Use and Application of the Ventilator Associated Event (VAE) Protocol

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Objectives

- Identify Ventilator Associated Events (VAE) definitions and surveillance algorithm
- Describe the use of the VAE Calculator
- Accurately apply the VAE algorithm to example case scenarios

Relevance

- Estimate: 157,000 healthcare-associated pneumonias occur in acute care hospitals in U.S. with 39% being ventilator-associated[1]
  - 2015 update showed stable prevalence between 2011 and 2015[2]
- CMS data revealed that between 2005-2013 patients with ventilator-associated pneumonia remained the same, at around 10%[3]
- Ventilator-associated pneumonia (VAP) is an important complication of mechanical ventilation but other adverse events also happen to ventilated patients

1. Magill SS., Edwards, JR., Bamberg, W., et al. "Multistate Point-Prevalence Survey of Health Care-Associated Infections, 2011". New England Journal of Medicine. 370: (2014): 1198-1208.

2. Magill, SS, O'Leary, E, Janelle, SJ, Thompson, DL, et al., Changes in Prevalence of Healthcare-associated Infections in US Hospitals. New England Journal of Medicine., 2018. 379:1732-1744

3. Metersky ML, Wang Y, Klompas M, Eckenrode S, Bakullari A, Eldridge N. Trend in ventilator-associated pneumonia rates between 2005 and 2013. JAMA 2016;316:2427-2429

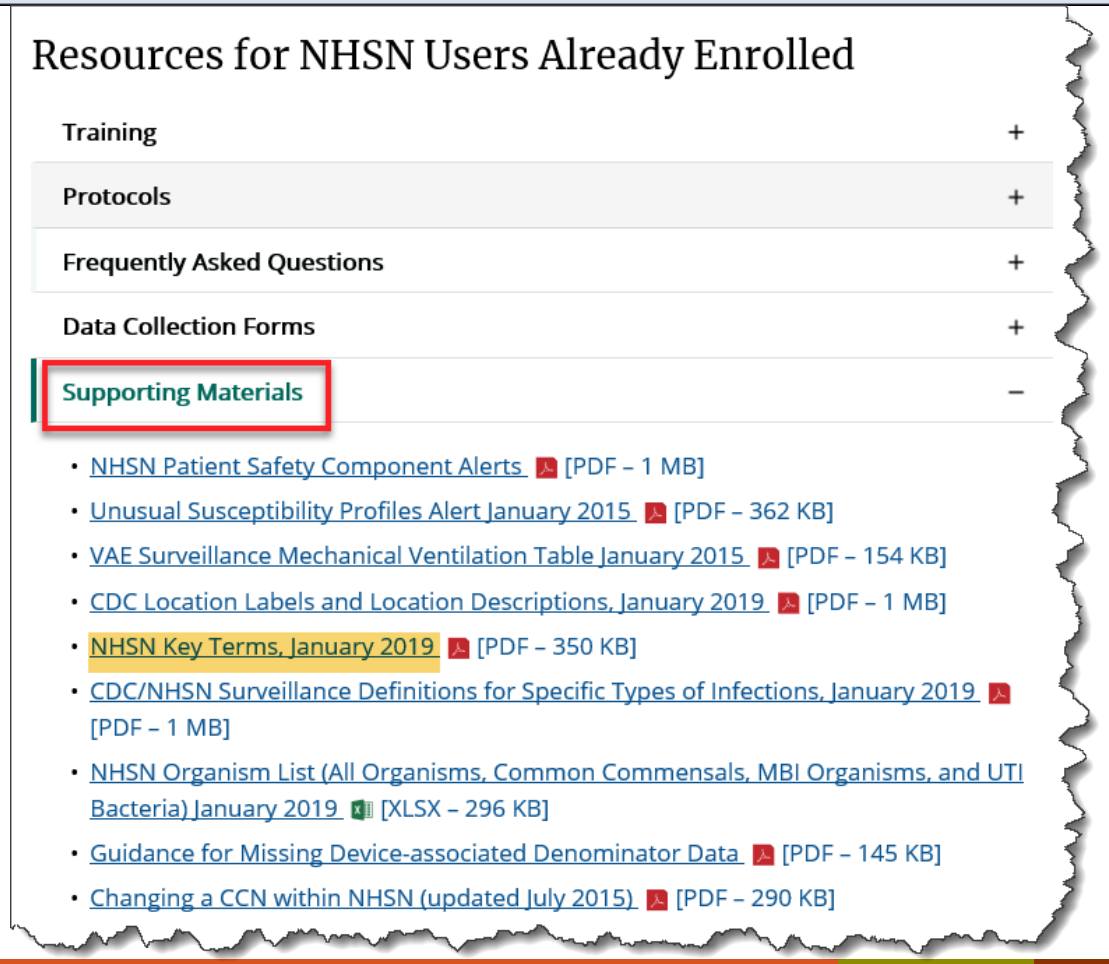
VAE - Ventilator "Associated" Event

- An event associated with the use of a ventilator
- Detection of VAE may be related to:
  - Infection - respiratory or other 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

Adult Surveillance

- **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
    - Identifies a broad range of conditions and complications occurring in mechanically ventilated patients (pneumonia, ARDS, atelectasis, pulmonary edema) which may be preventable
    - Enhance ability to use surveillance data to drive improvements in patient care and safety

In-plan surveillance	Facility has indicated in their monthly reporting plan that the NHSN surveillance protocol(s) will be utilized, in its entirety, for that particular event. Only in-plan data are submitted to CMS in accordance with CMS's Quality Reporting Programs. Only data that are entered into NHSN "in-plan" are included in NHSN annual reports or other NHSN publications.



Resources for NHSN Users Already Enrolled

Training +

Protocols +

Frequently Asked Questions +

Data Collection Forms +

Supporting Materials −

- NHSN Patient Safety Component Alerts [PDF – 1 MB]
- Unusual Susceptibility Profiles Alert January 2015 [PDF – 362 KB]
- VAE Surveillance Mechanical Ventilation Table January 2015 [PDF – 154 KB]
- CDC Location Labels and Location Descriptions, January 2019 [PDF – 1 MB]
- NHSN Key Terms, January 2019 [PDF – 350 KB]
- CDC/NHSN Surveillance Definitions for Specific Types of Infections, January 2019 [PDF – 1 MB]
- NHSN Organism List (All Organisms, Common Commensals, MBI Organisms, and UTI Bacteria) January 2019 [XLSX – 296 KB]
- Guidance for Missing Device-associated Denominator Data [PDF – 145 KB]
- Changing a CCN within NHSN (updated July 2015) [PDF – 290 KB]

Reporting Plan

Mandatory fields marked with *

Facility ID *: DHQP Memorial Hospital (ID 10000)

Month *: March

Year *: 2019

☐ No NHSN Patient Safety Modules Followed this Month

Device-Associated Module

	Locations	CLABSI	VAE	CAUTI	CLIP	PedVAP	PedVAE
🗑	IR - RADIOLOGY	☐	☐	☐	☑	☐	☐
🗑	BURN ICU 2 - BURN ICU	☑	☑	☑	☑	☐	☐
🗑	CMICU_N - CARDIAC ICU	☑	☑	☑	☑	☐	☐
🗑	PED HEMONC - PEDIATRIC HEMONC WARD	☑	☐	☑	☑	☑	☑
🗑	PICU2 - PEDIATRIC ICU	☑	☐	☑	☑	☑	☑

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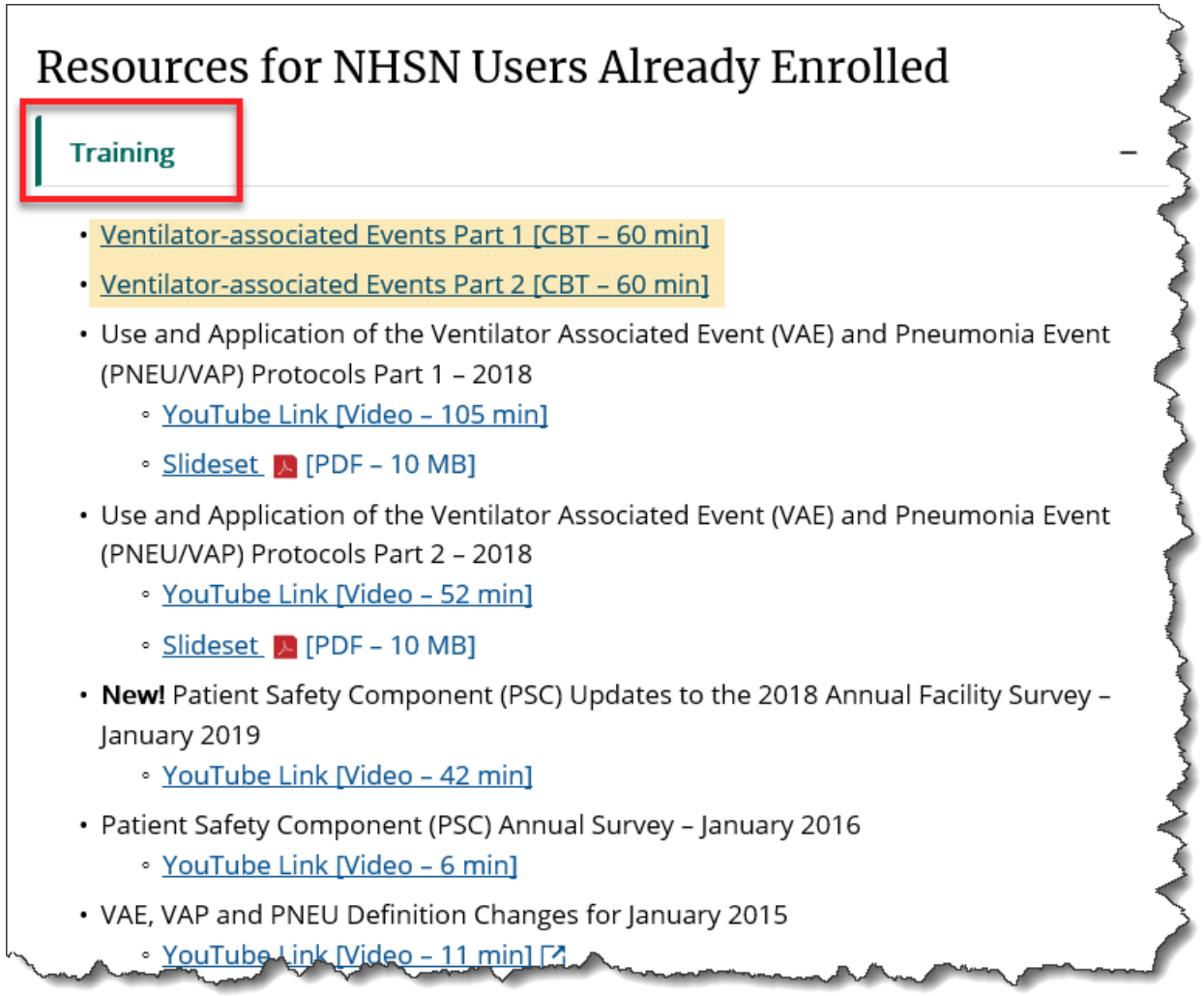
Identifying Healthcare-associated Infections (HAI) for NHSN Surveillance …….Does not apply to VAE

Table 1: Exceptions to application of Chapter 2

	SSI*	LabID*	VAE*
Infection Window Period†	Not Applicable	Not Applicable	Not Applicable
Date of Event			
POA			
HAI			
Repeat Infection Timeframe (RIT)†			
Secondary BSI Attribution Period†			

Training Options



Resources for NHSN Users Already Enrolled

Training

- Ventilator-associated Events Part 1 [CBT – 60 min]
- Ventilator-associated Events Part 2 [CBT – 60 min]
- Use and Application of the Ventilator Associated Event (VAE) and Pneumonia Event (PNEU/VAP) Protocols Part 1 – 2018
  - YouTube Link [Video – 105 min]
  - Slideset [PDF – 10 MB]
- Use and Application of the Ventilator Associated Event (VAE) and Pneumonia Event (PNEU/VAP) Protocols Part 2 – 2018
  - YouTube Link [Video – 52 min]
  - Slideset [PDF – 10 MB]
- **New!** Patient Safety Component (PSC) Updates to the 2018 Annual Facility Survey – January 2019
  - YouTube Link [Video – 42 min]
- Patient Safety Component (PSC) Annual Survey – January 2016
  - YouTube Link [Video – 6 min]
- VAE, VAP and PNEU Definition Changes for January 2015
  - YouTube Link [Video – 11 min]

VAE Surveillance

VAE Surveillance Evolution

- January 2013
  - Initial release
- July 2013
  - Modified PEEP criterion → PEEP values of 0-5 cmH_20 = 5 cmH_20
- January 2014
  - Age based surveillance → Location based surveillance (adult locations)
  - Daily minimum PEEP and FiO_2 → Maintain for at least 1 hour
  - Purulent respiratory secretions definition → adapted
  - List of antimicrobial agents eligible for IVAC → refined
- January 2015
  - Third tier possible & probable VAP → PVAP (possible VAP)
  - If no value maintained for at least 1 hour → daily minimum value is the lowest value
  - Community associated fungal pathogens → exclusions
  - New denominator → Episodes of Mechanical Ventilation (EMV)

VAE Surveillance Evolution

- January 2016
  - Addition → 6 new antimicrobial agents
  - Changes applicable to all NHSN events
    - Inclusion of pathogen identification → using non-culture based diagnostic test methods (e.g., PCR)
    - Exclusion of events → detected as a result of organ donation
- January 2017
  - Exclusion of → non-acute care locations in acute care facilities
- January 2018
  - Antimicrobial list updated
  - Definition of ventilator updated for clarity
  - Daily minimum PEEP and FiO2 values changed to lowest setting maintained for >1 hour
  - Clarification of exclusion for organ procurement procedures
  - Added cytology findings to meet PVAP Criterion 3
  - APRV: No longer a required field for event reporting, and also no longer required to report APRV denominator days
  - Changed analysis to only include total VAE rate

2019 Changes and Clarifications

- Updated ventilation support modalities which are excluded from VAE surveillance to include paracorporeal life support (specifically paracorporeal membrane oxygenation) *when in place for the entire calendar day*
- Updated the IVAC criteria in the algorithm to clarify that a new antimicrobial agent must be continued for at least 4 qualifying antimicrobial days instead of 4 calendar days
- Added an update to the antimicrobial appendix list

Who is eligible for VAE surveillance?

