC on 9/10/2017, did the patient have documentation of any of the following findings during the VAE Window: 9/9/2017 to 9/12/2017.

Question	Yes
<p>Criterion 1. Positive culture of one of the following (without requirement for purulent respiratory secretions):</p> <ul style="list-style-type: none"> <li>• Endotracheal aspirate <math>\geq 10^5</math> cfu/ml*</li> <li>• Bronchoalveolar lavage <math>\geq 10^4</math> cfu/ml*</li> <li>• Lung tissue <math>\geq 10^4</math> cfu/ml*</li> <li>• Protected specimen brush <math>\geq 10^3</math> cfu/ml*</li> </ul> <p>*or corresponding semi-quantitative result</p>	<input type="checkbox"/>
<p>Criterion 2. Positive culture of one of the following (qualitative or quantitative/semi-quantitative culture without sufficient growth to meet Criterion 1):</p> <ul style="list-style-type: none"> <li>• Sputum</li> <li>• Endotracheal aspirate</li> <li>• Bronchoalveolar lavage</li> <li>• Lung tissue</li> <li>• Protected specimen brush</li> </ul> <p>AND</p> <p>Evidence of purulent respiratory secretions (defined as secretions from lungs, bronchi or trachea that contain <math>\geq 25</math> neutrophils and <math>\leq 10</math> squamous epithelial cells).</p>	<input type="checkbox"/>
<p>Criterion 3. One of the following positive tests (as outlined in the protocol):</p> <ul style="list-style-type: none"> <li>• Pleural fluid culture</li> <li>• Lung histopathology</li> <li>• Diagnostic test for Legionella species</li> <li>• Diagnostic test for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus or coronavirus.</li> </ul>	<input type="checkbox"/>

**Calculate PVAP**

## 2. Result:

- After calculating PVAP, a pop up will appear verifying the type of event.
- Select Explain for information on the criteria used.

Start Over

Explain...

Go to PVAP


☐ Criterion 1 is checked. Clicking "Yes" to any of the three criteria is sufficient to meet the definition of a Possible Ventilator-Associated Pneumonia (PVAP) for the event on 9/10/2017.

**OK**

(Hint: this box is movable by dragging with your mouse. If you move it to one side and leave it open, the explanation will automatically update itself as things change.)

# Report Monthly VAE Summary Data

**NHSN Home**  
Alerts  
Dashboard  
Reporting Plan ▶  
Patient ▶  
Event ▶  
**Procedure ▶**  
Summary Data ▶  
Import/Export  
Surveys ▶  
Analysis ▶  
Users ▶  
Facility ▶  
Group ▶  
Logout

**Denominators for Intensive Care Unit (ICU)**

Mandatory fields marked with \*

Facility ID \*: California General Hospital (ID 15633) ▼

Location Code \*:

Month \*:

Year \*:

**Add**  
Find  
Incomplete

Report

Total Patient Days:

Central Line Days:

Urinary Catheter Days:

Ventilator Days: 80

APRV Days:

Episodes of Mechanical Ventilation:

CAUTI: ☐

VAE: ☐

PedVAP: ☐

Custom Fields

- Enter monthly denominator data for each patient location
  - Patient days
  - Ventilator line days



# Enter VAE Event

- Add VAE Events as they occur
- Collect criteria meeting definition to enter into NHSN
- NHSN has a worksheet available for data collection
- Use VAE Calculator

NHSN Home

Alerts

Dashboard

Reporting Plan ▶

Patient ▶

Event ▶

Procedure ▶

Summary Data ▶

Import/Export

Surveys ▶

Analysis ▶

Users ▶

Facility ▶

Group ▶

Logout

Add Event

Mandatory fields marked with \*

Fields required for record completion marked with \*\*

Fields required when in Plan marked with >

Add

Find

Incomplete

Facility ID \*: California Ge

Patient ID \*:

Secondary ID:

Last Name:

Middle Name:

Gender \*:

Ethnicity:

Race: ☐ American ☐ Black or A ☐ White

Event Information

Event Type \*: VAE - Ventil

Post-procedure: N - No ▼

MDRO Infection Surveillance \*: No, this infection's pathogen/location are not in-plan for Infection Surv

Location \*: .ATA - BURN ICU ▼

Date Admitted to Facility >:  4

Risk Factors

Location of Mechanical Ventilation \* .ATA - BURN ICU ▼

Event Details

Specific Event >: VAC - Ventilator-Associated Condition ▼

Specify Criteria Used \*

STEP 1:VAC (≥ 1 Required)

☐ Daily min FIO<sub>2</sub> increase ≥ 0.20 (20 points) for ≥ 2 days†

† after 2+ days of stable or decreasing daily minimum values

Secondary Bloodstream Infection >: N - No ▼

NHSN Home

Alerts

Dashboard

Reporting Plan ▶

Patient ▶

Event ▶

Procedure ▶

Summary Data ▶

Import/Export

Surveys ▶


Analysis ▶

Users ▶

Facility ▶

Group ▶

Logout

 Analysis Reports

Expand All

Collapse All

Search

Device-Associated (DA) Module

Central Line-Associated BSI

Mucosal Barrier Injury CLABSI

Ventilator-Associated PNEU

Ventilator-Associated Events

Line Listing - All VAE

Frequency Table - All VAE

Bar Chart - All VAE

Pie Chart - All VAE

Rate Table (Ventilator Days) - VAE Data for IC

Run Chart (Ventilator Days) - VAE Data for ICU-Other/SCA/ONC

SIR SIR (Ventilator Days) - Acute Care Hospitals VAE Data

SIR SUR - (Ventilator Days) - Acute Care Hospitals Ventilator Device Use

SIR SIR (Ventilator Days) - Critical Access Hospitals VAE Data

SIR SUR (Ventilator Days) - Critical Access Hospitals Ventilator Device Use

SIR SIR (Ventilator Days) - Long Term Acute Care VAE Data

Generate Data Sets

Reports

Statistics Calculator

- Generate data set prior to creating a report
- Choose report according to need
  - SIR report- Your incidence compared to expected incidence
  - SUR report- Your ventilator usage compared to expected

# Feedback VAE Results

- Share VAE SIR and SUR progress results with
  - ICU staff
  - ICU Committee
  - Infection Control Committee
  - Leadership
- Analysis of your data helps identify areas for further education and prevention activities

# Pneumonia Surveillance Summary

- Surveillance for pneumonia and VAP challenging
- VAE definitions reduce variability
  - Used only in adult locations
- Consistent use of standard surveillance methods and PNEU/VAE/VAP definitions are essential for accurate case finding
- Analysis and feedback of VAE/VAP data is necessary to review progress in VAE/VAP reduction

# References for VAP Prevention and Bundles

- Institute for Healthcare Improvement (IHI)  
<http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventVAP.aspx>
- 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>

# References and Resources

- Coffin, S, et al. (2008). Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals. *Infect Control Hosp Epidemiol*, 29:S31-S40.
- Greene LR, Sposato K, Farber MR, Fulton TM, Garcia RA. (2009). Guide to the Elimination of Ventilator – Associated Pneumonia. Washington, D.C.: APIC.
- Greene LR, Sposato K, Farber MR, Fulton TM, Garcia RA. (2009) Guide to the Elimination of Ventilator – Associated Pneumonia, APIC.
- Hidron AI, et.al., (2008) *Infect Control Hosp Epidemiol*, 29:996-1011
- NHSN Patient Safety Module: Chapter 6 (PNEU/VAP)  
<http://www.cdc.gov/nhsn/PDFs/pscManual/6pscVAPcurrent.pdf>
- Chapter 10(VAE) [http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE\\_FINAL.pdf](http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf)

## Questions?

For more information,  
please contact any  
HAI Liaison IP Team member

Or email

[HAIProgram@cdph.ca.gov](mailto:HAIProgram@cdph.ca.gov)