NHSN Annual Training

Ventilator-Associated Event (VAE): Surveillance Guidelines and Protocol Application 2026

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By the end of this lesson, you will be able to…

- Locate resources for VAE surveillance and reporting
- Explain VAE key terms
- Describe VAE surveillance algorithm
- Explain criteria for meeting each tier of the VAE algorithm
- Apply VAE criteria to case example

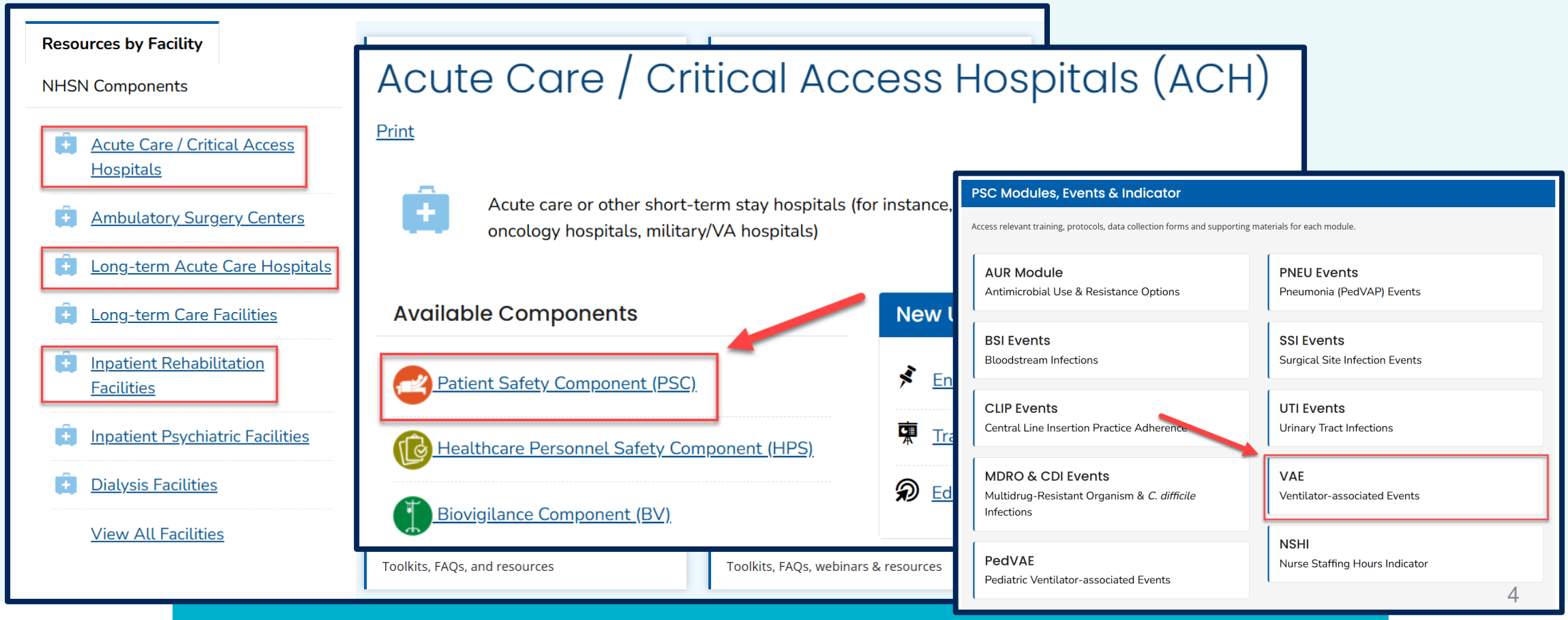
VAE Surveillance

Resources

VAE RESOURCES

Where do I find the VAE Surveillance Guidance?

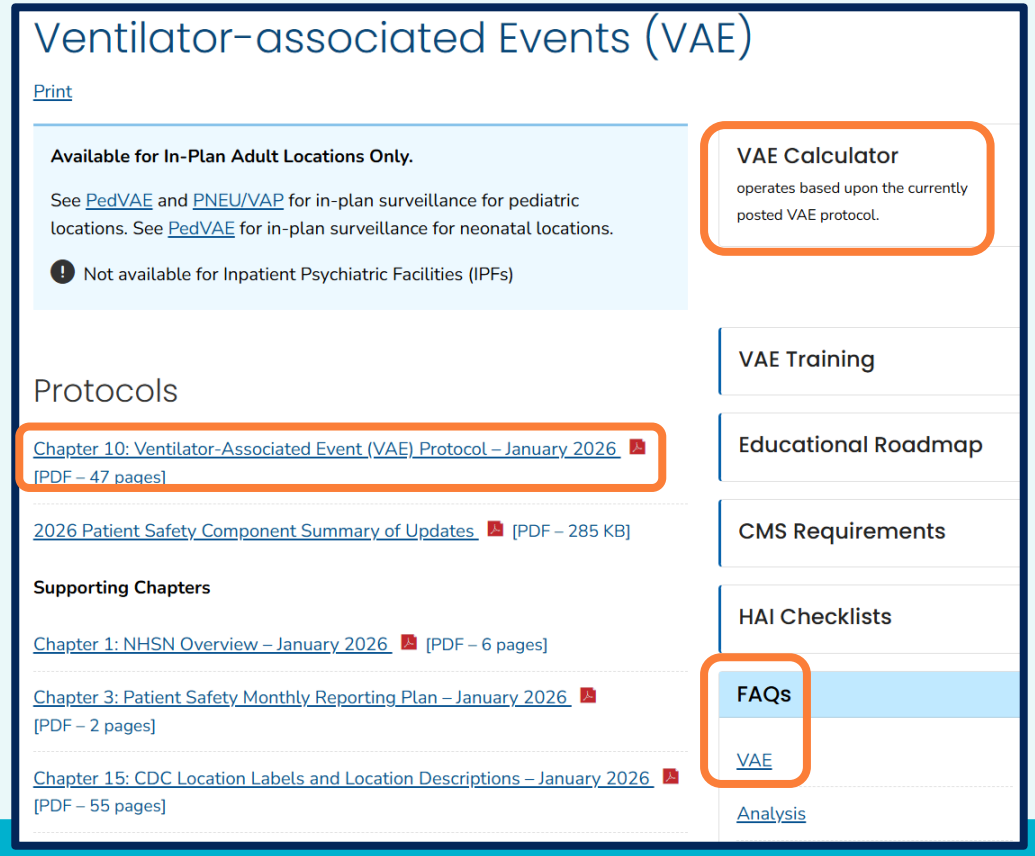
https://www.cdc.gov/nhsn/psc/index.html



VAE RESOURCES

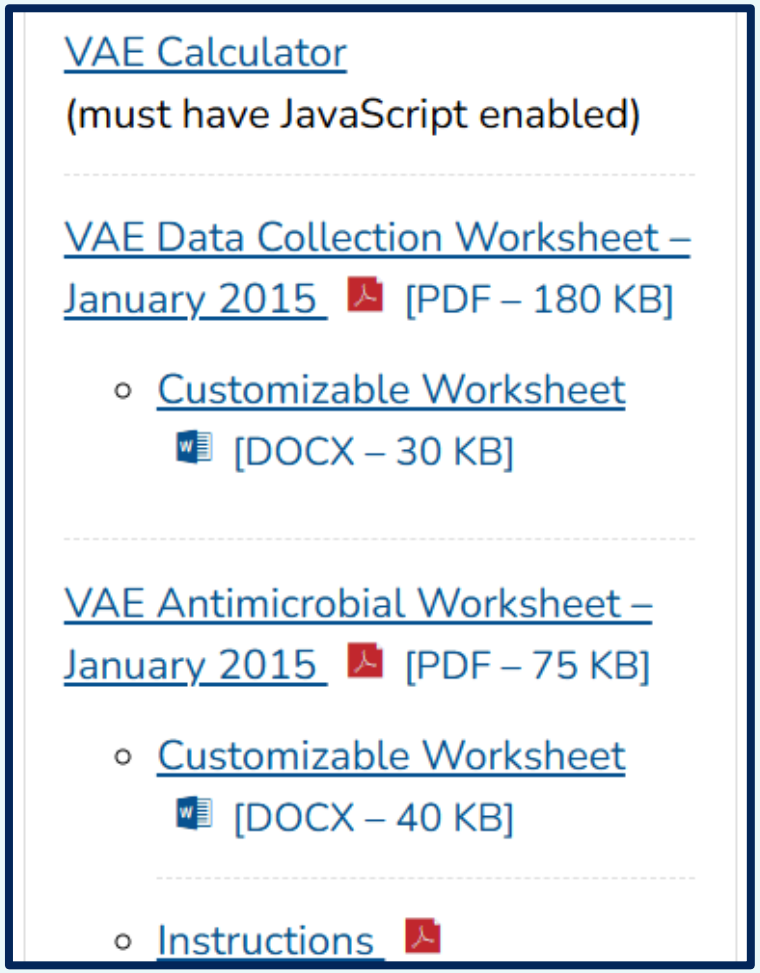
Where do I find the VAE Surveillance Guidance? Cont.