- Inpatients of acute care hospitals, long term acute care hospitals, inpatient rehabilitation facilities
- Patients in adult locations are eligible for VAE surveillance
  - Pediatric patients* in adult locations included in VAE surveillance
  - Adults in pediatric locations included in pedVAP surveillance

* NOT recommended to include in VAE surveillance young children housed in adult ICU locations who are not thought to be physiologically similar to the location's adult patient population (consider virtual location)

Who is NOT eligible for VAE surveillance?

- Patients who have been ventilated < 3 days are not eligible
- Patients on high frequency ventilation (HFV), paracorporeal, 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)

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 dispel the myth!
- VAE is designed to detect more than VAP

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

What about other alternative modes of mechanical ventilation?

- INCLUDE patients who are receiving a conventional mode of mechanical ventilation and:
  - Prone positioning
  - Nitric oxide therapy
  - Helium-oxygen mixture
  - Epoprostenol therapy
- INCLUDE patients on Airway Pressure Release Ventilation (APRV) or related modes. VAC determinations made using FiO_2

What is APRV ?

- A mode of mechanical ventilation characterized by continuous application of positive airway pressure with an intermittent pressure release phase
- Used in patients with Acute Lung Injury and Acute Respiratory Distress Syndrome and also after major surgery to treat/prevent atelectasis
- Other names: BiLevel, Bi Vent, BiPhasic, PCV+, DuoPAP

Stawicki SP, et al. J Intensive Care Med 2009;24:215-29; Modrykamien A, et al. Cleveland Clinic J Med 2011;78:101-10; Mireles-Cabodevila E, et al. Cleveland Clin J Med 2009;76:417-30

APRV and VAC Determinations

- Evaluation for VAC will be limited to the FiO_2 parameter when the patient is on APRV for the entire calendar day, since changes in PEEP as indicated in this surveillance algorithm may not be applicable to APRV.
  - Do not use Hi/Lo values
  - Do not designate PEEP as “0” on data collection tool or enter “0” into the calculator
  - PEEP is N/A
- When the patient is on APRV for portions of a calendar day PEEP values recorded during periods of time when the patient is on a conventional mode of ventilation are used to determine the daily minimum PEEP and thus can be used to make VAC determinations

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 when delivered through an artificial airway, specifically oral/nasal endotracheal or tracheostomy tubes
  - Ventilation and lung expansion devices that deliver positive pressure to the airway via a non-invasive means are not considered ventilators unless the positive pressure is delivered via an artificial an artificial airway

Episode of Mechanical Ventilation

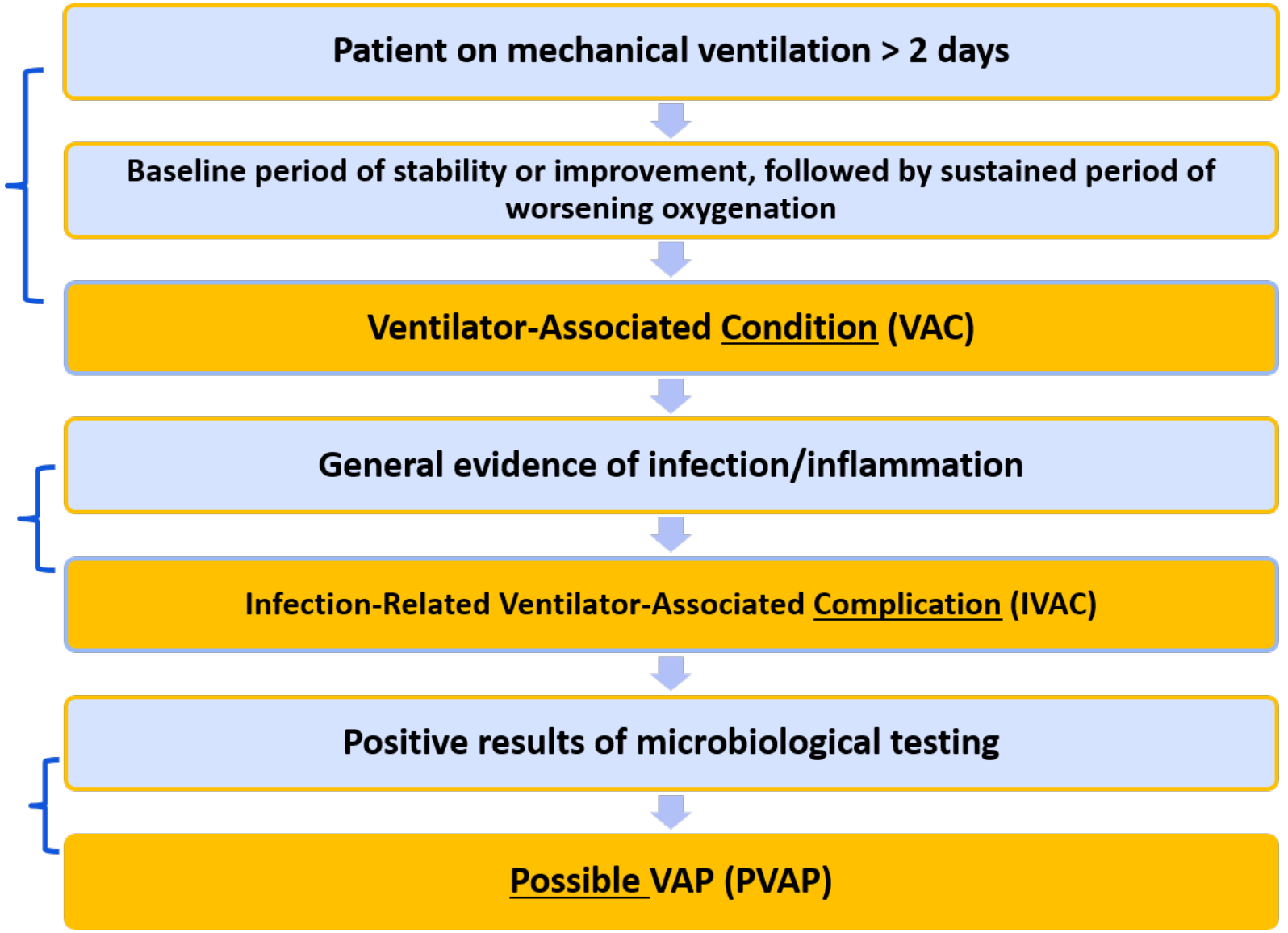
- A period of days during which the patient was mechanically ventilated for some portion of each consecutive day. A break in mechanical ventilation of at least one full calendar day followed by re-intubation or re-initiation of mechanical ventilation during the same hospitalization is a new episode.

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

- 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
- The fundamental definition within the algorithm is the VAC defined on the basis of respiratory deterioration
  - IVAC - additional evidence that the event may be infectious vs. non-infectious
  - PVAP – additional evidence the infection may be respiratory related
- Detection of VAC is just as significant as detection of an IVAC or PVAP

Respiratory Status Component of VAE Algorithm

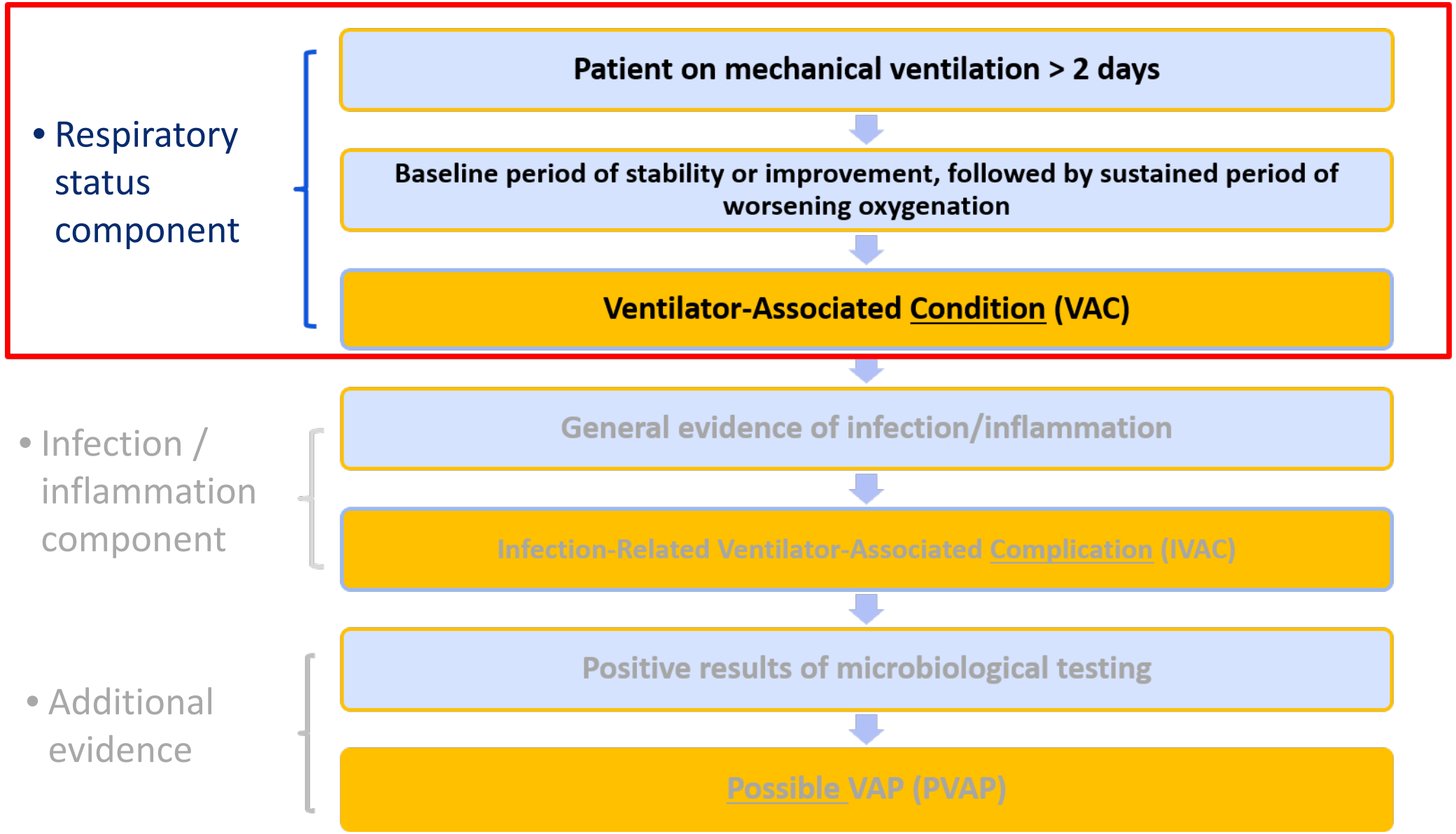
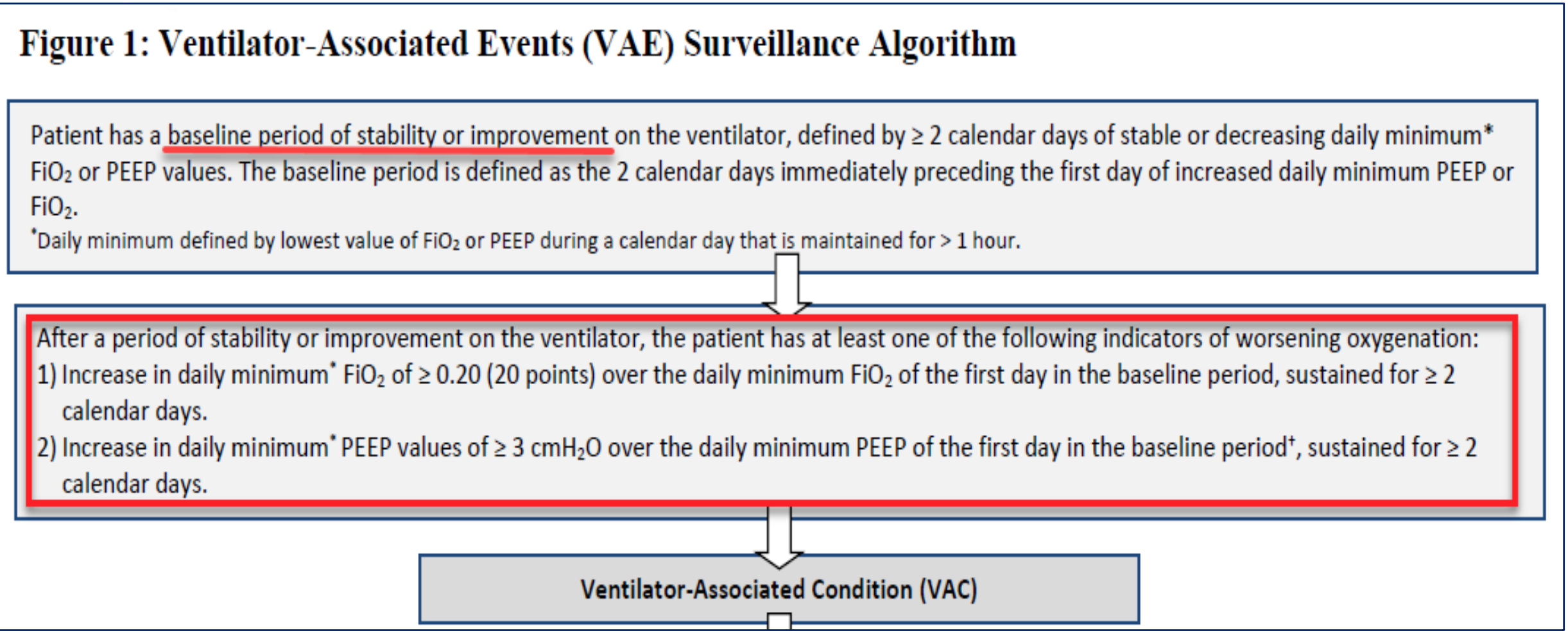


