# Ventilator Associated Event (VAE) –

# Surveillance Guidelines and Protocol Application 2024

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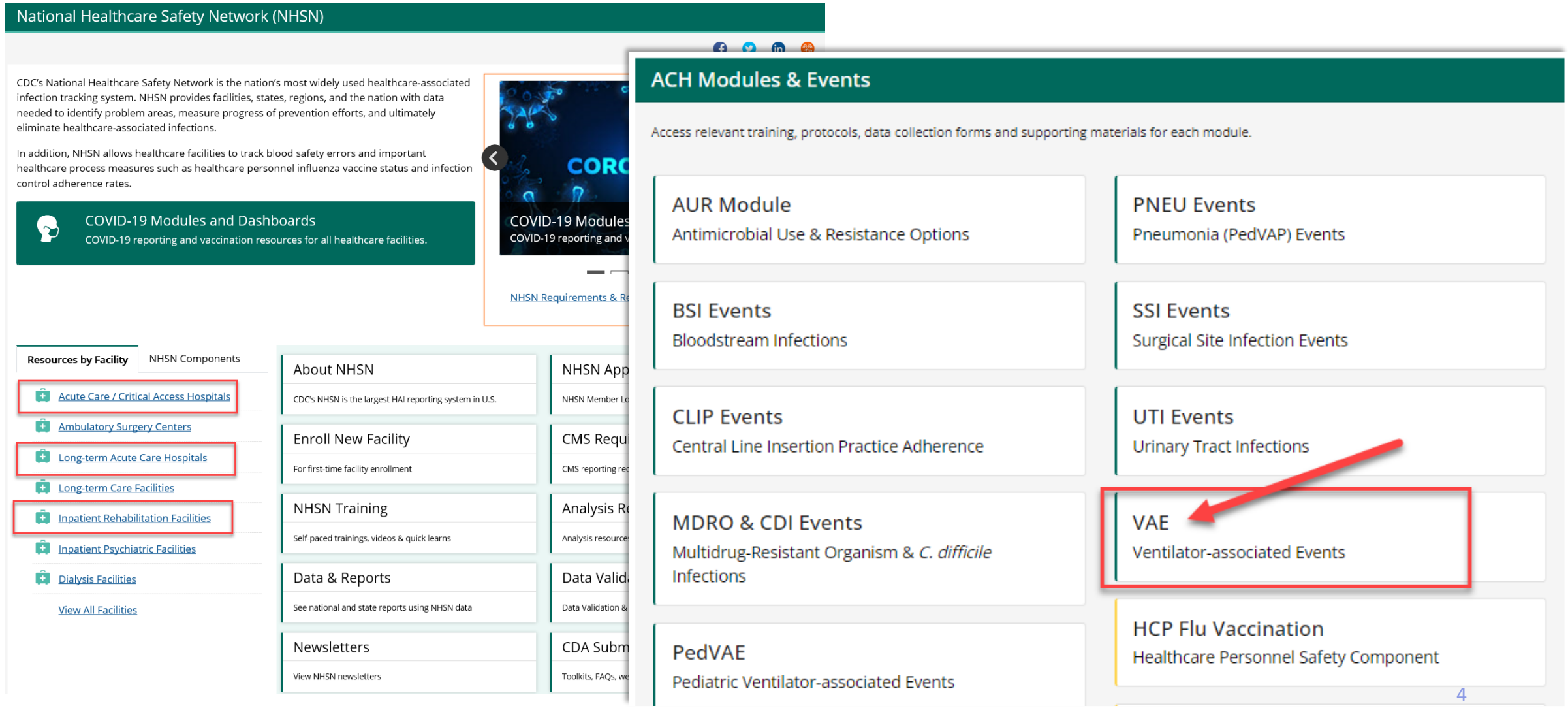
# Training Objectives

- **At the conclusion of this presentation, participants will be able to**
  - Describe the Ventilator Associated Events (VAE) surveillance algorithm
  - Explain VAE key terms
  - Explain criteria for meeting each tier of the VAE algorithm
  - Locate resources for VAE surveillance and reporting

# VAE Surveillance – Before you begin

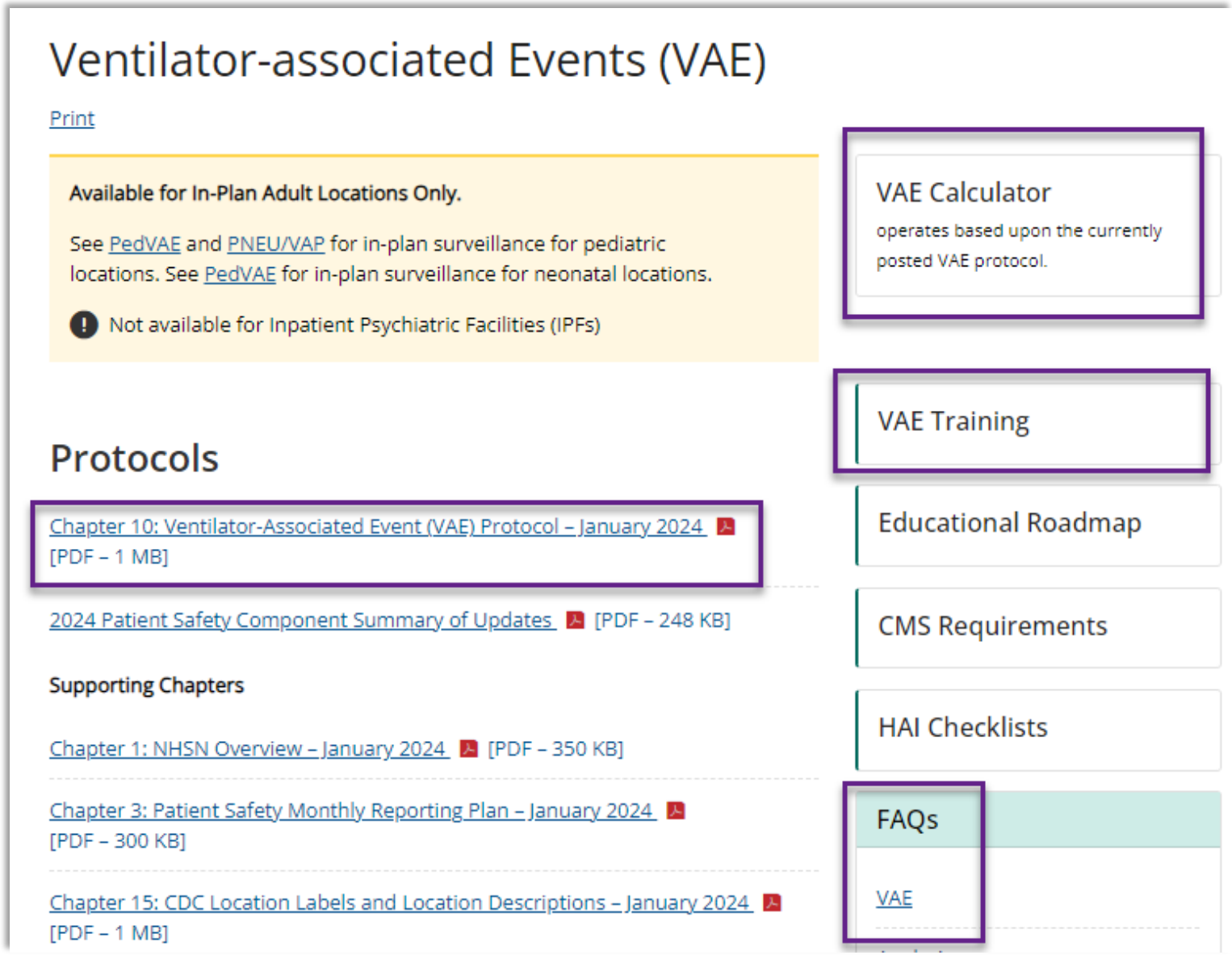
# Where Do I Find the VAE Surveillance Guidance?

https://www.cdc.gov/nhsn/index.html



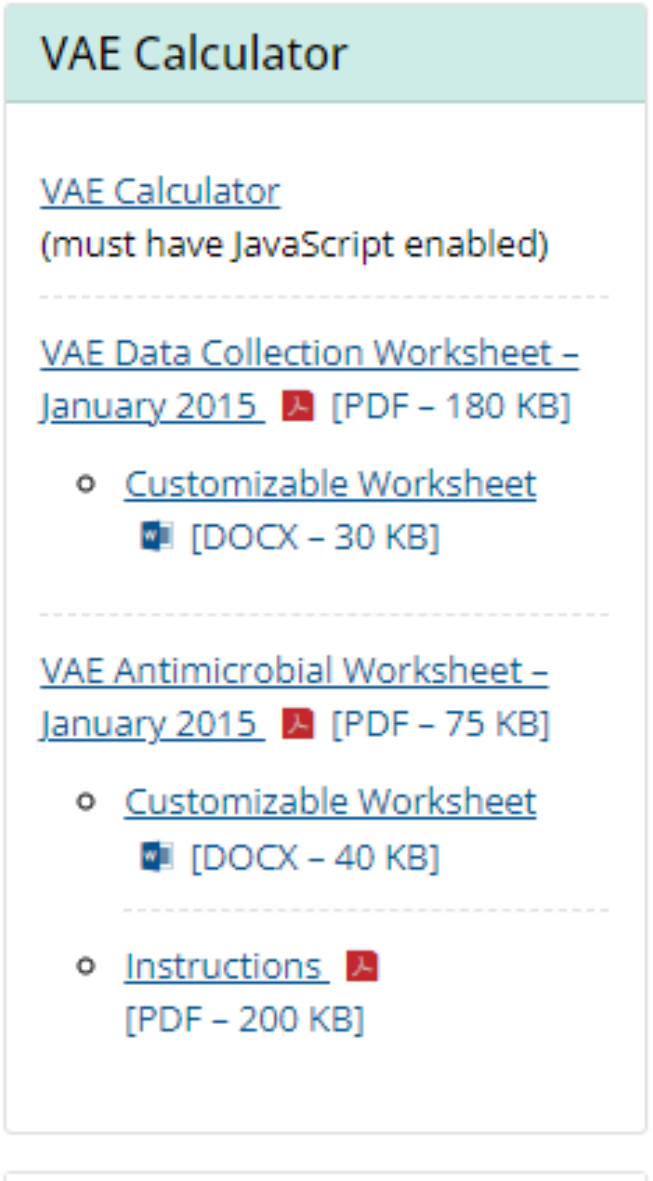
# Where Do I Find the VAE Surveillance Guidance? cont.

