Ventilator-associated Events; Challenges and Opportunities

Linda R. Greene, RN, MPS, CIC
Manager of Infection Prevention
Highland Hospital Rochester, NY
Affiliate of University of Rochester Medical Center
linda_greene@urmc.rochester.edu
Objectives

- Discuss the VAE definition changes for 2015
- Explain the importance of VAE Surveillance
- Describe various tools to assist with VAE Surveillance
The true incidence of VAP is difficult to determine

Traditional surveillance definitions are highly subjective

Chest x-ray interpretations variable

Klompas; Crit Care Med 2012 Vol. 40, No. 12
Difficulty in Applying the Previous Definition

Moderate right pleural effusion with possible overlying pneumonia

Pleural effusion or atelectasis; however, pneumonia cannot be ruled out

Opacities in lower lobe may be atelectasis, pneumonia, or emphysematous changes

Bibasilar changes which may represent atelectasis, pneumonia, or edema

Moderate right pleural effusion with possible overlying pneumonia
Differences in NYS among IPs Collecting previous VAP Data

- Must be vetted with physicians
- Start with sputum specimen
- Daily rounding
- Daily review of CXR
- Determination by ICU staff
What are the goals of switching from PNEU/VAP to VAE surveillance?

- Improve reliability of definitions
- Reduce burden of surveillance
- Enhance our ability to use surveillance data to drive improvements in patient care and safety
Why Collect VAE Data?

- Infection prevention efforts may fail due to silo mentality
- Need to view interventions under the larger context of patient safety
- Connect the dots to harm
Connect the Safety Dots

- Immobility
- VAC
- ARDS
- Pulmonary Edema
- Atelectasis
- Antibiotic Resistance
- IVAC
- C Diff infection
- VAP
- Morbidity
- Mortality
- Delays, LOS
- Cost$
- Ventilator Harm
NHSN VAE Changes 2015

VAE Changes
1. The third tier of the VAE algorithm is consolidated as one specific event: PVAP. After satisfying the requirements of the VAC and IVAC definitions there are three pathways to satisfy the PVAP definition:
   i. Quantitative or semi-quantitative equivalent culture result meeting specified growth thresholds, without purulent respiratory secretions
   ii. Culture result that does not satisfy the specified quantitative or semi-quantitative equivalent growth thresholds, with purulent respiratory secretions
   iii. Other positive laboratory test (positive pleural fluid culture, lung histopathology, diagnostics for Legionella or specified respiratory viruses)

2. Pathogens typically acquired from the environment and that are either not known to be acquired in health care settings have been removed.
The following community associated fungal pathogens will be excluded:
   • Cryptococcus
   • Histoplasma
   • Coccidioides
   • Paracoccidioides
   • Blastomyces
   • Pneumocystis
3. An exception regarding the selection of daily minimum PEEP and FiO2 settings is provided. The daily minimum PEEP and FiO2 values are defined as the lowest values during a calendar day that are set on the ventilator and maintained for at least 1 hour.

Exception may apply where there is no value for at least one hour:
- Ventilator support is initiated late in the calendar day
- Ventilator support is removed early in the calendar day
- Ventilator settings are changed frequently throughout the calendar day such that no setting is maintained for >1 hour

4. Collection and reporting of a new denominator, Episodes of Mechanical Ventilation (EMV) has been added.

EMV will be an optional denominator for VAE surveillance only. Ventilator days and APRV days continue to be required denominators.
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!**
Patient on mechanical ventilation > 2 days

Baseline period of stability or improvement, followed by sustained period of worsening oxygenation

Ventilator-Associated Condition (VAC)

Yes

No

STOP

FiO₂ or PEEP

Infection / inflammation component

General evidence of infection/inflammation

Infection-Related Ventilator-Associated Complication (IVAC)

Yes – Check for PVAP

No

VAC Only

Yes

No

VAC Only
• Additional evidence

Positive results of microbiological testing

Possible VAP (PVAP)

Yes – PVAP

No

IVAC Only
Welcome to the Ventilator-Associated Event Calculator. Version 3.0 operates based upon the currently posted (January 2015) VAE protocol. It is strongly encouraged that you read and study the VAE protocol found here.

- The calculator recognizes PEEP values ≤ 5 and corrects entries according to the VAE protocol prior to making a VAC determination.
- For periods of time where a patient is on APRV or a related type of mechanical ventilation for a full calendar day, a daily minimum PEEP value should not be entered into the calculator (i.e., do not enter zero)
- The calculator finds multiple VAEs per patient as long as they conform to the 14 day rule.

To get started, enter a date below that corresponds to the first day the patient was placed on mechanical ventilation during the mechanical ventilation episode of interest. You may type in a date or use the popup calendar when it appears. You may only enter dates within the past year. If the patient has been on mechanical ventilation for more than one year during the current mechanical ventilation episode, choose a start date that is more recent but is at least 7 days before the period of interest.

The calculator runs locally on your machine so no data are reported anywhere. Feel free to enter or change as much data as you like. If you don’t understand something there are several mechanisms for getting help. Most of the buttons and table headings will give an expanded description if you hover your mouse over the item in question. Also the explain button will pop up an explanation of the reasoning behind the calculator. The explanation box is movable as are all the popup windows. That allows you to open one up and drag it to the side as you work. The explanation will automatically update itself as you work through the protocol.

less...

Mechanical Ventilation Start Date: ______________________ (mm/dd/yyyy)
A Ventilator-Associated Condition (VAC) based on FiO2 values occurred on 4/3/2015

Click on the Go To IVAC button to move to the next part of the protocol or click on the “Explain” button to see how this determination was made.

<table>
<thead>
<tr>
<th>MV Day</th>
<th>Date</th>
<th>Min. PEEP (cmH2O)</th>
<th>Min. FiO2 (30 - 100)</th>
<th>VAE</th>
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</thead>
<tbody>
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<td>3/30/2015</td>
<td>6</td>
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<td>40</td>
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<tr>
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<td>40</td>
<td></td>
</tr>
<tr>
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<td>4/2/2015</td>
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<td>60</td>
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</tr>
<tr>
<td>8</td>
<td>4/5/2015</td>
<td>6</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>
## Ventilator-Associated Event (VAE) Calculator Ver. 3.0

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.

<table>
<thead>
<tr>
<th>MV Day</th>
<th>Date</th>
<th>Min. PEEP (cmH₂O)</th>
<th>Min. FiO₂ (30 - 100)</th>
<th>VAE T&lt;36° or T&gt;38°</th>
<th>WBC ≤4,000 or WBC ≥12,000 cells/mm³</th>
<th>QAD</th>
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<td>✓</td>
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<tr>
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<td>3/31/2015</td>
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<tr>
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**PIPERACILLIN/TAZOBACTAM**
**PVAP Determination**

For the IVAC on **4/3/2015**, did the patient have documentation of any of the following findings during the VAE Window: **4/1/2015 to 4/5/2015**.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion 1. Positive culture of one of the following (without requirement for purulent respiratory secretions):</td>
<td></td>
</tr>
<tr>
<td>• Endotracheal aspirate $\geq 10^5$ cfu/ml*</td>
<td></td>
</tr>
<tr>
<td>• Bronchoalveolar lavage $\geq 10^4$ cfu/ml*</td>
<td></td>
</tr>
<tr>
<td>• Lung tissue $\geq 10^4$ cfu/ml*</td>
<td></td>
</tr>
<tr>
<td>• Protected specimen brush $\geq 10^3$ cfu/ml*</td>
<td></td>
</tr>
<tr>
<td>*or corresponding semi-quantitative result</td>
<td></td>
</tr>
<tr>
<td>Criterion 2. Positive culture of one of the following (qualitative or quantitative/semi-quantitative culture without sufficient growth to meet Criterion 1).</td>
<td></td>
</tr>
<tr>
<td>• Sputum</td>
<td></td>
</tr>
<tr>
<td>• Endotracheal aspirate</td>
<td></td>
</tr>
<tr>
<td>• Bronchoalveolar lavage</td>
<td></td>
</tr>
<tr>
<td>• Lung tissue</td>
<td></td>
</tr>
<tr>
<td>• Protected specimen brush</td>
<td></td>
</tr>
<tr>
<td><strong>AND</strong></td>
<td></td>
</tr>
<tr>
<td>Evidence of purulent respiratory secretions (defined as secretions from lungs, bronchi or trachea that contain $\geq 25$ neutrophils and $\leq 10$ squamous epithelial cells).</td>
<td></td>
</tr>
<tr>
<td>Criterion 3. One of the following positive tests (as outlined in the protocol):</td>
<td></td>
</tr>
<tr>
<td>• Pleural fluid culture</td>
<td></td>
</tr>
<tr>
<td>• Lung histopathology</td>
<td></td>
</tr>
<tr>
<td>• Diagnostic test for <em>Legionella</em> species</td>
<td></td>
</tr>
<tr>
<td>• Diagnostic test for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus or coronavirus.</td>
<td></td>
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</table>
The event on 4/3/2015 conforms to a Possible Ventilator-Associated Pneumonia (PVAP) definition. For a discussion of why, click on the Explain button.