Figure 1: Ventilator-Associated Events (VAE) Surveillance Algorithm



Key ventilator parameters that can be adjusted depending on the patient's oxygenation needs are used to make VAC determinations

Positive End-Expiratory Pressure (PEEP)	Fraction of Inspired Oxygen (FiO_2)
"A technique used in respiratory therapy in which airway pressure greater than atmospheric pressure is achieved at the end of exhalation by the introduction of a mechanical impedance to exhalation."*	The fraction of oxygen in inspired gas. For example, the FiO_2 of ambient air is 0.21; the oxygen concentration of ambient air is 21%.
A sustained increase in the daily minimum PEEP of **≥ 3 cmH_2O** following a period of stability or improvement on the ventilator is one of two criteria that can be used in meeting the VAC definition.	A sustained increase in the daily minimum FiO_2 of **≥ 0.20 (20%)** following a period of stability or improvement on the ventilator is the second of the two criteria that can be used in meeting the VAC definition.

*Stedman's Medical Dictionary, (28th ed). (2005). Philadelphia: Lippincott, Williams, & Wilkins

What are Daily Minimum FiO_2 and PEEP

- FiO_2 and PEEP ventilator settings documented across the calendar day are used to identify the daily minimum FiO_2 and PEEP values
- FiO_2 and PEEP settings are typically recorded in the paper or electronic medical record, on respiratory therapy and/or nursing flow sheets, in the section of the flow sheet that pertains to respiratory status/mechanical ventilation
- Use a calendar day not some other “capture period” or other designated 24 hour time period

Daily Minimum FiO_2 and PEEP

- When choosing the daily minimum PEEP and FiO_2, use all eligible settings that are recorded throughout the calendar day during times when the patient is receiving support from an eligible mode of mechanical ventilation and the patient is eligible for VAE surveillance
  - Include settings collected during weaning/mechanical ventilation liberation trials as long as the patient is receiving ventilator support during those trials
  - Use all conventional mechanical ventilation settings
    - Include conventional MV settings during times when a patient is intermittently on an excluded mode of ventilation throughout a calendar day
    - Include recorded PEEP settings during times when a patient is not on APRV or a similar mode of ventilation

Daily Minimum FiO_2 and PEEP

- Settings not eligible for use
  - Periods of time when the patient is on HFV, PCLS, ECLS
  - Periods of time when the patient is not receiving mechanical ventilation support (e.g., a T-piece trial, or a trach collar trial, where the patient continues to receive supplemental oxygen, but is receiving no additional support from the mechanical ventilator).
  - Periods of time when the patient is being mechanically-ventilated using APRV or a related strategy (e.g. BiLevel, BiVent, BiPhasic, PCV+ and DuoPAP): only review FiO_2 data (not PEEP).

Daily Minimum FiO_2 and PEEP

- Choose 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
  - Ventilation initiated late in the calendar day
  - Ventilation discontinued early in the calendar day
  - Ventilator settings very unstable throughout the day

Identifying the Daily Minimum FiO_2 and PEEP

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

	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	0.70	0.75	0.70	0.70
PEEP	8	8	8	8	8	5	5	8

Note: FiO_2 and PEEP values are maintained for > 1 hour

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 of a certain level 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 a certain level would be needed (e.g., at 09:00, 09:30, and 10:00)
  - If tracking every hour, 2 consecutive recordings at a certain level (e.g., at 09:00 and 10:00)
- 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 value for the calendar day but it was not maintained for > 1 hour

Identifying the Daily Minimum FiO_2 and PEEP

(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	O.80	0.80	0.75	0.75	0.75
PEEP	8	5	8	8	8	8	8	8

0.70 is the lowest value for Monday because no value was maintained for > 1 hour

Knowledge Check 1

Mrs. Apnea was intubated at 10am. Below are the PEEP and FiO2 setting which were documented for the remainder of the calendar day.

What are the daily minimum PEEP and FiO2 values for this calendar day?

Time	10 am	12 pm	2 pm	6 pm	8 pm	12 am
PEEP (cmH_2O)	5	8	5	8	8	10
FiO_2	1.0	0.75	0.40	0.60	0.60	0.60

Knowledge Check 1 Rationale: What are the daily minimum PEEP and FiO_2?

A. 5 and 0.60

✓ B. 5 and 0.40

C. 8 and 0.60

D. 8 and 0.40

Time	10 am	12 pm	2 pm	6 pm	8 pm	12 am
PEEP (cmH_2O)	5	8	5	8	8	10
FiO_2	1.0	0.75	0.40	0.60	0.60	0.60

Knowledge Check 2

Mr. Blulips was intubated at 6 pm. The PEEP and FiO2 values for the remainder of the calendar day are displayed on the table below.

What are the daily minimum values for PEEP and FiO2 for this calendar day?

Time	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
PEEP (cmH_2O)	10	10	8	5	8	8
FiO_2	1.0	0.75	0.75	0.50	0.80	0.80

What are the daily minimum PEEP and FiO_2?

A. 5 and 0.50
B. 8 and 0.80
✓C. 8 and 0.75
D. 10 and 0.75

Time	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
PEEP (cmH_2O)	10	10	8	5	8	8
FiO_2	1.0	0.75	0.75	0.50	0.80	0.80

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.
- Remember daily minimum PEEP values of 0-5 cmH_2O are considered equivalent (equal to 5) for the purposes of VAE surveillance.

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 PEEP or FiO_2 (Evidence of worsening oxygenation)

*Daily minimum FiO_2 and PEEP must be maintained for at least 1 hour

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

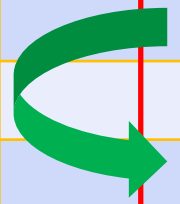
  - Increase in daily minimum* PEEP values of ≥ 3 cmH2O over the daily minimum PEEP of the first day in the baseline period†, sustained for≥ 2 calendar days

*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.

Define “Baseline”

MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	10	30
2	10	30
3	8	30
4	8	55
5	8	55
6	8	60

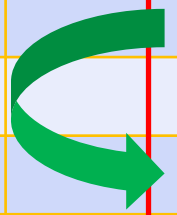


VAC

Baseline period of stability

Define “Baseline”

MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	10	35
2	10	35
3	8	30
4	8	70
5	8	70
6	8	60



VAC

Baseline period of improvement

2-day period of stability (PEEP or FiO_2)

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								
4	8	60								
5	8	50								
6	7	40								
7	5	40								
8	5	40								

2-day period of worsening, based on PEEP

Vent Day	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Polys /Epis	Org
1	10									
2	5	40								
3	5	40								
4	8	60								
5	8	50								
6	7	40								
7	5	40								
8	5	40								

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								
4	8	60								
5	8	50								
6	7	40								
7	5	40								
8	5	40								

= VAC

Knowledge Check 4: What if an increase over the baseline period meets the requirement relative to only one baseline day?

MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	10	100
2	7	90
3	5	90
4	8	50
5	8	50
6	8	50

Knowledge Check 4: Rationale

A. VAC

✓ B. NO VAC

MV Day	Daily [illegible]	Daily minimum FiO_2
1	10	100
[illegible]	7	90
[illegible]	5	90
4	8	50
5	8	50
6	8	50

VAC Definition Not Met

Knowledge Check 5:
What if there is an increase for one day, and then a decrease?

MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	10	100
2	5	90
3	5	90
4	8	50
5	7	50
6	8	50

Knowledge Check 5: Rationale

What if there is an increase for one day and then a decrease?

A. VAC

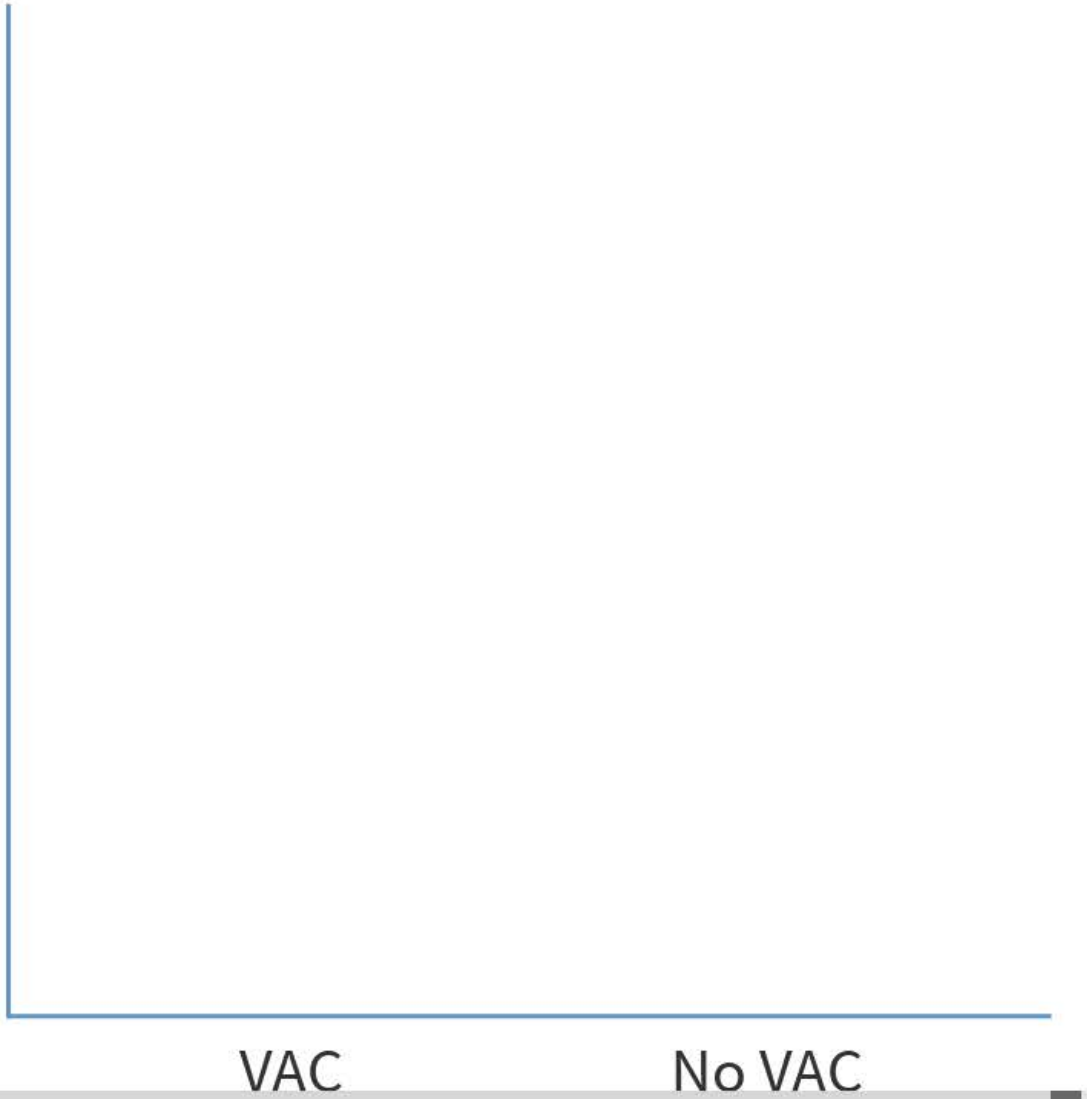
✓ B. NO VAC

MV Day		Daily minimum FiO_2
	10	100
	5	90
3	5	90
4	8	50
5	7	50
6	8	50

VAC Definition Not Met (increase is not sustained)

Knowledge Check 6: In this circumstance, would you consider this a VAC or No VAC?

MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	10	100
2	5	90
3	5	90
4	10	50
5	8	50
6	8	50

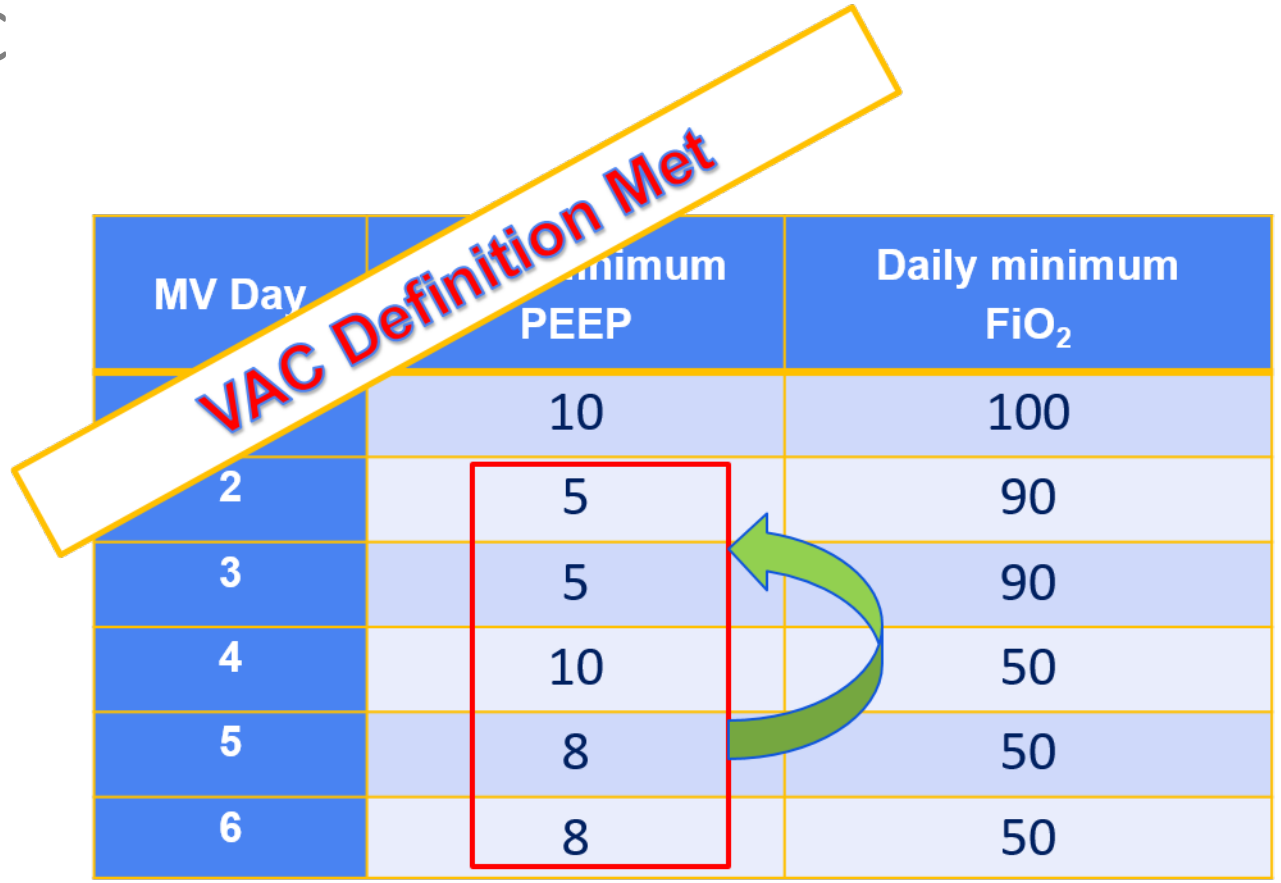


Knowledge Check 6: Rationale

VAC or No VAC?

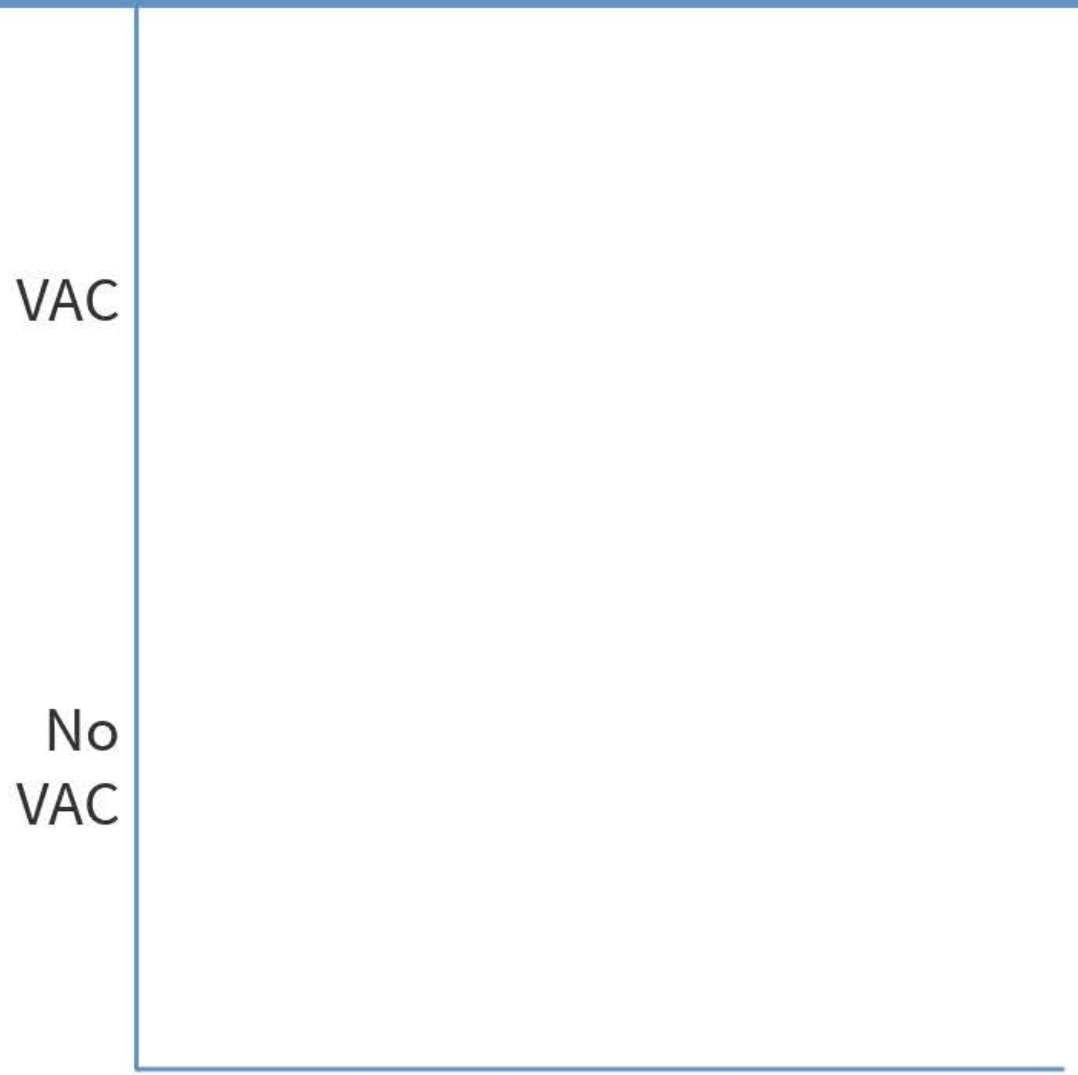
✔ A. VAC

B. No VAC



Knowledge Check 7: What if the PEEP goes up but FiO2 goes down. VAC or No VAC?

MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	8	100
2	7	90
3	7	90
4	10	50
5	10	50
6	8	50



Knowledge Check 7: Rationale

PEEP goes up but FiO_2 goes down

MV Day	Daily minim… PE…	Daily minimum FiO_2
1	[illegible]	100
2	7	90
3	7	90
4	10	50
5	10	50
6	8	50

VAC Definition is Met

Date of Event / Event Date

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

  - Earliest date of event for VAE is mechanical ventilation day 3 (first day of worsening oxygenation)

  - First possible day that VAC criteria can be fulfilled is mechanical ventilation day 4

Vent Day	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Poly/ Epis	Org
1	10	60								
2	5	40								
3	5	40								
4	8									
5	8	50								
6	7	40								
7	5	40								
8	5	40								

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

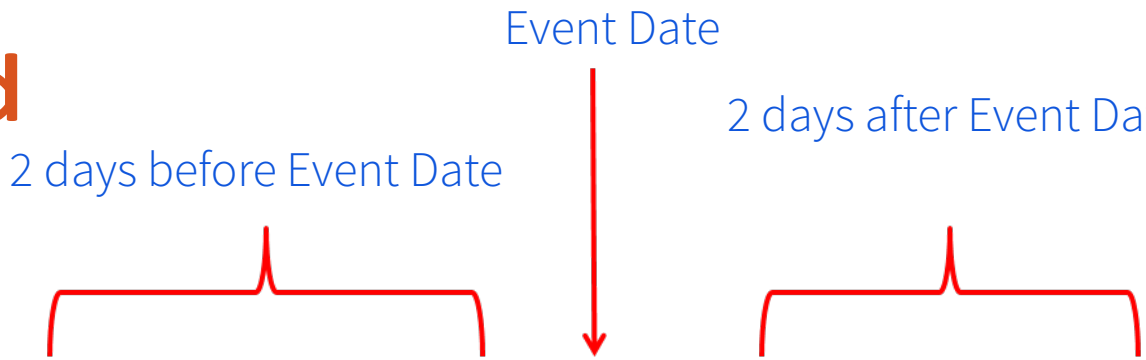
Why is the Event Date important?

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

VAE Window Period

This is the period of days around the event date (i.e., the day of onset of worsening oxygenation) within which all other VAE criteria must be met. It is usually a 5-day period and includes the 2 days before, the day of, and the 2 days after the VAE event date.

VAE Window Period



MV Day	10	11	12	13	14	15	16
VAE Day	-3	-2	-1	1	2	3	4
Worsening oxygenation	--	Day 1 of Stability or improve-ment	Day 2 of stability or improve-ment	Day 1 of worsening oxygena-tion	Day 2 of worsening oxygena-tion		
Temperature or WBC abnormality		←Documented within this shaded period→					
Antimicrobial agent		←Started on within this shaded period, and then continued for at least 4 days→					
Purulent respiratory secretions, positive culture, positive histopathology		←Collected within this shaded period→					

VAE Window Period: Important Note

- There is an exception, however, in which the VAE Window Period is only 3 or 4 days, as follows:

  In cases where the VAE event date corresponds to MV day 3 or day 4, the window period described above may only be a 3-day or a 4-day window, because it can NOT include any days before the 3rd day of MV.

  For example, if the VAE event date is MV day 3, then the window period includes only the day of VAE onset and the 2 days after VAE onset (because the 2 days before VAE onset are before the 3rd day of MV).

Exception: VAE Window Period

Can't count data in 1st 2 days of MV for IVAC, PVAP

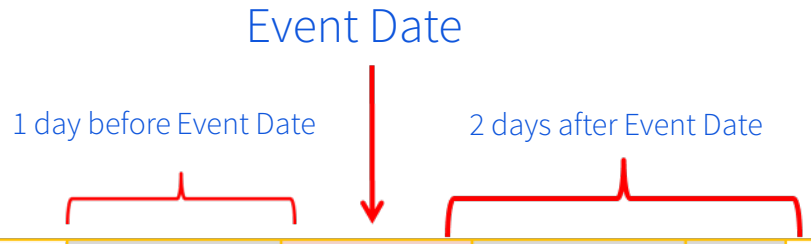
Event Date

2 days after Event Date

MV Day No.	1	2	3	4	5	6	7
VAE Day	-2	-1	1	2	3	4	5
Worsening	Day 1 of Stability or improve-ment	Day 2 of stability or improve-ment	Day 1 of worsening oxygena-tion	Day 2 of worsening oxygena-tion			
Temperature or WBC abnormality			←Documented within this shaded period→				
Antimicrobial agent			←Started on within this shaded period, and then continued for at least 4 days→				
Purulent respiratory secretions, positive culture, positive histopathology			←Collected within this shaded period→				