- https://www.cdc.gov/nhsn/psc/vae/index.html



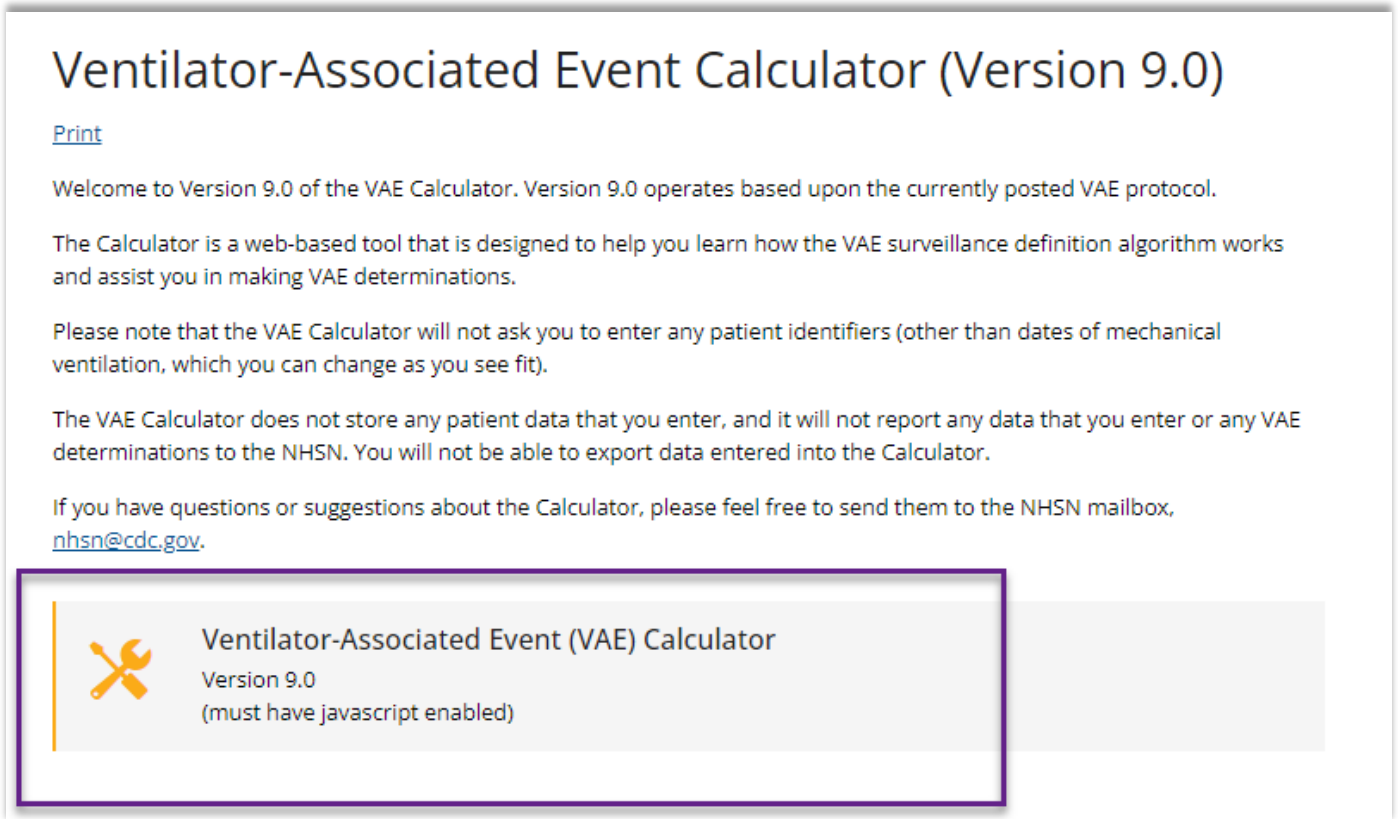
# Tools for Visualizing VAE

- VAE Calculator and Worksheets: https://www.cdc.gov/nhsn/psc/vae/index.html



# Tools for Visualizing VAE - cont.

- VAE Calculator: https://www.cdc.gov/nhsn/vae-calculator/index.html



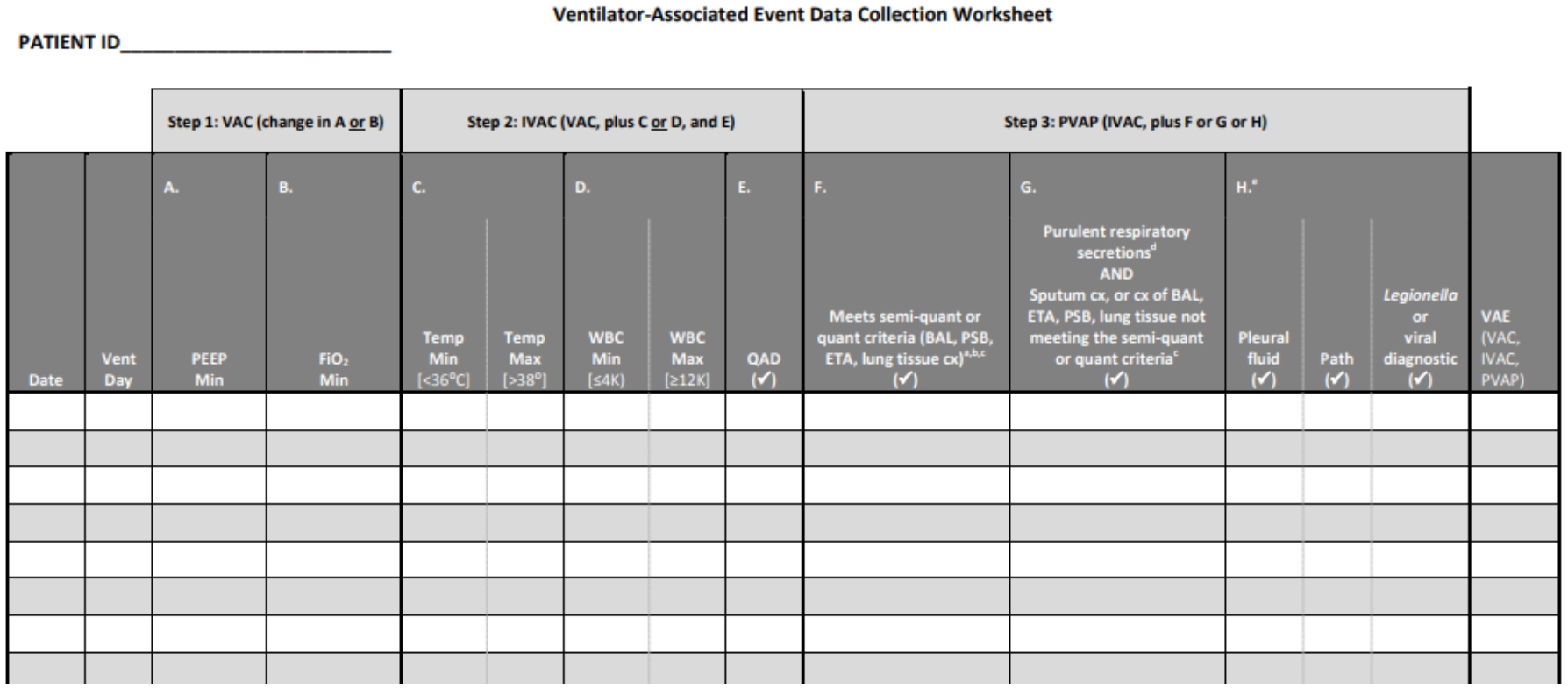
# VAE Calculator

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

- Available as a tool to assist with making VAE determinations
  - Operates based on the VAE algorithm
- The “Explain” button in the calculator will pop up an explanation as to how the “calculation” for the case determination was made
- The calculator runs locally on your computer and none of the data you enter is reported, uploaded, or stored
  - Experiment with it – put in test scenarios to see what happens
- Remember - the correct determination by the calculator is dependent upon the correct data being entered
  - It is not a substitute for you knowing and understanding the rules for entering the values into the designated data fields

# Tools for Visualizing VAE – cont'd

- VAE Worksheet: https://www.cdc.gov/nhsn/pdfs/vae/VAE_DataCollectionWorksheet_FINAL.pdf



**Ventilator-Associated Event Data Collection Worksheet**

**PATIENT ID**_____

| | | Step 1: VAC (change in A or B) | | Step 2: IVAC (VAC, plus C or D, and E) | | | | | Step 3: PVAP (IVAC, plus F or G or H) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A. | B. | C. | | D. | | E. | F. | G. | H.[e] | | | |
| Date | Vent Day | PEEP Min | $FiO_2$ Min | Temp Min [<36°C] | Temp Max [>38°] | WBC Min [≤4K] | WBC Max [≥12K] | QAD (✓) | Meets semi-quant or quant criteria (BAL, PSB, ETA, lung tissue cx)[a,b,c] (✓) | Purulent respiratory secretions[d] AND Sputum cx, or cx of BAL, ETA, PSB, lung tissue not meeting the semi-quant or quant criteria[c] (✓) | Pleural fluid (✓) | Path (✓) | *Legionella* or viral diagnostic (✓) | VAE (VAC, IVAC, PVAP) |
| | | | | | | | | | | | | | | |
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# Tools for Visualizing VAE – Example Manual Worksheet

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | QAD | Spec | Polys/ Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | | | | |
| 3 | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | None | **Pleural Fluid** | | ***Candida albicans*** |
| 4 | 8 | 60 | 38.1 | 39.2 | 14.5 | 16.8 | Yes | -- | -- | -- |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Yes | -- | -- | -- |
| 6 | 7 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Yes | -- | -- | --- |
| 7 | 5 | 40 | | | | | Yes | | | |
| 8 | 5 | 40 | | | | | | | | |

# VAE Surveillance – Primer

# Ventilator Definition

- **Ventilator** is defined as a device used to support, assist, or control respiration (inclusive of the weaning period) through the application of positive pressure to the airway when delivered via an artificial airway, specifically oral/nasal endotracheal or tracheostomy tube.

**Note:** Ventilation and lung expansion devices that deliver positive pressure to the airway (for example, CPAP, BiPAP, Bi-level, IPPB, and PEEP) via non-invasive means (for example, nasal prongs, nasal mask, full face mask, total mask, etc.) are not considered ventilators unless positive pressure is delivered via an artificial airway (oral/nasal endotracheal or tracheostomy tube).

# Why Perform Surveillance for Patients Receiving Mechanical Ventilation?

- 2015 CDC point-prevalence survey determined that of the 427 healthcare–associated infections identified in a sample of acute care hospitals in the U.S., pneumonia was the most common infection, with 35% of those being ventilator associated*

- Ventilator-associated pneumonia (VAP) is an important complication of mechanical ventilation, but other adverse events also happen to ventilated patients
  - Acute Respiratory Distress Syndrome (ARDS), sepsis, pulmonary embolism, barotrauma, and pulmonary edema, among other complications

*Magill SS, O'Leary E, Janelle SJ, et al. Changes in prevalence of healthcare-associated infections in US hospitals. New England Journal of Medicine 2018; 379:1732-1744.

# VAE - Ventilator "Associated" Event

- An adverse event "associated" with the use of a mechanical ventilator
- Detection of VAE may be related to:
  - Infection - respiratory or another site
  - Fluid overload
  - ARDS
  - Atelectasis
  - Provider preference in adjusting settings
  - Other
- "Surveillance is information for action"
  - Address duration of mechanical ventilation
  - Address issues found to be "associated" with VAE detection

# VAE - Ventilator "Associated" Event

- **VAE Surveillance Working Group** convened in 2011
- **Currently** (as of January 2013)
  - Ventilator-Associated Event (VAE) is the only event available for *in-plan* surveillance in adult locations
    - Focus on objectivity, reliability, and ability to automate
    - Identify a broad range of conditions and complications occurring in mechanically ventilated adult patients (pneumonia, ARDS, atelectasis, pulmonary edema, etc.) which may be preventable
    - Enhance ability to use surveillance data to drive improvements in patient care and safety

# VAE ≠ VAP(PNEU) & PVAP ≠ VAP(PNEU)

- VAE and PNEU protocols detect two separate and distinct events
  - It is possible to meet VAE and PNEU
  - It is possible to meet VAE and not PNEU
  - It is possible to meet PNEU and not VAE
  - May not meet either
- Educate your clinicians to dispel the myth!
- VAE is designed to detect more than VAP

**VAP** – Ventilator-associated Pneumonia (PNEU definition)

**PVAP** – Possible Ventilator-associated Pneumonia (VAE definition)

**NOTE:** Both VAE and PNEU are available for secondary BSI assignment when conducting BSI surveillance

# VAE Surveillance Inclusion Criteria: Settings

- 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
- Patients must be receiving support with mechanical ventilation
  - Patients must be mechanically ventilated for more than 2 calendar days to be eligible for VAE

**Note:** It is 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).

# VAE Surveillance Inclusion Criteria: Adjunct Therapies or Alternative Modes of Mechanical Ventilation

- **INCLUDE** patients who are receiving a conventional mode of mechanical ventilation
  - while in the prone position
  - while receiving nitric oxide therapy, helium-oxygen mixtures (heliox), or epoprostenol therapy

- **INCLUDE** patients on Airway Pressure Release Ventilation (APRV) or related modes
  - A mode of mechanical ventilation characterized by continuous application of positive airway pressure with an intermittent pressure release phase
  - Other names: BiLevel, Bi Vent, BiPhasic, PCV+, DuoPAP

# VAE Surveillance Exclusion Criteria

- Patients on high frequency ventilation (HFV), paracorporeal membrane oxygenation, or extracorporeal life support (ECLS) are **not eligible** for VAE surveillance (during the time they are receiving those therapies)
- Patients in non-acute care locations in an acute care setting (such as a chronic care unit)
- Adult patients in non-adult or pediatric locations
  - Adults in pediatric locations included in pedVAP surveillance

# Who is not Eligible to meet VAE?

- Patients meeting inclusion criteria for VAE surveillance cannot meet VAE criteria if they have been ventilated less than 3 days
- The first two days of ventilation can be used to establish the baseline period of stability or improvement, but the earliest date of event for VAE is day 3 of mechanical ventilation

# 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/or re-initiation of mechanical ventilation during the same hospitalization, defines a new episode of mechanical ventilation.

# VAE Algorithm Overview

*Note that these are NOT clinical definitions and are not intended for use in the management of patients.*

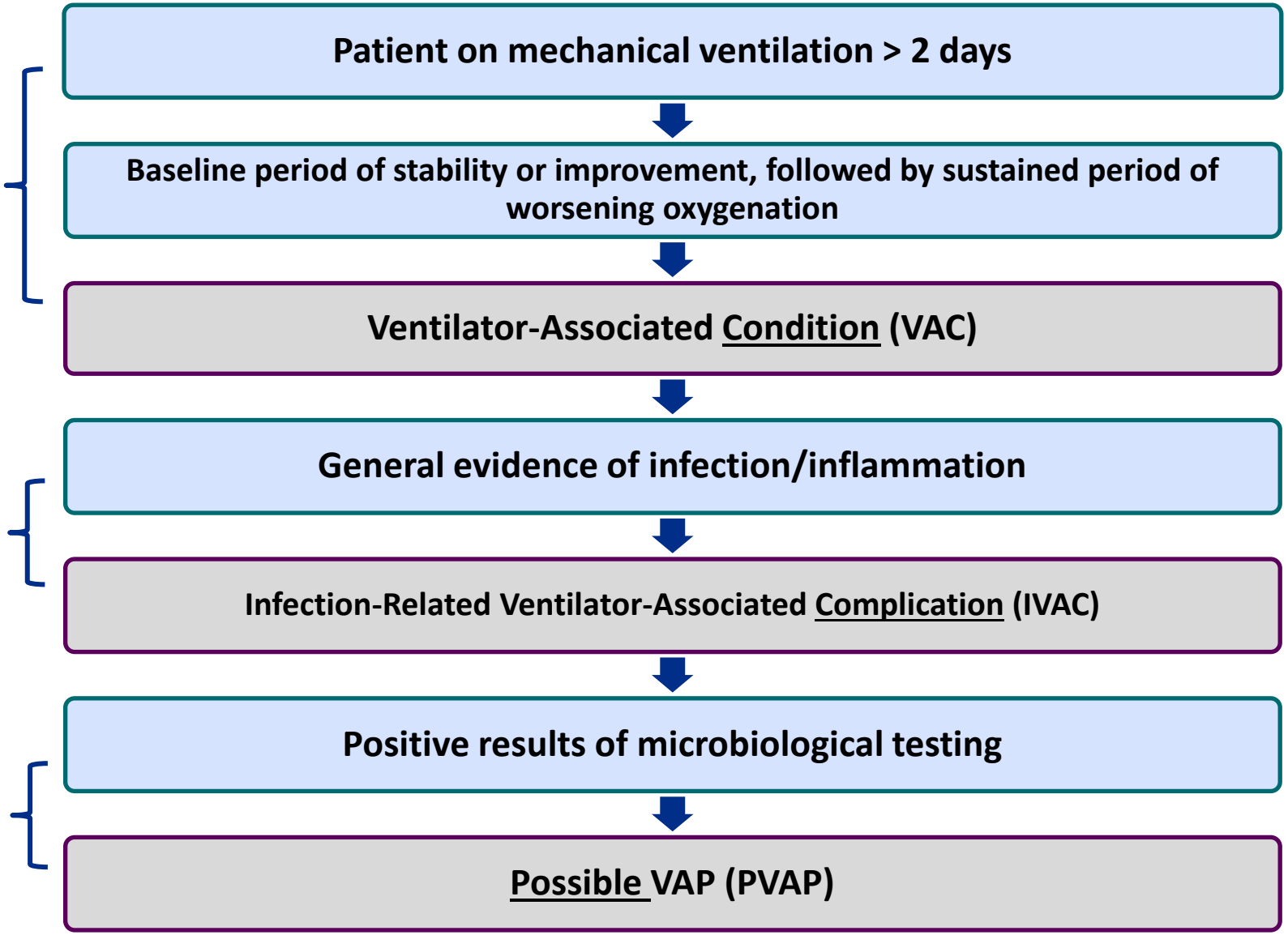
# NHSN Chapter 2 Definitions - Identifying Healthcare-associated Infections (HAI) for NHSN Surveillance

## Do not apply to VAE

| Concept | SSI | LabID | VAE | PedVAE |
|---|---|---|---|---|
| Infection Window Period | Not Applicable | Not Applicable | Not Applicable | Not Applicable |
| Date of Event | | | | |
| Present on Admission | | | | |
| Healthcare-associated Infection | | | | |
| Repeat Infection Timeframe | | | | |
| Secondary BSI Attribution Period | | | | |

# VAE Definition Algorithm Summary

- Respiratory status component
- Infection / inflammation component
- Additional evidence



# VAE Algorithm

- Algorithm is progressive in terms of criteria to be met
  - VAC → IVAC → PVAP
  - Each subsequent tier is not more significant than the one before
  - All events start with VAC
    - IVAC is not necessarily “worse” than having  VAC
    - PVAP is not necessarily “worse” than having  IVAC

# VAE Algorithmco - cont.

- The fundamental definition within the algorithm is the VAC, which is defined on the basis of respiratory deterioration
  - All events start with VAC – evidence of respiratory deterioration
  - IVAC - additional evidence that the event may be infectious vs. non-infectious
  - PVAP - additional evidence the infection may be respiratory related
- The VAE is reported at the highest tier of the algorithm that is met

# Respiratory Status Component of VAE Algorithm

- 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)

# Oxygenation – $FiO_2$ and PEEP

- A patient's oxygenation needs can be addressed by adjusting the $FiO_2$ and PEEP settings on the ventilator

- **$FiO_2$** – the fraction of oxygen in inspired air
  - For example, the $FiO_2$ of room air is 0.21
  - The oxygen concentration of room air is 21%
  - 0.21 is equivalent to 21%

- **PEEP** – positive end-expiratory pressure – the alveolar pressure above atmospheric pressure at the end of exhalation
  - Achieved by the introduction of mechanical impedance to exhalation
  - Expressed in $cmH_2O$

# Oxygenation – $FiO_2$ and PEEP - cont.

## Figure 1: Ventilator-Associated Events (VAE) Surveillance Algorithm

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 2 calendar days immediately preceding the first day of increased daily minimum PEEP or $FiO_2$.