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



Tools for Visualizing VAE

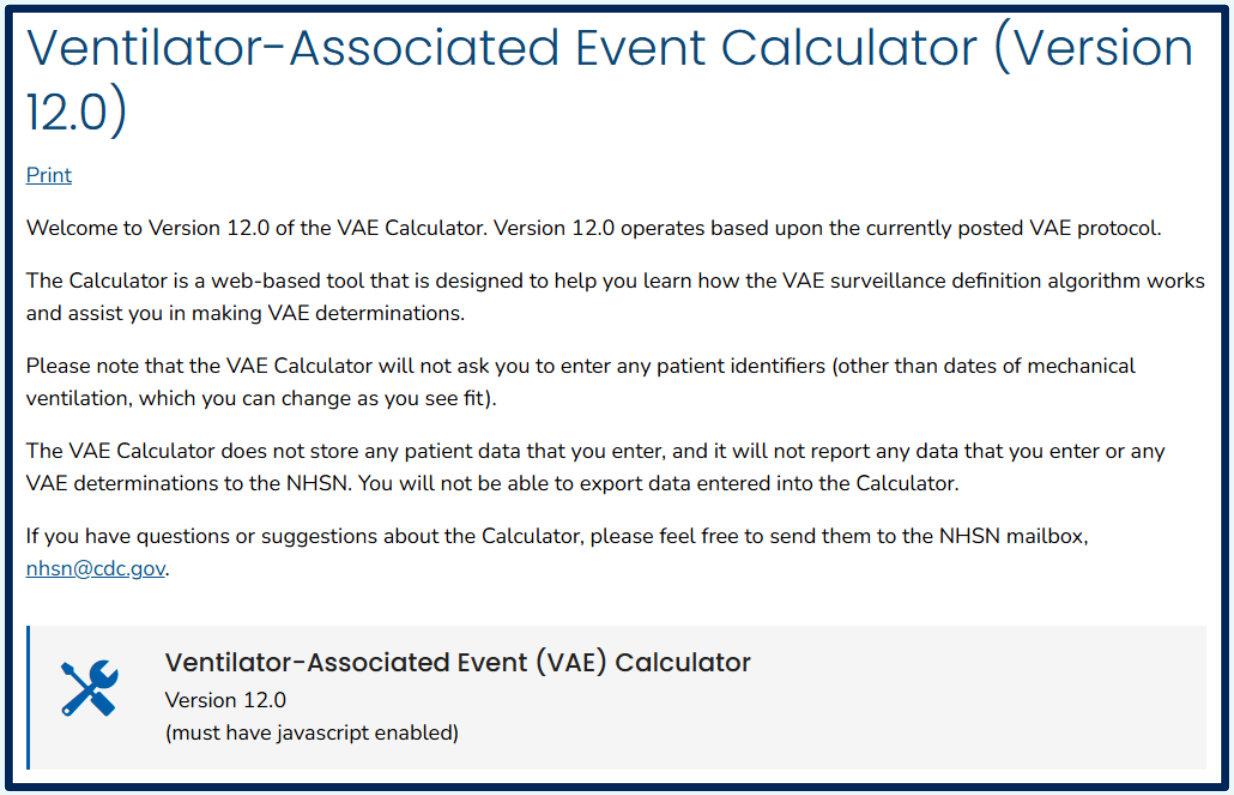
VAE Calculator and Worksheets:
https://www.cdc.gov/nhsn/psc/vae/index.html



VAE RESOURCES

Tools for Visualizing VAE, Cont.

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



Ventilator-Associated Event Calculator (Version 12.0)

Print

Welcome to Version 12.0 of the VAE Calculator. Version 12.0 operates based upon the currently posted VAE protocol.

The Calculator is a web-based tool that is designed to help you learn how the VAE surveillance definition algorithm works and assist you in making VAE determinations.

Please note that the VAE Calculator will not ask you to enter any patient identifiers (other than dates of mechanical ventilation, which you can change as you see fit).

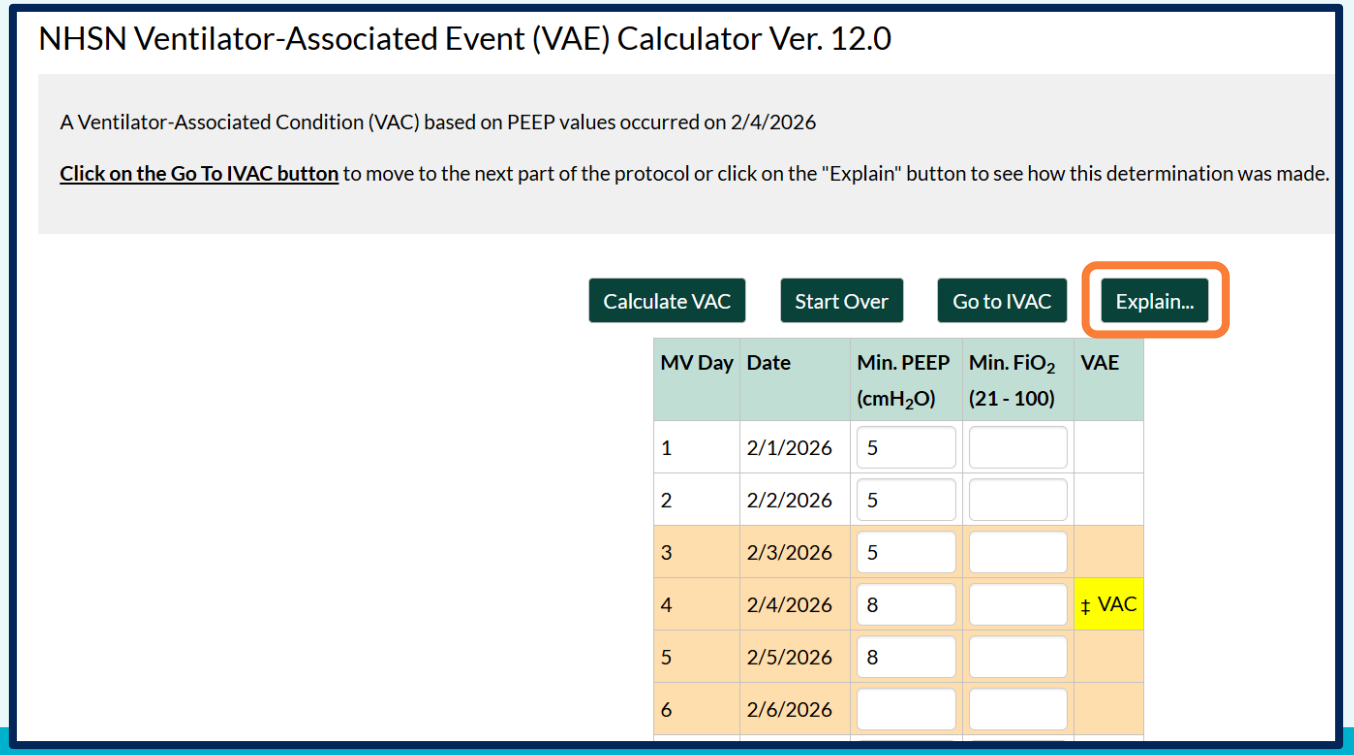
The VAE Calculator does not store any patient data that you enter, and it will not report any data that you enter or any VAE determinations to the NHSN. You will not be able to export data entered into the Calculator.

If you have questions or suggestions about the Calculator, please feel free to send them to the NHSN mailbox, nhsn@cdc.gov.

Ventilator-Associated Event (VAE) Calculator
Version 12.0
(must have javascript enabled)

VAE Calculator

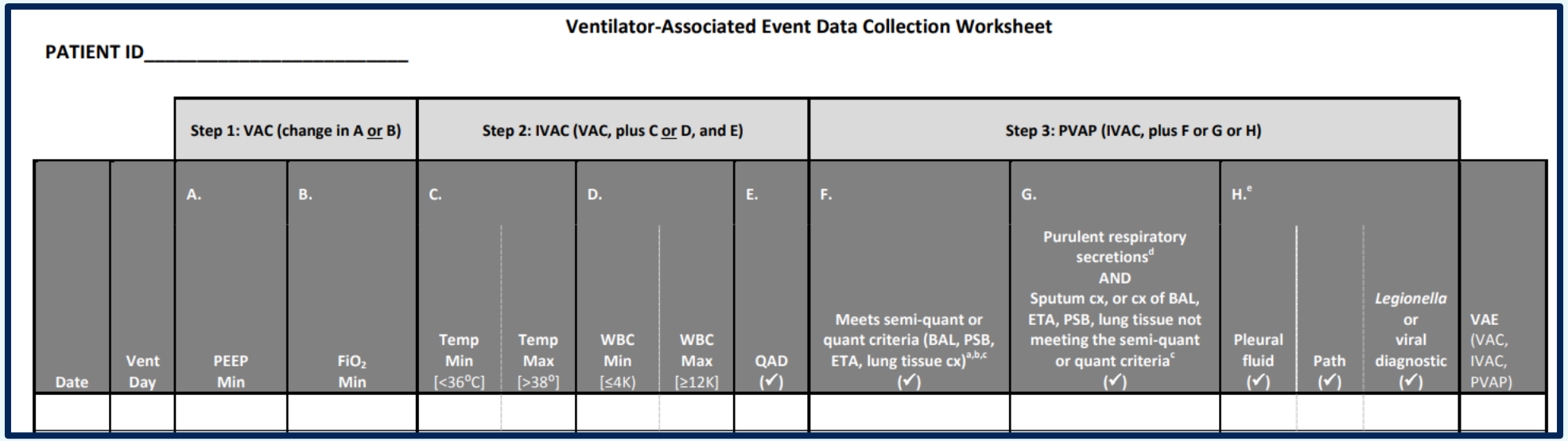
- https://nhsnsa.cdc.gov/Calculators/ps/VAE/vaecalc_v12.html
- The '**Explain**' button in the calculator will display an explanation about how the 'calculation' for the case determination was made.



VAE RESOURCES

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)

VAE Manual Worksheet - Example

Vent Day	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WMC max	QAD	Spec	Polys/Epis	Org
1	8	60								
2	8	60								
3	8	50								
4	5	40	37.6	37.8	10.3	10.9	Yes			
5	5	40	38.3	38.6	11.1	11.8	Yes	BAL	>25/<10	*P. aeruginosa*
6	8	60	37.9	38.3	11.7	12.2	Yes			
7	8	70	38.0	38.6	11.5	12.4	Yes			
8	10	60	37.5	37.8	11.4	12.1				

VAE Surveillance

Introduction

What is a ventilator?

