Ventilator Associated Events
Background: Why we monitor


- The Guideline strongly recommends that surveillance be conducted for bacterial pneumonia in ICU patients who are mechanically ventilated to facilitate identification of trends and for inter-hospital comparisons.
Background: Impact of VAP

- VAP is the leading cause of death associated with healthcare-associated infections (IHI 2012).
- As many as 28% of all patients who received mechanical ventilation will develop VAP and the incidence increases with duration.
- Crude mortality is 20% - 60%.
- Patients who acquire VAP have significant longer durations of mechanical ventilation, length of ICU stay & hospital stays.
- VAP is associated with > $40,000 in mean hospital charges per patient.
Prevention of VAE - Implement evidence based guidelines

- Maintain elevation of head of bed (HOB) 30-45 degrees. Education family why this is needed.
- Avoid gastric over-distention (NG/OG tube)
- Regular antiseptic oral care (CHG)
- Avoid unplanned extubation & re-intubation
- Use cuffed ET tubes with inline or subglottic suctioning
- Maintain ET cuff pressure at greater than 20 cmH20
- Encourage early mobilization of patients with physical/occupational therapy.
- Conduct sedation vacations/spontaneous breathing trials
- Change ventilator circuit ONLY when malfunctioning or visibly soiled.
- Remove condensation from vent circuits
NHSN Lower Respiratory Event Surveillance

- VAE (Ventilator-associated Event) is the only in-plan option available for ventilated patients in adult locations
NHSN Lower Respiratory Event Surveillance

- VAP (Ventilator-associated Pneumonia) is the only in-plan option for ventilated patients in pediatric locations (pedVAP)
  - As of January 2014 in-plan neonatal VAP surveillance is no longer available for use
Definitions for VAE
Positive End-Expiratory Pressure (PEEP)

• “A technique used in respiratory therapy in which airway pressure greater than atmospheric pressure is achieved at the end of exhalation by the introduction of a mechanical impedance to exhalation.”*

• In patients on conventional mechanical ventilation, PEEP is one of the parameters that can be adjusted depending on the patient’s oxygenation needs.

• A sustained increase in the daily minimum PEEP of ≥ 3 cmH²O following a period of stability or improvement on the ventilator is one of two criteria that can be used in meeting the VAC definition.

Fraction of Inspired Oxygen (FiO\textsuperscript{2})

- The fraction of oxygen in inspired gas.
  - For example, the FiO\textsuperscript{2} of ambient air is 0.21; the oxygen concentration of ambient air is 21%.

- In patients on mechanical ventilation, the FiO\textsuperscript{2} is one of the key parameters that can be adjusted depending on the patient’s oxygenation needs.

- A sustained increase in the daily minimum FiO\textsuperscript{2} of ≥ 0.20 (20%) following a period of stability or improvement on the ventilator is the second of the two criteria that can be used in meeting the VAC definition.
Who is eligible for VAE surveillance?

- Inpatients of acute care hospitals, long term acute care hospitals, inpatient rehabilitation facilities

- Patients in adult locations are eligible for VAE surveillance
  - Pediatric patients* in adult locations included in VAE surveillance
  - Adults in pediatric locations included in pedVAP surveillance

- NOT recommended to include in VAE surveillance young children housed in adult ICU locations who are not thought to be physiologically similar to the location’s adult patient population (consider virtual location)
Who is NOT eligible for VAE surveillance?

- Inpatients of facilities other than acute care hospitals, long-term acute care hospitals and inpatient rehabilitation facilities are not eligible.

- Patients who have been ventilated < 3 days are not eligible.

- Patients on high frequency ventilation (HFV) or extracorporeal life support (ECLS) are not eligible for VAE surveillance (during the time they are receiving those therapies).
What about other alternative modes of mechanical ventilation?