*Daily minimum defined by lowest value of $FiO_2$ or PEEP during a calendar day that is maintained for > 1 hour.

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 $FiO_2$ of the first day in the baseline period, sustained for ≥ 2 calendar days.
2) Increase in daily minimum* PEEP values of ≥ 3 $cmH_2O$ over the daily minimum PEEP of the first day in the baseline period†, sustained for ≥ 2 calendar days.

*Daily minimum defined by lowest value of $FiO_2$ or PEEP during a calendar day that is maintained for > 1 hour.

†Daily minimum PEEP values of 0-5 $cmH_2O$ are considered equivalent for the purposes of VAE surveillance.

**Ventilator-Associated Condition (VAC)**

# Daily Minimum $FiO_2$ and PEEP

- **Daily Minimum $FiO_2$** – the lowest value of $FiO_2$ during a calendar day that is set on the ventilator and *maintained for > 1 hour*

- **Daily Minimum PEEP** – the lowest value of PEEP during a calendar day that is set on the ventilator and *maintained for > 1 ho*ur
  - Daily minimum PEEP values of 0-5 $cmH_2O$ are considered equivalent (equal to 5 $cmH_2O$) for the purposes of VAE surveillance.

# Eligible $FiO_2$ and PEEP Settings

- The daily minimum $FiO_2$ and PEEP values are determined using all **eligible** $FiO_2$ and PEEP **settings** that are documented throughout the **calendar day** during times when the patient is **receiving support from an eligible mode of mechanical ventilation** in an **inpatient location**
  - All conventional mechanical ventilation settings are to be used
    - Include settings collected during weaning/mechanical ventilation liberation trials if the patient is receiving ventilator support during those trials
    - Include conventional MV settings during times when a patient is intermittently on an excluded mode of ventilation or support throughout a calendar day
    - Do NOT include settings from the Emergency Department or other pre-hospital/pre-inpatient locations

# Ineligible $FiO_2$ and PEEP Settings

- Settings not eligible for use
  - Periods of time when the patient is on high frequency ventilation, extracorporeal life support or paracorporeal membrane oxygenation.
  - Periods of time when the patient is not receiving mechanical ventilation support (for example, 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 (for example, BiLevel, BiVent, BiPhasic, PCV+ and DuoPAP)
    - Only review $FiO_2$ data (PEEP settings are not eligible for use).

# Determining Daily Minimum $FiO_2$ and PEEP

- From the eligible documented settings, use the lowest $FiO_2$ and PEEP setting during the calendar day that was maintained for greater than 1 hour
- In the event there is no value that has been maintained for greater than 1 hour, then select the lowest value available regardless of the period of time in which the setting was maintained
  - **When might there be no $FiO_2$ and PEEP setting during the calendar day that was maintained for greater than 1 hour?**
    - Ventilation initiated late in the calendar day
    - Ventilation discontinued early in the calendar day
    - Ventilator settings very unstable throughout the day

# Knowledge Check: Select the lowest value recorded for $FiO_2$ and PEEP for the calendar day that is maintained for > one hour

- $FiO_2$ of 1; PEEP of 8
- $FiO_2$ of 0.80; PEEP of 5
- $FiO_2$ of 0.75; PEEP of 5
- $FiO_2$ of 0.70; PEEP of 5

| | Monday 12am | 3am | 6am | 9am | 12pm | 3pm | 6pm | 9pm |
|---|---|---|---|---|---|---|---|---|
| MV mode | ACV | ACV | ACV | ACV | ACV | ACV | ACV | ACV |
| $FiO_2$ | 1.0 | 1.0 | 0.80 | 0.70 | 0.75 | 0.75 | 0.80 | 0.80 |
| PEEP | 8 | 8 | 8 | 8 | 8 | 5 | 8 | 8 |

# Knowledge Check: Select the lowest value recorded for $FiO_2$ and PEEP for the calendar day that is maintained for > one hour

- $FiO_2$ of 1; PEEP of 8
- $FiO_2$ of 0.80; PEEP of 5
- $FiO_2$ of 0.75; PEEP of 5
- **$FiO_2$ of 0.70; PEEP of 5**

| | Monday 12am | 3am | 6am | 9am | 12pm | 3pm | 6pm | 9pm |
|---|---|---|---|---|---|---|---|---|
| MV mode | ACV | ACV | ACV | ACV | ACV | ACV | ACV | ACV |
| $FiO_2$ | 1.0 | 1.0 | 0.80 | 0.70 | 0.75 | 0.75 | 0.80 | 0.80 |
| PEEP | 8 | 8 | 8 | 8 | 8 | 5 | 8 | 8 |

# Guidance for Determining Daily Minimum PEEP and $FiO_2$ when Settings are Recorded Every Hour or More Frequently

- Specific guidance is found in the protocol
- Must be sufficient documentation of consecutive recordings to meet the minimum required duration of > 1 hour
  - If tracking every 15 minutes, 5 consecutive recordings at the same setting would be needed (e.g., at 09:00, 09:15, 09:30, 09:45 and 10:00)
  - If tracking every 30 minutes, 3 consecutive recordings at the same setting would be needed (e.g., at 09:00, 09:30, and 10:00)
  - If tracking every hour, 2 consecutive recordings at the same setting would be needed (e.g., at 09:00 and 10:00)
- Provides standardization

# Identifying the Daily Minimum $FiO_2$ and PEEP

(Select the lowest value recorded for each calendar day that is maintained for >1 hour)

| | Monday 12am | 3am | 4am | 6am | 9am | 12pm | 3pm | 9pm |
|---|---|---|---|---|---|---|---|---|
| MV mode | ACV | ACV | ACV | ACV | ACV | ACV | ACV | ACV |
| $FiO_2$ | 0.80 | 0.70 | 0.90 | 0.80 | 0.80 | 0.75 | 0.75 | 0.75 |
| PEEP | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

**0.70 is the lowest $FiO_2$ value for the calendar day - but it was not maintained for > 1 hour. 0.75 is the next lowest $FiO_2$ value that was maintained for > 1 hour.**

# Identifying the Daily Minimum $FiO_2$ and PEEP - cont.

(Ventilation is initiated late in the calendar day)

| | Monday 2300 | 2330 | Tuesday 2400 (midnight) | 0100 | 0300 | 0600 | 0900 | 1200… |
|---|---|---|---|---|---|---|---|---|
| MV mode | ACV | ACV | ACV | ACV | ACV | ACV | ACV | ACV |
| $FiO_2$ | 0.80 | 0.70 | 0.80 | 0.80 | 0.80 | 0.75 | 0.75 | 0.75 |
| PEEP | 8 | 5 | 8 | 8 | 8 | 8 | 8 | 8 |

**$FiO_2$ of 0.70 and PEEP of 5 are the lowest values for Monday because no value was maintained for > 1 hour**

# Baseline Period of Stability or Improvement

- A period of stability or improvement, defined by ≥ 2 calendar days of stable or decreasing daily minimum $FiO_2$ values or stable or decreasing daily minimum PEEP values.
- The baseline period is defined as the two calendar days immediately preceding the first day of increased daily minimum $FiO_2$ or PEEP (Evidence of worsening oxygenation)

# Evidence of Worsening Oxygenation

- After an identified period of stability or improvement there is evidence of worsening oxygenation in the same parameter
  - Increase in daily minimum* $FiO_2$ of ≥ 0.20 (20 points) over the daily minimum $FiO_2$ of the first day in the baseline period, sustained for ≥ 2 calendar days.

  **OR**

  - Increase in daily minimum* PEEP values of ≥ 3 cmH2O over the daily minimum PEEP of the first day in the baseline period†, sustained for ≥ 2 calendar days

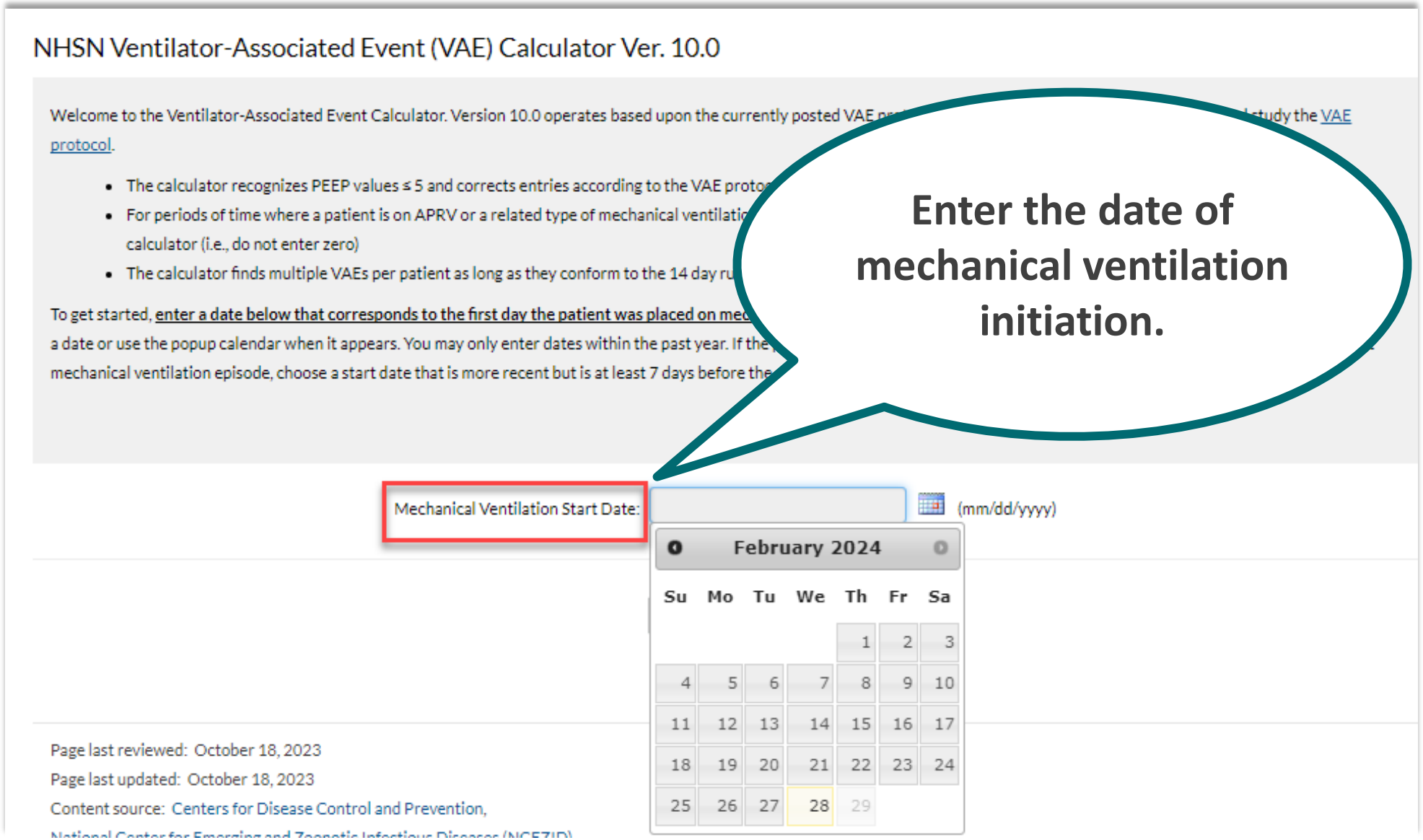
*Daily minimum defined by lowest value of $FiO_2$ or PEEP during a calendar day that is maintained for > 1 hour.

†Daily minimum PEEP values of 0-5 cmH2O are considered equivalent for the purposes of VAE surveillance.

# Meeting the VAC Definition

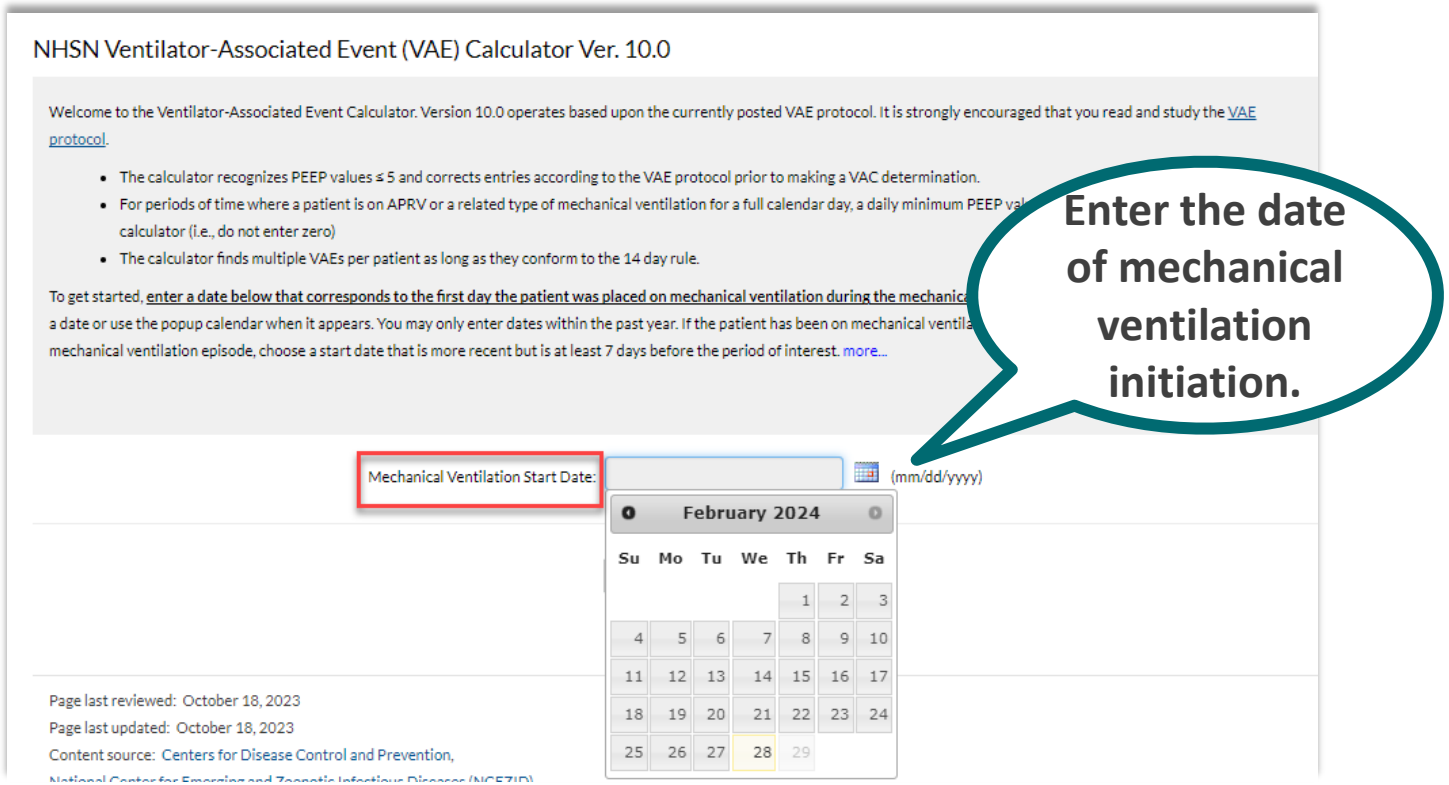
- Use the daily minimum $FiO_2$ and PEEP values when assessing for both the period of stability or improvement and the period that indicates worsening oxygenation.
- Do not compare values that occur within a calendar day to determine stability, improvement, or worsening.
- The baseline period and the evidence of worsening oxygenation must occur in the same parameter
- Each parameter is assessed independently of the other – VAC may be met in the $FiO_2$ parameter, or in the PEEP parameter, or in both parameters