- **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).

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
  - Acute Respiratory Distress Syndrome (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

Ventilator-Associated Event (VAE)

VAEs are identified using a combination of objective criteria: deterioration in respiratory status after a period of stability or improvement on the ventilator, evidence of infection or inflammation, and laboratory evidence of respiratory infection, and are categorized into the following 3 tiers:

- Ventilator-associated condition (VAC)
- Infection-related ventilator-associated complication (IVAC)
- Possible ventilator-associated pneumonia (PVAP)

Why perform VAE surveillance?

- 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 occur in ventilated patients, such as:
  - 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 Development

- The **VAE Surveillance Working Group** was established in 2011.
- **Currently** (as of January 2013)
  - 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, pulmonary edema, etc.) that 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 meet PNEU.
  - It is possible to meet PNEU and not meet VAE.
  - It is possible not to meet either.
- VAE is designed to detect more than VAP.
- Educate your clinicians on the difference.

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, and inpatient rehabilitation facilities
- Patients in **adult locations** are eligible for VAE surveillance
  - Pediatric patients in adult locations included in VAE 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: NHSN does NOT recommend including young children housed in adult locations that are not physiologically similar to the location's adult patient population in VAE surveillance. Instead, consider using a 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

https://www.cdc.gov/nhsn/pdfs/vae/VAEMVtable-current.pdf

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

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.

Ineligible: <3 Days on MV

NO VAE possible

- 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.

MV Days 1 & 2 can establish baseline period

Earliest event = MV Day 3

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**.

NHSN Chapter 2 Definitions – Identifying Healthcare-Associated Infections (HAI) for NHSN Surveillance

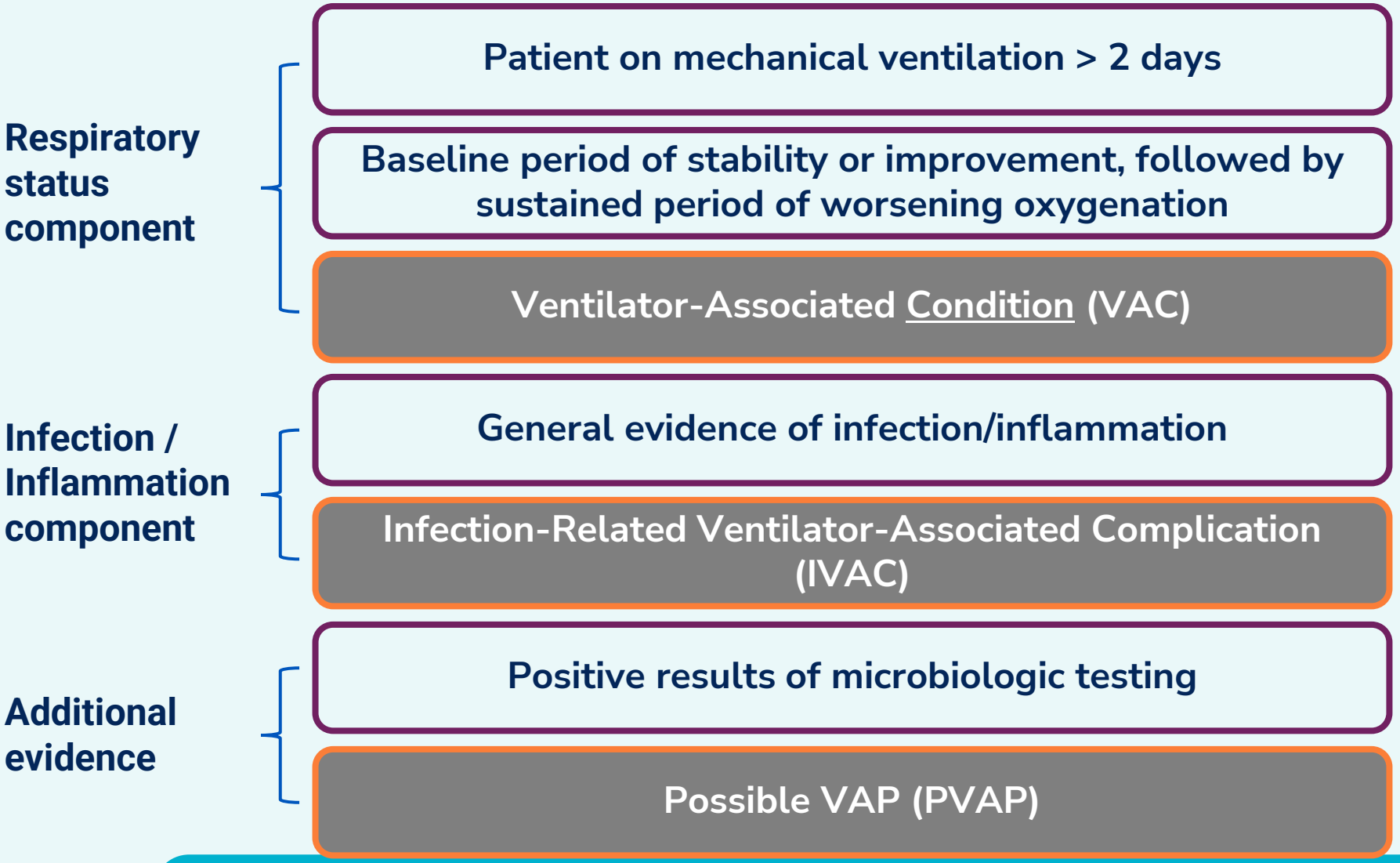
Do not apply to VAE.

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 Algorithm Overview

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

VAE Definition Algorithm Summary



VAE Algorithm

The VAE algorithm is progressive in terms of criteria to be met.

- Each subsequent tier is not more clinically 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.

⚠️ **Important:** The algorithm is **progressive in criteria met**, not in clinical severity.

VAE Algorithm – Cont.

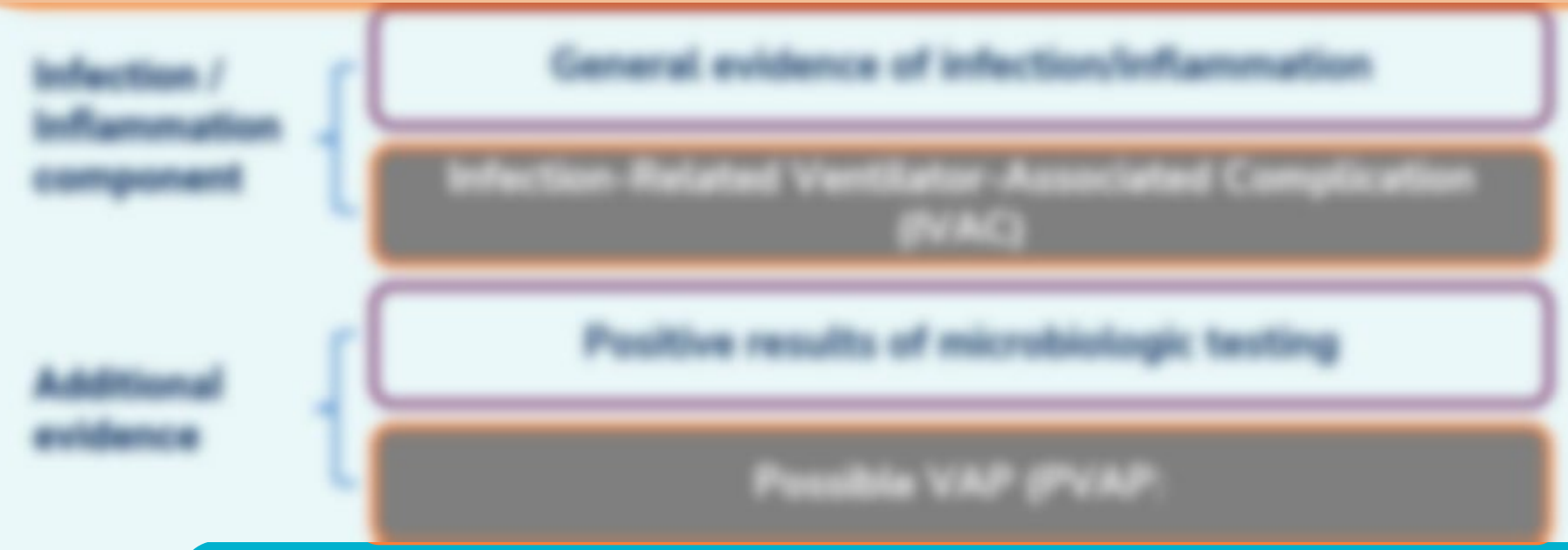
- The fundamental definition within the algorithm is the VAC, which is defined on the basis of respiratory deterioration.
  - All events start with VAC – evidence of respiratory deterioration
  - IVAC – additional evidence that the event may be infectious vs. non-infectious
  - PVAP – additional evidence that 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)