INCLUDE patients who are receiving a conventional mode of mechanical ventilation and:

▪ Prone positioning
▪ Nitric oxide therapy
▪ Helium-oxygen mixture
▪ Epoprostenol therapy

INCLUDE patients on Airway Pressure Release Ventilation (APRV) or related modes. VAC determinations made using FiO2
What is APRV?

- A mode of mechanical ventilation characterized by continuous application of positive airway pressure with an intermittent pressure release phase
- Used in patients with Acute Lung Injury and Acute Respiratory Distress Syndrome and also after major surgery to treat/prevent atelectasis
- Other names: BiLevel, Bi Vent, BiPhasic, PCV+, DuoPAP
- If you have questions about mechanical ventilation, check with the Respiratory Care or Respiratory Therapy and/or Care departments in your facility.

APRV and VAC Determinations

• Evaluation for VAC will be limited to the FiO\(^2\) parameter when the patient is on APRV for the entire calendar day, since changes in PEEP as indicated in this surveillance algorithm may not be applicable to APRV.
  – Do not use Hi/Lo values
  – Do not designate PEEP as “0” on data collection tool or enter “0” into the calculator
  – PEEP is N/A

• When the patient is on APRV for portions of a calendar day PEEP values recorded during periods of time when the patient is on a conventional mode of ventilation are used to determine the daily minimum PEEP and thus can be used to make VAC determinations
If a Patient is admitted with a community acquired pneumonia (CAP), they are excluded from VAE Surveillance for 14 days.

A. True
B. False
ANSWER

If a Patient is admitted with a community acquired pneumonia (CAP), they are excluded from VAE Surveillance for 14 days.

A. True

B. False
• All patients who are eligible for VAE surveillance are to be included in VAE surveillance

• No exclusions for specific admitting diagnoses or underlying illnesses.
  – Present on Admission (POA) definition does not apply to VAE

• Algorithm requires a period of stability on the ventilator and typically should not be capturing events that represent ongoing worsening
  – If patient stabilizes or improves then worsens again, this is a possible indication of a new ventilator-associated event
  – Patients with CAP, may truly experience complications related to mechanical ventilation that are preventable
VAE Definition Algorithm Summary

- **Respiratory status component**
  - Patient on mechanical ventilation > 2 days
  - Baseline period of stability or improvement, followed by sustained period of worsening oxygenation
  - **Ventilator-Associated Condition (VAC)**

- **Infection / inflammation component**
  - General evidence of infection/inflammation
  - **Infection-Related Ventilator-Associated Complication (IVAC)**

- **Additional evidence**
  - Positive results of microbiological testing
  - **Possible VAP (PVAP)**

**No CXR needed!**
Ventilator Definition

• Ventilator is defined as a device to assist or control respiration, inclusive of the weaning period, through a tracheostomy or by endotracheal intubation
  – Intermittent positive-pressure breathing (IPPB); nasal positive end-expiratory pressure (nasal PEEP); and continuous nasal positive airway pressure (CPAP, hypoCPAP) are not considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g., ET-CPAP)

Same definition used for NHSN pedVAP surveillance
<table>
<thead>
<tr>
<th>Episode of Mechanical Ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A period of days during which the patient was mechanically ventilated for some portion of each consecutive day.</td>
</tr>
<tr>
<td>A break in mechanical ventilation of at least one full calendar day followed by re-intubation or re-initiation of mechanical ventilation during the same hospitalization is a new episode.</td>
</tr>
</tbody>
</table>
VAE Definition Algorithm Summary

- Respiratory status component
  - Patient on mechanical ventilation > 2 days
  - Baseline period of stability or improvement, followed by sustained period of worsening oxygenation
  - Ventilator-Associated Condition (VAC)

- Infection / inflammation component
  - General evidence of infection/inflammation
  - Infection-Related Ventilator-Associated Complication (VAC)

- Additional evidence
  - Positive results of microbiological testing
  - Possible VAP (PVAP)
Daily Minimum FiO² and PEEP

- FiO² and PEEP ventilator settings documented across the calendar day are used to identify the daily minimum FiO² and PEEP values

- FiO² and PEEP settings are typically recorded in the paper or electronic medical record, on respiratory therapy and/or nursing flow sheets, in the section of the flow sheet that pertains to respiratory status/mechanical ventilation

- Use a calendar day not some other “capture period” or other designated 24 hour time period
Daily Minimum $\text{FiO}^2$ and PEEP

- Choose the lowest $\text{FiO}^2$ and PEEP setting during the calendar day that was maintained for at least 1 hour.