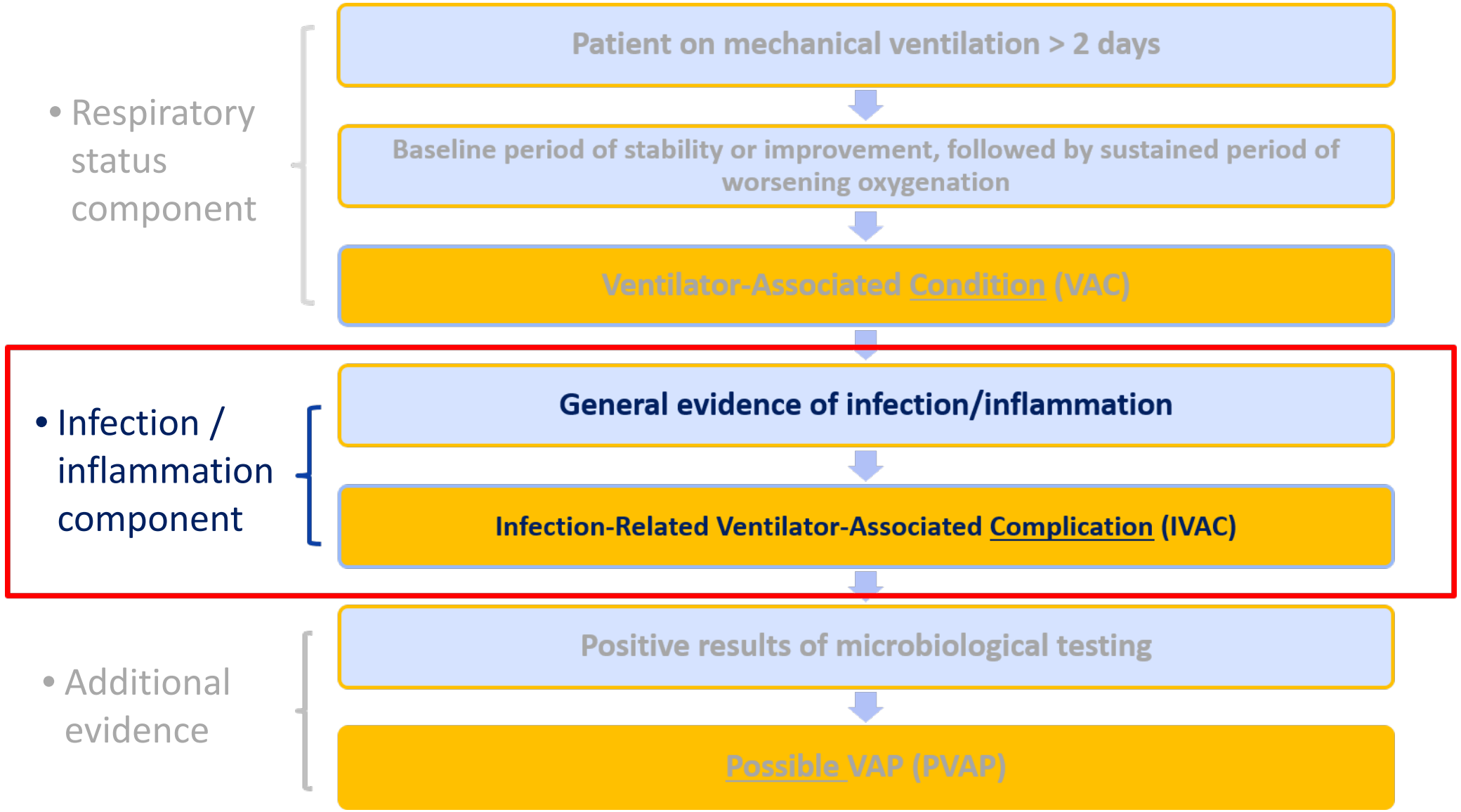
Exception: VAE Window Period

Can't count data in 1st 2 days of MV for IVAC, PVAP

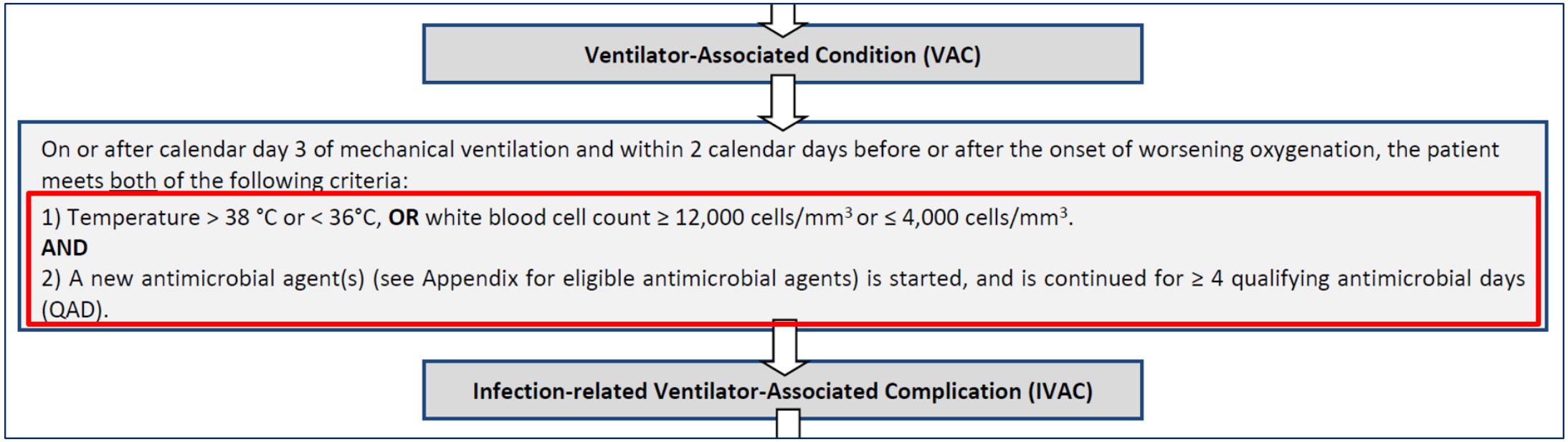


MV Day No.	1	2	3	4	5	6	7	8
VAE Day	-2	-1	1	2	3	4	5	6
Worsening oxygenation		Day 1 of Stability or improve-ment	Day 2 of stability or improve-ment	Day 1 of worseni ng oxygena -tion	Day 2 of worsenin g oxygena-tion			
Temperature or WBC abnormality			←Documented within this shaded period→					
Antimicrobial agent			←Started on within this shaded period, and then continued for at least 4 days→					
Purulent respiratory secretions, positive culture, positive histopathology			←Collected within this shaded period→					

Infection/Inflammation Component of VAE Algorithm



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/mm^3 or ≤ 4,000 cells/mm^3.
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 & WBC Count

As long as there is an abnormal temperature (> 38 °C or < 36°C) OR 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 WBC count was also present on admission or outside the VAE Window Period.

Look for abnormal temp or white 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								

Knowledge Check 8: Rationale

If performing in-plan VAE surveillance in an ICU, the IP will need to gather minimum and maximum temperatures and WBC counts for all ventilated patients.

A. True


B. False

Only for those patients that meet the VAC definition

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
  - A new agent must be continued for ≥ 4 qualifying antimicrobial days
  - There is no requirement that the same antimicrobial agent be given on the 4 qualifying antimicrobial days
  - New agent must be administered IV, IM, via digestive tract or via respiratory tract

IVAC Antimicrobial Criterion

- Probably the most complicated portion of the VAE surveillance definition algorithm
- Rules for meeting this criterion are not perfect—but we need a standardized method for assessment of antimicrobial therapy, without needing knowledge of dosing, renal function, indication for therapy, etc.

Which antimicrobial drugs are in the Appendix?

- Mostly antibacterials, antifungals, limited antivirals
- Drugs that are not included:
  - anti-HIV agents, anti-TB agents
  - agents used to treat viral hepatitis
  - anti-parasitics
  - agents used to treat herpes virus infections

IVAC Antimicrobials

- A broad range of agents that could be used to treat healthcare-associated infections—not just respiratory related infections.
- Concerns when an antimicrobial agent resulted in an IVAC determination and then subsequently a PVAP determination but the agent was not used to treat a respiratory infection
  - 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 are not available
    - Oral cephalosporins and penicillins, erythromycin, erythromycin/sulfisoxazole, amantadine, rimantadine, chloramphenicol, tinidazole, fidaxomicin, nitrofurantoin, oral vancomycin and daptomycin

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
  - If the patient expires prior to 4th day of administration the QAD parameter is not met
  - 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

Qualifying Antimicrobial Days

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	3/2/2019	5 (2)*	40				☐	
3	3/3/2019	5 (2)*	40				☐	
† 4	3/4/2019	5	40		☑	☐	☐	
† 5	3/5/2019	5	40		☐	☐	☑	¶ yes
† 6	3/6/2019	10	40	‡ IVAC	☑	☐	☑	¶ yes
† 7	3/7/2019	10	40		☐	☐	☑	¶ yes
† 8	3/8/2019				☐	☐	☑	¶ yes
9	3/9/2019						☑	¶ yes

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

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

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	3/2/2019	5 (2)*	40				☐	
3	3/3/2019	5 (2)*	40				☐	
† 4	3/4/2019	5	40		☑	☐	☐	
† 5	3/5/2019	5	40		☐	☐	☑	¶ yes
† 6	3/6/2019	10	40	‡ IVAC	☑	☐	☐ →	¶ yes
† 7	3/7/2019	10	40		☐	☐	☑	¶ yes
† 8	3/8/2019				☐	☐	☐ →	¶ yes
9	3/9/2019						☑	¶ yes

QADs: Different Agents

- In contrast, days between administration of DIFFERENT antimicrobial agents do NOT count as QADs
  - Ceftazidime is administered MV days 4 & 5, there is a gap on day 6 between different agents. Vancomycin is administered MV days 7-9. MV day 4 does not count as a QAD.

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	3/2/2019	5 (2)*	40				☐	☐	
3	3/3/2019	5 (2)*	40				☐	☐	
† 4	3/4/2019	5	40		☑	☐	☑	☐	¶ yes
† 5	3/5/2019	5	40		☐	☐	☑	☐	¶ yes
† 6	3/6/2019	10	40	‡ VAC	☑	☐	☐	☐	
† 7	3/7/2019	10	40		☐	☐	☐	☑	¶ yes
† 8	3/8/2019				☐	☐	☐	☑	¶ yes
9	3/9/2019						☐	☑	¶ yes

Date of Initiation of Antimicrobial Agent is Important

NHSN Ventilator-Associated Event (VAE) Calculator Ver. 6.0

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/mm³ or ≤ 4,000 cells/mm³ 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/mm³	Add... Remove... Choose a Drug: Choose a Drug	QAD
2	3/2/2019	5 (2)*	40				☐	
3	3/3/2019	5 (2)*	40				☐	
† 4	3/4/2019	5	40		☐	☐	☐	
† 5	3/5/2019	5	40		☐	☐	☐	
† 6	3/6/2019	10	40	‡ VAC	☐	☐	☐	
† 7	3/7/2019	10	40		☐	☐	☐	
† 8	3/8/2019				☐	☐	☐	
9	3/9/2019						☐	

No QADs – VAC Determination

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	Add... Remove... Choose a Drug: LINEZOLID	QAD
2	3/2/2019	5 (2)*	40				☐	
3	3/3/2019	5 (2)*	40				☑	
† 4	3/4/2019	5	40		☑	☐	☑	
† 5	3/5/2019	5	40		☑	☐	☑	
† 6	3/6/2019	10	40	‡ VAC	☐	☐	☑	
† 7	3/7/2019	10	40		☐	☐	☑	
† 8	3/8/2019				☐	☐	☐	
9	3/9/2019						☐	

Not New

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?

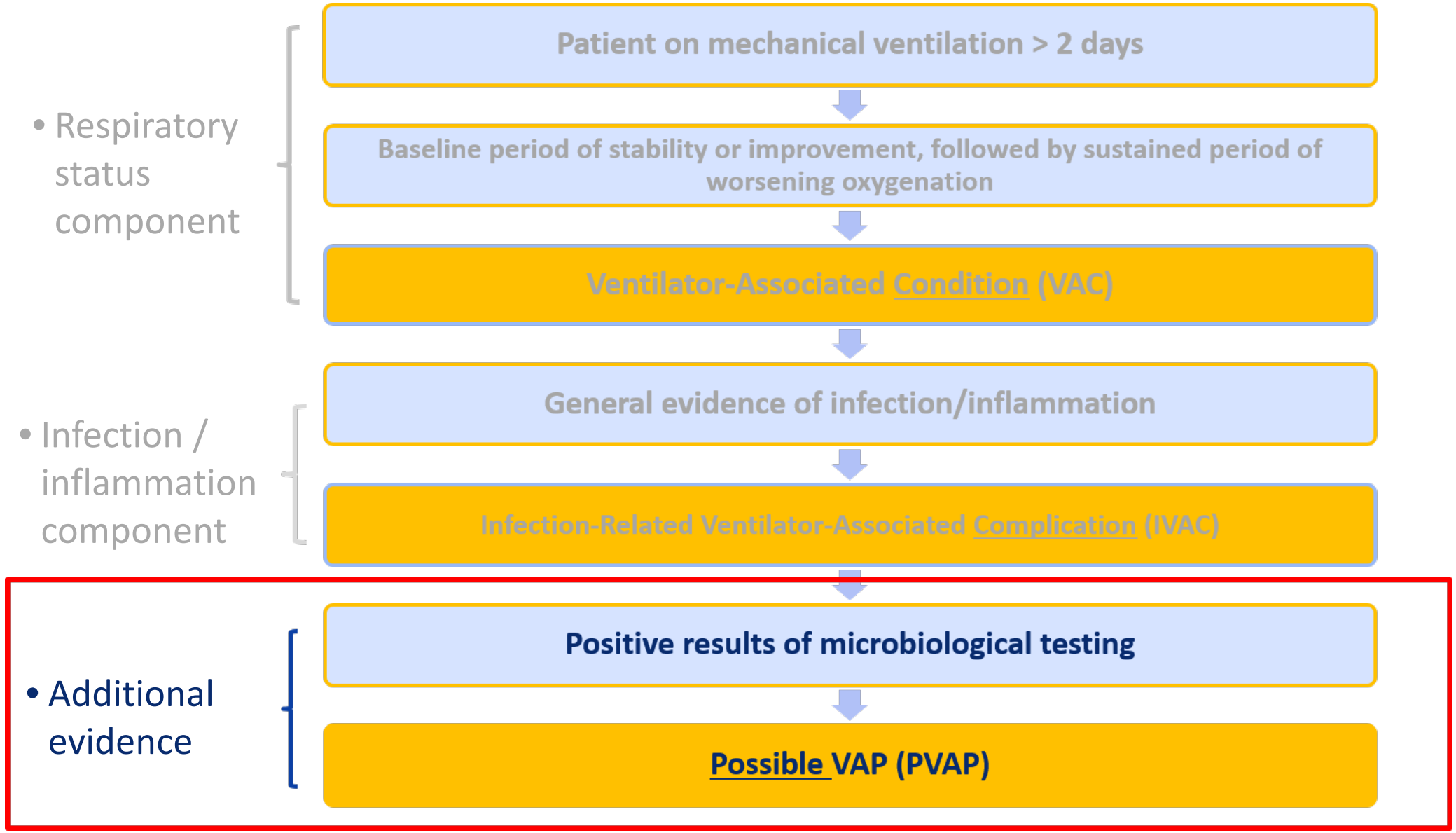
Yes

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 Infection-related Ventilator –Associated Complication (IVAC) definition does not mean that the “infection related” event is necessarily respiratory in origin.
- The IVAC antimicrobial list was refined by removing selected antimicrobial agents that would not be used, or would be unlikely to be used, in treating a lower respiratory infection in a critically ill patient.
- Still possible that an existing agent may have dual purposes and not necessarily be treating a respiratory infection.
- No need to discern the reason for the administration of the antimicrobial.
  - Prophylaxis, de-escalation, change within a class of antimicrobials is not a reason for exclusion

Additional Evidence Component of VAE Algorithm



Tier 3: PVAP

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

AND

- ONE of the following criteria must be met

Tier 3: PVAP

Infection-related Ventilator-Associated Complication (IVAC)

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, 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

   [†] If the laboratory reports semi-quantitative results, those results must correspond to the quantitative thresholds. See additional instructions for using the purulent respiratory secretions criterion in the VAE Protocol.
3) Criterion 3: One of the following positive tests:
   - Organism identified from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
   - 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

January 2019

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, ≥ 10^5 CFU/ml or corresponding semi-quantitative result
- Bronchoalveolar lavage, ≥ 10^4 CFU/ml or corresponding semi-quantitative result
- Lung tissue, ≥ 10^4 CFU/g or corresponding semi-quantitative result
- Protected specimen brush, ≥ 10^3 CFU/ml or corresponding semi-quantitative result

How do I relate my lab's semi-quantitative culture result reporting to the quantitative thresholds in the algorithm?