# Meeting VAC – Examples Using the VAE Calculator



# Date of Mechanical Ventilation Initiation

- Actual date of mechanical ventilation initiation, not the date of admission to the facility
- Estimate of the actual date of mechanical ventilation initiation can be used if needed
- Only if the actual date or an estimate of the actual date cannot be determined will the date of mechanical ventilation initiation default to the date of admission to the facility



# Meeting VAC – Baseline Period of Stability

Calculate VAC  Start Over

| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 8 | 30 | |
| 2 | 2/2/2024 | 8 | 30 | |
| 3 | 2/3/2024 | 8 | 30 | |
| 4 | 2/4/2024 | 8 | 55 | |
| 5 | 2/5/2024 | 8 | 55 | |
| 6 | 2/6/2024 | 8 | 60 | |

≥ 2 calendar days of stable daily minimum $FiO_2$ values

# Meeting VAC – Baseline Period of Improvement

Calculate VAC  Start Over

| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 8 | 35 | |
| 2 | 2/2/2024 | 8 | 35 | |
| 3 | 2/3/2024 | 8 | 30 | |
| 4 | 2/4/2024 | 8 | 55 | |
| 5 | 2/5/2024 | 8 | 55 | |
| 6 | 2/6/2024 | 8 | 60 | |

≥ 2 calendar days of **improving** daily minimum $FiO_2$ values

# Meeting VAC

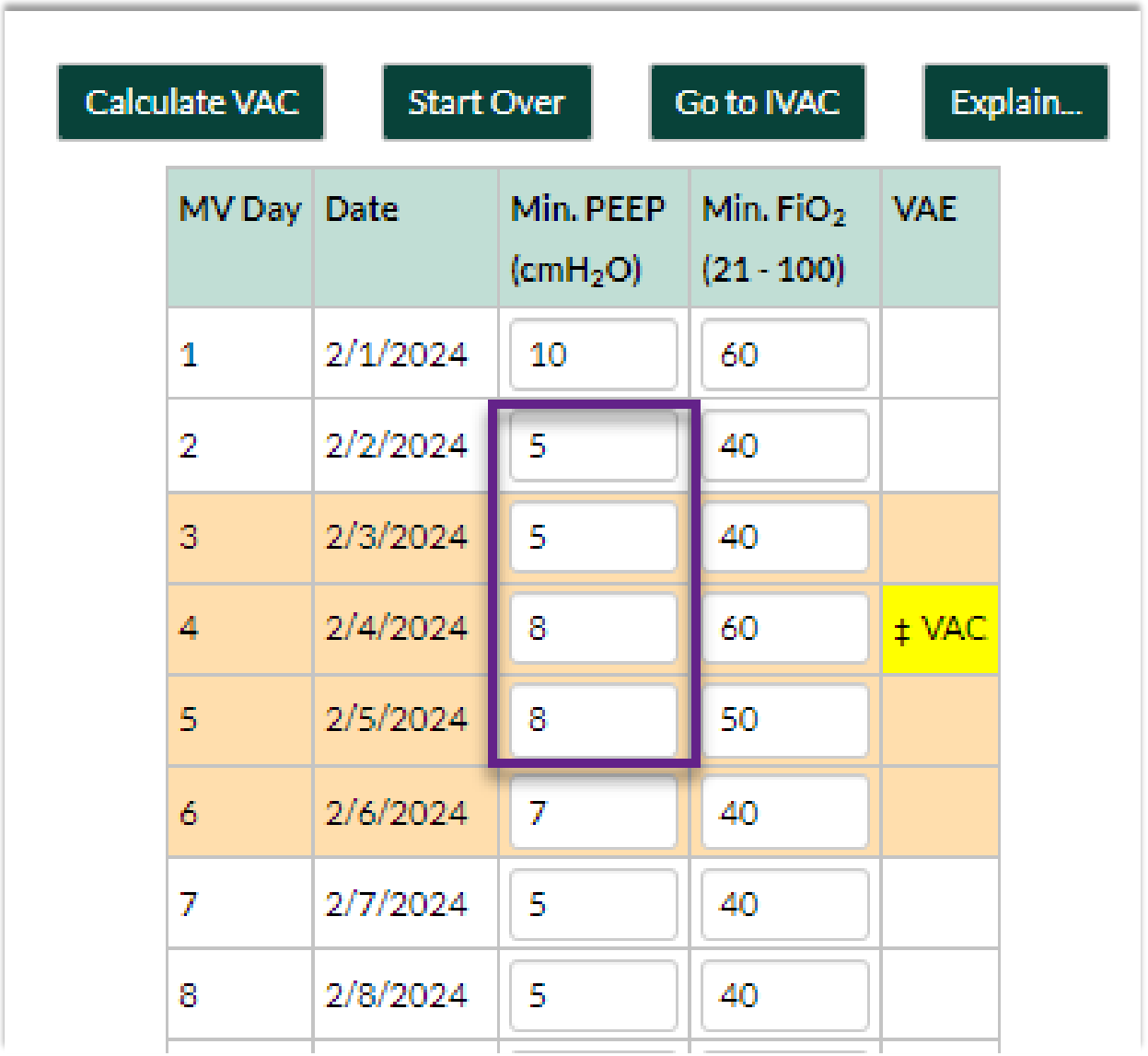
- 2-day period of **stability** (PEEP or FiO2)
- 2-day period of **worsening** (PEEP parameter)

Calculate VAC  Start Over

| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 10 | 60 | |
| 2 | 2/2/2024 | 5 | 40 | |
| 3 | 2/3/2024 | 5 | 40 | |
| 4 | 2/4/2024 | 8 | 60 | |
| 5 | 2/5/2024 | 8 | 50 | |
| 6 | 2/6/2024 | 7 | 40 | |
| 7 | 2/7/2024 | 5 | 40 | |
| 8 | 2/8/2024 | 5 | 40 | |

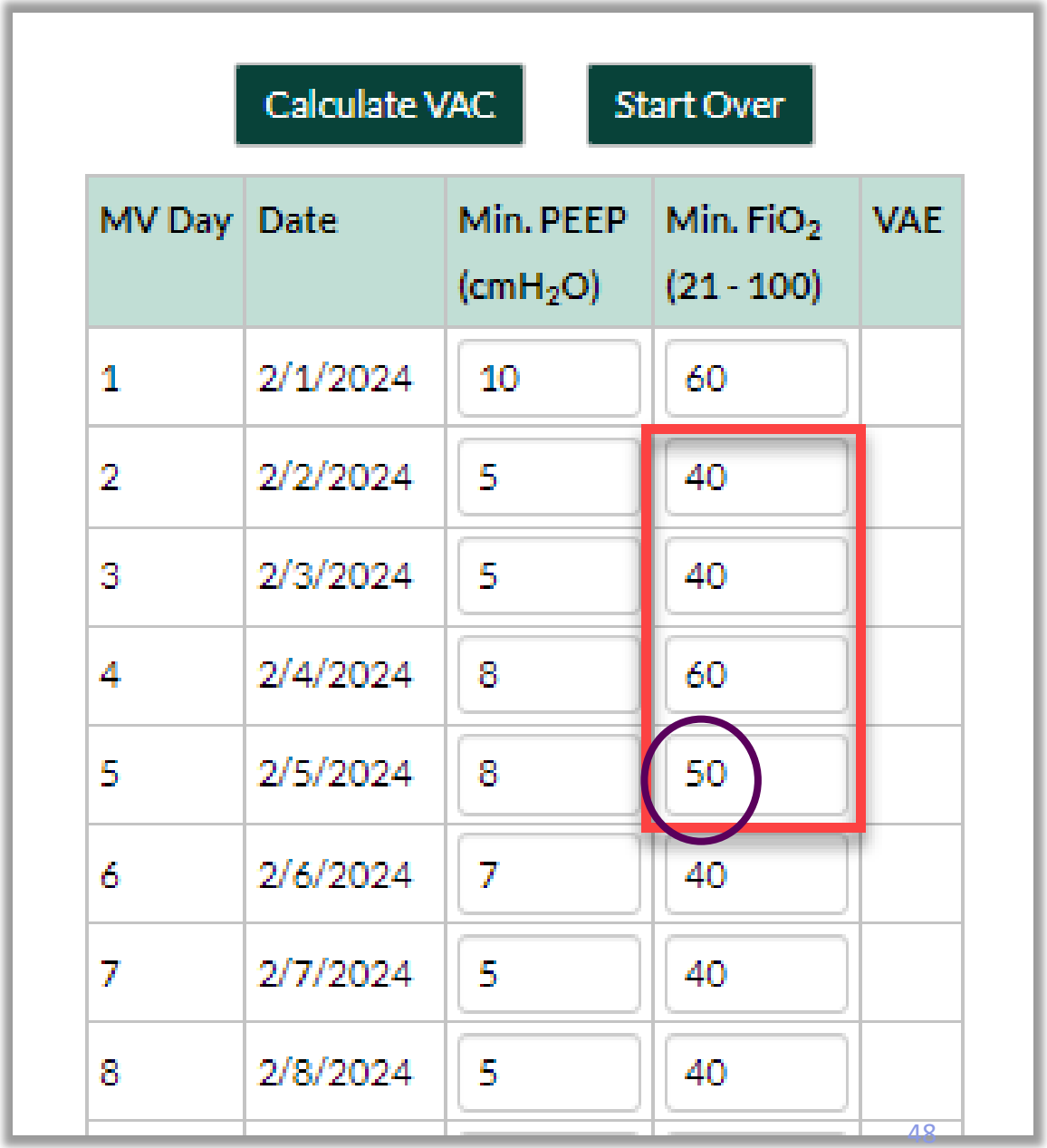
# Meeting VAC

- **VAC is met in the PEEP parameter**
  - Baseline period of ≥ 2 calendar days of stable daily minimum PEEP values
  - Increase in daily minimum PEEP values of ≥ 3 $cmH_2O$ over the daily minimum PEEP of the first day in the baseline period



# Meeting VAC

- **VAC is NOT met in the $FiO_2$ parameter**
  - Baseline period of ≥ 2 calendar days of improving daily minimum PEEP values
  - However, the increase in daily minimum $FiO_2$ values of ≥ 0.20 (20 points) over the daily minimum $FiO_2$ of the <u>first day</u> in the baseline period is NOT sustained at the required threshold for at least 2 days (50 on MV day 5).




| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 10 | 60 | |
| 2 | 2/2/2024 | 5 | 40 | |
| 3 | 2/3/2024 | 5 | 40 | |
| 4 | 2/4/2024 | 8 | 60 | |
| 5 | 2/5/2024 | 8 | 50 | |
| 6 | 2/6/2024 | 7 | 40 | |
| 7 | 2/7/2024 | 5 | 40 | |
| 8 | 2/8/2024 | 5 | 40 | |

# Meeting VAC - cont.

- **VAC is NOT met in the PEEP parameter**
  - Baseline period of ≥ 2 calendar days of improving daily minimum PEEP values
  - Increase in daily minimum PEEP values does not meet worsening oxygenation criteria of ≥ 3 $cmH_2O$ over the daily minimum PEEP of the <u>first day</u> in the baseline period.

NHSN Ventilator-Associated Event (VAE) Calculator Ver. 9.0

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

Calculate VAC | Start Over

| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 10 | | |
| 2 | 2/2/2024 | 7 | | |
| 3 | 2/3/2024 | 5 | | |
| 4 | 2/4/2024 | 8 | | |
| 5 | 2/5/2024 | 8 | | |
| 6 | 2/6/2024 | 7 | | |
| 7 | 2/7/2024 | 5 | | |
| 8 | 2/8/2024 | 5 | | |

# Meeting VAC - cont.

- **VAC is met in the PEEP parameter**
  - Baseline period of ≥ 2 calendar days of stable daily minimum PEEP values
  - Increase in daily minimum PEEP values of ≥ 3 $cmH_2O$ over the daily minimum PEEP of the first day in the baseline period is maintained for at least 2 days

NHSN Ventilator-Associated Event (VAE) Calculator Ver. 9.0

A Ventilator-Associated Condition (VAC) based on PEEP values occurred on 2/4/2023

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.