- If there is no value that has been maintained for at least 1 hour then select the lowest value available regardless of the period of time in which the setting was maintained.

- Exception to the 1 hour maintenance requirement:
  - Ventilation initiated late in the calendar day
  - Ventilation discontinued early in the calendar day
  - Ventilator settings very unstable throughout the day
Daily Minimum FiO2 and PEEP

• When choosing the daily minimum PEEP and FiO2, use all settings that are recorded during times when the patient is receiving support from an eligible mode of mechanical ventilation and the patient is eligible for VAE surveillance
  – Include settings collected during weaning/mechanical ventilation liberation trials as long as the patient is receiving ventilator support during those trials

  – Use all conventional mechanical ventilation settings
    • Include conventional MV settings during times when a patient is intermittently on an excluded mode of ventilation throughout a calendar day
    • Include recorded PEEP settings during times when a patient is not on APRV or a similar mode of ventilation.
Daily Minimum FiO² and PEEP

Exceptions/Exclusions:

▪ Periods of time when the patient is on HFV, ECLS

▪ Periods of time when the patient is not receiving mechanical ventilation support (e.g., a T-piece trial, or a trach collar trial, where the patient continues to receive supplemental oxygen, but is receiving no additional support from the mechanical ventilator).

    – Periods of time when the patient is being mechanically-ventilated using APRV or a related strategy (e.g. BiLevel, BiVent, BiPhasic, PCV+ and DuoPAP): only review FiO² data (not PEEP).
Identifying the Daily Minimum $\text{FiO}_2$ and PEEP

(Select the lowest value recorded for each calendar day that is maintained for at least one hour)

<table>
<thead>
<tr>
<th></th>
<th>Monday 12am</th>
<th>3am</th>
<th>6am</th>
<th>9am</th>
<th>12pm</th>
<th>3pm</th>
<th>6pm</th>
<th>9pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV mode</td>
<td>ACV</td>
<td>ACV</td>
<td>ACV</td>
<td>ACV</td>
<td>ACV</td>
<td>ACV</td>
<td>ACV</td>
<td>ACV</td>
</tr>
<tr>
<td>$\text{FiO}_2$</td>
<td>1.0</td>
<td>1.0</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.75</td>
<td><strong>0.70</strong></td>
<td>0.70</td>
</tr>
<tr>
<td>PEEP</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: $\text{FiO}_2$ and PEEP values are maintained for at least 1 hour
Guidance for determining daily minimum PEEP and FiO2 when settings are recorded < 1 hour intervals

• Specific guidance is found in the protocol

• Must be sufficient documentation of consecutive recordings to meet the minimum required duration of 1 hour
In general, when selecting the daily minimum PEEP and FiO\(^2\) for each calendar day.....

1. Throw out the lowest value

2. Choose the most consistent value

3. Select the value using any 24 hour time period

4. Choose the lowest value that has been maintained for at least 1 hour
In general, when selecting the daily minimum PEEP and FiO² for each calendar day.....

1. Throw out the lowest value
2. Choose the most consistent value
3. Select the value using any 24 hour time period
4. Choose the lowest value that has been maintained for at least 1 hour
Daily Minimum FiO\textsuperscript{2} and PEEP

• Use the daily minimum FiO\textsuperscript{2} and PEEP values when assessing for both the period of stability or improvement and the period that indicates worsening oxygenation.