- Ask your laboratory manager/director first—she/he may be able to tell you
- If your laboratory does not have this information,
  - For the purposes of this surveillance, we will assume that a semi-quantitative result of "moderate" or "heavy" growth, or 2+, 3+ or 4+ growth (in a culture of lung tissue, BAL, PSB, or ETA) meets Criterion 1 of the PVAP surveillance definition.
- See FAQ # 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 you 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 then refer to Table 2 or FAQ # 19

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

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 (e.g., "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: heavy, 4+, or ≥25 neutrophils per low power field (lpf) [x100], AND rare, occasional, few, 1+ or 2+, or ≤10 squamous epithelial cells per lpf [x100] [19].
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 (i.e., heavy, 4+, or ≥25 neutrophils per lpf [x100]).
My laboratory uses different reporting thresholds for neutrophils and squamous epithelial cells (e.g., maximum report of ≥ 20 neutrophils per low power field [x100], or minimum report of ≤ 15 squamous epithelial cells per low power field [x100])?	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 (e.g., "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.

Table 2

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

PVAP – Criterion 3

One of the following positive tests:

- Pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
- Lung histopathology, 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 (cont'd)

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 and according to the usual pathogen and antimicrobial susceptibility reporting methods utilized in NHSN for other events
  - Exception: excluded pathogens
- Pathogens are not reported for VAC or for IVAC

Pathogen Exclusions

- ***Candida* species or yeast not otherwise specified**, **coagulase-negative *Staphylococcus* species,** and ***Enterococcus* species** are excluded for use unless isolated from lung tissue or pleural fluid

- Likewise a BSI with these exclude pathogens cannot be attributed as secondary to VAE unless the excluded pathogen is isolated from lung tissue or pleural fluid

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	PEEP min	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

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

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	ETA	>25/ <10	*Staph 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)

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

Vent Day	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WBC max	QAD	Spe	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								

= PVAP Criterion #3

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
  - And when the blood culture was collected within the 14 -day event period
- Secondary BSI may not be reported for PVAP when a respiratory culture was not performed.
  - PVAP met with histopathology criterion
  - A positive diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

Secondary BSI assignment and VAE Surveillance

WHAT IF……

- No VAE definition is met?
- Only the VAC or IVAC definition is met?
- PVAP definition is met but the positive blood culture is determined NOT to be secondary to VAE?

Secondary BSI and Lower Respiratory Site Infections

- Determine if the BSI is secondary to another site specific infection (Chapter 17, PNEU, SSI, UTI)
- If the patient does not meet one of the site specific definitions to which the BSI can be attributed, the BSI may need to be reported as a primary BSI/CLABSI.

Knowledge Check 9

A patient in your ICU has met the IVAC definition. On the VAE Date of Event, there was a positive blood culture which grew *Acinetobacter baumanii,* and on the same day the physician documented in the medical record that the patient had pneumonia. The patient has a tunneled central hemodialysis catheter which has been accessed for dialysis. How should this event be reported?

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.

Transfer from MICU to SICU on MV Day 2, event date is MV Day 4—therefore attributed to SICU (more than 1 day since transfer)

Vent Day	Location	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Polys /Epis	Org
1	MICU	10	60								
2	**MICU→ 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, event date is MV Day 4—therefore 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 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								

Conducting VAE Surveillance and Reporting Events into NHSN

Conducting Surveillance

- Familiarize yourself with the VAE web page
- Read the protocol
- Review the FAQs –
  - Protocol FAQs
  - FAQs found on the VAE web page
- Locate and use the worksheets
  - VAE Data Collection Worksheet
  - VAE Antimicrobial Worksheet
- Learn to use the VAE Calculator version 6.0

Surveillance for Ventilator-associated Events

VAE surveillance is available in-plan for adult inpatient locations only. See PedVAE and PNEU/VAP for in-plan surveillance for pediatric locations. See PedVAE for in-plan surveillance for neonatal locations.

The Ventilator-Associated Event Calculator (must have javascript enabled) operates based upon the currently posted VAE protocol.

Resources for NHSN Users Already Enrolled

- **Training** +
- **Protocols** +
- **Frequently Asked Questions** +
- **Data Collection Forms** +
- **Supporting Materials** +
- **Calculator and Worksheets** +
- **Related Publications and Other Resources** +
- **Analysis Resources** +

Resources for NHSN Users Already Enrolled

Training

Protocols

- Ventilator-Associated Event (VAE) Protocol, January 2019 [PDF – 1 MB]
- NHSN Overview January, 2019 [PDF – 350 KB]
- Identifying Healthcare-associated Infections (HAIs) in NHSN, January 2019

Calculator and Worksheets

- Ventilator-Associated Event Calculator (javascript must be enabled)
- VAE Data Collection Worksheet January 2015 [PDF – 157K]
  - VAE Data Collection Worksheet January 2015 [DOCX – 29K]
- VAE Antimicrobial Worksheet January 2015 [PDF – 74K]
  - VAE Antimicrobial Worksheet January 2015 [DOCX – 32K]
- VAE Antimicrobial Worksheet Instructions January 2015 [PDF – 198K]

  - YouTube Link [Video – 11 min]

Tips for VAE Surveillance

- Establish relationships with **Respiratory Therapy and/or 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
- 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 quantitatively?
  - What quantitative ranges correspond to the semi-quantitative reports?
  - Where will you find histopathology/cytology reports?

VAE Reporting Requirements

- NHSN requirement to report VAE is determined by selection of this event in your monthly reporting plan
  - VAE is not included in CMS' Hospital Inpatient Quality Reporting (IQR) program for acute care or inpatient rehabilitation facilities
  - As of October, 2018, VAE is no longer included in CMS' Long Term Care Hospital Quality Reporting (LTCHQR)
- You may have other entities that require you to report

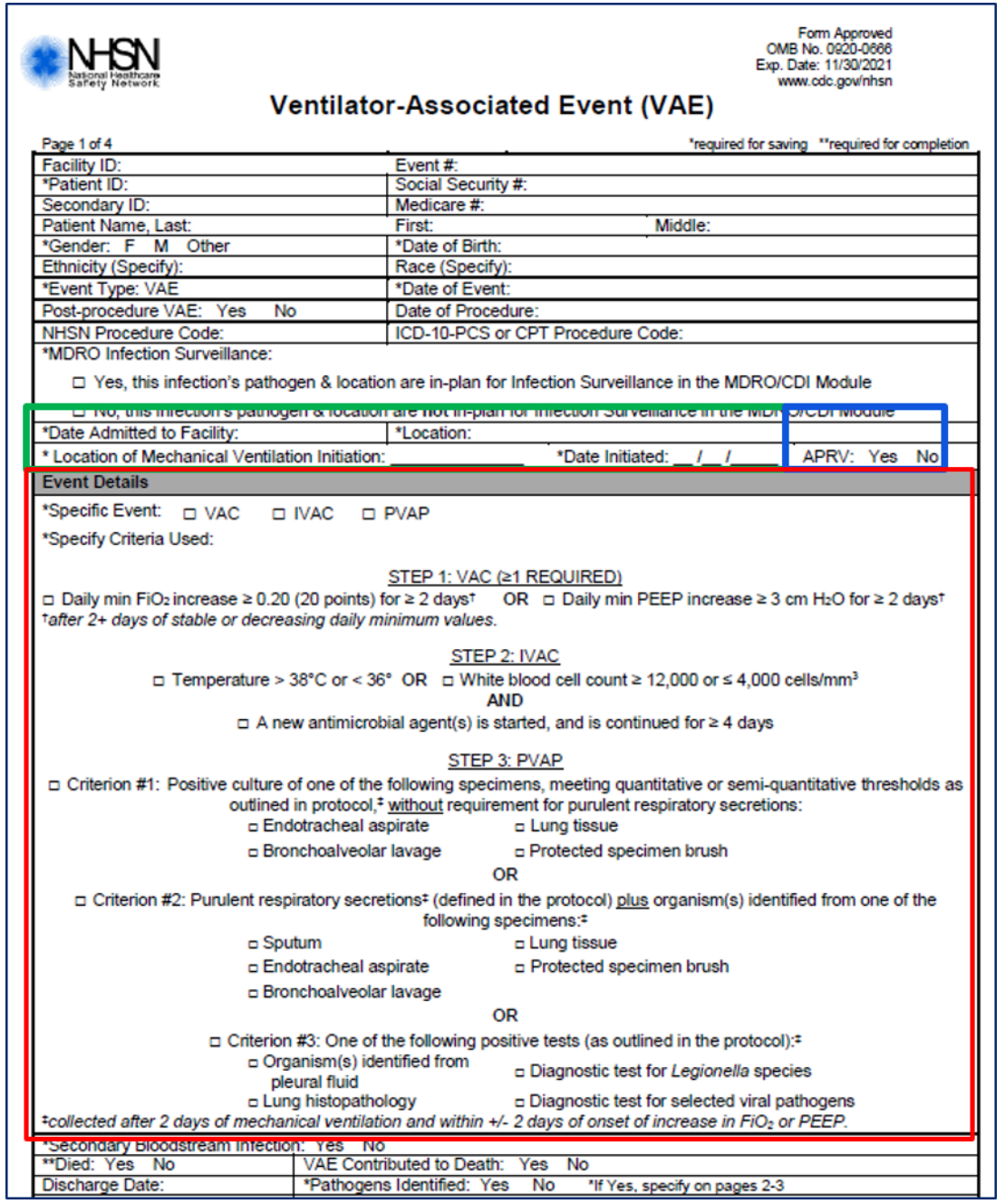
VAE Reporting

- 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
    - 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

VAE Reporting

- Events are not upgraded within the 14 day VAE Period
  - IVAC reported MV Day 5
  - 14 Day VAE Period MV Day 5 – 18
  - BAL culture with collection date on MV Day 10 is reported to be growing many *Pseudomonas aeruginosa*
  - Culture result satisfies PVAP Criterion 1, however the collection date is outside of the VAE window period
  - IVAC is not upgraded to PVAP nor is a new event reported

VAE Data Collection Form



NHSN National Healthcare Safety Network

Form Approved
OMB No. 0920-0666
Exp. Date: 11/30/2021
www.cdc.gov/nhsn

Ventilator-Associated Event (VAE)

Page 1 of 4 *required for saving **required for completion

Facility ID:	Event #:
*Patient ID:	Social Security #:
Secondary ID:	Medicare #:
Patient Name, Last:	First: Middle:
*Gender: F M Other	*Date of Birth:
Ethnicity (Specify):	Race (Specify):
*Event Type: VAE	*Date of Event:
Post-procedure VAE: Yes No	Date of Procedure:
NHSN Procedure Code:	ICD-10-PCS or CPT Procedure Code:

*MDRO Infection Surveillance:

☐ Yes, this infection's pathogen & location are in-plan for Infection Surveillance in the MDRO/CDI Module

☐ No, this infection's pathogen & location are **not** in-plan for Infection Surveillance in the MDRO/CDI Module

*Date Admitted to Facility:	*Location:

* Location of Mechanical Ventilation Initiation: _____ *Date Initiated: __/__/____ APRV: Yes No

Event Details

*Specific Event: ☐ VAC ☐ IVAC ☐ PVAP

*Specify Criteria Used:

STEP 1: VAC (≥1 REQUIRED)

☐ Daily min FiO_2 increase ≥ 0.20 (20 points) for ≥ 2 days† OR ☐ Daily min PEEP increase ≥ 3 cm H_2O for ≥ 2 days†

†*after 2+ days of stable or decreasing daily minimum values.*

STEP 2: IVAC

☐ Temperature > 38°C or < 36° OR ☐ White blood cell count ≥ 12,000 or ≤ 4,000 cells/mm^3