VAE ALGORITHM OVERVIEW

Respiratory Status – FiO_2 and PEEP

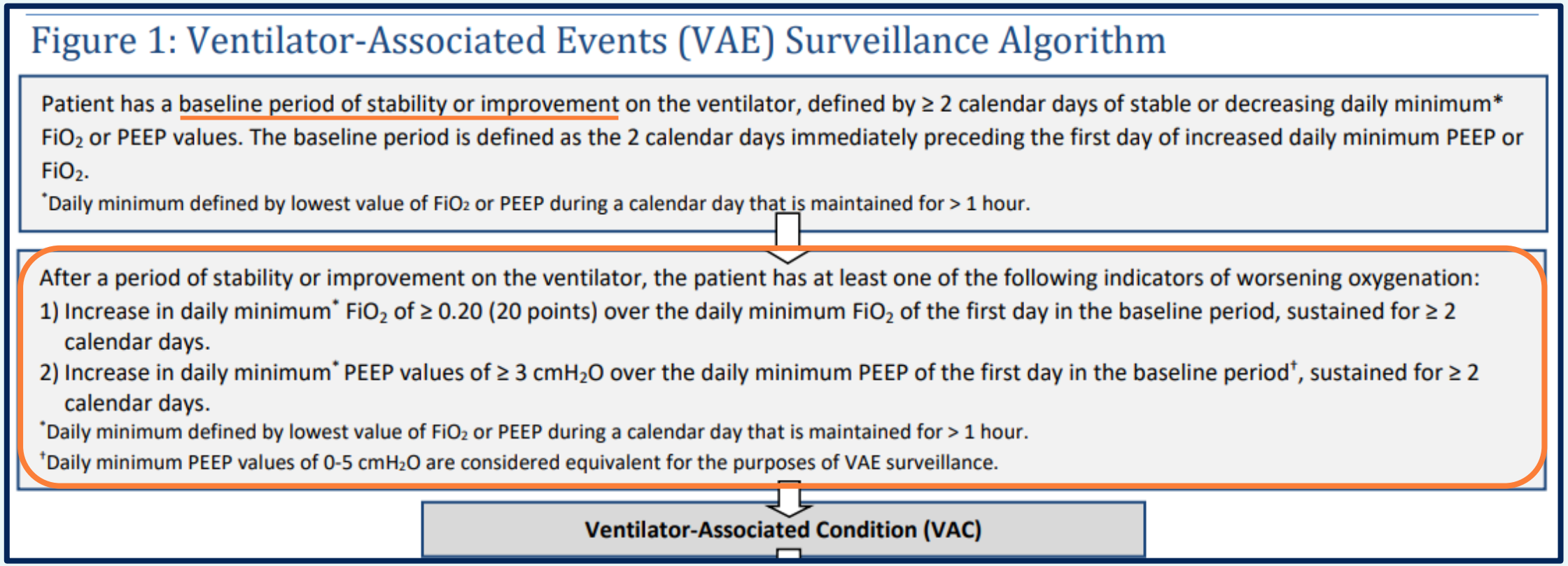


Figure 1: Ventilator-Associated Events (VAE) Surveillance Algorithm

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)

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** – 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

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 hour
  - 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 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 during periods of time when:

- Patient is on high frequency ventilation (HFV), extracorporeal life support (ECLS), or paracorporeal membrane oxygenation.
- Patient is not receiving mechanical ventilation support.
- Patient is being mechanically ventilated using APRV or a related mode (for example, BiLevel, BiVent, BiPhasic, PCV+, and DuoPAP).
  - Only review FiO_2 data (PEEP settings 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 > 1 hour.**
- If there is no value that has been maintained for > 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

Guidance for Determining Daily Minimum FiO_2 and PEEP

- **When settings are recorded every hour or more frequently**
  - Must be sufficient documentation of consecutive recordings to meet the minimum required duration of > 1 hour
    - If documented every 30 minutes, 3 consecutive recordings at the same setting would be needed (for example, at 09:00, 09:30, and 10:00).
    - If documented every hour, 2 consecutive recordings at the same setting would be needed (for example, at 09:00 and 10:00).
  - Provides standardization
- **When settings are recorded less frequently than an hour**
  - The daily minimum FiO_2 and PEEP values are simply the lowest value set on the ventilator during a calendar day

Identifying the Daily Minimum FiO_2 and PEEP

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

	Friday 00:00	05:00	06:00	10:00	12:00	13:00	16:00	20:00
MV mode	ACV	ACV	ACV	ACV	ACV	ACV	ACV	ACV
FiO_2	0.8	0.6	0.8	0.7	0.7	0.8	0.7	0.7
PEEP	8	8	8	8	8	8	8	8

0.6 is the lowest FiO_2 value recorded during the calendar day – but it was not maintained for > 1 hour. 0.7 is the next lowest FiO_2 value that was maintained for > 1 hour.

Identifying the Daily Minimum FiO_2 and PEEP – cont.

Ventilation is discontinued early in the calendar day on Saturday at 01:30:

	Friday 20:00	22:00	23:30	Saturday 00:00 (midnight)	01:00
MV mode	ACV	ACV	ACV	ACV	ACV
FiO_2	0.8	0.7	0.7	0.7	0.6
PEEP	10	8	8	8	5

FiO_2 of 0.6 and PEEP of 5 cmH_2O are the lowest values for Saturday because no value was maintained for > 1 hour.

Identifying the Daily Minimum FiO_2 and PEEP – cont.

Select the lowest value recorded for FiO_2 and PEEP for the calendar day that is maintained for >1 hour:

	Friday 00:00	02:00	04:00	06:00	08:00	10:00	12:00
MV mode	ACV	ACV	ACV	ACV	ACV	ACV	AVC
FiO_2	0.8	1.0	0.7	0.8	0.6	0.7	0.7
PEEP	10	10	8	10	8	10	10

Since values are recorded every 2 hours in this scenario, you would select the lowest value in each parameter – in this case 0.6 is the lowest FiO_2 and the lowest PEEP is 8 cmH_2O.

Baseline Period of Stability or Improvement

- A period of stability or improvement is 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 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.

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.
- Stability or improvement and worsening are not identified by comparing FiO_2 and PEEP values that occur during a calendar day but by comparing the daily minimum values from calendar day to calendar day.
- 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 – 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.

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

Why is the Date of Event Important?

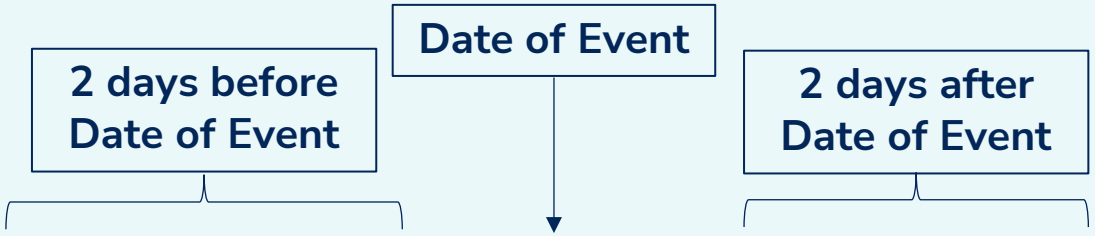
- Defines the **VAE Window Period**
  - Period during which criteria for other events – IVAC, PVAP – must be met
- Sets the **VAE 14-day Event Period**
  - Day 1 is the Date of Event – so if March 1 is date of onset of worsening oxygenation and a VAC is reported, a second VAE cannot be detected and reported until March 15.
  - You may not 'upgrade' a VAE based on data collected outside the VAE Window Period but within the 14-day event period.
  - You may not report a new VAE until the 14-day event 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 bet 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 – cont.



MV Day	5	6	7	8	9	10	11
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 Secretions, positive culture, positive histopathology		← Collected within this shaded period →					

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 date of event corresponds to MV day 3 or day 4, the VAE Window Period may only be a **3- or 4-day window**, because it CANNOT include any days before the third day of MV.

Exception to VAE Window Period

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

Date of Event

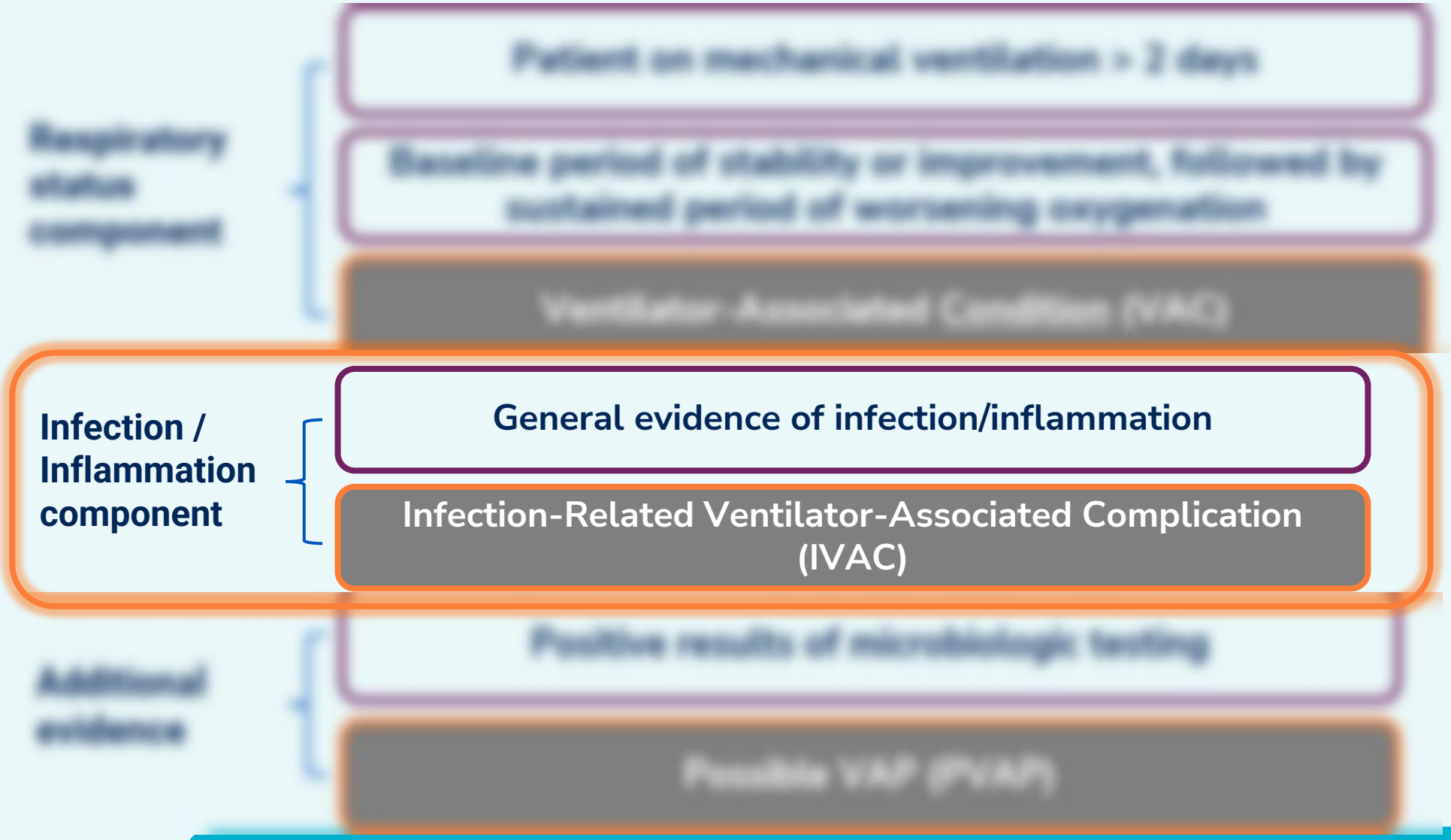
2 days after Date of Event

MV Day	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 continued for at least 4 QADs →				
Purulent Secretions, positive culture, positive histopathology			← Collected within this shaded period →				