Calculate VAC | Start Over | Go to IVAC | Explain...

| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 10 | | |
| 2 | 2/2/2024 | 5 | | |
| 3 | 2/3/2024 | 5 | | |
| 4 | 2/4/2024 | 10 | | ‡ VAC |
| 5 | 2/5/2024 | 8 | | |
| 6 | 2/6/2024 | 7 | | |
| 7 | 2/7/2024 | 5 | | |
| 8 | 2/8/2024 | 5 | | |

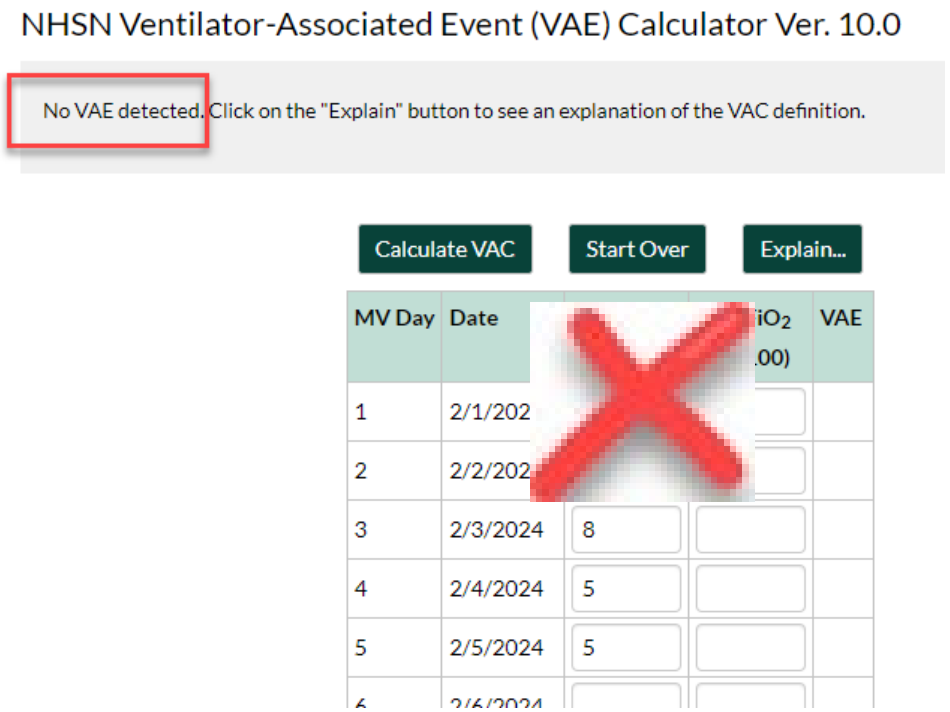
# Date of Event

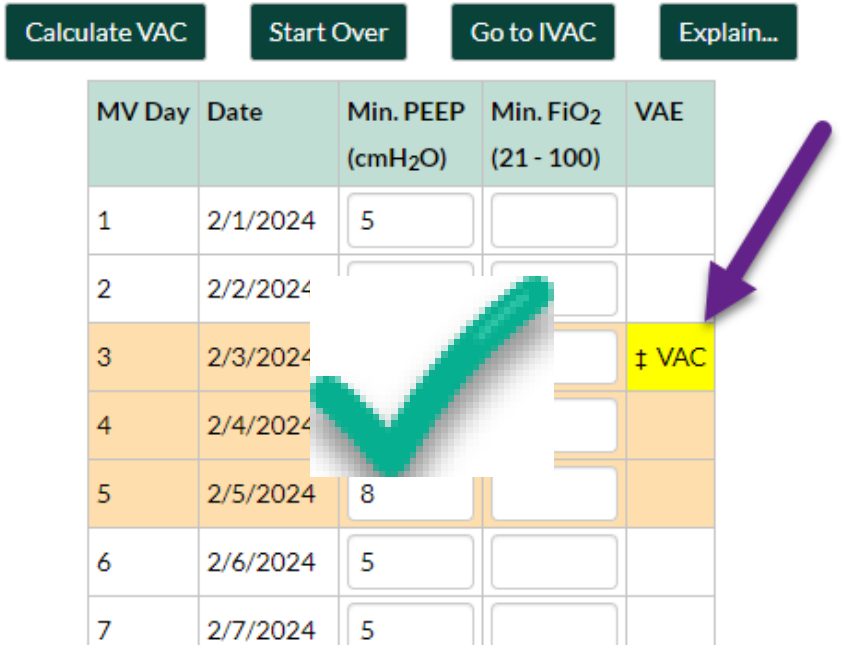
- The date of onset of worsening oxygenation (day 1 of the required ≥ 2-day period of worsening oxygenation following a ≥ 2-day period of stability or improvement on the ventilator).
  - *It is not the date on which all VAE criteria are met.*
  - *It is not the date of the first day of the baseline period.*
- 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

# Back to the VAE calculator!

- While the earliest date VAE can be met is MV day 3, the first two days of ventilator settings can still be used to establish the baseline period of stability or improvement. DMV for MV days 1 and 2 should included when assessing for VAE:

| MV Day | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| PEEP | 5 | 5 | 8 | 8 | 8 | 5 | 5 |



# Date of Event = Vent Day 4 (first day of worsening oxygenation)

Calculate VAC | Start Over | Go to IVAC | Explain...

| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 10 | | |
| 2 | 2/2/2024 | 5 | | |
| 3 | 2/3/2024 | 5 | | |
| 4 | 2/4/2024 | 10 | | ‡ VAC |
| 5 | 2/5/2024 | 8 | | |
| 6 | 2/6/2024 | 7 | | |
| 7 | 2/7/2024 | 5 | | |
| 8 | 2/8/2024 | 5 | | |

Date of Event (DOE)

# Why is the Date of Event Important?

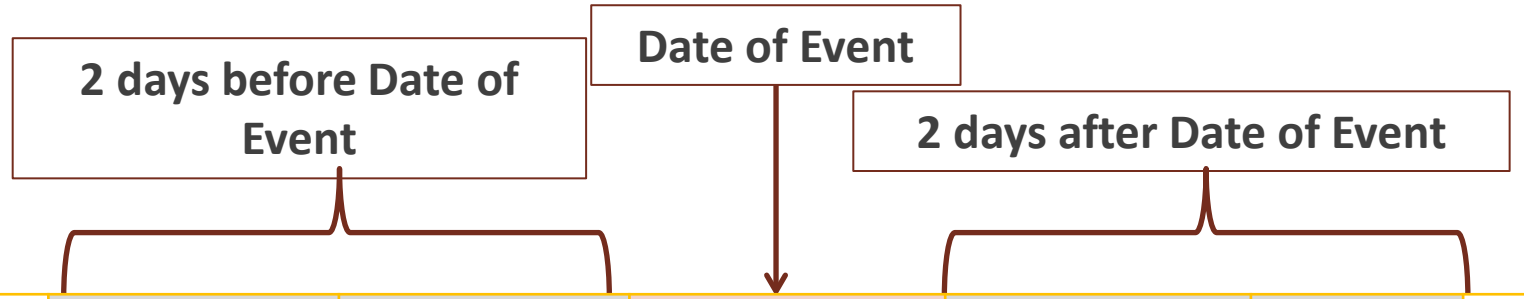
- Defines the **VAE Window Period**
  - Period during which criteria for other events—IVAC, PVAP—must be met
- Sets the **VAE 14-day Event Period**
  - Day 1 is the Date of Event—so if June 1 is date of onset of worsening oxygenation and a VAC is reported, a second VAE cannot be detected and reported 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

# VAE Window Period

- This is the period of days around the Date of Event (specifically, 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 date of event.

# VAE Window Period




| MV Day | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|
| **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 QADs→ | | | | | |
| **Purulent respiratory secretions, positive culture, positive histopathology** | | ←Collected within this shaded period→ | | | | | |

# VAE Window Period - cont.

2 days before Date of Event

Date of Event

2 days after Date of Event

| MV Day | Date | Min. PEEP ($cmH_2O$) | Min. $FiO_2$ (21 - 100) | VAE |
|---|---|---|---|---|
| 1 | 2/1/2024 | 5 | | |
| 2 | 2/2/2024 | 5 | | |
| 3 | 2/3/2024 | 5 | | |
| 4 | 2/4/2024 | 5 | | |
| 5 | 2/5/2024 | 5 | | |
| 6 | 2/6/2024 | 5 | | |
| 7 | 2/7/2024 | 8 | | ‡ VAC |
| 8 | 2/8/2024 | 8 | | |
| 9 | 2/9/2024 | 8 | | |
| 10 | 2/10/2024 | 5 | | |
| 11 | 2/11/2024 | | | |

# VAE Window Period: Important Note

- There is an exception in which the VAE Window Period is only 3 or 4 days
- In cases where the VAE event date corresponds to MV day 3 or day 4, the VAE Window Period may only be a 3-day or a 4-day window, because it can NOT include any days before the 3rd day of MV.
  - 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).
  - If the VAE event date is MV day 4, then the window period includes only the day before, the day of, and the 2 days after the day of VAE onset

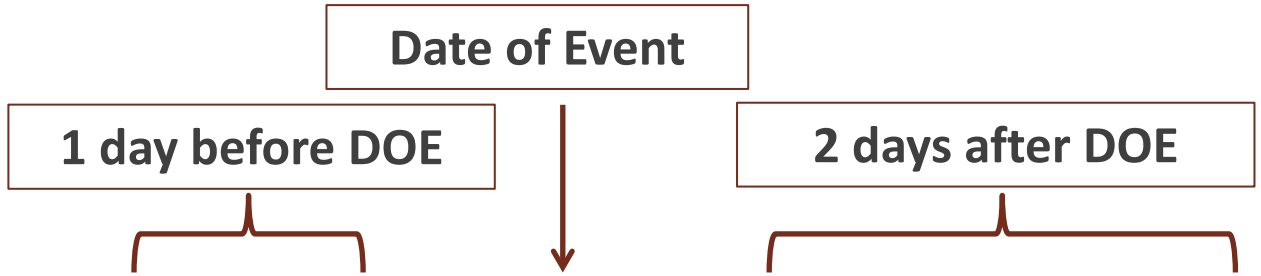
# Exception to VAE Window Period

Date of Event is MV day 3. MV Day 1 and 2 are not included in the VAE Window Period, so VAE Window Period is MV Days 3-5.


| MV Day No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **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 within this shaded period, and then continued for at least 4 QADs→ | | | | |
| **Purulent respiratory secretions, positive culture, positive histopathology** | | | ←Collected within this shaded period→ | | | | |

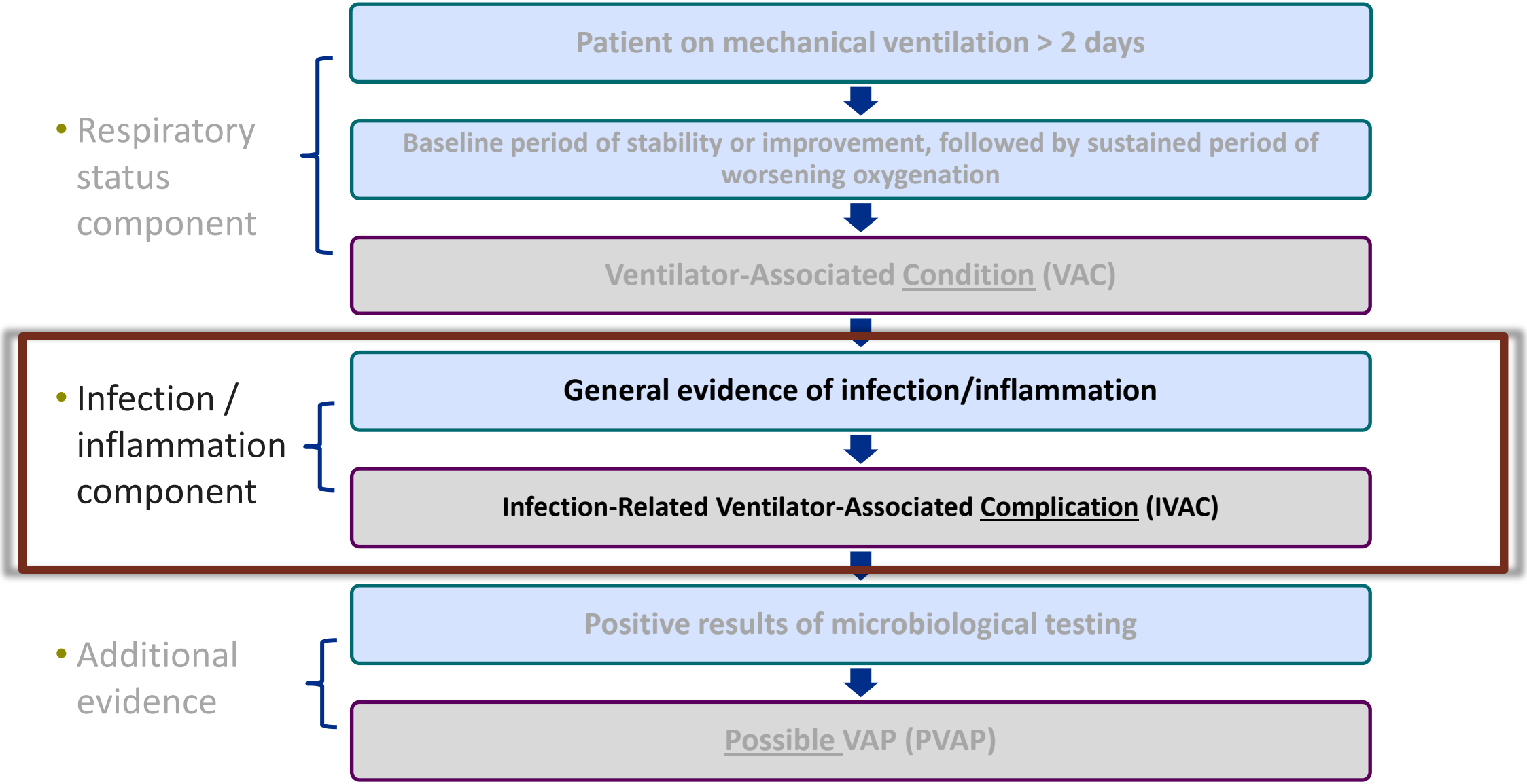
# Exception to VAE Window Period - cont.

- Date of Event (DOE) is MV day 4.
- MV Day 1 and 2 are not included in the VAE Window Period, so VAE Window Period is MV Days 3-6.