AND

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

STEP 3: 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 ☐ Lung tissue

☐ Bronchoalveolar lavage ☐ Protected specimen brush

OR

☐ Criterion #2: Purulent respiratory secretions‡ (defined in the protocol) plus organism(s) identified from one of the following specimens:‡

☐ Sputum ☐ Lung tissue

☐ Endotracheal aspirate ☐ Protected specimen brush

☐ Bronchoalveolar lavage

OR

☐ Criterion #3: One of the following positive tests (as outlined in the protocol):‡

☐ Organism(s) identified from pleural fluid ☐ Diagnostic test for *Legionella* species

☐ Lung histopathology ☐ Diagnostic test for selected viral pathogens

‡*collected after 2 days of mechanical ventilation and within +/- 2 days of onset of increase in FiO_2 or PEEP.*

*Secondary Bloodstream Infection: Yes No

**Died: Yes No	VAE Contributed to Death: Yes No
Discharge Date:	*Pathogens Identified: Yes No *If Yes, specify on pages 2-3

NHSN Application

Event Information

Event Type *: VAE - Ventilator-Associated Event

Date of Event *:

Post procedural:

MDRO Infection Surveillance *:

Location *:

Date Admitted to Facility >:

Risk Factors

Location of Mechanical Ventilation *

Date Mechanical Ventilation Initiated *

APRV

Event Details

Specific Event >: PVAP - Possible Ventilator-Associated Pneumonia

Specify Criteria Used *

STEP 1:VAC (≥ 1 Required)

☐ Daily min FiO_2 increase ≥ 0.20 (20 points) for ≥ 2 days†

☐ Daily min PEEP increase ≥ 3 cm H_2O for ≥ 2 days†

† after 2+ days of stable or decreasing daily minimum values

STEP 2:IVAC

☐ Temperature > 38°C or < 36°C **OR** ☐ White blood cell count ≥ 12,000 or ≤ 4,000 cells/mm^3

plus

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

STEP 3: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: ǂ

☐ Endotracheal aspirate

☐ Lung tissue

☐ Bronchoalveolar lavage

☐ Protected specimen brush

OR

Criterion #2:

☐ Purulent respiratory secretions (defined in the protocol) **plus** Organism(s) identified from one of the following specimens.

☐ Sputum

☐ Lung tissue

☐ Endotracheal aspirate

☐ Protected specimen brush

☐ Bronchoalveolar lavage

OR

Criterion #3: One of the following positive tests (as outlined in the protocol): ǂ

☐ Organism(s) identified from pleural fluid

☐ Diagnostic test for Legionella species

☐ Lung histopathology

☐ Diagnostic test for selected viral pathogens

ǂ Collected after 2 days of mechanical ventilation and within +/- 2 days of onset of increase in FiO_2 or PEEP

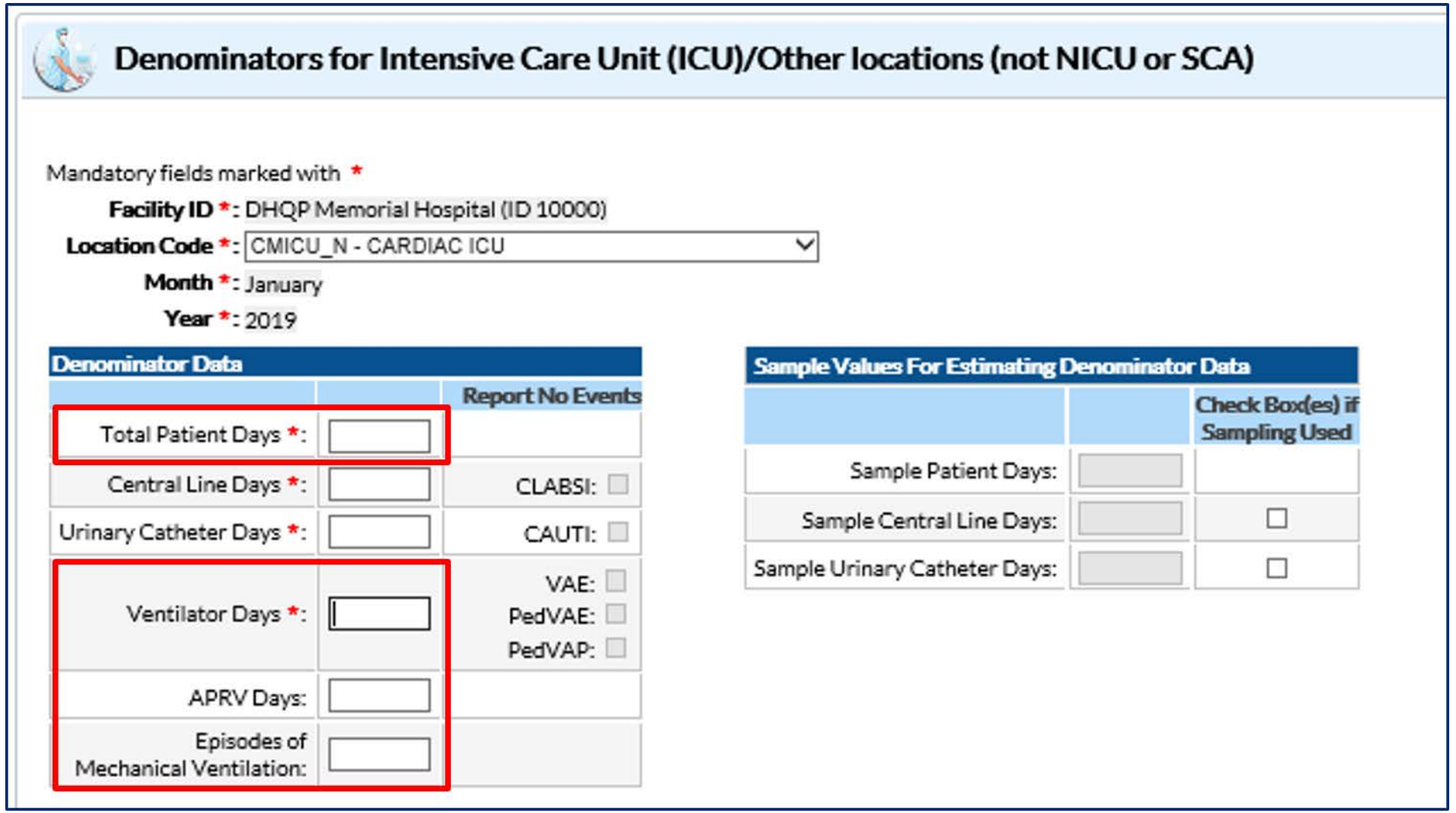
Denominator Data

- Device (ventilator) days and patient days are used for denominators.
    - Collect data daily at the same time each day
- Ventilator days –
    - number of patients in the chosen location who are ventilated at the time of the count
    - all patients (not just those eligible for VAE surveillance) are counted to include those on ventilator < 3 days, those receiving excluded therapies, etc.
    - For VAE surveillance only: APRV (or related) modes of ventilation optional
- Patient days
    - number of patients in the chosen location at the time of the count

Denominator Data-EMV

- Optional denominator reporting for VAE
- Episodes of Mechanical Ventilation (EMV)
  - Count all patients that were on mechanical ventilation the first day of the month.
  - For each subsequent day, count each additional new patient started on mechanical ventilation to include new episodes in previously ventilated patients.
  - Day 1 Episodes + All Subsequent Day Episodes = total EMV

Summary Data



Denominators for Intensive Care Unit (ICU)/Other locations (not NICU or SCA)

Mandatory fields marked with *

Facility ID *: DHQP Memorial Hospital (ID 10000)

Location Code *: CMICU_N - CARDIAC ICU

Month *: January

Year *: 2019

Denominator Data

		Report No Events
Total Patient Days *:		
Central Line Days *:		CLABSI: ☐
Urinary Catheter Days *:		CAUTI: ☐
Ventilator Days *:		VAE: ☐ PedVAE: ☐ PedVAP: ☐
APRV Days:		
Episodes of Mechanical Ventilation:		

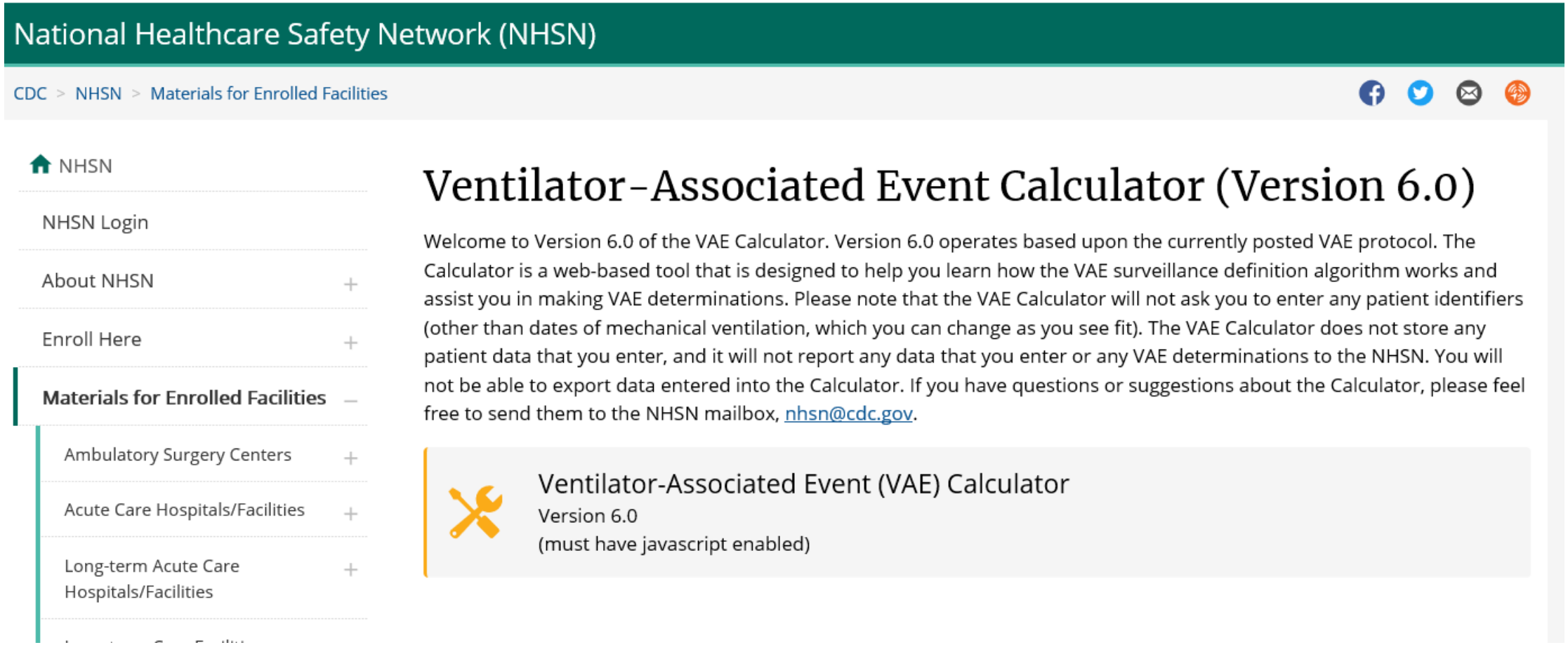
Sample Values For Estimating Denominator Data

		Check Box(es) if Sampling Used
Sample Patient Days:		
Sample Central Line Days:		☐
Sample Urinary Catheter Days:		☐

VAE Calculator

VAE Calculator

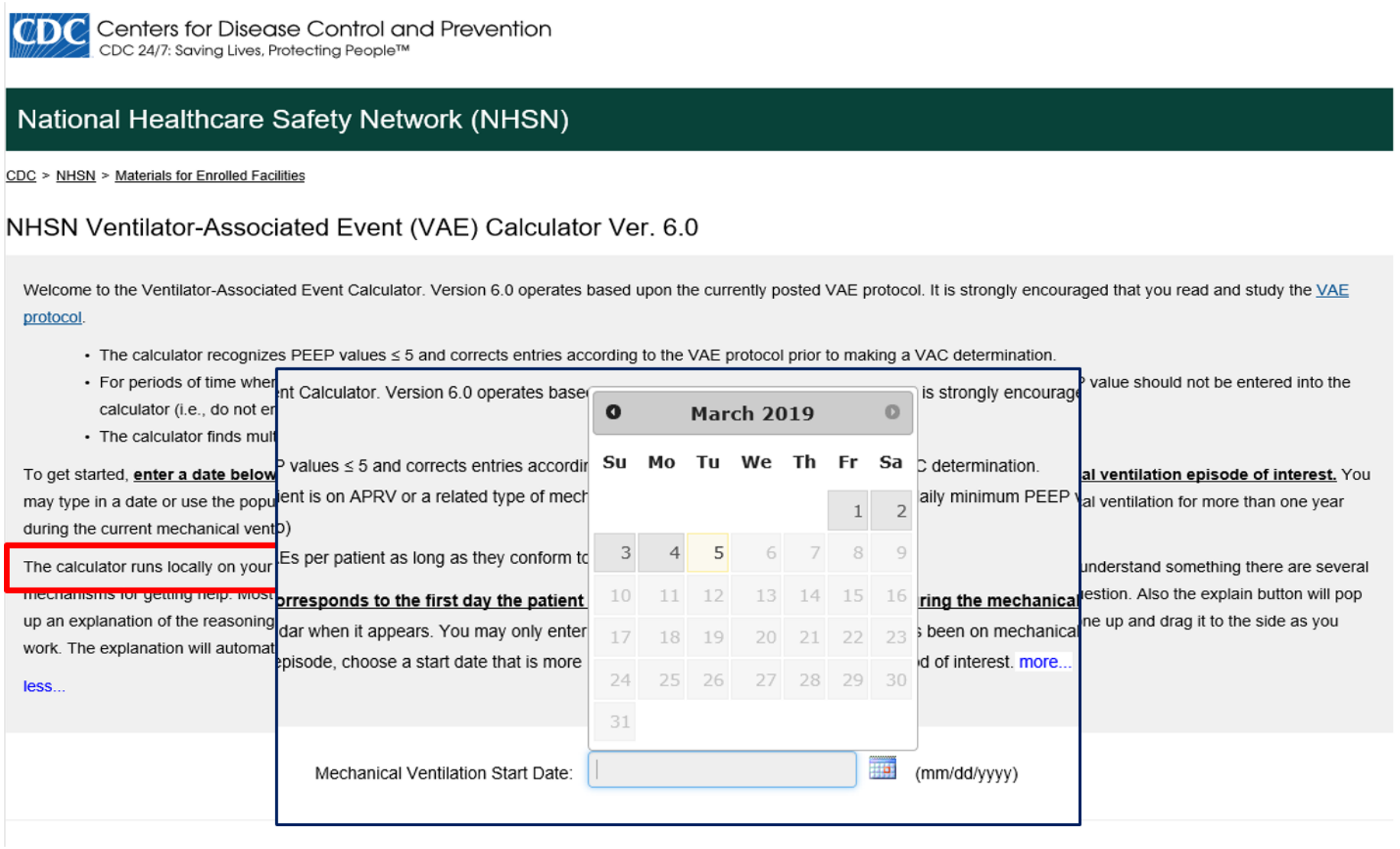
http://www.cdc.gov/nhsn/VAE-calculator/index.html