  – Do not compare values that occur within a calendar day to determine stability, improvement or worsening.

  – Remember daily minimum PEEP values of 0-5 cmH\textsuperscript{2}O are considered equivalent (equal to 5) for the purposes of VAE surveillance.
<table>
<thead>
<tr>
<th>Day</th>
<th>Daily Min PEEP</th>
<th>Daily Min FiO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>5 (0)</td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td>5 (0)</td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Saturday</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Sunday</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**Ventilator-Associated Event (VAE) Calculator Ver. 3.0**

No VAE detected. Click on the "Explain" button to see an explanation of the VAC definition.

<table>
<thead>
<tr>
<th>MV Day</th>
<th>Date</th>
<th>Min. PEEP (cmH₂O)</th>
<th>Min. FiO₂ (30 - 100)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/5/2015</td>
<td>10</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1/6/2015</td>
<td>8</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1/7/2015</td>
<td>5</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1/8/2015</td>
<td>5 (0)*</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1/9/2015</td>
<td>5 (0)*</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1/10/2015</td>
<td>5</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1/11/2015</td>
<td>5</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1/12/2015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1/13/2015</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Period of Stability or Improvement

- Patient has a baseline period of stability or improvement on the ventilator, defined by $\geq 2$ calendar days of stable or decreasing daily minimum* FiO$_2$ or PEEP values.
- The baseline period is defined as the two calendar days immediately preceding the first day of increased daily minimum PEEP or FiO$_2$.

*Daily minimum FiO$_2$ and PEEP must be maintained for at least 1 hour
Evidence of Worsening Oxygenation

• After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:
  – Increase in daily minimum* FiO\textsuperscript{2} of $\geq 0.20$ (20 points) over the daily minimum FiO\textsuperscript{2} in the baseline period, sustained for $\geq 2$ calendar days.
  
  OR

  – Increase in daily minimum* PEEP values of $\geq 3$ cmH\textsubscript{2}O over the daily minimum PEEP in the baseline period**, sustained for $\geq 2$ calendar days.

*Daily minimum FiO\textsuperscript{2} and PEEP must be maintained for at least 1 hour
**Daily minimum PEEP values of 0 to 5 cmH\textsubscript{2}O are considered equivalent for purposes of VAE surveillance
Date of Event / Event Date

- The date of onset of worsening oxygenation (day 1 of the required ≥ 2 day period of worsening oxygenation).
- It is not the date on which all VAE criteria are met.
- It is not the date of the first day of the baseline period
  - 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
Why is the Event Date important?

• Defines the “VAE Window Period”
  – Period during which criteria for other events—IVAC, PVAP—must be met
• Sets the 14 day VAE Event Period
  – Each VAE is 14 days in duration (arbitrary—to standardize).
  – Day 1 is the Event Date—so if June 1 is date of onset of worsening oxygenation and a VAC is reported, a second VAE cannot be detected and reported until June 15.
  – May not “upgrade” a VAE based on data collected outside the VAE Window Period but within the 14-day event period.
  – May not report a new VAE until that 14 day period has elapsed (keep in mind that 14 day period is event date to event date—so baseline period can occur during previous event period).
  – Blood cultures must be collected within the 14 day event period for a BSI to be secondary to VAE
This is the period of days around the event date (i.e., the day of onset of worsening oxygenation) within which other VAE criteria must be met. It is usually a 5-day period and includes the 2 days before, the day of, and the 2 days after the VAE event date (i.e., the first day of worsening oxygenation, the day of VAE onset).
VAE Window Period: Important Note

• There is an exception, however, in which the VAE Window Period is only 3 or 4 days, as follows:
  – In cases where the VAE event date corresponds to MV day 3 or day 4, the window period described above may only be a 3-day or a 4-day window, because it can NOT include any days before the 3rd day of MV.

