Ventilator-Associated Events: Definitions and Surveillance Methods

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Overview

- What is a “Ventilator-Associated Event” (VAE)?
  - Surveillance definitions

- Who is eligible for VAE surveillance, and when will it be available in the NHSN application?

- How do I prepare for and conduct VAE surveillance, and what key terms do I need to know?
  - Pearls and pitfalls of VAE surveillance
  - Tools

- VAE case discussion and tool demonstration
WHAT IS VAE?
REVIEW OF DEFINITIONS
## Adult VAP/VAE Surveillance Definitions Working Group Members and Participants

<table>
<thead>
<tr>
<th>Society/Organization</th>
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<tr>
<td>American Association of Critical-Care Nurses</td>
<td>Suzanne Burns, Beth Hammer</td>
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<td>American Association for Respiratory Care</td>
<td>Dean Hess</td>
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<td>American College of Chest Physicians</td>
<td>Robert Balk, David Gutterman</td>
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<td>Association of Professionals in Infection Control and Epidemiology</td>
<td>Linda Greene</td>
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<td>American Thoracic Society</td>
<td>Nicholas Hill, Mitchell Levy</td>
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<td>Council of State and Territorial Epidemiologists</td>
<td>Carole VanAntwerpen</td>
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<td>HICPAC Surveillance Working Group</td>
<td>Daniel Diekema</td>
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<td>Infectious Diseases Society of America</td>
<td>Edward Septimus</td>
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<td>Clifford Deutschman, Marin Kollef, Pamela Lipsett</td>
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<td>Society for Healthcare Epidemiology of America</td>
<td>Michael Klompas</td>
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<td>U.S. Department of Health and Human Services/Office of Healthcare Quality</td>
<td>Don Wright</td>
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<td>National Institutes of Health</td>
<td>David Henderson</td>
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VAE Surveillance Definition Algorithm—Tiered Approach

- **Tiers 1 and 2: Definitions suitable for potential use in public reporting**
  - Objective, general measures of *Ventilator-Associated Conditions (VAC)* and *Infection-related, Ventilator-Associated Complications (IVAC)*
  - Definitions similar to Tier 1 VAC definition evaluated by Klompas et al. identified events associated with longer duration of mechanical ventilation, longer ICU stay, and increased mortality—and were more efficient to apply than current VAP definitions *(PLoS One 2011;6:e18062, Crit Care Med 2012; in press)*

- **Tier 3: Internal use definitions**
  - Possible VAP and Probable VAP, incorporating laboratory evidence

***Note that this is NOT a clinical definition algorithm and is not intended for use in the management of patients.***
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 or Probable VAP
Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 2 calendar days of stable or decreasing daily minimum FiO₂ or PEEP values. The baseline period is defined as the two calendar days immediately preceding the first day of increased daily minimum PEEP or FiO₂.

AND

After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:

1) Increase in daily minimum FiO₂ of ≥ 0.20 (20 points) over the daily minimum FiO₂ in the baseline period, sustained for ≥ 2 calendar days.

2) Increase in daily minimum PEEP values of ≥ 3 cmH₂O over the daily minimum PEEP in the baseline period, sustained for ≥ 2 calendar days.
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 $>38^\circ C$ 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.
Tier 3: Possible VAP

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections)
   - Defined as secretions from the lungs, bronchi, or trachea that contain ≥25 neutrophils and ≤10 squamous epithelial cells per low power field [lpf, x100].
   - If the laboratory reports semi-quantitative results, those results must be equivalent to the above quantitative thresholds.

2) Positive culture (qualitative, semi-quantitative or quantitative) of sputum*, endotracheal aspirate*, bronchoalveolar lavage*, lung tissue, or protected specimen brushing*

*Excludes the following:
   - Normal respiratory/oral flora, mixed respiratory/oral flora or equivalent
   - Candida species or yeast not otherwise specified
   - Coagulase-negative Staphylococcus species
   - Enterococcus species
On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections—and defined as for possible VAP)

AND one of the following (see Table 2):

- Positive culture of endotracheal aspirate*, \( \geq 10^5 \) CFU/ml or equivalent semi-quantitative result
- Positive culture of bronchoalveolar lavage*, \( \geq 10^4 \) CFU/ml or equivalent semi-quantitative result
- Positive culture of lung tissue, \( \geq 10^4 \) CFU/g or equivalent semi-quantitative result
- Positive culture of protected specimen brush*, \( \geq 10^3 \) CFU/ml or equivalent semi-quantitative result

*Same organism exclusions as noted for Possible VAP.