GIGO

Garbage IN  Garbage OUT

Landing Page



Calculate VAC Start Over

MV Day	Date	Min. PEEP (cmH_2O)	Min. FiO_2 (21 - 100)	VAE
1	2/24/2019	2	30	
2	2/25/2019	2	30	
3	2/26/2019	2	40	
4	2/27/2019	2	40	
5	2/28/2019	5	40	
6	3/1/2019	5	40	
7	3/2/2019	5	40	
8	3/3/2019	8	40	
9	3/4/2019	8	40	
10	3/5/2019	8	40	
11	3/6/2019	8	40	

Legend: † - VAE Window ‡ - VAE Date ¶ - Qualifying Antimicrobial Day (QAD)

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

MV Day	Date	Min. PEEP (cmH_2O)	Min. FiO_2 (21 - 100)	VAE
1	2/24/2019	5 (2)*	30	
2	2/25/2019	5 (2)*	30	
3	2/26/2019	5 (2)*	40	
4	2/27/2019	5 (2)*	40	
5	2/28/2019	5	40	
6	3/1/2019	5	40	
7	3/2/2019	5	40	
8	3/3/2019	8	40	‡ VAC
9	3/4/2019	8	40	
10	3/5/2019	8	40	
11	3/6/2019	8	40	

Legend: † - VAE Window | ‡ - VAE Date | ¶ - Qualifying Antimicrobial Day (QAD)

Explanation:

X

The two days preceding 3/3/2019 are the baseline period of stability or improvement followed by a sustained period (≥ 2 days) of worsening oxygenation.

OK

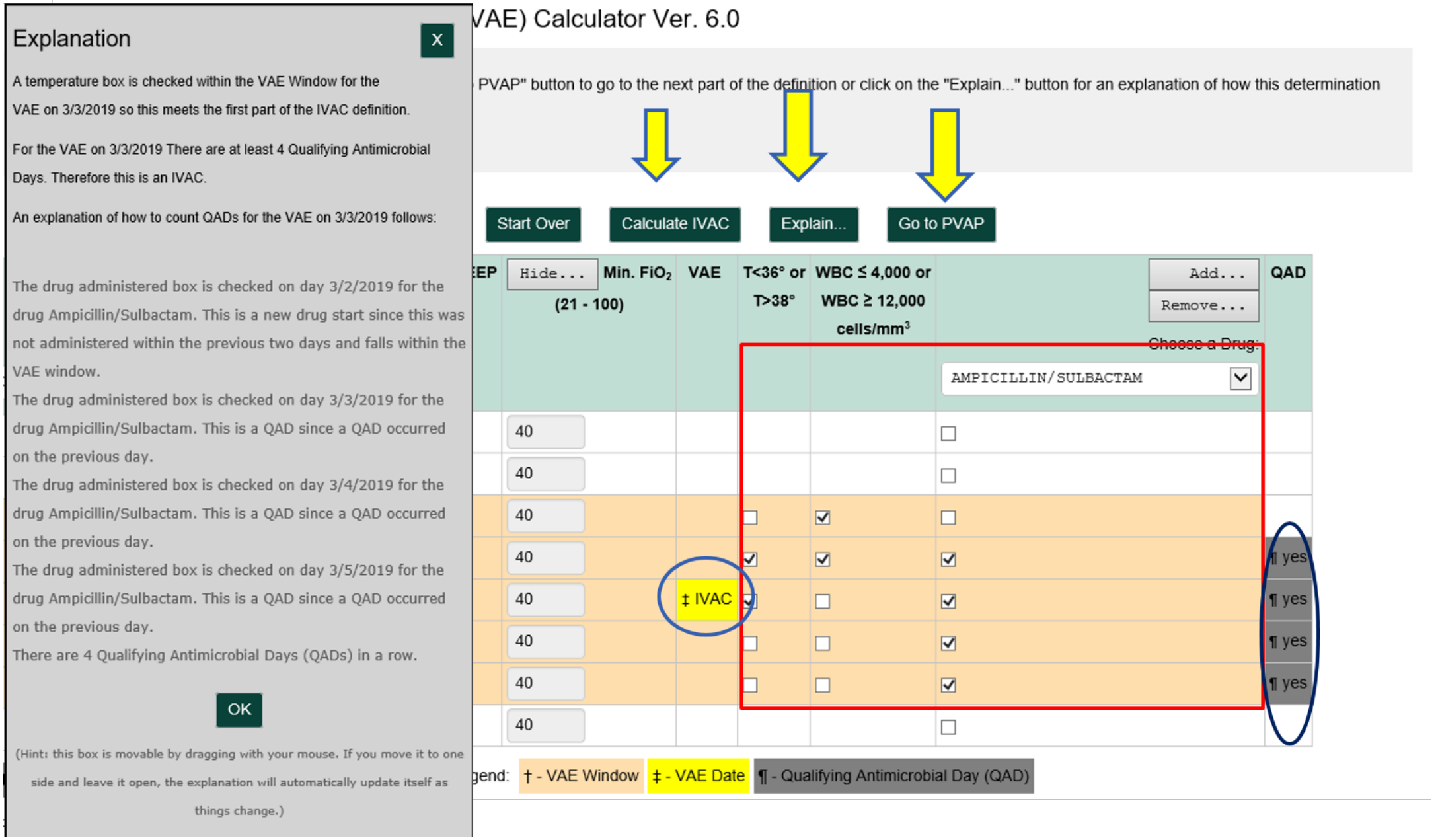
(Hint: this box is movable by dragging with your mouse. If you move it to one side and leave it open, the explanation will automatically update itself as things change.)

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
4	2/27/2019	5 (2)*	40				☐	
5	2/28/2019	5	40				☐	
† 6	3/1/2019	5	40		☐	☐	☐	
† 7	3/2/2019	5	40		☐	☐	☐	
† 8	3/3/2019	8	40	‡ VAC	☐	☐	☐	
† 9	3/4/2019	8	40		☐	☐	☐	
† 10	3/5/2019	8	40		☐	☐	☐	
11	3/6/2019	8	40				☐	

Legend: † - VAE Window | ‡ - VAE Date | ¶ - Qualifying Antimicrobial Day (QAD)


Explanation
X
A temperature box is checked within the VAE Window for the VAE on 3/3/2019 so this meets the first part of the IVAC definition.
For the VAE on 3/3/2019 There are at least 4 Qualifying Antimicrobial Days. Therefore this is an IVAC.
An explanation of how to count QADs for the VAE on 3/3/2019 follows:
The drug administered box is checked on day 3/2/2019 for the drug Ampicillin/Sulbactam. This is a new drug start since this was not administered within the previous two days and falls within the VAE window.
The drug administered box is checked on day 3/3/2019 for the drug Ampicillin/Sulbactam. This is a QAD since a QAD occurred on the previous day.
The drug administered box is checked on day 3/4/2019 for the drug Ampicillin/Sulbactam. This is a QAD since a QAD occurred on the previous day.
The drug administered box is checked on day 3/5/2019 for the drug Ampicillin/Sulbactam. This is a QAD since a QAD occurred on the previous day.
There are 4 Qualifying Antimicrobial Days (QADs) in a row.
OK
(Hint: this box is movable by dragging with your mouse. If you move it to one side and leave it open, the explanation will automatically update itself as things change.)
VAE) Calculator Ver. 6.0
PVAP" button to go to the next part of the definition or click on the "Explain..." button for an explanation of how this determination
Start Over
Calculate IVAC
Explain...
Go to PVAP
EP
Hide...
Min. FiO2 (21 - 100)
VAE
T<36° or T>38°
WBC ≤ 4,000 or WBC ≥ 12,000 cells/mm3
Add...
Remove...
Choose a Drug:
AMPICILLIN/SULBACTAM
QAD
40
‡ IVAC
¶ yes
gend:
† - VAE Window
‡ - VAE Date
¶ - Qualifying Antimicrobial Day (QAD)

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

National Healthcare Safety Network (NHSN)

CDC > NHSN > Materials for Enrolled Facilities

NHSN Ventilator-Associated Event (VAE) Calculator Ver. 6.0

Now that an IVAC determination has been made, click the checkbox if the patient experienced any of the listed condit
"Calculate PVAP" button.

Start Over | Explain... | Go to PVAP

MV Day	Date	Hide... Min. PEEP (cmH_2O)	Hide... Min. FiO_2 (21 - 100)	VAE	T<36° or T>38°	WBC ≤ 4,000 WBC ≥ 12,0 cells/mm³
4	2/27/2019	5 (2)*	40			
5	2/28/2019	5	40			
† 6	3/1/2019	5	40		☐	☑
† 7	3/2/2019	5	40		☑	☑
† 8	3/3/2019	8	40	‡ IVAC	☑	☐
† 9	3/4/2019	8	40		☐	☐
† 10	3/5/2019	8	40		☐	☐
11	3/6/2019	8	40			

Legend: † - VAE Window | ‡ - VAE Date | ¶ - Qualifying Antimic

* All values of PEEP less than 5 cmH_2O are considered to be 5 cmH_2O for purposes of the VAC definition. So for PEEP values entered as less than o
sustained for 2 or more calendar days, is required to meet the VAC definition.

PVAP Determination

For the IVAC on **3/3/2019**, did the patient have documentation of any of the following findings during the VAE Window: **3/1/2019 to 3/5/2019**.

Question	Yes
Criterion 1. Positive culture of one of the following (without requirement for purulent respiratory secretions): • Endotracheal aspirate ≥ 10^5 cfu/ml* • Bronchoalveolar lavage ≥ 10^4 cfu/ml* • Lung tissue ≥ 10^4 cfu/ml* • Protected specimen brush ≥ 10^3 cfu/ml* *or corresponding semi-quantitative result	☐
Criterion 2. Positive culture of one of the following (qualitative or quantitative/semi-quantitative culture without sufficient growth to meet Criterion 1). • Sputum • Endotracheal aspirate • Bronchoalveolar lavage • Lung tissue • Protected specimen brush	☐
AND Evidence of purulent respiratory secretions (defined as secretions from lungs, bronchi or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells).	
Criterion 3. One of the following positive tests (as outlined in the protocol): • Pleural fluid culture • Lung histopathology • Diagnostic test for *Legionella* species • Diagnostic test for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus or coronavirus.	☐

Calculate PVAP

National Healthcare Safety Network (NHSN)

CDC > NHSN > Materials for Enrolled Facilities

NHSN Ventilator-Associated Event (VAE) Calculator Ver. 6.0

The event on 3/3/2019 conforms to a Possible Ventilator-Associated Pneumonia (PVAP) definition. For a discussion of why, click on the Explain button.

The event on 3/3/2019 conforms to a Possible Ventilator-Associated Pneumonia (PVAP) definition. For a discussion of why, click on the Explain button.

Close

Start Over | Explain... | Go to PVAP

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: AMPICILLIN/SULBACTAM	
4	2/27/2019	5 (2)*	40				☐	
5	2/28/2019	5	40				☐	
† 6	3/1/2019	5	40		☐	☑	☐	
† 7	3/2/2019	5	40		☑	☑	☑	¶ yes
† 8	3/3/2019	8	40	‡ PVAP	☑	☐	☑	¶ yes
† 9	3/4/2019	8	40		☐	☐	☑	¶ yes
† 10	3/5/2019	8	40		☐	☐	☑	¶ yes
11	3/6/2019	8	40				☐	

Legend: † - VAE Window | ‡ - VAE Date | ¶ - Qualifying Antimicrobial Day (QAD)

* All values of PEEP less than 5 cmH_2O are considered to be 5 cmH_2O for purposes of the VAC definition. So for PEEP values entered as less than or equal to 5 cmH_2O, an increase in the daily minimum PEEP to at least 8 cmH_2, sustained for 2 or more calendar days, is required to meet the VAC definition.