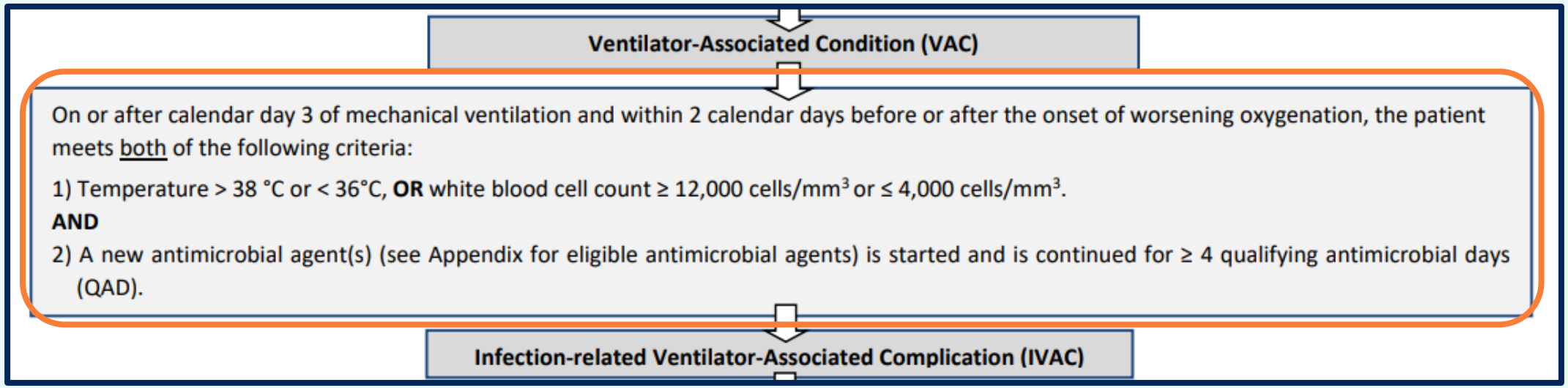
Location of Attribution & Transfer Rule

- **Location of Attribution** is the inpatient location where the patient was assigned on the VAE Date of Event (date of onset of worsening oxygenation).
- **Transfer Rule**
  - If the 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.
  - Transfer Rule Scenario Examples can be found in VAE FAQ #23 on the VAE Webpage.
    - https://www.cdc.gov/nhsn/faqs/faq-vae.html

VAE Definition Algorithm Summary



Tier 2: Infection-Related Ventilator-Associated Complication (IVAC)



Temperature and White Blood Cell (WBC) Count

- If there an abnormal temperature (> 38°C or < 36°C)

OR

- An abnormal WBC count (≥ 12,000 or ≤ 4,000 cells/mm^3) 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	FiO2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Polys/ Epis	Org
1	10	80								
2	8	80								
3	5	60	35.8	36.7	5.2	6.0				
4	5	40	36.2	37.1	4.8	5.3				
5	8	80	37.6	37.8	4.2	4.7				
6	10	80	37.7	38.2	3.8	4.2				
7	8	70	36.8	37.7	3.3	3.9				
8	8	60								

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 within 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 the digestive tract, or via the respiratory tract.
  - A new agent must be continued for **≥ 4 qualifying antimicrobial days.**

Qualifying Antimicrobial Days (QADs)

- 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 QADs.
  - QADs can accrue outside the VAE Window Period.

VAE ALGORITHM OVERVIEW

Date of Initiation of Antimicrobial Agent is Important

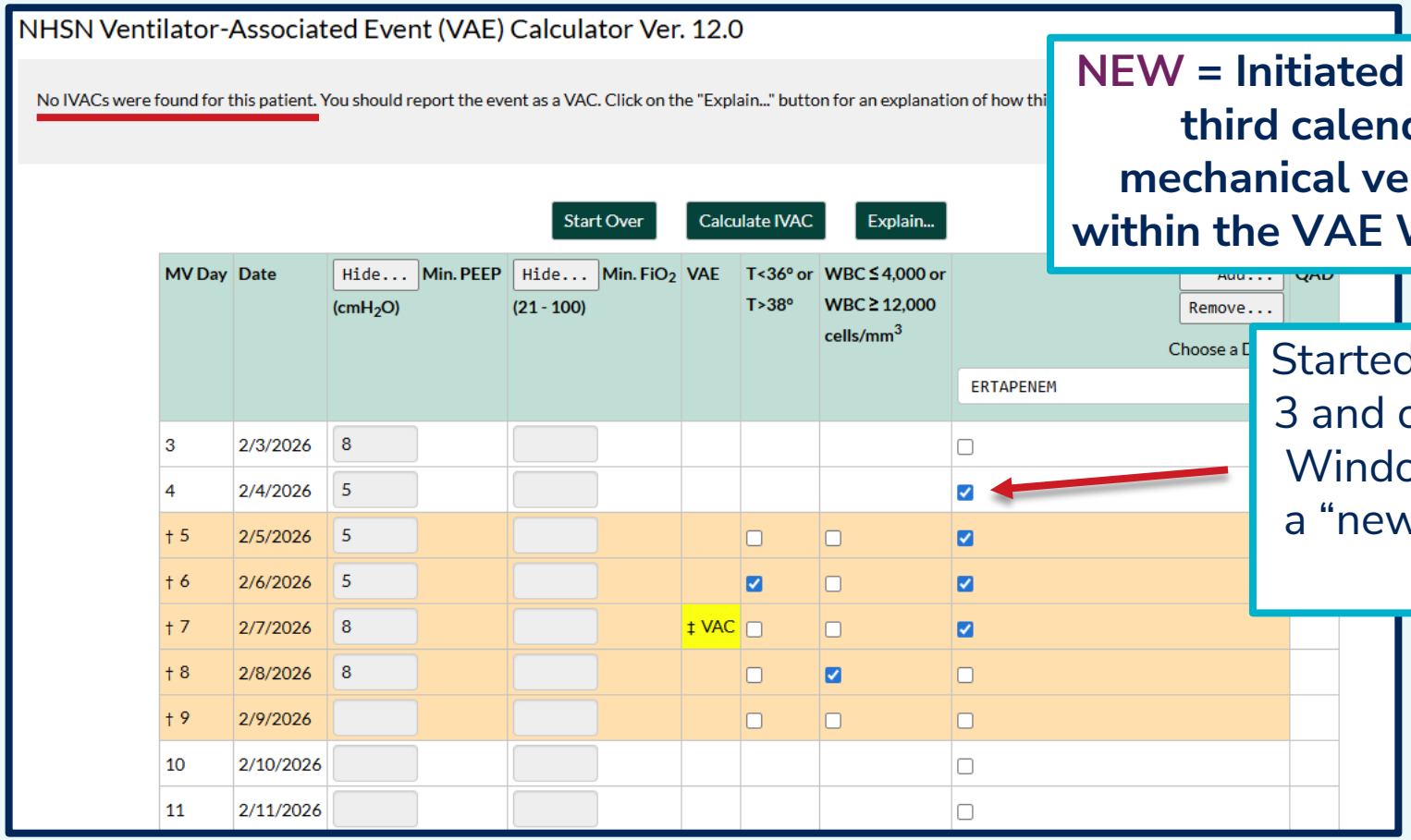
NHSN Ventilator-Associated Event (VAE) Calculator Ver. 12.0

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
3	2/3/2026	8					☐	
4	2/4/2026	5					☐	
† 5	2/5/2026	5			☐	☐	☐	
† 6	2/6/2026	5			☐	☐	☐	
† 7	2/7/2026	8		‡ VAC	☐	☐	☐	
† 8	2/8/2026	8			☐	☐	☐	
† 9	2/9/2026				☐	☐	☐	
10	2/10/2026						☐	
11	2/11/2026						☐	

No QADs – VAC Determination



NEW = Initiated on or after the third calendar day of mechanical ventilation and within the VAE Window Period