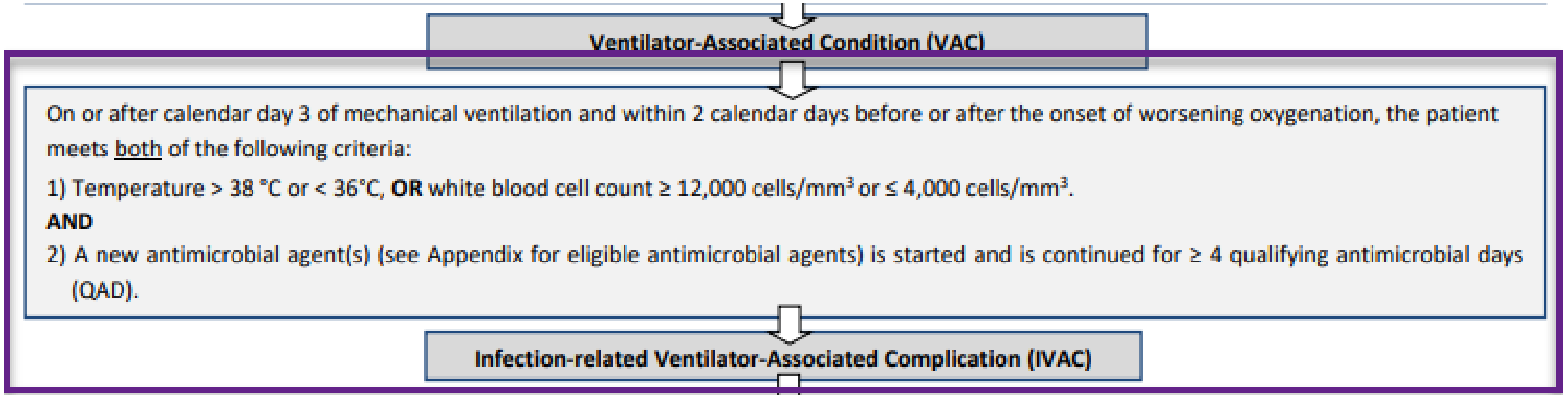

| MV Day No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **Worsening oxygenation** | | Day 1 of stability or improvement | Day 2 of stability or improvement | Day 1 of worsening oxygenation | Day 2 of worsening oxygenation | | | |
| **Temperature or WBC abnormality** | | | ←Documented within this shaded period→ | | | | | |
| **Antimicrobial agent** | | | ←Started within this shaded period, and then continued for at least 4 QADs→ | | | | | |
| **Purulent respiratory secretions, positive culture, positive histopathology** | | | ←Collected within this shaded period→ | | | | | |

# VAE Definition Algorithm Summary - cont.




- Respiratory status component
- Infection / inflammation component
- Additional evidence

# Tier 2: IVAC


Ventilator-Associated Condition (VAC)
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) (see Appendix for eligible antimicrobial agents) is started and is continued for ≥ 4 qualifying antimicrobial days (QAD).
Infection-related Ventilator-Associated Complication (IVAC)

# Temperature and White Blood Cell (WBC) Count

As long as there is an abnormal temperature (> 38 °C or < 36°C) OR abnormal WBC count (≥ 12,000 or ≤ 4,000 cells/mm3) documented during the VAE Window Period, it should be used in determining whether the patient meets the IVAC definition, regardless of whether an abnormal temperature or abnormal WBC count was also present on admission or outside the VAE Window Period.

# Look for Abnormal Temperature or Abnormal WBC Count During VAE Window Period

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | Abx | Spec | Polys /Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | | | | |
| 3 | 5 | 40 | 35.8 | 37.6 | 7.1 | 10.3 | | | | |
| 4 | 5 | 60 | 36.1 | 39.2 | 3.6 | 4.2 | | | | |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | | | | |
| 6 | 8 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | | | | |
| 7 | 8 | 40 | 36.6 | 37.7 | 5.6 | 8.0 | | | | |
| 8 | 5 | 40 | | | | | | | | |

# What is a “New” Antimicrobial Agent:

- **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
  - The agent is considered “new” if it was NOT given to the patient on either of the 2 days preceding the current start date
  - The new agent must be administered IV, IM, via digestive tract, or via respiratory tract
  - A new agent must be continued for ≥ 4 qualifying antimicrobial days

# Qualifying Antimicrobial Days (QAD)

- QAD is 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
  - 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
  - There is no requirement that the same antimicrobial agent be given on the 4 qualifying antimicrobial days
  - QADs can accrue outside the VAE Window Period

# Date of Initiation of Antimicrobial Agent is Important

## NHSN Ventilator-Associated Event (VAE) Calculator Ver. 10.0

Now that a VAC determination has been made, enter yes (check) or no (leave box unchecked) if the patient has had a temperature > 38° C or < 36° C or a WBC ≥ 12,000 cells/$mm^3$ or ≤ 4,000 cells/$mm^3$ within the VAE Window Period. Choose a drug from the drop down list and **check all the corresponding days shown on the screen** that the agent was administered. If more than one drug was given over the course of treatment, click on the "Add..." button in the drug column header and do the same. Once all data have been entered, **click the "Calculate IVAC" button.**

Start Over | Calculate IVAC | Explain...

| MV Day | Date | Hide... Min. PEEP ($cmH_2O$) | Hide... Min. $FiO_2$ (21 - 100) | VAE | T<36° or T>38° | WBC ≤ 4,000 or WBC ≥ 12,000 cells/$mm^3$ | Add... Remove... Choose a Drug: Choose a Drug | QAD |
|---|---|---|---|---|---|---|---|---|
| 1 | 2/1/2024 | 5 | | | | | ☐ | |
| 2 | 2/2/2024 | 5 | | | | | ☐ | |
| † 3 | 2/3/2024 | 5 | | | ☐ | ☐ | ☐ | |
| † 4 | 2/4/2024 | 8 | | ‡ VAC | ☐ | ☐ | ☐ | |
| † 5 | 2/5/2024 | 8 | | | ☐ | ☐ | ☐ | |
| † 6 | 2/6/2024 | 8 | | | ☐ | ☐ | ☐ | |
| 7 | 2/7/2024 | | | | | | ☐ | |

# No QADs – VAC Determination

**NEW: Initiated on or after the third calendar day of mechanical ventilation and in the VAE Window Period**

No IVACs were found for this patient. You should report the event as a VAC. Click on the "Explain..." button for an explanation of ho

Start Over | Calculate IVAC | Explain...

| MV Day | Date | Hide... Min. PEEP ($cmH_2O$) | Hide... Min. $FiO_2$ (21 - 100) | VAE | T<36° or T>38° | WBC ≤ 4,000 or WBC ≥ 12,000 cells/$mm^3$ | Add... Remove... Choose a Drug: AMIKACIN | QAD |
|---|---|---|---|---|---|---|---|---|
| 1 | 2/1/2024 | 5 | | | | | ☐ | |
| 2 | 2/2/2024 | 5 | | | | | ☑ | |
| † 3 | 2/3/2024 | 5 | | | ☑ | ☑ | ☑ | |
| † 4 | 2/4/2024 | 5 | | | ☐ | ☐ | ☑ | |
| † 5 | 2/5/2024 | 8 | | ‡ VAC | ☐ | ☐ | ☑ | |
| † 6 | 2/6/2024 | 8 | | | ☐ | ☐ | ☑ | |
| † 7 | 2/7/2024 | 8 | | | ☐ | ☐ | ☐ | |
| 8 | 2/8/2024 | | | | | | ☐ | |

Started before MV day 3 and outside the VAE Window Period – not a "new" antimicrobial agent

# Qualifying Antimicrobial Days

**NEW:** Initiated on or after the third calendar day of mechanical ventilation and in the VAE Window Period

| MV Day | Date | Hide... Min. PEEP ($cmH_2O$) | Hide... Min. $FiO_2$ (21 - 100) | VAE | T<36° or T>38° | WBC ≤ 4,000 or WBC ≥ 12,000 cells/$mm^3$ | Choose a Drug: CEFTAZIDIME | |
|---|---|---|---|---|---|---|---|---|
| 2 | 2/3/2024 | 5 (2)* | 40 | | | | ☐ | |
| 3 | 2/4/2024 | 5 | 40 | | | | ☐ | |
| † 4 | 2/5/2024 | 5 | 40 | | ☑ | ☐ | ☐ | |
| † 5 | 2/6/2024 | 5 | 40 | | ☐ | ☐ | ☐ | |
| † 6 | 2/7/2024 | 10 | 40 | ‡ IVAC | ☐ | ☐ | ☐ | |
| † 7 | 2/8/2024 | 10 | 40 | | ☐ | ☐ | ☑ | ¶ yes |
| † 8 | 2/9/2024 | | | | ☐ | ☐ | ☑ | ¶ yes |
| 9 | 2/10/2024 | | | | | | ☑ | ¶ yes |
| 10 | 2/11/2024 | | | | | | ☑ | ¶ yes |
| 11 | 2/12/2024 | | | | | | ☐ | |
| 12 | 2/13/2024 | | | | | | ☐ | |

# QADs: Same Agent

- Days between administrations of the **SAME** 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**.

| MV Day | Date | Hide... Min. PEEP ($cmH_2O$) | Hide... Min. $FiO_2$ (21 - 100) | VAE | T<36° or T>38° | WBC ≤ 4,000 or WBC ≥ 12,000 $cells/mm^3$ | Add... Remove... Choose a Drug: CEFTAZIDIME | QAD |
|---|---|---|---|---|---|---|---|---|
| 2 | 2/3/2024 | 5 (2)* | 40 | | | | ☐ | |
| 3 | 2/4/2024 | 5 | 40 | | | | ☐ | |
| † 4 | 2/5/2024 | 5 | 40 | | ☑ | ☐ | ☐ | |
| † 5 | 2/6/2024 | 5 | 40 | | ☐ | ☑ | ☑ | ¶ yes |
| † 6 | 2/7/2024 | 10 | 40 | ‡ IVAC | ☐ | ☐ | ☐ → | ¶ yes |
| † 7 | 2/8/2024 | 10 | 40 | | ☐ | ☐ | ☑ | ¶ yes |
| † 8 | 2/9/2024 | | | | ☐ | ☐ | ☐ → | ¶ yes |
| 9 | 2/10/2024 | | | | | | ☑ | ¶ yes |
| 10 | 2/11/2024 | | | | | | ☐ | |

- Ceftazidime is administered on MV days 5, 7, 9 but not MV days 6 and 8. This represents 5 consecutive QADs.

# QADs: Different Agents

- The requirement for 4 QADs can be met with multiple antimicrobial agents, as long as each antimicrobial agent was determined to be **new**.

| MV Day | Date | Hide... Min. PEEP ($cmH_2O$) | Hide... Min. $FiO_2$ (21 - 100) | VAE | T<36° or T>38° | WBC ≤ 4,000 or WBC ≥ 12,000 cells/$mm^3$ | Add... Remove... Choose a Drug: CEFTAZIDIME | Add... Remove... Choose a Drug: MEROPENEM | QAD |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 2/3/2024 | 5 (2)* | 40 | | | | ☐ | ☐ | |
| 3 | 2/4/2024 | 5 | 40 | | | | ☐ | ☐ | |
| † 4 | 2/5/2024 | 5 | 40 | | ☑ | ☐ | ☑ | ☐ | ¶ yes |
| † 5 | 2/6/2024 | 5 | 40 | | ☐ | ☐ | ☑ | ☐ | ¶ yes |
| † 6 | 2/7/2024 | 10 | 40 | ‡ IVAC | ☐ | ☐ | ☑ | ☐ | ¶ yes |
| † 7 | 2/8/2024 | 10 | 40 | | ☐ | ☐ | ☐ | ☑ | ¶ yes |
| † 8 | 2/9/2024 | | | | ☐ | ☐ | ☐ | ☑ | ¶ yes |
| 9 | 2/10/2024 | | | | | | ☐ | ☑ | ¶ yes |
| 10 | 2/11/2024 | | | | | | ☐ | ☐ | |
| 11 | 2/12/2024 | | | | | | ☐ | ☐ | |
| 12 | 2/13/2024 | | | | | | ☐ | ☐ | |

# QADs: Different Agents - cont.

- Days between administration of **DIFFERENT** antimicrobial agents do NOT count as QADs

- Ceftazidime is administered MV days 4 and 5, and there is a gap on MV day 6 between different agents. Meropenem is administered MV days 7-9.
- MV day 6 does not count as a QAD. **Therefore, the 4 QAD criterion is NOT met.**

| MV Day | Date | Hide... Min. PEEP ($cmH_2O$) | Hide... Min. $FiO_2$ (21 - 100) | VAE | T<36° or T>38° | WBC ≤ 4,000 or WBC ≥ 12,000 cells/$mm^3$ | Remove... Choose a Drug: CEFTAZIDIME | Remove... Choose a Drug: MEROPENEM | |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 2/3/2024 | 5 (2)* | 40 | | | | ☐ | ☐ | |
| 3 | 2/4/2024 | 5 | 40 | | | | ☐ | ☐ | |
| † 4 | 2/5/2024 | 5 | 40 | | ☑ | ☐ | ☑ | ☐ | ¶ yes |
| † 5 | 2/6/2024 | 5 | 40 | | ☐ | ☐ | ☑ | ☐ | ¶ yes |
| † 6 | 2/7/2024 | 10 | 40 | ‡ VAC | ☐ | ☐ | ☐ | ☐ | |
| † 7 | 2/8/2024 | 10 | 40 | | ☐ | ☐ | ☐ | ☑ | ¶ yes |
| † 8 | 2/9/2024 | | | | ☐ | ☐ | ☐ | ☑ | ¶ yes |
| 9 | 2/10/2024 | | | | | | ☐ | ☑ | ¶ yes |
| 10 | 2/11/2024 | | | | | | ☐ | ☐ | |
| 11 | 2/12/2024 | | | | | | ☐ | ☐ | |
| 12 | 2/13/2024 | | | | | | ☐ | ☐ | |

## **FAQ:** 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?

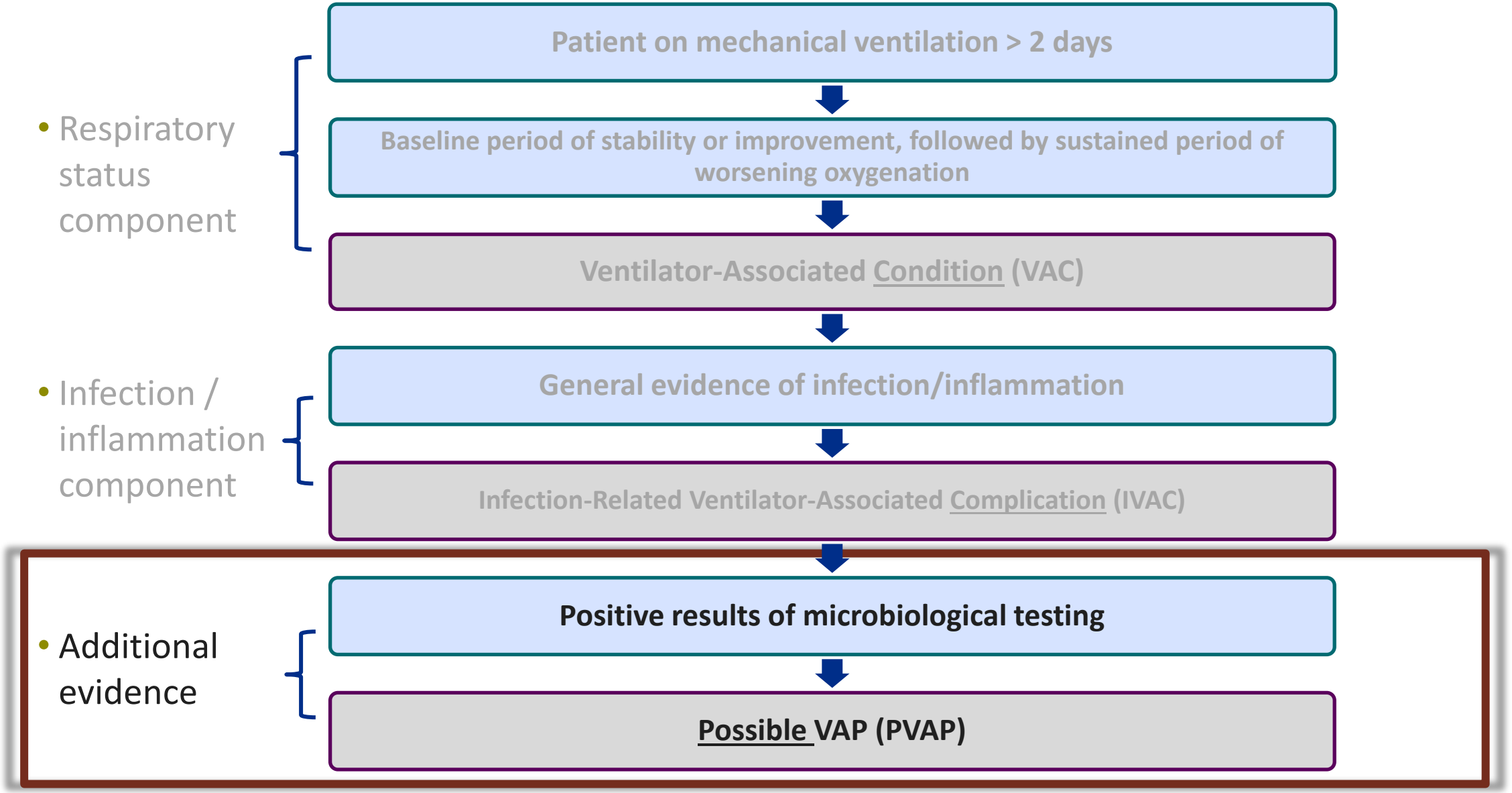
## Yes

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.