2) One of the following (without requirement for purulent respiratory secretions):

- Positive pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
- Positive lung histopathology
- Positive diagnostic test for *Legionella* spp.
- Positive diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus
Slide 11

**Event Details**

- **Location of Mechanical Ventilation Initiation:**
- **Date Initiated:**
- **APRV:** Yes / No

**Specific Event:**
- □ VAC
- □ IVAC
- □ Possible VAP
- □ Probable VAP

**Specify Criteria Used:**

**STEP 1: VAC (≥1 REQUIRED)**

- □ Daily min \( \text{FiO}_2 \) increase ≥ 0.20 (20 points) for ≥ 2 days\(^\dagger\)  OR  □ Daily min PEEP increase ≥ 3 cm H\(_2\)O for ≥ 2 days\(^\dagger\)  
  \(^\dagger\)after 2+ days of stable or decreasing daily minimum values.

**STEP 2: IVAC**

- □ Temperature > 38°C or < 36°C  OR  □ White blood cell count ≥ 12,000 or ≤ 4,000 cells/mm\(^3\)
  
  AND

- □ A new antimicrobial agent(s) is started, and is continued for ≥ 4 days

**STEP 3: Possible VAP**

- □ Purulent respiratory secretions\(^\dagger\) (defined as secretions from the lungs, bronchi, or trachea that contain ≥25 neutrophils and ≤10 squamous epithelial cells per low power field [lpf, x100], or equivalent semi-quantitative results)
  
  OR

- □ One of the following (qualitative, semi-quantitative or quantitative):\(^\dagger\)
  - Positive culture of sputum
  - Positive culture of endotracheal aspirate
  - Positive culture of bronchoalveolar lavage
  - Positive culture of lung tissue
  - Positive culture of protected specimen brushing

**STEP 3: Probable VAP**

- □ Purulent respiratory secretions\(^\dagger\)
  
  AND one of the following (meeting quantitative or semi-quantitative threshold as outlined in protocol):\(^\dagger\)
  - Positive culture of endotracheal aspirate
  - Positive culture of bronchoalveolar lavage
  - Positive culture of lung tissue
  - Positive culture of protected specimen brushing
  
  OR

- □ One of the following results (without requirement for purulent respiratory secretions), as outlined in protocol:\(^\dagger\)
  - Positive pleural fluid culture
  - Positive lung histopathology
  - Positive diagnostic test for Legionella spp.
  - Positive diagnostic test for viral pathogens

\(^\dagger\)collected after 2 days of mechanical ventilation and within +/- 2 days of onset of increase in \( \text{FiO}_2 \) or PEEP.
Do I have to use the entire algorithm? Can I decide to conduct surveillance only for IVAC, for example?

- **Conducting in-plan VAE surveillance in 2013 requires assessing patients for ALL events:**
  - VAC
  - IVAC
  - Possible or Probable VAP

- **Hierarchy of definitions:**
  - If a patient meets criteria for VAC and IVAC, report as IVAC.
  - If a patient meets criteria for VAC, IVAC and Possible VAP, report Possible VAP.
  - If a patient meets criteria for VAC, IVAC and Probable VAP, report Probable VAP.
  - If a patient meets criteria for VAC, IVAC, Possible VAP and Probable VAP, report Probable VAP.
THE WHO AND WHEN OF VAE SURVEILLANCE
Who is eligible for VAE surveillance?

- Patients ≥18 years of age
- Inpatients of acute care hospitals, long term acute care hospitals, inpatient rehabilitation facilities
Who is NOT eligible for VAE surveillance?

- Children are **not** eligible.
- Inpatients of facilities **other than** acute care hospitals, long-term acute care hospitals and inpatient rehabilitation facilities are **not** eligible.
- Patients on high frequency ventilation or extracorporeal life support are **NOT ELIGIBLE** for VAE surveillance.
What about patients receiving other types of life support or alternative modes of mechanical ventilation?