*EXAMPLE:  if the VAE event date is MV day 3, then the window period includes only the day of VAE onset and the 2 days after VAE onset (because the 2 days before VAE onset are before the 3rd day of MV)
VAE Definition Algorithm Summary

- **Respiratory status component**
  - Patient on mechanical ventilation > 2 days
  - Baseline period of stability or improvement, followed by sustained period of worsening oxygenation
  - Ventilator-Associated Condition (VAC)
  - New antimicrobial agent
  - Temperature or WBC and

- **Infection / inflammation component**
  - General evidence of infection/inflammation
  - Infection-Related Ventilator-Associated Complication (IVAC)

- **Additional evidence**
  - Positive results of microbiological testing
  - Possible VAP (PVAP)
Tier 2: IVAC

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:

1) Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³.

AND

2) A new antimicrobial agent(s)* is started, and is continued for ≥ 4 calendar days.

*See Appendix for eligible agents.
Infection-related Ventilator-Associated Complication (IVAC)

Patient meets criteria for VAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:

1) Temperature $>38^\circ C$ or $<36^\circ C$, OR white blood cell count $\geq 12,000$ cells/mm$^3$ or $\leq 4,000$ cells/mm$^3$.

AND

2) A new antimicrobial agent(s)* is started, and is continued for $\geq 4$ calendar days.

*See Appendix for eligible agents.
Temperature / WBC

As long as there is an abnormal temperature (> 38 °C or < 36°C) or white blood cell count (≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³) documented during the VAE Window Period, it should be used in determining whether the patient meets the IVAC definition or not, regardless of whether the temperature or white blood cell count was also present on admission or outside the VAE Window Period.
If Temperature, WBC or laboratory criteria are present prior to detection of a VAE and also present within the VAE Window Period, they **can** be used to meet the IVAC definition.

1. True
2. False
ANSWER:

• If Temperature, WBC or laboratory criteria are present prior to detection of a VAE and also present within the VAE Window Period, they can be used to meet the IVAC definition.
• 1. True
• 2. False
If I am conducting in-plan VAE surveillance in my ICU, I will need to assess daily minimum and maximum temperatures for the following patients:

1. All patients in the ICU
2. All patients in the ICU who are on a ventilator
3. Patients who I have determined to meet the VAC definition
4. Patient who have me the VAC definition and also have an abnormal WBC
5. Patients who the clinical care providers have diagnosed with VAP
If I am conducting in-plan VAE surveillance in my ICU, I will need to assess daily minimum and maximum temperatures for the following patients:

1. All patients in the ICU
2. All patients in the ICU who are on a ventilator
3. Patients who I have determined to meet the VAC definition
4. Patient who have me the VAC definition and also have an abnormal WBC
5. Patients who the clinical care providers have diagnosed with VAP
Infection-related Ventilator-Associated Complication (IVAC)

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:

1) Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³.

2) A new antimicrobial agent(s)* is started, and is continued for ≥ 4 calendar days.

*See Appendix for eligible agents.
• Probably the most complicated portion of the VAE surveillance definition algorithm
• Rules for meeting this criterion are not perfect—but we need a standardized method for assessment of antimicrobial therapy, without needing knowledge of dosing, renal function, indication for therapy, etc.
What antimicrobial drugs are in the Appendix?

• Mostly antibacterials, antifungals, limited antivirals

• Drugs that are not included = anti-HIV agents, anti-TB agents, agents used to treat viral hepatitis, agents used to treat herpes virus infections, anti-parasitic

• Originally a broad range of agents that could be used to treat healthcare-associated infections—not just respiratory related infections.
Figuring out if a “new” antimicrobial agent(s) has been given

- New antimicrobial agent: Defined as any agent listed in the protocol Appendix that is initiated on or after the third calendar day of mechanical ventilation AND in the VAE Window Period (i.e., the period typically defined by the 2 calendar days before, the day of, and the 2 calendar days after the onset date of the VAE).
  - The agent is considered new for the purposes of this definition if it was NOT given to the patient on either of the 2 days preceding the current start date.
  - A new agent must be continued for ≥ 4 consecutive days.
  - There is no requirement that the same antimicrobial agent be given on the 4 consecutive days.
  - New agent must be administered IV, IM, via digestive tract or via respiratory tract
Qualifying Antimicrobial Days (QAD)

- A day on which the patient was administered an antimicrobial agent that was determined to be “new” within the VAE Window Period.

- Four consecutive QADs are needed to meet the IVAC antimicrobial criterion—starting within the VAE Window Period.
Do you count an antimicrobial agent as “new” if it is new as a result of de-escalation or simply a switch from one agent to another in the same drug class?

Yes

To avoid additional substantial complexity, there are not rules or exceptions for changes that represent narrowing of spectrum/de-escalation, switches to other agents in the same class, etc. These kinds of situations are very difficult to operationalize in a way that is understandable, standardized and implementable by any facility that might decide to do VAE Surveillance.
QUESTION?

When Evaluating patient data to see if the IVAC definition is met, I should focus only on antibiotics that are used to treat respiratory infections.

A. True
B. False
When Evaluating patient data to see if the IVAC definition is met, I should focus only on antibiotics that are used to treat respiratory infections.

A. True

B. False
IVAC and Antimicrobial Agents

- Meeting Infection-related Ventilator –Associated Complication (IVAC) definition does not mean that the “infection related” event is necessarily respiratory in origin.

- The IVAC antimicrobial list was refined by removing selected antimicrobial agents that would not be used, or would be unlikely to be used, in treating a lower respiratory infection in a critically ill patient.

- Still possible that an existing agent may have dual purposes and not necessarily be treating a respiratory infection.

- No need to discern the reason for the administration of the antimicrobial.
  
  - Prophylaxis, de-escalation, change within a class of antimicrobials is not a reason for exclusion
VAE Definition Algorithm Summary

- Respiratory status component
  - Patient on mechanical ventilation > 2 days
  - Baseline period of stability or improvement, followed by sustained period of worsening oxygenation
    - Ventilator-Associated Condition (VAC)

- Infection / inflammation component
  - General evidence of infection/inflammation
    - Infection-Related Ventilator-Associated Complication (IVAC)
      - Purulent secretions, positive cultures and other positive laboratory evidence

- Additional evidence
  - Positive results of microbiological testing
    - Possible VAP (PVAP)
PVAP

- VAC, IVAC must be met
- Laboratory test collection dates must occur
  - On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation (VAE Window Period)
- Organism exclusions must be considered
  - Normal respiratory/oral flora, mixed respiratory/oral flora or equivalent
  - Candida species or yeast not otherwise specified; coagulase-negative Staphylococcus species; Enterococcus species unless isolated from lung tissue or pleural fluid
  - Community-associated respiratory pathogens: Blastomyces, Histoplasma, Coccidioides, Paracoccidioides, Cryptococcus and Pneumocystis.

AND

- ONE of the following criteria must be met
PVAP

Criterion 1:

• Positive culture of one of the following specimens, meeting quantitative or semi-quantitative thresholds as outlined in protocol, without requirement for purulent respiratory secretions:
  – Endotracheal aspirate, ≥ $10^5$ CFU/ml or corresponding semi-quantitative result
  – Bronchoalveolar lavage, ≥ $10^4$ CFU/ml or corresponding semi-quantitative result
  – Lung tissue, ≥ $10^4$ CFU/g or corresponding semi-quantitative result
  – Protected specimen brush, ≥ $10^3$ CFU/ml or corresponding semi-quantitative result
How do I relate my lab’s semi-quantitative culture result reporting to the quantitative thresholds in the algorithm?

• Ask your laboratory manager/director first—she/he may be able to tell you

• If your laboratory does not have this information,
  – For the purposes of this surveillance, we will assume that a semi-quantitative result of “moderate” or “heavy” growth, or 2+, 3+ or 4+ growth (in a culture of lung tissue, BAL, PSB, or ETA) meets Criterion 1 of the PVAP surveillance definition.