# IVAC and Antimicrobial Agents

- Meeting the 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.
  - It is 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, etc. is not a reason for exclusion

# VAE Definition Algorithm Summary - cont'd.



# Tier 3: PVAP

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 (**taking into account organism exclusions specified in the protocol**):

1) 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
2) Criterion 2: Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells per low power field [lpf, x100])† **PLUS** organism identified from one of the following specimens (to include qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet Criterion #1):
   - Sputum
   - Endotracheal aspirate
   - Bronchoalveolar lavage
   - Lung tissue
   - Protected specimen brush
3) Criterion 3: One of the following positive tests:
   - Organism identified from pleural fluid (where specimen was obtained during thoracentesis or within 24 hours of chest tube placement; pleural fluid specimens collected after a chest tube is repositioned or from a chest tube in place > 24 hours are not eligible for PVAP)
   - Lung histopathology, defined as: 1) abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli; 2) evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae, or yeast forms); 3) evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue
   - Diagnostic test for *Legionella* species
   - Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

† If the laboratory reports semi-quantitative results, those results must correspond to the quantitative thresholds. Refer to Table 2 and 3.

**Possible Ventilator-Associated Pneumonia (PVAP)**

# 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 (ETA), ≥ $10^5$ CFU/ml or corresponding semi-quantitative result
- Bronchoalveolar lavage (BAL), ≥ $10^4$ CFU/ml or corresponding semi-quantitative result
- Lung tissue, ≥ $10^4$ CFU/g or corresponding semi-quantitative result
- Protected specimen brush (PSB), ≥ $10^3$ 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 – they may be able to provide guidance

- If your laboratory does not have this information:
  - For the purposes of VAE surveillance, a semi-quantitative result of "moderate" "many" "numerous" or "heavy" growth, or 2+, 3+ or 4+ growth, meets the PVAP definition (Criterion 1).

- See **FAQ no. 24** in the VAE Protocol

*Reference: Garcia, LS (Ed.). (2010). Clinical Microbiology Procedures Handbook. Herndon, VA: ASM Press, page 3.2.1.16.

# PVAP – Criterion 2

Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain ≥25 neutrophils and ≤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 the laboratory for direction in interpreting your facility's reporting method
- If your laboratory cannot provide guidance on how to correlate your facility's reporting method to the purulent respiratory secretions quantitative definition, refer to **Table 2** or **FAQ no. 19** in the VAE protocol

*Reference: Garcia, LS (Ed.). (2010). Clinical Microbiology Procedures Handbook. Herndon, VA: ASM Press, page 3.2.1.16.

# Table 2

Some clinical laboratories use different result reporting formats for respiratory secretion direct examination results.

Table 2: Instructions for using the purulent respiratory secretions criterion, based on laboratory reporting of respiratory secretion direct examination results.

| How do I use the purulent respiratory secretions criterion if ... | Instruction |
|---|---|
| My laboratory reports counts of "white blood cells" or "polymorphonuclear leukocytes" or "leukocytes" rather than counts of "neutrophils"? | Assume that counts of cells identified by these other descriptors (for example, "white blood cells") are equivalent to counts of neutrophils, unless the laboratory tells you this is not the case. |
| My laboratory reports semi-quantitative results (not quantitative results) for numbers of neutrophils and squamous epithelial cells? | Check with the laboratory to get information about what quantitative ranges the semi-quantitative reports correspond to. |
| My laboratory cannot provide additional information on how its semi-quantitative reporting corresponds to quantitative reporting ranges for neutrophils and squamous epithelial cells? | Use the following direct examination results to meet the purulent respiratory secretions criterion: many, heavy, numerous, 4+, or ≥ 25 neutrophils per low power field (lpf) [x100], AND no, rare, occasional, few, 1+ or 2+, or ≤ 10 squamous epithelial cells per lpf [x100] [20]. |
| My laboratory reports only the numbers of neutrophils present, without reporting the number of squamous epithelial cells? | In this situation, the purulent secretions criterion may be met using the specified quantitative and semi-quantitative thresholds for neutrophils alone (specifically many, heavy, numerous, 4+, or ≥ 25 neutrophils per lpf [x100]). |
| My laboratory uses different reporting thresholds for neutrophils and squamous epithelial cells (for example, maximum report of ≥ 20 neutrophils per low power field [x100], or minimum report of ≤ 15 squamous epithelial cells per low power field [x100])? | 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. |
| My laboratory processes respiratory specimens such as bronchoalveolar lavage fluid using a centrifugation procedure (for example, "cytospin"), and there is no quantitation or semi-quantitation of neutrophils or white blood cells in the direct examination report? | In this situation, a report indicating the presence of white blood cells, without quantitation, is sufficient to meet the purulent secretions criterion. |

# PVAP – Criterion 3

**One of the following positive tests:**

- Organism identified from pleural fluid (where specimen was obtained during thoracentesis or within 24 hours of chest tube placement; pleural fluid specimens collected after a chest tube is repositioned or from a chest tube in place > 24 hours are not eligible for PVAP)
- Lung histopathology, defined as:
    1. abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli
    2. evidence of lung parenchyma invasion by fungi (hyphae, pseudo hyphae or yeast forms)
    3. evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue

# PVAP – Criterion 3 (continued)

**One of the following positive tests:**

- Diagnostic test for *Legionella* species
- Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

# Pathogen Reporting

- Pathogens may only be reported for PVAP events
  - Exception: excluded pathogens (see next slide)
- Pathogens are not reported for VAC or for IVAC

# Pathogen Exclusions

- "Normal respiratory flora," "normal oral flora," "mixed respiratory flora," "mixed oral flora," "altered oral flora" or other similar results indicating isolation of commensal flora of the oral cavity or upper respiratory tract
- ***Candida* species or yeast not otherwise specified**, **coagulase-negative *Staphylococcus* species,** and ***Enterococcus* species** only available for use as PVAP pathogens when isolated from lung tissue or pleural fluid
  - Cannot be used to meet PVAP definition when identified from sputum, endotracheal aspirates, bronchoalveolar lavage, or protected specimen brushings

## 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 if a pathogen is identified outside the VAE Window Period and then during the VAE Window Period the same pathogen is identified again. Can I use that pathogen identification to meet a PVAP criterion?

### Yes

- It does not matter if the patient had previous positive cultures for certain organisms—if an eligible pathogen is recovered from an eligible specimen with a collection date during the VAE window period, it should be used in determining if PVAP is met.

# Positive Quantitative or Semi-Quantitative* ETA Culture *(meeting specified threshold)*

| Vent Day | PEEPmin | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | QAD | Spec | Polys /Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | None | | | |
| 3 | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | None | ETA | | $10^5$ CFU/ml *S. aureus* |
| 4 | 8 | 60 | 38.1 | 39.2 | 14.5 | 16.8 | Yes | -- | -- | -- |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Yes | -- | | |
| 6 | 7 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Yes | -- | -- | --- |
| 7 | 5 | 40 | | | | | Yes | | | |

**PVAP Criterion 1 is met.**

*semi-quantitative result of “moderate” “many” “numerous” or “heavy” growth, or 2+, 3+ or 4+ growth (in a culture of lung tissue, BAL, PSB, or ETA) meets the PVAP surveillance definition.

# Meeting PVAP Criterion 2

| Vent Day | PEEPmin | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | QAD | Spec | Polys/ Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | e | | | |
| 3 | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | None | ETA | >25/ <10 | *S. aureus* |
| 4 | 8 | 60 | 38.1 | 39.2 | 14.5 | 16.8 | Yes | | | |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Yes | | | |
| 6 | 7 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Yes | -- | -- | --- |
| 7 | 5 | 40 | | | | | Yes | | | |
| 8 | 5 | 40 | | | | | | | | |

**Purulent respiratory secretions and ETA culture positive for *S. aureus (not meeting the specified threshold)***

**PVAP Criterion 2 is met.**

# Meeting PVAP Criterion 3

| Vent Day | PEEPmin | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | QAD | Spec | Polys/ Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | | | | |
| 3 | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | None | Pleural Fluid | | *Candida albicans* |
| 4 | 8 | 60 | 38.1 | 39.2 | 14.5 | 16.8 | Yes | -- | -- | -- |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Yes | | | |
| 6 | 7 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Yes | -- | -- | --- |
| 7 | 5 | 40 | | | | | Yes | | | |
| 8 | 5 | 40 | | | | | | | | |

**Positive pleural fluid, lung histopathology, *Legionella* or viral test result**

**PVAP Criterion 3 is met.**

# What about positive blood cultures that occur around the same time as a VAE?

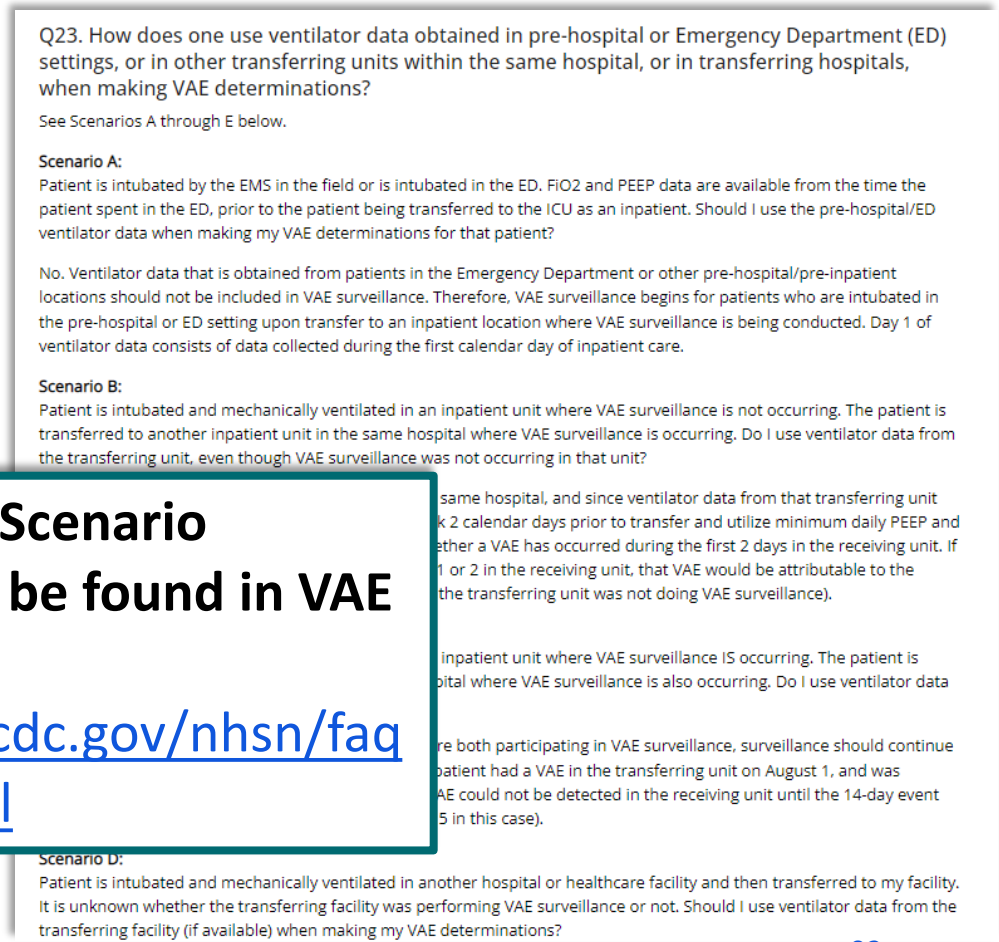
- Secondary BSIs are not reported for VAC or IVAC
- Secondary BSI may only be reported for PVAP
  - When at least one eligible organism from the blood culture specimen matches an eligible organism from an appropriate respiratory tract specimen collected during the VAE Window Period
  - When the blood culture was collected within the 14-day event period (VAE Date of Event is Day 1 of the 14-day event period)
- Secondary BSI may not be reported for PVAP:
  - In cases where PVAP is met with only the histopathology criterion and no culture or non-culture-based testing is performed on an eligible respiratory specimen
  - In cases where a culture or non-culture-based testing of respiratory secretions, pleural fluid, or lung tissue is performed and does not identify an organism that matches an organism identified from blood

# 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.



Q23. How does one use ventilator data obtained in pre-hospital or Emergency Department (ED) settings, or in other transferring units within the same hospital, or in transferring hospitals, when making VAE determinations?

See Scenarios A through E below.

**Scenario A:**
Patient is intubated by the EMS in the field or is intubated in the ED. FiO2 and PEEP data are available from the time the patient spent in the ED, prior to the patient being transferred to the ICU as an inpatient. Should I use the pre-hospital/ED ventilator data when making my VAE determinations for that patient?

No. Ventilator data that is obtained from patients in the Emergency Department or other pre-hospital/pre-inpatient locations should not be included in VAE surveillance. Therefore, VAE surveillance begins for patients who are intubated in the pre-hospital or ED setting upon transfer to an inpatient location where VAE surveillance is being conducted. Day 1 of ventilator data consists of data collected during the first calendar day of inpatient care.