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

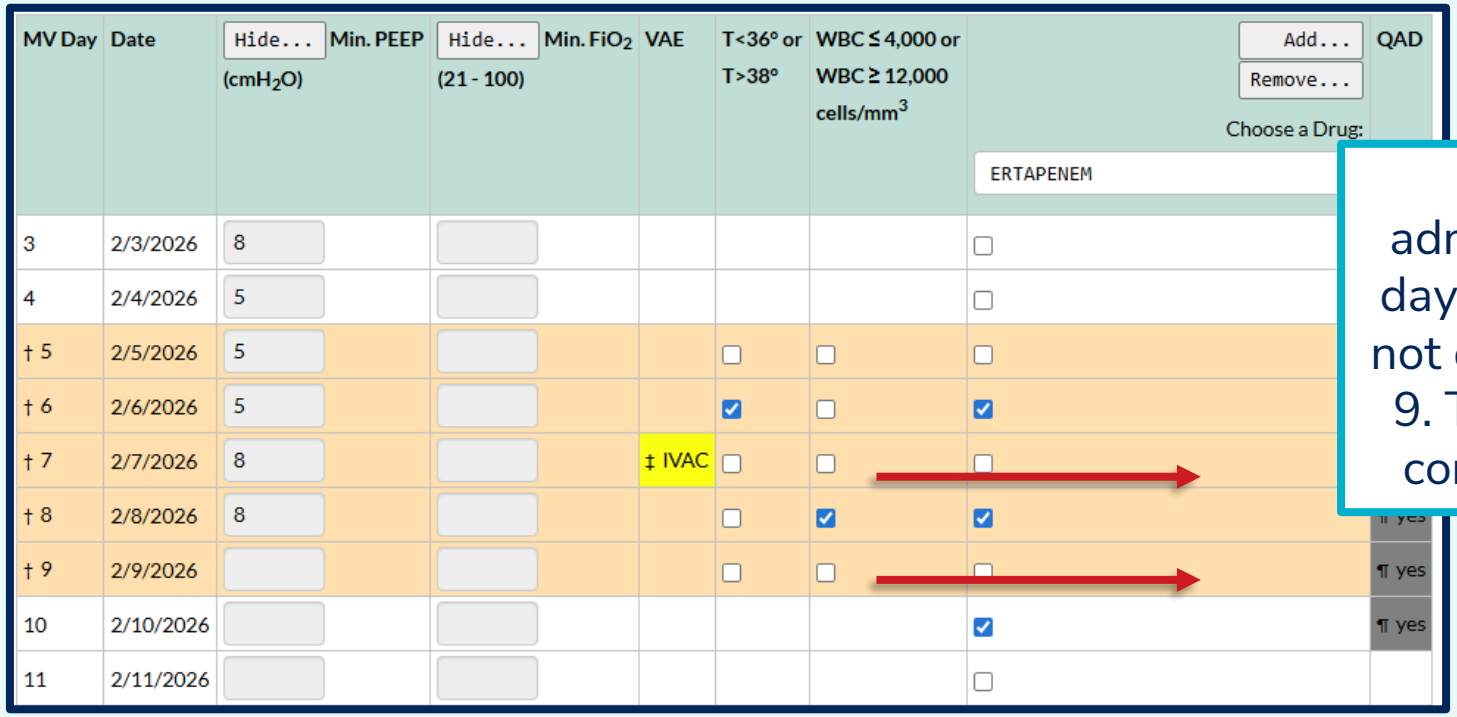
QADs

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: ERTAPENEM	
3	2/3/2026	8					☐	
4	2/4/2026	5					☐	
† 5	2/5/2026	5			☐	☐	☐	
† 6	2/6/2026	5			☑	☐	☐	
† 7	2/7/2026	8		‡ IVAC	☐	☐	☑	¶ yes
† 8	2/8/2026	8			☐	☑	☑	¶ yes
† 9	2/9/2026				☐	☐	☑	¶ yes
10	2/10/2026						☑	¶ yes
11	2/11/2026						☐	

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: ERTAPENEM	QAD
3	2/3/2026	8					☐	
4	2/4/2026	5					☐	
† 5	2/5/2026	5			☐	☐	☐	
† 6	2/6/2026	5			☑	☐	☑	
† 7	2/7/2026	8		‡ IVAC	☐	☐	☐	
† 8	2/8/2026	8			☐	☑	☑	
† 9	2/9/2026				☐	☐	☐	¶ yes
10	2/10/2026						☑	¶ yes
11	2/11/2026						☐	

Ertapenem is administered on MV days 6, 8 and 10, but not on MV days 7 and 9. 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: ERTAPENEM	Add... Remove... Choose a Drug: LEVOFLOXACIN	QAD
3	2/3/2026	8					☐	☐	
4	2/4/2026	5					☐	☐	
† 5	2/5/2026	5			☐	☐	☐	☐	
† 6	2/6/2026	5			☑	☐	☑	☐	¶ yes
† 7	2/7/2026	8		‡ IVAC	☐	☐	☑	☐	¶ yes
† 8	2/8/2026	8			☐	☑	☐	☑	¶ yes
† 9	2/9/2026				☐	☐	☐	☑	¶ yes
10	2/10/2026						☐	☐	
11	2/11/2026						☐	☐	

QADs: Different Agents

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

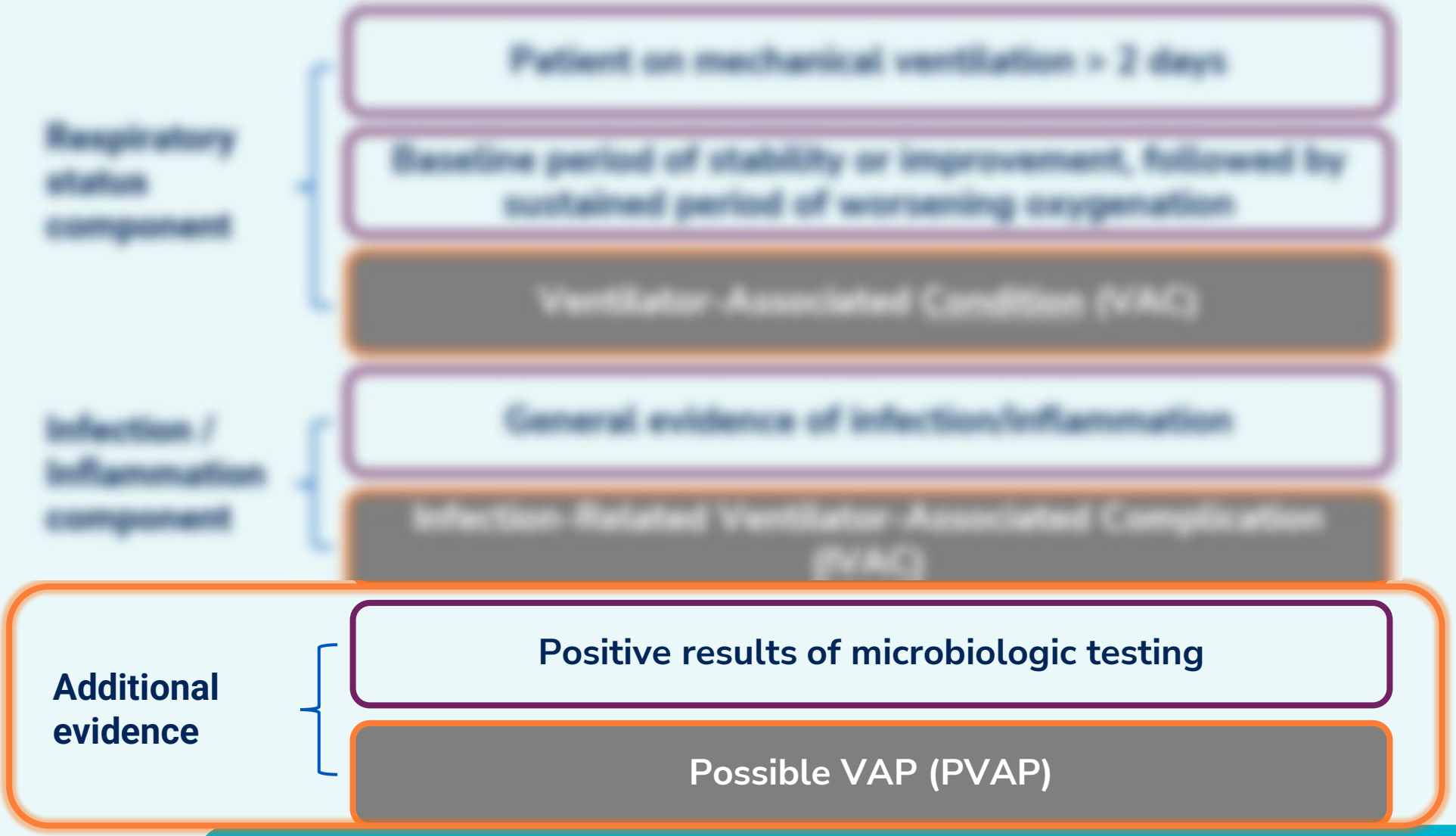
- Ertapenem is administered MV days 6 & 7, and there is a gap on MV day 8 between different agents. Levofloxacin is administered MV days 9-11.
- MV day 8 does not count as a QAD. **Therefore, the 4 QAD criterion is NOT met.**

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	Add... Remove... Choose a Drug: ERTAPENEM	LEVOFLOXACIN	
3	2/3/2026	8					☐	☐	
4	2/4/2026	5					☐	☐	
† 5	2/5/2026	5			☐	☐	☐	☐	
† 6	2/6/2026	5			☑	☐	☑	☐	¶ yes
† 7	2/7/2026	8		‡ VAC	☐	☐	☑	☐	¶ yes
† 8	2/8/2026	8			☐	☑	☐	☐	
† 9	2/9/2026				☐	☐	☐	☑	¶ yes
10	2/10/2026						☐	☑	¶ yes
11	2/11/2026						☐	☑	¶ yes
12	2/12/2026						☐	☐	

IVAC and Antimicrobial Agents

- Meeting the IVAC definition does not mean that the “infection-related’ event is necessarily respiratory in origin.
- The IVAC antimicrobial list was refined by removing select 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.
- There is no need to discern the reason for the administration of the antimicrobial.
  - Prophylaxis, de-escalation, change within class of antimicrobials, etc. are not reasons for exclusion.

VAE Definition Algorithm Summary



VAE ALGORITHM OVERVIEW

Tier 3: Possible Ventilator-Associated Pneumonia (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 the 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. 15** in the VAE Protocol.