- Patients on high frequency ventilation or extracorporeal life support are **EXCLUDED** from VAE surveillance.

- Patients who are receiving a conventional mode of mechanical ventilation while in the prone position, and patients who are receiving a conventional mode of mechanical ventilation while receiving nitric oxide therapy or epoprostenol therapy are **INCLUDED**.

- Patients on Airway Pressure Release Ventilation (APRV) or related modes are **INCLUDED**, but VAC will be determined by changes in FiO$_2$ only, since changes in PEEP as indicated in this surveillance algorithm may not be applicable to APRV.

*If you have questions about mechanical ventilation, check with the Respiratory Care or Respiratory Therapy and/or Critical Care departments in your facility.*
**Event Details**

- **Specific Event:**
  - □ VAC
  - □ IVAC
  - □ Possible VAP
  - □ Probable VAP

- **APRV:** Yes  No

**STEP 1: VAC (≥1 REQUIRED)**

- □ Daily min \(\text{FiO}_2\) increase \(≥ 0.20\) (20 points) for \(≥ 2\) days\(^\dagger\) **OR** □ Daily min PEEP increase \(≥ 3\) cm \(\text{H}_2\text{O}\) for \(≥ 2\) days\(^\dagger\)
  \(^\dagger\)after 2+ days of stable or decreasing daily minimum values.

**STEP 2: IVAC**

- □ Temperature > 38°C or < 36°C **OR** □ White blood cell count \(≥ 12,000\) or \(≤ 4,000\) cells/mm\(^3\) **AND**
- □ A new antimicrobial agent(s) is started, and is continued for \(≥ 4\) days.

**STEP 3: Possible VAP**

- □ Purulent respiratory secretions\(^\dagger\) (defined as secretions from the lungs, bronchi, or trachea that contain \(≥ 25\) neutrophils and \(≤ 10\) squamous epithelial cells per low power field [lpf, \(x100\)], or equivalent semi-quantitative results)
  **OR**
- □ One of the following (qualitative, semi-quantitative or quantitative):\(^\dagger\)
  - □ Positive culture of sputum
  - □ Positive culture of endotracheal aspirate
  - □ Positive culture of bronchoalveolar lavage
  - □ Positive culture of lung tissue
  - □ Positive culture of protected specimen brushing

**STEP 3: Probable VAP**

- □ Purulent respiratory secretions\(^\dagger\)
  **AND** one of the following (meeting quantitative or semi-quantitative threshold as outlined in protocol):\(^\dagger\)
  - □ Positive culture of endotracheal aspirate
  - □ Positive culture of bronchoalveolar lavage
  - □ Positive culture of lung tissue
  - □ Positive culture of protected specimen brushing
  **OR**
- □ One of the following results (without requirement for purulent respiratory secretions), as outlined in protocol: \(^\dagger\)
  - □ Positive pleural fluid culture
  - □ Positive lung histopathology
  - □ Positive diagnostic test for Legionella spp.
  - □ Positive diagnostic test for viral pathogens

\(^\dagger\) collected after 2 days of mechanical ventilation and within +/- 2 days of onset of increase in \(\text{FiO}_2\) or PEEP.
When will VAE surveillance be available in NHSN, and what is happening to PNEU/VAP?

- The VAE protocol is “live” as of January 2013.
- NHSN will be able to accept VAE reports starting in February 2013.
- In 2013, current VAP protocol will still be used for neonatal and pediatric patients ONLY.
  - Pediatric and Neonatal VAE Surveillance Definition Working Group kick-off meeting held on September 6, 2012
- In 2013, the current PNEU definitions will still be available for off-plan surveillance of VAP in adults or non-ventilated PNEU in adults or children.
HOW TO PREPARE FOR AND CONDUCT VAE SURVEILLANCE, AND KEY TERMS
Preparing for VAE Surveillance

- Read the surveillance protocol.

- Identify surveillance partners in the ICU or other units in which VAE surveillance may take place.
  - Infection Control/Prevention
  - Respiratory Therapy
  - Critical Care

- If hospital laboratory reports Gram stain or culture results in a semi-quantitative way, find out from the lab what quantitative ranges correspond to the semi-quantitative scale (for Possible/Probable VAP).