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<th>Cumulative QAD</th>
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<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
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</table>
Getting Started

Where to Start?

1. Look at both process and outcome measures
2. Do we see improvements?
3. Important to track your own performance over time
Comparative Data

- NHSN Comparative data not yet available
- Increasing evidence that most VAE’s are health care associated and not present on admission

* Magill abstract ID Week 2014
VAE Rates in Published Studies

![Bar chart showing VAE rates per 1000 vent-days across different studies.]

- Wash U
- Netherlands (2 hospitals)
- Brigham & Women's
- Epicenters (8 Hospitals)
- Wake Up & Breathe
### Rates

#### spcEvent=Total VAE orgid=10952 loccdc=IN:ACUTE:CC:MS

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#### spcEvent=IVAC orgid=10952 loccdc=IN:ACUTE:CC:MS

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<tbody>
<tr>
<td>ICU</td>
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<td>0</td>
<td>636</td>
<td>0.000</td>
<td>1054</td>
<td>0.603</td>
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</table>
## What can we learn from VAC?

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<th>patname</th>
<th>patsurname</th>
<th>spcEvent</th>
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<tbody>
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<td>ICU</td>
<td>1234</td>
<td>Mickey</td>
<td>Mouse</td>
<td>POVAP</td>
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<tr>
<td>VAE</td>
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<td>Spider</td>
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<td>VAC</td>
</tr>
</tbody>
</table>
Case Study VAE

- Ms. X is a 26 y.o. vent dependent patient. She has a history of anoxic brain injury and is admitted with pneumonia from a long-term care facility (LTCF).
- She is placed on antibiotics and after 4 days has stabilized on the vent. She is improving clinically and the plan is to return to the LTCF.
- On day 7, she has a significant event and a sustained period of worsening oxygenation.
- She meets definition for VAE.
Is VAC Preventable?

- Evidence to suggest that VAC is a complication rather than just a marker for severity of illness

- Evidence that most are acquired ICU conditions such as Pneumonia, ARDS, PE, and atelectasis.
Case Review

- The clinicians have identified that her event was caused by a mucus plug.

- What do we do next?
The Analysis

- Changes in Nurses and Respiratory Therapy staff- no documentation of secretions
- Failure to notice thickened secretions and change in color of secretions
- Although Patient was at baseline – did not get her up into a chair
- Patient was dehydrated
Opportunities

- Hardwire ambulation protocols
- Assure documentation of secretions
- Work collaboratively with respiratory therapy to identify subtle changes
- Daily huddle
Data Sharing and Feedback

At the bedside

In Meetings

Use your data to drive improvement
The Bottom Line

• VAE associated with mortality and LOS (my experience supports this)
• Continue to monitor processes of care and outcomes
• Give feedback to providers and assess potential for preventable events
• Enter data into NHSN
• Notify NHSN when issues or problems are identified
Execute—Applying the NHSN Definition
Your Role

- Your information is important
- Feedback will pinpoint new opportunities for improvement
- Become part of the transition to a new standard of care
References

- https://www.youtube.com/watch?v=dwuqY9AHblw&feature=youtu.be Definitions