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 (quantitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet PVAP Criterion 1):
  - Sputum
  - Endotracheal aspirate
  - Bronchoalveolar lavage
  - Lung tissue
  - Protected specimen brush

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

What if my laboratory reports Gram stain / direct exam results in a manner that does not quantify 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 facility 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. 11** in the VAE protocol.

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

- Instructions for using the purulent respiratory secretions criterion, based on laboratory reporting of respiratory secretion direct examination results can be found on pg. 10-15 of VAE protocol.
- Some clinical laboratories use different result reporting formats for respiratory secretion direct examination results.

Table 2

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 chest tube is repositioned or from a chest tube in place > 24 hours are not eligible for PVAP)
- Lung histopathology, defined as:
  - Abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli
  - Evidence of lung parenchyma invasion by fungi (hyphae, pseudo hyphae or yeast forms)
  - Evidence of infection with select viral pathogens (listed in protocol) based on results of immunohistochemical assays, cytology, or microscopy performed on the lung tissue

PVAP – Criterion 3 cont.

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 (including COVID-19)

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 events

Pathogen Exclusions

- “Normal respiratory flora,” “normal oral flora,” “mixed respiratory flora,” “mixed oral flora,” “altered oral flora” or other similar results indicate 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 in sputum, endotracheal aspirates, bronchoalveolar lavage, or protected specimen brushings

PVAP Criterion 1 – Positive Quantitative or Semi-Quantitative* ETA Culture (meeting specific threshold)

Vent Day	PEEP min	FiO2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Polys/ Epis	Org
1	10	80								
2	8	80								
3	5	60	35.8	36.7	5.2	6.0				
4	5	40	36.2	37.1	4.8	5.3		ETA		4+ *Klebsiella pneumoniae*
5	8	80	37.6	37.8	4.2	4.7	Yes			
6	10	80	37.7	38.2	3.8	4.2	Yes			
7	8	70	36.8	37.7	3.3	3.9	Yes			
8	8	60					Yes			

*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.

PVAP Criterion 2

Vent Day	PEEP min	FiO2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Polys/ Epis	Org
1	10	80								
2	8	80								
3	5	60	35.8	36.7	5.2	6.0				
4	5	40	36.2	37.1	4.8	5.3		ETA	>25 poly/<10 epi	4+ *Klebsiella pneumoniae*
5	8	80	37.6	37.8	4.2	4.7	Yes			
6	10	80	37.7	38.2	3.8	4.2	Yes			
7	8	70	36.8	37.7	3.3	3.9	Yes			
8	8	60					Yes			

PVAP Criterion 3

Vent Day	PEEP min	FiO2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Polys/ Epis	Org
1	10	80								
2	8	80								
3	5	60	35.8	36.7	5.2	6.0				
4	5	40	36.2	37.1	4.8	5.3		ETA		Influenza A
5	8	80	37.6	37.8	4.2	4.7	Yes			
6	10	80	37.7	38.2	3.8	4.2	Yes			
7	8	70	36.8	37.7	3.3	3.9	Yes			
8	8	60					Yes			

Secondary BSI

- 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
  - The blood culture is 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 when:
  - PVAP is met with only the histopathology criterion and no culture or non-culture based testing is performed on an eligible respiratory specimen
  - 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

VAE Surveillance

Tips for surveillance and reporting

VAE Resources

- Familiarize yourself with the VAE webpage: 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 10-32
  - FAQs found on the VAE webpage: https://www.cdc.gov/nhsn/faqs/faq-vae.html
- Utilize 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 as PVAP only
- Review the VAE Event Form and Table of Instructions on the VAE webpage.

VAE Reporting – Denominator Data

- Collect device (ventilator) days and patient days at the same time each day.
- 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.
- Patient days
  - Number of patients in the chosen location at the time of the count
- https://www.cdc.gov/nhsn/pdfs/vae/VAEMVtable-current.pdf

Steps in Monitoring for a VAE

- For every patient receiving mechanical ventilation, determine daily minimum FiO_2 or 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 abnormal temperature and WBC counts within the VAE Window Period.
  - If abnormal temperature/WBC count element 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 FiO_2 and PEEP 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 Case Studies

Case Example

- A 62-year-old patient presents to the Emergency Department (ED) at 22:30 on 2/17 following a motor vehicle accident. He was intubated and mechanical ventilation was initiated by EMS en route to the ED.
- The patient is taken to the Operating Room (OR) for emergent surgery at 23:40.
- After surgery, the patient is admitted to the Surgical ICU (SICU) on 2/18 at 05:45.
- VAE surveillance is selected in the Monthly Reporting Plan for the SICU.

At what point in this patient's hospital stay did he become eligible for VAE surveillance?

A. In the ED
B. In the OR
C. In the SICU

Case Summary:

- A 62-year-old patient presents to the Emergency Department (ED) at 22:30 on 2/17 following a motor vehicle accident. He was intubated and mechanical ventilation was initiated by EMS en route to the ED.
- The patient is taken to the Operating Room (OR) for emergent surgery at 23:40.
- After surgery, the patient is admitted to the Surgical ICU (SICU) on 2/18 at 05:45.
- VAE surveillance is selected in the Monthly Reporting Plan for the SICU.

Answer: In the OR

A. In the ED

B. In the OR

C. In the SICU

An inpatient OR is considered an inpatient location (just not a bedded location where denominator data can be collected).

All calendar days during which the patient is an inpatient and during which the patient was mechanically ventilated for any portion of the day are eligible for inclusion in VAE surveillance.

All available ventilator settings that are documented once the patient is an inpatient and while the patient is in an inpatient location are to be used in determining daily minimum values, including those documented in the OR.

Patient Ventilator Settings Example 1

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8	50						
2	10	60						
3	10	60						
4	8	60						
5	8	40						
6	8	40						
7	8	60						
8	8	50						

Is a VAE identified for this patient?

A. Yes, in the PEEP parameter

B. Yes, in the FiO2 parameter

C. No VAE identified

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8	50						
2	10	60						
3	10	60						
4	8	60						
5	8	40						
6	8	40						
7	8	60						
8	8	50						

Answer: Is a VAE identified for this patient?

A. Yes, in the PEEP parameter

B. Yes, in the FiO2 parameter

C. <u>No VAE identified</u>

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8	50						
2	10	60						
3	10	60						
4	8	60						
5	8	40	←					
6	8	40						
7	8	60						
8	8	50	←					

- There are 2 days of stable daily minimum FiO2 values on MV days 5 and 6 (**baseline period of stability**).
- While there is worsening FiO2 on MV days 7 and 8, the increase in daily minimum FiO2 values does not meet worsening oxygenation criteria of ≥20 points over the daily minimum FiO2 of the first day in the baseline period and is **sustained** for at least 2 calendar days.
- VAC is not met.

Patient Ventilator Settings Example 2

- Let's use the previous example, but increase the daily minimum FiO2 on MV day 8 to 60 so that VAC criteria are met…
- Brain death/injury is declared on the Date of Event (MV day 7), but the patient remains ventilated until MV day 8.

Vent Day	PEEP min	FiO2 min
1	8	50
2	10	60
3	10	60
4	8	60
5	8	40
6	8	40
7	8	60
8	8	**60**

Is the VAC reported to NHSN?

A. Yes – the VAC is reported despite brain death/injury.

B. No – brain death/injury excludes the VAC from reporting.

Vent Day	PEEP min	FiO2 min
1	8	50
2	10	60
3	10	60
4	8	60
5	8	40
6	8	40
7	8	60
8	8	60

Answer: Is the VAC reported to NHSN?

A. **Yes** – the VAC is reported despite brain death/injury.
   - Brain death/injury alone is not sufficient for exclusion from VAE surveillance or reporting (VAE FAQ #2).
   - Requirement is that if the VAE date of event is on or after the date of documentation in the medical record of evidence of consent for organ donation AND patient is being supported for organ donation purposes, then the event should not be reported as a VAE (Reporting Instruction #4).
   - If the requirement is not met, the patient is not excluded from surveillance, and a VAE should be reported at the highest level met in the VAE algorithm if in-plan VAE surveillance is conducted for the patient's location.

B. No.

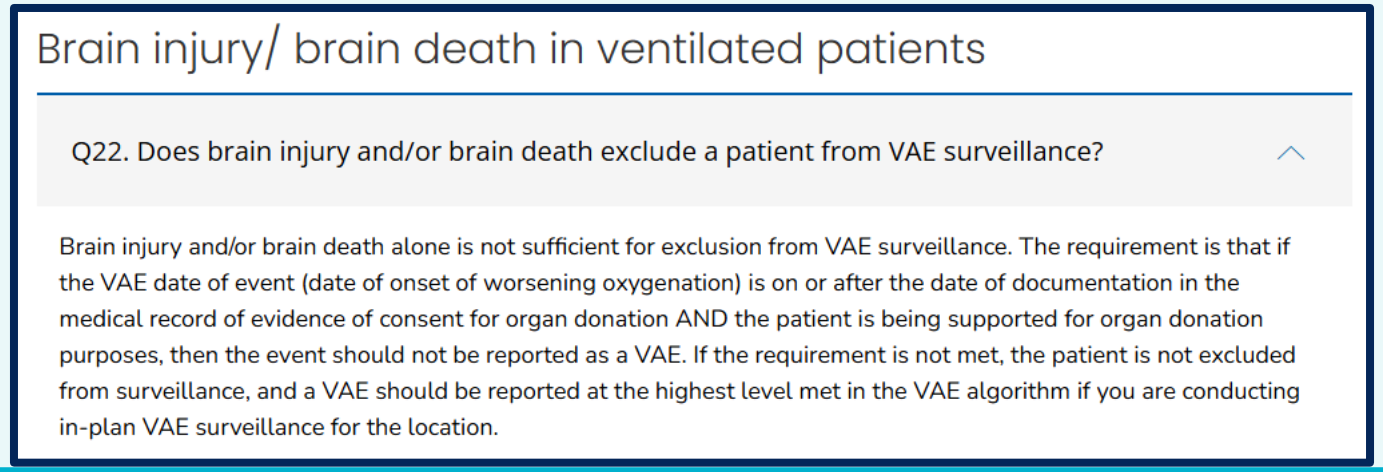
Vent Day	PEEP min	FiO2 min
1	8	50
2	10	60
3	10	60
4	8	60
5	8	40
6	8	40
7	8	60
8	8	60

Brain Death/Injury

- Reporting Instruction #4 in VAE Protocol (pg. 10-17)

> 4. If the date of event (date of onset of worsening oxygenation) is on or after the date of documentation of evidence of consent AND the patient is being supported for organ donation purposes, the event should not be reported as a VAE.