**PVAP**

**Criterion 2:**

Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain $\geq 25$ neutrophils and $\leq 10$ squamous epithelial cells per low power field [lpf, x100])

**AND**

A positive culture of one of the following specimens (qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet criterion #1):

- Sputum
- Endotracheal aspirate
- Bronchoalveolar lavage
- Lung tissue
- Protected specimen brush
What if my laboratory reports Gram stain / direct exam results in a manner that does not quantitate neutrophils and squamous epithelial cells as the definition is written?

- Check with you laboratory for direction in interpreting your facility’s reporting method
- If your laboratory cannot provide guidance on how to correlate you facility’s reporting method to the purulent respiratory secretions quantitative definition then refer to Table 2
<table>
<thead>
<tr>
<th>How do I use the purulent respiratory secretions criterion if ...</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>My laboratory reports counts of “white blood cells” or “polymorphonuclear leukocytes” or “leukocytes” rather than counts of “neutrophils”?</td>
<td>Assume that counts of cells identified by these other descriptors (e.g., “white blood cells”) are equivalent to counts of neutrophils, unless the laboratory tells you this is not the case.</td>
</tr>
<tr>
<td>My laboratory reports semi-quantitative results (not quantitative results) for numbers of neutrophils and squamous epithelial cells?</td>
<td>Check with the laboratory to get information about what quantitative ranges the semi-quantitative reports correspond to.</td>
</tr>
<tr>
<td>My laboratory cannot provide additional information on how its semi-quantitative reporting corresponds to quantitative reporting ranges for neutrophils and squamous epithelial cells?</td>
<td>Use the following direct examination results to meet the purulent respiratory secretions criterion: heavy, 4+, or ≥25 neutrophils per low power field (lpf) [x100], AND rare, occasional, few, 1+ or 2+, or ≤10 squamous epithelial cells per lpf [x100] [19].</td>
</tr>
<tr>
<td>My laboratory reports only the numbers of neutrophils present, without reporting the number of squamous epithelial cells?</td>
<td>In this situation, the purulent secretions criterion may be met using the specified quantitative and semi-quantitative thresholds for neutrophils alone (i.e., heavy, 4+, or ≥25 neutrophils per lpf [x100]).</td>
</tr>
<tr>
<td>My laboratory uses different reporting thresholds for neutrophils and squamous epithelial cells (e.g., maximum report of ≥20 neutrophils per low power field [x100], or minimum report of ≤15 squamous epithelial cells per low power field [x100])?</td>
<td>In this situation, the purulent secretions criterion may be met using the laboratory’s specified maximum quantitative threshold for neutrophils, and/or minimum quantitative threshold for squamous epithelial cells.</td>
</tr>
<tr>
<td>My laboratory processes respiratory specimens such as bronchoalveolar lavage fluid using a centrifugation procedure (e.g., “cytospin”), and there is no quantitation or semi-quantitation of neutrophils or white blood cells in the direct examination report?</td>
<td>In this situation, a report indicating the presence of white blood cells, without quantitation, is sufficient to meet the purulent secretions criterion.</td>
</tr>
</tbody>
</table>
PVAP

Criterion 3:

• One of the following positive tests:
  – Pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
  – Lung histopathology
  – Diagnostic test for Legionella species
  – Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus
Histopathology (Lung) Results

- Identification of abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli.

- Evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms).

- Evidence of infection with viral pathogens (immunohistochemical assays, cytology, microscopy).
Non-Culture-Based Results: PVAP

• Pathogens (Legionella spp., selected viruses) identified utilizing non-culture-based diagnostic testing may qualify as criterion for meeting Criterion 3 of the PVAP definition.
  – Antigen testing
  – PCR
  – Direct Fluorescent Antibody Testing
  – Serology

NOTE: Many other pathogens (including respiratory pathogens such as Mycoplasma and Chlamydophila) that may be detected using non-culture-based techniques are not currently included in PVAP criteria.
Pathogen Reporting

• Pathogens may be reported for PVAP, according to the usual pathogen and antimicrobial susceptibility reporting methods utilized in NHSN for other events.
  - Exception: excluded pathogens

• Pathogens are not reported for VAC or for IVAC.
What does Candida species or yeast not otherwise specified refer to?

All Candida species—those that have been identified to the species level such as Candida albicans, those that are reported as Candida species and also to include culture reports that may simply say for example, “many yeast isolated”
What if I have a BAL culture report similar to this:
   – Normal Flora with many Pseudomonas aeruginosa and moderate Candida species

Can I use this report to meet Criterion 1 of the PVAP definition?

Yes

• An eligible pathogen accompanied by an ineligible pathogen may be used to satisfy the PVAP criteria.
• Note the report is not a quantitative report, however, the “Many” quantity is acceptable as a semi-quantitative equivalent
What about positive blood cultures that occur around the same time as a VAE?

Secondary BSI may only be reported for PVAP

- When at least one eligible organism from the blood culture specimen matches an eligible organism from an appropriate respiratory tract specimen collected during the VAE Window Period
- And when the blood culture was collected within the 14-day event period
Location of Attribution

The inpatient location where the patient was assigned on the date of the VAE (date of onset of worsening oxygenation).

Transfer Rule

If a VAE date of event is on the day of transfer or the day following transfer from one inpatient location to another in the same facility or to a new facility, the event is attributed to the transferring location.
VAE Calculator
http://www.cdc.gov/nhsn/VAE-calculator/index.html

National Healthcare Safety Network (NHSN)

Welcome to Version 3.0 of the VAE Calculator. Version 3.0 operates based upon the currently posted (January 2015) VAE protocol. The Calculator is a web-based tool that is designed to help you learn how the VAE surveillance definition algorithm works and assist you in making VAE determinations. Please note that the VAE Calculator will not ask you to enter any patient identifiers (other than dates of mechanical ventilation, which you can change as you see fit). The VAE Calculator does not store any patient data that you enter, and it will not report any data that you enter or any VAE determinations to the NHSN. You will not be able to export data entered into the Calculator. If you have questions or suggestions about the Calculator, please feel free to send them to the NHSN mailbox, nhsn@cdc.gov.

NEW Ventilator-Associated Event Calculator (2015 Version 3.0) (must have javascript enabled)

2014 Ventilator-associated Event (VAE) Calculator
- Ventilator-Associated Event Calculator (2014 Version 2.1) (must have javascript enabled)
Ventilator-Associated Event (VAE) Calculator Ver. 3.0

Now enter PEEP and/or FiO₂ values and when done, click the "Calculate VAC" button. **You do not need to enter data for every day.** Concentrate on the dates where you believe a Ventilator-Associated Event may be likely. If your values meet the Ventilator-Associated Condition (VAC) definition, the event day will be identified and the VAE Window will be defined.

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<th>Date</th>
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<th>Min. FiO₂ (30 - 100)</th>
<th>VAE</th>
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<td>30</td>
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Case Study 1
A 69-year old female is seen in the ER with an admitting diagnosis of community acquired pneumonia (CAP). She is admitted to the ICU the same day on a ventilator. Review her ventilator settings and determine if VAE criteria are met.

A. Yes
B. No
**Case Study 1**

A 69-year old female is seen in the ER with an admitting diagnosis of community acquired pneumonia (CAP). She is admitted to the ICU the same day on a ventilator. Review her ventilator settings and determine if VAE criteria are met.

<table>
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<th>Daily minimum PEEP</th>
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</table>

A. Yes

B. No
References

CDC Ventilator-Associated Pneumonia (VAP) Event Manual

http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf

http://www.cdc.gov/nhsn/VAE-calculator/index.html