- Develop a plan for organizing the data elements needed to identify VAEs.
Example: Operationalizing VAE

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<th>Vent Day</th>
<th>PEEP min</th>
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Ventilator Definition

- **Ventilator** is defined as a device to assist or control respiration continuously, 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)

*No change from current NHSN ventilator definition*
Episode of Mechanical Ventilation

- A period of days during which the patient was mechanically ventilated for some portion of each consecutive day. A break in mechanical ventilation of at least one full calendar day followed by reintubation and reinitiation of mechanical ventilation during the same hospitalization is a new episode.
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 $\geq 3$ cmH$_2$O 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 (FiO₂)**

- The fraction of oxygen in inspired gas.
  - For example, the FiO₂ of ambient air is 0.21; the oxygen concentration of ambient air is 21%.

- In patients on mechanical ventilation, the FiO₂ is one of the key parameters that can be adjusted depending on the patient’s oxygenation needs.

- A sustained increase in the daily minimum FiO₂ 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.
Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 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$_2$.

AND

After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:

1) Increase in daily minimum FiO$_2$ of ≥ 0.20 (20 points) over the daily minimum FiO$_2$ in the baseline period, sustained for ≥ 2 calendar days.

2) Increase in daily minimum PEEP values of ≥ 3 cmH$_2$O over the daily minimum PEEP in the baseline period, sustained for ≥ 2 calendar days.
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2-day period of stability (PEEP or FiO₂)
2-day period of worsening, based on PEEP or FiO$_2$

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= VAC
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.*
<table>
<thead>
<tr>
<th>Vent Day</th>
<th>PEEP min</th>
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Event Date = Vent Day 4 (first day of worsening oxygenation)
Why is the Event Date important?

- **Defining the “VAE Window Period”**
  - Period during which criteria for other events—IVAC, Possible, Probable VAP—must be met

- **Detecting multiple VAEs in the same patient**
  - 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).
VAE Window Period

- 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

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<th>MV Day</th>
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</table>

- **Worsening oxygenation**:
  - Day 1 of stability or improvement
  - Day 2 of stability or improvement
  - Day 1 of worsening oxygenation
  - Day 2 of worsening oxygenation

- **Temperature or WBC abnormality**:
  - Documented within this shaded period

- **Antimicrobial agent**:
  - Started on within this shaded period, and then continued for at least 4 days

- **Purulent respiratory secretions, positive culture, positive histopathology**:
  - Collected within this shaded period
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. For 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).
### Exception: VAE Window Period

*When the event occurs early in course of mechanical ventilation*

Can’t count data in 1st 2 days of MV for IVAC, Poss/Prob VAP

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<th>MV Day No.</th>
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- **Worsening oxygenation**
  - Day 1 of Stability or improvement
  - Day 2 of stability or improvement
  - Day 1 of worsening oxygenation
  - Day 2 of worsening oxygenation

- **Temperature or WBC abnormality**
  - Documented within this shaded period

- **Antimicrobial agent**
  - Started on within this shaded period, and then continued for at least 4 days

- **Purulent respiratory secretions, positive culture, positive histopathology**
  - Collected within this shaded period
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 °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.
### Defining the VAE Window Period

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<th>Vent Day</th>
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**What’s wrong with this VAE Window Period?**

- 2-day period after onset of worsening
- Vent Date, day 1 of worsening
- 2-day period after onset of worsening

2-day period after onset of worsening
### Defining the VAE window

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In this case—there is **only 1 day before onset of worsening** (because **cannot count 1st 2 days of MV**)

**Event Date, day 1 of worsening**

**2-day period after onset of worsening**
### Look for abnormal temp or white count during VAE Window Period

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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.
IVAC Antimicrobial Criterion

- 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.
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 \( \geq 4 \) 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.
What antimicrobial drugs are in the Appendix?

- Broad range of agents that could be used to treat healthcare-associated infections—mostly antibacterials, antifungals, limited antivirals
  - Including agents that are not used to treat respiratory infections (e.g., oral vancomycin, fidaxomicin)
  - To emphasize that an “IVAC” does not mean that the “infection related” event is respiratory in origin

- 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-parasitics
Figuring out if ≥4 days of therapy have been given: 
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.
Days between administrations of a new antimicrobial agent also count as QADs as long as there is a gap of no more than 1 calendar day between administrations of the same drug. For example, if levofloxacin is given on VAE Day 1, has not been given in the 2 preceding calendar days, and is given again on VAE Days 3, 5 and 7, there are 7 QADs—because the days between levofloxacin doses also count as QADs.
By contrast, days between administrations of different antimicrobial agents do NOT count as QADs.

For example, if levofloxacin is given to the patient on VAE Days -2 and -1 only, no antimicrobials are given on VAE Day 1, and meropenem is given only on VAE Day 2 (remember there is no VAE Day 0), then there are not 4 consecutive QADs. VAE Days -2 and -1 count as 2 consecutive QADs, but VAE Day 1 cannot be counted as a QAD because it is a day between different antimicrobial agents.
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New antimicrobial agent started and continued for 4 days

= IVAC
Possible and Probable VAP

- Purulent respiratory secretions
- Positive lower respiratory tract cultures
- Other criteria for Probable VAP (less common)
  - Positive pleural fluid culture
  - Positive lung histopathology
  - Positive tests for *Legionella* or respiratory virus infection
Purulent Respiratory Secretions

- Gram stain polymorphonuclear leukocyte ("polys", "PMN", neutrophil) counts and squamous epithelial cell counts
- Can be used alone to meet Possible VAP definition, or in combination with a semi-quantitative or quantitative culture result (with the appropriate growth) to meet the Probable VAP definition
How do I relate my lab’s semi-quantitative Gram stain reporting to the quantitative thresholds in the algorithm?

- Ask your laboratory manager/director first—he/she may be able to tell you.
- If your laboratory does not have this information, we are working to provide guidance on this issue* ...

  1+ = occasional or rare = <1 cell per low power field (lpf, x100)
  2+ = few = 1-9 cells per lpf, x100
  3+ = moderate = 10-25 cells per lpf, x100
  4+ = heavy = >25 cells per lpf, x100

- This means that in the absence of information from your lab, “purulent respiratory secretions” are defined by “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

Lower Respiratory Culture Results

- **Appropriate specimen types include:**
  - Sputum, endotracheal aspirate, bronchoalveolar lavage, protected specimen brushings, lung tissue, pleural fluid

- **Exclude the following as a pathogen unless isolated from lung tissue or pleural fluid**
  - *Candida* species or yeast not otherwise specified
  - Coagulase negative *Staphylococcus* species
  - *Enterococcus* species

- **Exclude the following culture results (or similar) ...**
  - Normal respiratory flora / Normal oral flora
  - Mixed respiratory flora / Mixed oral flora
  - Altered oral / respiratory flora
Positive Culture Result Reporting

- **Qualitative**
  - Identification of organism with no quantity assigned
  - Example: “Organism 1: *Staphylococcus aureus*”

- **Semi-quantitative**
  - Identification of organism with estimated quantity
  - Example: 1+, 2+, 3+, 4+
  - Example: Rare, Few, Moderate, Heavy

- **Quantitative**
  - Identification of organism with exact quantity expressed
  - Example: $10^4$ cfu/ml (colony forming units/milliliter)
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, we are working to provide guidance on this issue* ...
  - 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 the Probable VAP surveillance definition.

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<th>FiO₂ min</th>
<th>Temp min</th>
<th>Temp max</th>
<th>WBC min</th>
<th>WBC max</th>
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= Probable VAP

Purulent respiratory secretions AND positive quantitative or semi-quantitative ETA culture (*meeting specified threshold*)
Pathogen Reporting

- Pathogens may be reported for Possible VAP and Probable VAP, 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 about positive blood cultures that occur around the same time as a VAE?

- Secondary BSI = A culture-confirmed BSI associated with a documented HAI at another site (i.e., meets CDC criteria of infection at another site such as UTI).
  - If the primary infection is cultured, the Secondary BSI must yield culture of a same organism as the primary HAI site, regardless of antibiogram.
What about positive blood cultures that occur around the same time as a VAE?

- **Secondary BSI may be reported for Possible and Probable VAP.**
  - When at least one organism from the blood culture specimen matches an 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

- **Secondary BSI may not be reported for Possible and Probable VAP when a respiratory culture was not performed.**
  - Possible VAP met with purulent respiratory secretions
  - Probable VAP met with histopathology criterion

- **Secondary BSIs are not reported for VAC or IVAC.**
Key Things to Remember about Numerator Data Collection

- **For most patients**—will only need to record daily minimum PEEP and FiO₂ while on ventilator. Nothing else!

- **Only need to assess temperature and white blood cell count information for patients who fulfill VAC criteria**
  - And only need to look at these values during the VAE Window Period (3-5 days)

- **Only need to look at antimicrobial administrations for patients with VAC AND abnormal temp or white count**
  - New during the VAE Window Period (3-5 days)

- **Only need to assess lab/microbiology/pathology data for patients with IVAC**
  - Collected during the VAE Window Period (3-5 days)
Denominator Data

- **Device (ventilator) days and patient days are used for denominators.**
  - Collect data daily at the same time each day.
  - Daily counts are summed and only the total for the month is reported in NHSN.

- **Ventilator days – number of patients in the chosen location who are managed with a ventilatory device**
  - Ventilator days for all patients are counted to include those on ventilator < 3 days, those receiving excluded therapies and pediatric patients housed in adult locations.
  - Number of patients on APRV mode of ventilation or related modes are included in total and also indicated separately.

- **Patient days = number of patients in the chosen location**
### Denominator Form

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<th>*Number of Patients</th>
<th><strong>Number of patients with 1 or more central lines</strong></th>
<th><strong>Number of patients with a urinary catheter</strong></th>
<th><strong>Number of patients on a ventilator</strong></th>
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*required for saving

**Location Code:**

**Month:**

**Year:**
Remember ... Tips for Getting Started

- Get familiar with the protocol and review FAQs.
- Establish relationships with Respiratory Therapy and/or Critical Care:
  - Discuss options for collection of minimum daily PEEP and FiO₂ for each MV day (IP, RT, electronically generated).
  - May want to ask about frequency with which excluded therapies (HFV, extracorporeal support) are used, and APRV.
- Determine your laboratory’s approach to Gram stain and culture result reporting.
- Explore use of tools for data collection and for learning the definitions and making VAE determinations.
Acknowledgments

- Patients and staff in NNIS and NHSN participating facilities
- VAP Surveillance Definition Working Group
- Other subject matter experts
- HHS Office of Healthcare Quality
- CDC Prevention Epicenters
- CDC VALORI/draft sVAP project collaborators
- CDC/DHQF colleagues

The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.
Thank you!

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E-mail: cdcinfo@cdc.gov   Web: www.cdc.gov

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EXTRA SLIDES
Non-Culture-Based Results: Probable VAP

- Pathogens (*Legionella* spp., selected viruses) identified utilizing non-culture-based diagnostic testing may qualify as criterion for meeting Probable VAP.
  - Antigen testing
  - PCR
  - Direct Fluorescent Antibody Testing
  - Serology

- 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 Probable VAP criteria.
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)
Analysis

- VAE Rate per 1000 ventilator days = 
  \[ \frac{\text{Number of VAEs}}{\text{Number of Ventilator Days}} \]

- Ventilator Utilization Ratio = 
  \[ \frac{\text{Ventilator Days}}{\text{Patient Days}} \]
Key Take-Home Points

- Patient must be ventilated more than 2 calendar days.
- Patient must have ≥2 calendar days of stability or improvement of oxygenation followed by ≥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.
More Key Take-Home Points

- **Event Date defines the VAE Window Period:**
  - 2 days before, day of and 2 days after the Event Date – 5 days
  - May be shorter if worsening occurs early in the course of ventilation

- **All other criteria (for IVAC, Possible VAP, Probable VAP) must be identified within the VAE Window Period.**

- **The “VAE clock” starts over again when ...**
  - The patient begins a new episode of mechanical ventilation
  - A new event period starts (i.e., 14 days have elapsed since previous VAE Event Date)
  - The patient comes off of an excluded therapy (such as HFV or ECMO) and goes back on conventional mode of ventilation