- VAE FAQ #22 - https://www.cdc.gov/nhsn/faqs/faq-vae.html#Brain-injury/-brain-death-in-ventilated-patients



Brain injury/ brain death in ventilated patients

Q22. Does brain injury and/or brain death exclude a patient from VAE surveillance?

Brain injury and/or brain death alone is not sufficient for exclusion from VAE surveillance. The requirement is that if the VAE date of event (date of onset of worsening oxygenation) is on or after the date of documentation in the medical record of evidence of consent for organ donation AND the patient is being supported for organ donation purposes, then the event should not be reported as a VAE. If the requirement is not met, the patient is not excluded from surveillance, and a VAE should be reported at the highest level met in the VAE algorithm if you are conducting in-plan VAE surveillance for the location.

Patient Ventilator Settings Example 3

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8	50	37.2	13.2				
2	10	60	37.5	12.6	Meropenem			
3	10	60	37.8	12.3	Meropenem			
4	5	60	38.0	11.5	Meropenem			
5	5	40	38.3	11.1		Cefazolin		
6	8	40	38.1	9.6		Cefazolin	ETA	*S. aureus*
7	8	60	37.9	8.8		Cefazolin		
8	8	50	37.4	8.2				

Is a VAE identified for this patient?

A. Yes, in the PEEP parameter

B. Yes, in the FiO2 parameter

C. No VAE identified

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8	50	37.2	13.2				
2	10	60	37.5	12.6	Meropenem			
3	10	60	37.8	12.3	Meropenem			
4	5	60	38.0	11.5	Meropenem			
5	5	40	38.3	11.1		Cefazolin		
6	8	40	38.1	9.6		Cefazolin	ETA	*S. aureus*
7	8	60	37.9	8.8		Cefazolin		
8	8	50	37.4	8.2				

Answer: Is a VAE identified for this patient?

A. Yes, in the PEEP parameter

B. Yes, in the FiO2 parameter

C. No VAE identified

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8							
2	10							
3	10							
4	5							
5	5							
6	8							
7	8							
8	8							

- There are 2 calendar days of stable daily minimum PEEP values on MV days 4 and 5 (baseline period of stability).
- On MV day 6, 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 6 and 7).
- VAC is met in the PEEP parameter with a date of event on MV day 6 (date of onset of worsening oxygenation).

Let's continue look at this same example:

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8	50	37.2	13.2				
2	10	60	37.5	12.6	Meropenem			
3	10	60	37.8	12.3	Meropenem			
4	5	60	38.0	11.5	Meropenem			
5	5	40	38.3	11.1		Cefazolin		
6	8	40	38.1	9.6		Cefazolin	ETA	*S. aureus*
7	8	60	37.9	8.8		Cefazolin		
8	8	50	37.4	8.2				

What level of the VAE algorithm is met?

A. VAC

B. IVAC

C. PVAP

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
1	8	50	37.2	13.2				
2	10	60	37.5	12.6	Meropenem			
3	10	60	37.8	12.3	Meropenem			
4	5	60	38.0	11.5	Meropenem			
5	5	40	38.3	11.1		Cefazolin		
6	8	40	38.1	9.6		Cefazolin	ETA	*S. aureus*
7	8	60	37.9	8.8		Cefazolin		
8	8	50	37.4	8.2				

Answer: What level of the VAE algorithm is met?

A. VAC

- VAC is met in the PEEP parameter
- Foundational definition is met (VAC), progress to review of IVAC criteria

B. IVAC

- Temperature criterion for IVAC is met within VAE Window Period
- There are not 4 consecutive QADs within the VAE Window Period
- **IVAC is not met**

C. PVAP

- Although there is an organism identified from a respiratory specimen during the VAE Window Period, remember that the VAE surveillance algorithm is progressive. VAC must be met to assess for IVAC, IVAC must be met to assess for PVAP. **IVAC is not met, so criteria for PVAP is not assessed.**

Therefore, VAC is the highest level of the algorithm that is met.

Rationale: What level of the VAE algorithm is met?

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
		50	37.2	13.2				
		60	37.5	12.6	✗ Meropenem			
		60	37.8	12.3	✗ Meropenem			
4	5	60	38.0	11.5	✗ Meropenem			
5	5	40	38.3	11.1		✓ Cefazolin		
6	8	40	38.1	9.6		✓ Cefazolin	ETA	*S. aureus*
7	8	60	37.9	8.8		✓ Cefazolin		
8								

VAC is met in the PEEP parameter with a date of event on MV day 6 (date of onset of worsening oxygenation).

- ≥4 QAD requirement for IVAC is **NOT** met.
- Meropenem not considered 'new' – started on MV day 2 and not within VAE Window Period
- Cefazolin started on after MV day 2 and within VAE Window Period on MV days 5-7
- Only 3 QADs – IVAC cannot be met

Temperature requirement (> 38°C or < 36°C) for **IVAC** is met on MV days 5 and 6.

PVAP unable to be assessed for since IVAC not met – algorithm is progressive in terms of criteria to be met.

Back to the Case Example

- A 62-year-old patient presents to the Emergency Department (ED) at 22:30 on 2/17 following a motor vehicle accident. He was intubated and mechanical ventilation was initiated by EMS en route to the ED.
- The patient is taken to the Operating Room (OR) for emergent surgery at 23:40.
- After surgery, the patient is admitted to the Surgical ICU (SICU) on 2/18 at 05:45.
- VAE surveillance is selected in the Monthly Reporting Plan for the SICU.
- **ECMO initiated in SICU on 2/22**

Patient Ventilator Settings Example 4

Date	2/18	2/19	2/20	2/21	2/22	2/23
MV Day	2	3	4	5	6	7
VAC Criterion	Baseline Day 1	Baseline Day 2	Worsening Day 1	Worsening Day 2		
IVAC Criteria			QAD	QAD	QAD WBC 14.6	QAD
Vent Mode					ECMO	ECMO

What level of the VAE algorithm is met?

A. VAC

B. IVAC

C. No VAE identified

Date	2/18	2/19	2/20	2/21	2/22	2/23
MV Day	2	3	4	5	6	7
VAC Criterion	Baseline Day 1	Baseline Day 2	Worsening Day 1	Worsening Day 2		
IVAC Criteria			QAD	QAD	QAD WBC 14.6	QAD
Vent Mode					ECMO	ECMO

Answer: What level of the VAE algorithm is met?

A. VAC
- Foundational definition is met (VAC) on MV day 4 (first day of worsening oxygenation), progress to review of IVAC criteria

B. IVAC
- WBC and QAD requirements met within VAE Window Period
- IVAC is met – despite ECMO being initiated on MV day 6.
  - If VAC criteria are met prior to initiation of ECLS (such as ECMO) or paracorporeal membrane oxygenation, then a VAE is identified and the patient is not excluded from being evaluated for IVAC or PVAP (VAE FAQ #5).

C. No VAE identified

IVAC is the highest level of the algorithm that is met.

VAE FAQ #5

https://www.cdc.gov/nhsn/faqs/faq-vae.html#Excluded-ventilator-modes

Q5. If VAC criteria are met prior to initiation of extracorporeal life support (ECLS, such as ECMO) or paracorporeal membrane oxygenation, do I still evaluate for IVAC or PVAP?

The exclusion for ECLS and paracorporeal membrane oxygenation is related to the oxygenation of the blood. When ECLS or paracorporeal membrane oxygenation is in place, the blood is artificially oxygenated via a membrane oxygenator. The use of the oxygenator does not allow for correct application of the VAC portion of the VAE protocol (identifying evidence of respiratory deterioration based on PEEP and FiO2 settings); therefore, the exclusion is related to meeting the VAC criteria.

If VAC criteria are met prior to initiation of ECLS or paracorporeal membrane oxygenation, then a VAE is identified and the patient would not be excluded from being evaluated for IVAC or PVAP. The VAE should be reported at the highest level of the algorithm met.

Is this VAE reportable to NHSN?

A. Yes – IVAC criteria are met while the patient was in an adult inpatient location where VAE is included in the Monthly Reporting Plan.

B. No – the use of ECMO on MV days 6 and 7 excludes this VAE from reporting.

Date	2/18	2/19	2/20	2/21	2/22	2/23
MV Day	2	3	4	5	6	7
VAC Criterion	Baseline Day 1	Baseline Day 2	Worsening Day 1	Worsening Day 2		
IVAC Criteria			QAD	QAD	QAD WBC 14.6	QAD
Vent Mode					ECMO	ECMO

Answer: Is this VAE reportable to NHSN?

A. <u>Yes</u> – IVAC criteria are met while the patient was in an adult inpatient location where VAE is included in the Monthly Reporting Plan.

B. No – the use of ECMO on MV days 6 and 7 **DOES NOT** exclude the VAE from reporting.

Questions

Thank you.

For any questions or concerns, contact the NHSN Helpdesk

- **NHSN-ServiceNow** to submit questions to the NHSN Help Desk.
- Access new portal at **https://servicedesk.cdc.gov/nhsncsp**.
- 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, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 https://www.cdc.gov/
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