**Scenario B:**
Patient is intubated and mechanically ventilated in an inpatient unit where VAE surveillance is not occurring. The patient is transferred to another inpatient unit in the same hospital where VAE surveillance is occurring. Do I use ventilator data from the transferring unit, even though VAE surveillance was not occurring in that unit?

same hospital, and since ventilator data from that transferring unit
k 2 calendar days prior to transfer and utilize minimum daily PEEP and
ether a VAE has occurred during the first 2 days in the receiving unit. If
1 or 2 in the receiving unit, that VAE would be attributable to the
the transferring unit was not doing VAE surveillance).

inpatient unit where VAE surveillance IS occurring. The patient is
ital where VAE surveillance is also occurring. Do I use ventilator data

re both participating in VAE surveillance, surveillance should continue
patient had a VAE in the transferring unit on August 1, and was
AE could not be detected in the receiving unit until the 14-day event
5 in this case).

**Scenario D:**
Patient is intubated and mechanically ventilated in another hospital or healthcare facility and then transferred to my facility. It is unknown whether the transferring facility was performing VAE surveillance or not. Should I use ventilator data from the transferring facility (if available) when making my VAE determinations?

**Transfer Rule Scenario Examples can be found in VAE FAQ #23:**
https://www.cdc.gov/nhsn/faqs/faq-vae.html

# Transfer from MICU to SICU on MV Day 2, Date of Event is MV Day 4 - therefore VAE is Attributed to SICU (more than one day since transfer)

| Vent Day | Location | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | Abx | Spec | Poly/E pis | Org |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MICU | 10 | 60 | | | | | | | | |
| 2 | MICU to SICU | 5 | 40 | | | | | None | | | |
| 3 | **SICU** | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | None | **Pleural Fluid** | | ***Candida albicans*** |
| 4 | **SICU** | 8 | 60 | 38.1 | 39.2 | 14.5 | 16.8 | Yes | -- | -- | -- |
| 5 | SICU | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Yes | -- | -- | -- |
| 6 | SICU | 7 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Yes | -- | -- | --- |
| 7 | SICU | 5 | 40 | | | | | Yes | | | |
| 8 | SICU | 5 | 40 | | | | | | | | |

# Transfer from MICU to SICU on MV Day 3, Date of Event is MV Day 4 - therefore VAE is Attributed to MICU (within 2 days of transfer)

| Vent Day | Location | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | Abx | Spec | Poly/Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MICU | 10 | 60 | | | | | | | | |
| 2 | MICU | 5 | 40 | | | | | None | | | |
| 3 | **MICU to SICU** | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | None | **Pleural Fluid** | | ***Candida albicans*** |
| 4 | **SICU** | 8 | 60 | 38.1 | 39.2 | 14.5 | 16.8 | Yes | -- | -- | -- |
| 5 | SICU | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Yes | -- | -- | -- |
| 6 | SICU | 7 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Yes | -- | -- | --- |
| 7 | SICU | 5 | 40 | | | | | Yes | | | |
| 8 | SICU | 5 | 40 | | | | | | | | |

# Tips for VAE Surveillance and Reporting

# VAE Resources

- Familiarize yourself with the VAE web page: https://www.cdc.gov/nhsn/psc/vae/index.html
  - Review the Supporting Materials section
- Read the protocol: https://www.cdc.gov/nhsn/pdfs/pscmanual/10-vae_final.pdf
- Review the FAQs
  - Protocol FAQs – starting on page 10-28
  - FAQs found on the VAE web page: https://www.cdc.gov/nhsn/faqs/faq-vae.html
- VAE training resources: https://www.cdc.gov/nhsn/training/patient-safety-component/vae.html
- Use the VAE Calculator: https://www.cdc.gov/nhsn/vae-calculator/index.html

# VAE Reporting – Event Data

- When conducting in-plan reporting (selected in your monthly reporting plan) you must report all events detected and at the highest level of the algorithm that is met.
- Assess patients for ALL events: VAC, IVAC, and PVAP
- Hierarchy of definitions:
  - If a patient meets VAC only, report as VAC
  - If a patient meets criteria for VAC and IVAC, report as IVAC only
  - If a patient meets criteria for VAC, IVAC and PVAP, report PVAP only
- Review the VAE Event Form and Table of Instructions on the VAE webpage

# Steps in Monitoring for a VAE

- For every patient receiving mechanical ventilation, determine daily minimum $FiO_2$ and PEEP values from the documented ventilator settings
  - https://www.cdc.gov/nhsn/pdfs/vae/VAE_DataCollectionWorksheet_FINAL.pdf
- For patients meeting VAC, determine Date of Event and set VAE Window Period
  - Review medical record for qualifying temperature and WBC counts within VAE window period
  - If temperature/WBC count parameter is met, review MAR for new antimicrobials and QADs
  - https://www.cdc.gov/nhsn/pdfs/vae/VAE_AntimicrobialWorksheet_FINAL.pdf
- For patients meeting IVAC, review laboratory results for specimens with collection dates during the VAE window period
  - Determine if results from eligible specimens meet a PVAP criterion

# Tips for VAE Surveillance

- Establish relationships with **Respiratory Therapy and Critical Care colleagues**:
  - Share the protocol and FAQs
  - Discuss options for collection of minimum daily PEEP and $FiO_2$ for each MV day (IP, RT, electronically generated)
  - Inquire about the frequency of use of excluded therapies (HFV, ECLS) and APRV, and how to identify these patients
- Determine your **laboratory's** approach to Gram stain and culture result reporting
  - Share the protocol and FAQs
  - How does your hospital laboratory report Gram stain results?
  - Does your hospital laboratory report culture results semi-quantitatively?
  - What quantitative ranges correspond to the semi-quantitative reports?
  - Where will you find histopathology/cytology reports?

# VAE Reporting – Denominator Data

- Collect device (ventilator) days and patient days at the same time each day
- Patient days
  - Number of patients in the chosen location at the time of the count
- Ventilator days
  - Number of patients in the chosen location who are on a mechanical ventilator at the time of the count
  - All patients (not just those eligible for VAE surveillance) are counted to include those on a ventilator < 3 days, those receiving excluded therapies, etc.
- Review the Denominator Forms and Tables of Instructions on the VAE webpage
- https://www.cdc.gov/nhsn/pdfs/vae/VAEMVtable-current.pdf

# Ventilator Associated Event (VAE) – Case Scenario

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National Healthcare Safety Network

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# Case Example

- The patient presents to the ED at 9pm on 2/1 with an admitting diagnosis of influenza with a suspicion of a complication related to bacterial pneumonia.
- The patient experiences respiratory distress and is intubated and placed on the ventilator in the ED.
- The patient remains in the ED for a couple of hours before admission to an inpatient unit.
- The patient is admitted to an adult inpatient location (ICU) at 11:30pm on 2/1 (same day).
- VAE surveillance is selected in the monthly reporting plan for the adult ICU.

# What are the Daily Minimum $FiO_2$ and PEEP Values for the Patient on 2/1?

- 0.40 and 5
- 0.40 and 8
- 0.40 and 10
- 0.60 and 10

| Date and Time | February 1 2100 | 2200 | 2330 | February 2 2400 (midnight) | 0300 | 1200 | 1500 | 2000 | 2200 |
|---|---|---|---|---|---|---|---|---|---|
| Location | ED | ED | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** |
| $FiO_2$ | 0.40 | 0.40 | 0.60 | 0.70 | 0.40 | 0.40 | 0.75 | 0.75 | 0.75 |
| PEEP | 5 | 8 | 10 | 10 | 8 | 8 | 5 | 8 | 8 |

# What are the Daily Minimum $FiO_2$ and PEEP Values for the Patient on 2/1? - cont.

- 0.40 and 5
- 0.40 and 8
- 0.40 and 10
- **0.60 and 10**

| Date and Time | February 1 2100 | 2200 | 2330 | February 2 2400 (midnight) | 0300 | 1200 | 1500 | 2000 | 2200 |
|---|---|---|---|---|---|---|---|---|---|
| Location | ED | ED | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** |
| $FiO_2$ | 0.40 | 0.40 | 0.60 | 0.70 | 0.40 | 0.40 | 0.75 | 0.75 | 0.75 |
| PEEP | 5 | 8 | 10 | 10 | 8 | 8 | 5 | 8 | 8 |

# Explanation: Daily Minimum $FiO_2$ and PEEP Values for the Patient on 2/1 are $FiO_2$ of 0.60 and PEEP of 10

- Ventilator data obtained from patients in the Emergency Department or other pre-hospital/pre-inpatient locations should not be included in VAE surveillance. Only ventilator settings that are documented while an admitted patient is located in an adult inpatient location are used to make a VAE determination.
- When no $FiO_2$ or PEEP value is documented to have been maintained for > 1 hour, the daily minimum $FiO_2$ or PEEP should default to the lowest setting documented during the calendar day (regardless of how long that setting was maintained).

| Date and Time | February 1 2100 | 2200 | 2330 | February 2 2400 (midnight) | 0300 | 1200 | 1500 | 2000 | 2200 |
|---|---|---|---|---|---|---|---|---|---|
| Location | ED | ED | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** | **ICU** |
| $FiO_2$ | 0.40 | 0.40 | 0.60 | 0.70 | 0.40 | 0.40 | 0.75 | 0.75 | 0.75 |
| PEEP | 5 | 8 | 10 | 10 | 8 | 8 | 5 | 8 | 8 |

# Case Example - cont.

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | ABX | Spec | Polys /Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 10 | 60 | | | | | | | | |
| **2** | 5 | 40 | | | | | Ceftriaxone | | | |
| **3** | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | Ceftriaxone | | | |
| **4** | 5 | 55 | 38.1 | 39.2 | 14.5 | 16.8 | Ceftriaxone | BAL | | 3+ *P. aeruginosa* |
| **5** | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Ceftriaxone | | | |
| **6** | 8 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Ceftriaxone | | | |
| **7** | 8 | 40 | | | | | | | | |
| **8** | 5 | 30 | | | | | | | | |

# Is a VAE Identified for this Patient?

- Yes
- No, the patient had pneumonia on admission and is excluded from VAE surveillance

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | ABX | Spec | Polys /Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | Ceftriaxone | | | |
| 3 | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | Ceftriaxone | | | |
| 4 | 5 | 55 | 38.1 | 39.2 | 14.5 | 16.8 | Ceftriaxone | BAL | | 3+ *P. aeruginosa* |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Ceftriaxone | | | |
| 6 | 8 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Ceftriaxone | | | |
| 7 | 8 | 40 | | | | | | | | |
| 8 | 5 | 30 | | | | | | | | |

# Is a VAE Identified for this Patient? - cont.

- **Yes** – VAC is met in the PEEP parameter

- ~~No, the patient had pneumonia on admission and is excluded from VAE surveillance~~
  - There is no exclusion from meeting a VAE definition (VAC, IVAC, or PVAP) based on an underlying condition or diagnosis.

# Case Explanation

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp | WBC | WBC | ABX | Spec | Polys | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | | | | |
| 3 | 5 | 40 | 36.9 | | | | | | | |
| 4 | 5 | 55 | 38.1 | | | | | | | 3+ *P. aeruginosa* |
| 5 | 8 | 50 | 38.4 | | | | | | | |
| 6 | 8 | 40 | 36.5 | | | | | | | |
| 7 | 8 | 40 | | | | | | | | |
| 8 | 5 | 30 | | | | | | | | |

- There are 2 calendar days of stable daily minimum PEEP values on MV day 3 and 4 (**baseline period of stability**).
- On MV day 5 the daily minimum PEEP meets the threshold for **worsening oxygenation with an increase of at least 3 cmH2O over the daily minimum PEEP on the first day in the baseline period (from 5 to 8)**.
- The increase is **maintained for at least 2 calendar days**, MV days 5 and 6.
- VAC is met in the PEEP parameter with a date of event on MV day 5 (date of onset of worsening oxygenation).

# Let's Continue Looking at the Same Patient:

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | ABX | Spec | Polys /Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 10 | 60 | | | | | | | | |
| **2** | 5 | 40 | | | | | Ceftriaxone | | | |
| **3** | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | Ceftriaxone | | | |
| **4** | 5 | 55 | 38.1 | 39.2 | 14.5 | 16.8 | Ceftriaxone | BAL | | 3+ *P. aeruginosa* |
| **5** | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Ceftriaxone | | | |
| **6** | 8 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Ceftriaxone | | | |
| **7** | 8 | 40 | | | | | | | | |
| **8** | 5 | 30 | | | | | | | | |

# What Level of the VAE Algorithm did this Patient Meet?

- VAC
- IVAC
- PVAP

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | ABX | Spec | Polys /Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | Ceftriaxone | | | |
| 3 | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | Ceftriaxone | | | |
| 4 | 5 | 55 | 38.1 | 39.2 | 14.5 | 16.8 | Ceftriaxone | BAL | | 3+ *P. aeruginosa* |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Ceftriaxone | | | |
| 6 | 8 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Ceftriaxone | | | |
| 7 | 8 | 40 | | | | | | | | |
| 8 | 5 | 30 | | | | | | | | |

# What Level of the VAE Algorithm did this Patient Meet? cont.

- **VAC**
- ~~IVAC~~
  - Antimicrobial was started outside the VAE Window Period and does not meet the definition of a "new" antimicrobial.
  - Although the temperature and WBC criteria for IVAC were met, both temp/WBC **and** QAD criteria must be met for IVAC.
- ~~PVAP~~
  - Although the semi-quantitative result of 3+ *P. aeruginosa* meets PVAP criterion 1 and was collected within the VAE Window Period, remember, **the VAE surveillance algorithm is progressive in terms of criteria to be met**. VAC must be met to assess for IVAC, IVAC must be met to assess for PVAP.

# Case Explanation

| Vent Day | PEEP min | $FiO_2$ min | Temp min | Temp max | WBC min | WBC max | ABX | Spec | Polys /Epis | Org |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 60 | | | | | | | | |
| 2 | 5 | 40 | | | | | Ceftriaxone | | | |
| 3 | 5 | 40 | 36.9 | 37.6 | 12.1 | 12.1 | Ceftriaxone | | | |
| 4 | 5 | 55 | 38.1 | 39.2 | 14.5 | 16.8 | Ceftriaxone | BAL | | *P. aeruginosa* |
| 5 | 8 | 50 | 38.4 | 38.9 | 12.6 | 15.9 | Ce | | | |
| 6 | 8 | 40 | 36.5 | 37.8 | 11.1 | 13.6 | Ce | | | |
| 7 | 8 | 40 | | | | | | | | |
| 8 | 5 | 30 | | | | | | | | |

- Temperature > 38 °C OR white blood cell count ≥ 12,000 cells/mm3 met within the VAE Window Period.
- Ceftriaxone started outside the VAE Window Period and therefore is not a "new" antimicrobial agent.
- **IVAC not met.**
- Will not progress to PVAP.

# Contact the NHSN Helpdesk with Any Questions

**NHSN-ServiceNow** to submit questions to the NHSN Help Desk.
The new portal can be accessed at **https://servicedesk.cdc.gov/nhsncsp**
Users will be authenticated using CDC's Secure Access Management Services (SAMS) the same way you access NHSN. If you do not have a SAMS login, or are unable to access ServiceNow, you can still email the NHSN Help Desk at nhsn@cdc.gov

**For more information please contact Centers for Disease Control and Prevention**
1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov