CMS
CENTERS FOR MEDICARE & MEDICAID SERVICES

LTCH QRP Provider Training

VAE

Ventilator- Associated Events

November 20, 2015

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Objectives

- Identify Ventilator Associated Events (VAE) definitions and surveillance algorithm
- Describe how to correctly enter VAE into NHSN
- Describe the use of the VAE Calculator
- Accurately apply the VAE algorithms to example case scenarios

BACKGROUND AND RATIONALE

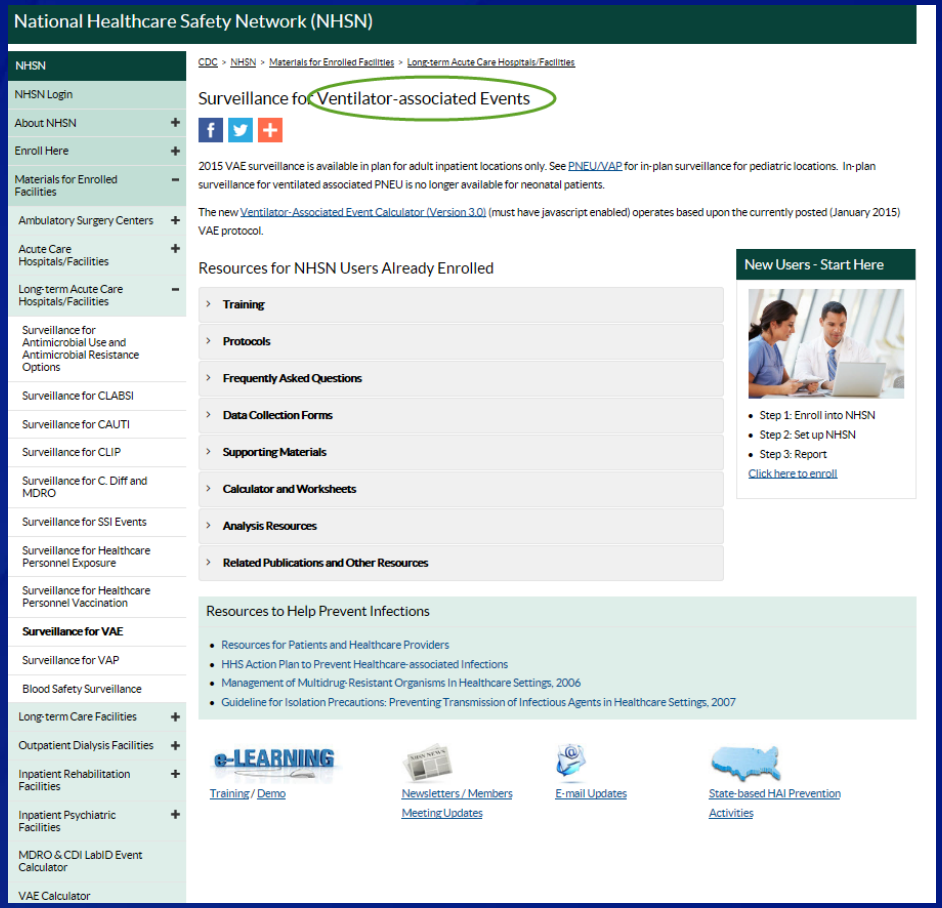
Ventilated Patients and Surveillance Efforts

- **Ventilator-associated pneumonia (VAP) is an important complication of mechanical ventilation**
  - But other adverse events also happen to patients on ventilators
- **No valid, reliable definition for VAP**
- **PNEU-VAP definition includes subjective elements and is neither sensitive nor specific for VAP**
  - Not ideal in an era of public reporting of healthcare-associated infection (HAI) rates, comparisons among facilities and pay-for-performance programs

VAE Surveillance

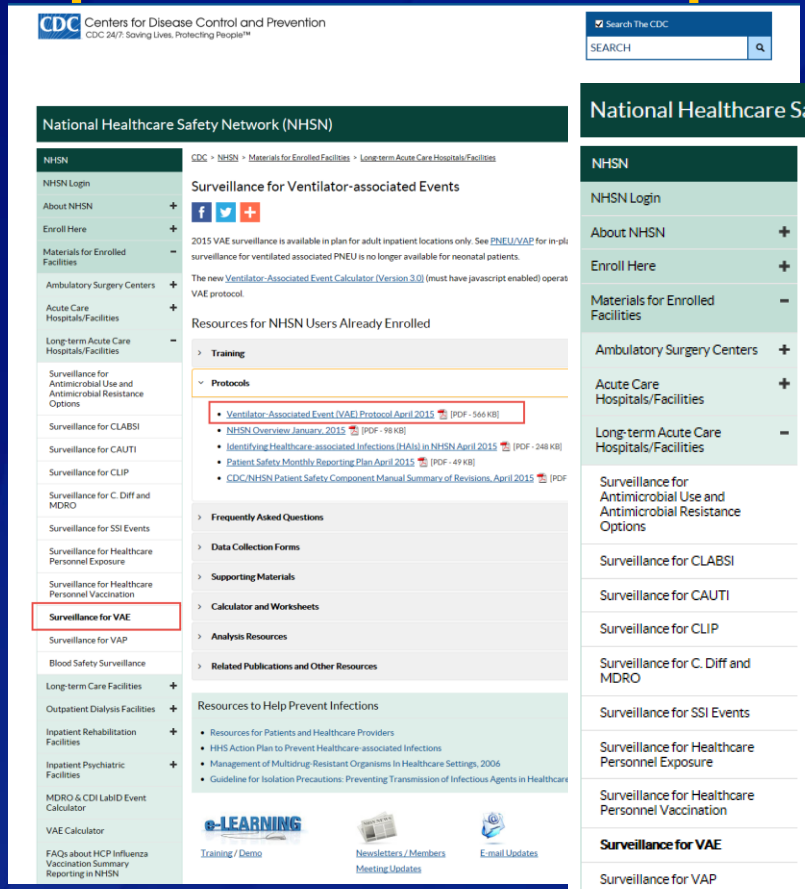
- **VAE Surveillance Working Group convened in 2011**
- **January 2013 new approach finalized by the working group and implemented in NHSN**
- **Ventilator-Associated Events (VAE) replaced in-plan VAP surveillance for ventilated patients for patients in adult locations**
  - Focus on objectivity, reliability and ability to automate
  - Enhance ability to use surveillance data to drive improvements in patient care and safety

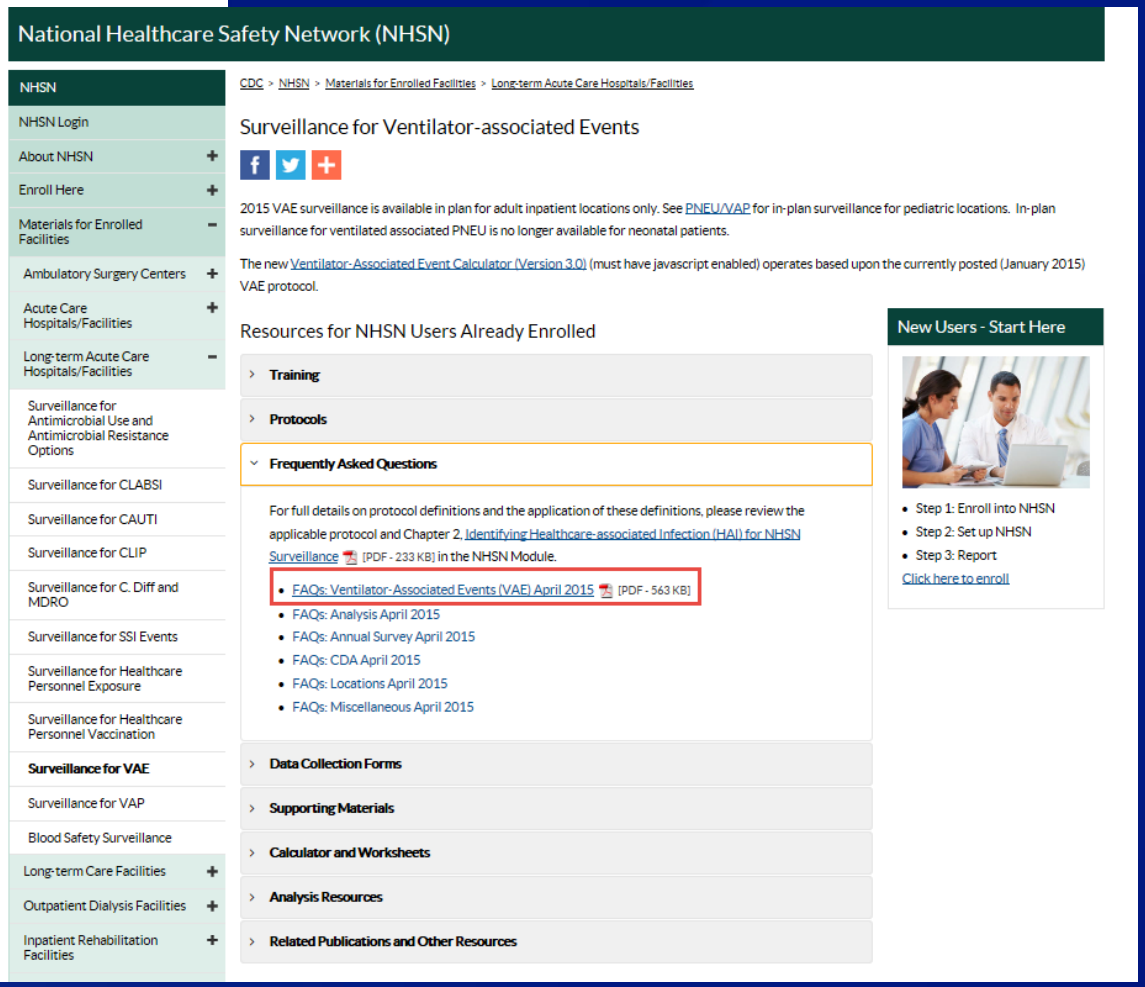
VAE (Ventilator-associated Event) is the only in-plan option for ventilated patients in adult locations



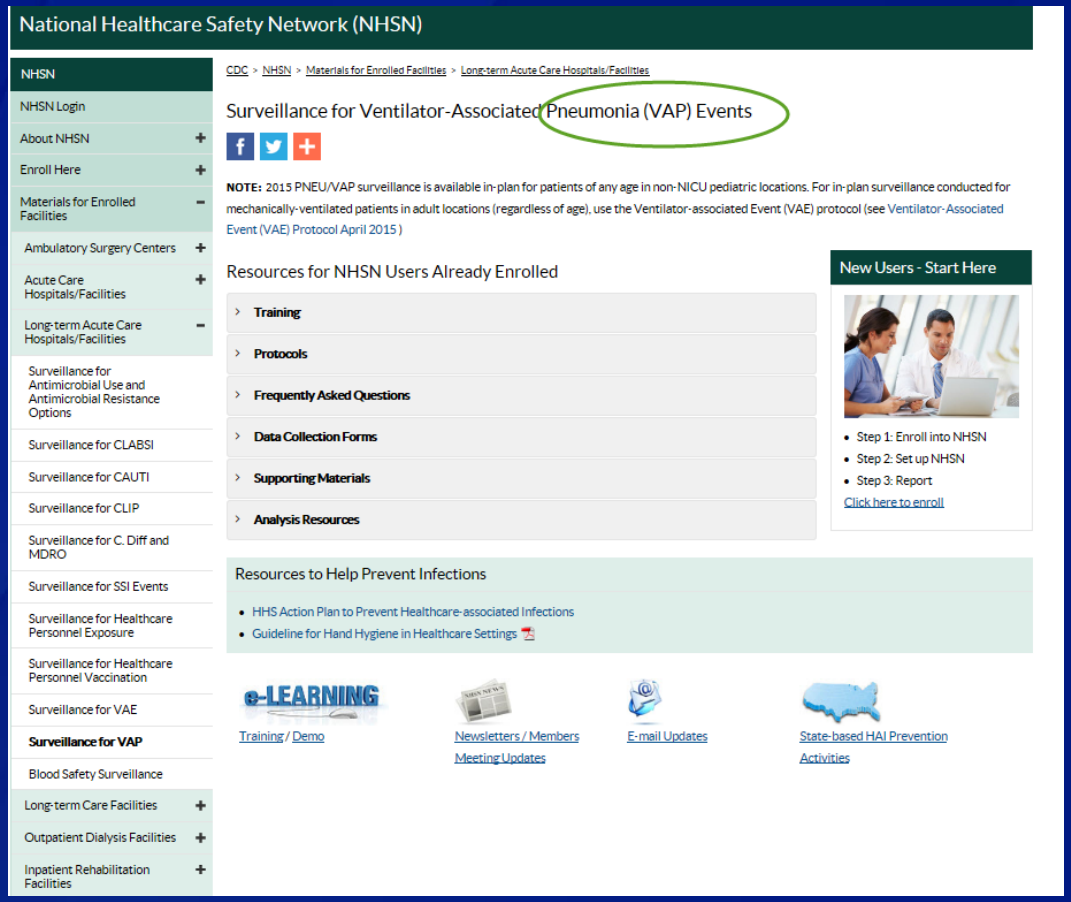
http://www.cdc.gov/nhsn/ltach/vae/index.html

VAE (Ventilator-associated Event) is the only in-plan option for ventilated patients in adult locations





pedVAP (Ventilator-associated Pneumonia)is the only in-plan option for ventilated patients in pediatric locations



http://www.cdc.gov/nhsn/ltach/vap/index.html

NHSN Lower Respiratory Event Surveillance

- **PNEU definitions are still available for**
  - off-plan surveillance of VAP in adults , children, neonates AND non-ventilated PNEU in adults, children or neonates
  - Use as a site specific infection for secondary BSI attribution
- **PNEU definitions are found in Chapter 6 of the NHSN Protocol Manual**
- **Note the title of Chapter 6:**

Pneumonia (Ventilator-associated [VAP] and non-ventilator-associated Pneumonia [PNEU]) Event

Can I use the PNEU definitions to assign a secondary BSI when doing CLABSI surveillance?

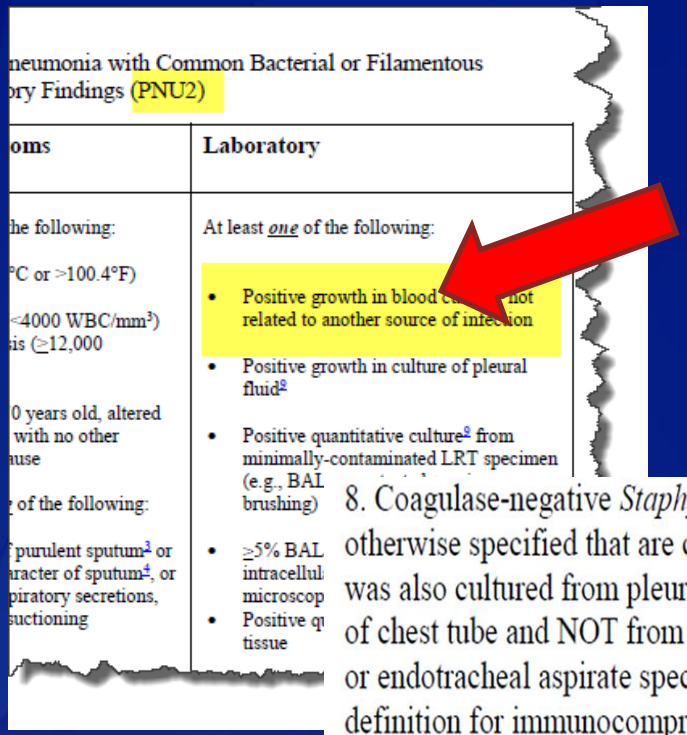
- **Yes, if you believe that there is a non-blood source of infection to which an LCBI may be secondary, you must first fully meet one of the NHSN site specific infection definitions (Chapter 17 definitions, PNEU, UTI, VAE).**
- **Apply guidelines located in Appendix 1, Secondary BSI Guide, Chapter 4 (Bloodstream Infection Event)**
  - Blood culture must either be an element used to meet the site-specific criterion

  OR
  - Blood & site-specific specimen cultures (used to meet the infection criterion) must match for at least one organism.
- **Secondary bloodstream infections can only be reported for PNU2 and PNU3 specific events**

BSI Secondary to PNEU

Blood culture as an element of the definition

- Blood culture collection date occurs within the 7-day infection window period
- Pathogen exclusions apply [exception: *Candida* species exclusion does not apply to PNU3 when blood and sputum/endotracheal aspirate both are growing *Candida* species (Footnote 8)]



neumonia with Common Bacterial or Filamentous
ory Findings (PNU2)

oms	Laboratory
he following: °C or >100.4°F) <4000 WBC/mm³) is (≥12,000 0 years old, altered with no other use of the following: purulent sputum[3] or aracter of sputum[4], or piratory secretions, suctioning	At least *one* of the following: • Positive growth in blood c… not related to another source of infection • Positive growth in culture of pleural fluid[8] • Positive quantitative culture[8] from minimally-contaminated LRT specimen (e.g., BAL brushing) • ≥5% BAL intracellul… microscop… • Positive q… tissue

8. Coagulase-negative *Staphylococcus* species, *Enterococcus* species and *Candida* species or yeast not otherwise specified that are cultured from blood cannot be deemed secondary to a PNEU, unless the organism was also cultured from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube) or lung tissue. *Candida* species isolated from sputum or endotracheal aspirate specimen combined with a matching blood culture can be used to satisfy the PNU3 definition for immunocompromised patients.

BSI Secondary to PNEU

Blood culture as an element of the definition

Hospital Day	BSI	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Blood culture: *A. baumannii*
12		6	
13		7	
14		8	
15		9	
16		10	
17		11	
18		12	
19		13	
20		14	
21			

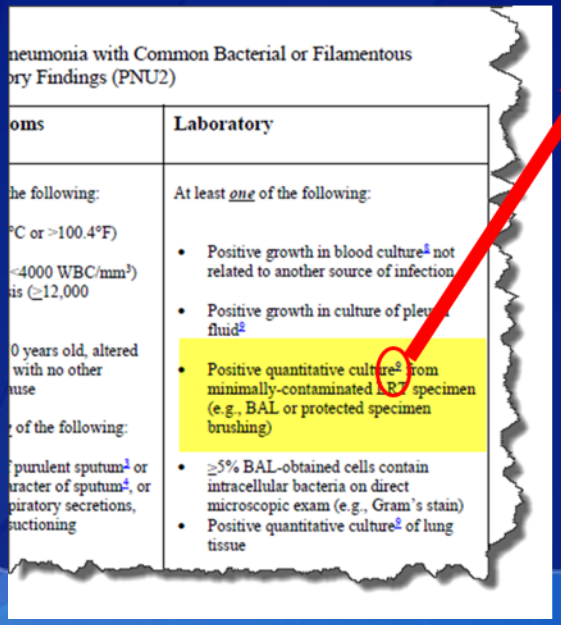
PNU2 & Secondary BSI
Date of Event = Day 7
Pathogen: *A.baumannii*

BSI Secondary to PNEU

Blood & site-specific specimen cultures *(used to meet the infection criterion)* must match for at least one organism.

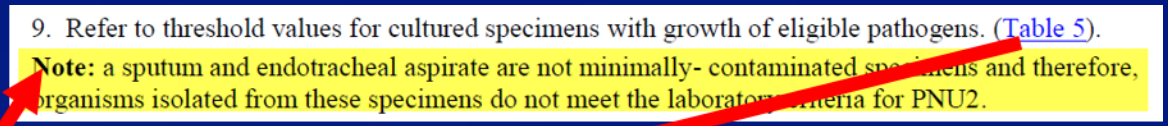
- Eligible site specific culture collection date occurs within the 7-day infection window period. Eligible specimens include:
  - Minimally contaminated specimen (BAL, protected specimen brushing)
  - Pleural fluid
  - Lung tissue

  Sputum is **NOT** an eligible specimen for meeting PNU2 (Footnote #9)
- Blood culture collection date occurs in the secondary BSI attribution period



neumonia with Common Bacterial or Filamentous
ory Findings (PNU2)

oms	Laboratory
he following:	At least *one* of the following:
°C or >100.4°F)	• Positive growth in blood culture[5] not related to another source of infection
<4000 WBC/mm³) is (≥12,000	• Positive growth in culture of pleural fluid[2]
0 years old, altered with no other use	• Positive quantitative culture[2] from minimally-contaminated LRT specimen (e.g., BAL or protected specimen brushing)
of the following:	
purulent sputum[3] or racter of sputum[4], or piratory secretions, uctioning	• ≥5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (e.g., Gram's stain) • Positive quantitative culture[2] of lung tissue



9. Refer to threshold values for cultured specimens with growth of eligible pathogens. (Table 5).

Note: a sputum and endotracheal aspirate are not minimally- contaminated specimens and therefore, organisms isolated from these specimens do not meet the laboratory criteria for PNU2.

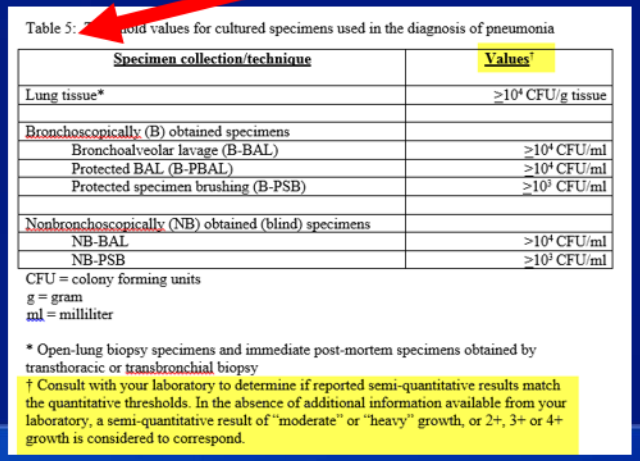


Table 5: Threshold values for cultured specimens used in the diagnosis of pneumonia

Specimen collection/technique	Values†
Lung tissue*	≥10^4 CFU/g tissue
Bronchoscopically (B) obtained specimens	
Bronchoalveolar lavage (B-BAL)	≥10^4 CFU/ml
Protected BAL (B-PBAL)	≥10^4 CFU/ml
Protected specimen brushing (B-PSB)	≥10^3 CFU/ml
Nonbronchoscopically (NB) obtained (blind) specimens	
NB-BAL	≥10^4 CFU/ml
NB-PSB	≥10^3 CFU/ml

CFU = colony forming units
g = gram
ml = milliliter

* Open-lung biopsy specimens and immediate post-mortem specimens obtained by transthoracic or transbronchial biopsy

† Consult with your laboratory to determine if reported semi-quantitative results match the quantitative thresholds. In the absence of additional information available from your laboratory, a semi-quantitative result of "moderate" or "heavy" growth, or 2+, 3+ or 4+ growth is considered to correspond.

BSI Secondary to PNEU

Blood & site-specific specimen cultures ***(used to meet the infection criterion)*** **must match for at least one organism.**

Hospital Day	BSI	RIT	Infection Window Period
1			
2			
3			
4			
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12		6	
13		7	
14		8	
15		9	
16		10	Blood Culture : *A baumannii*
17		11	
18		12	
19		13	
20		14	
21			

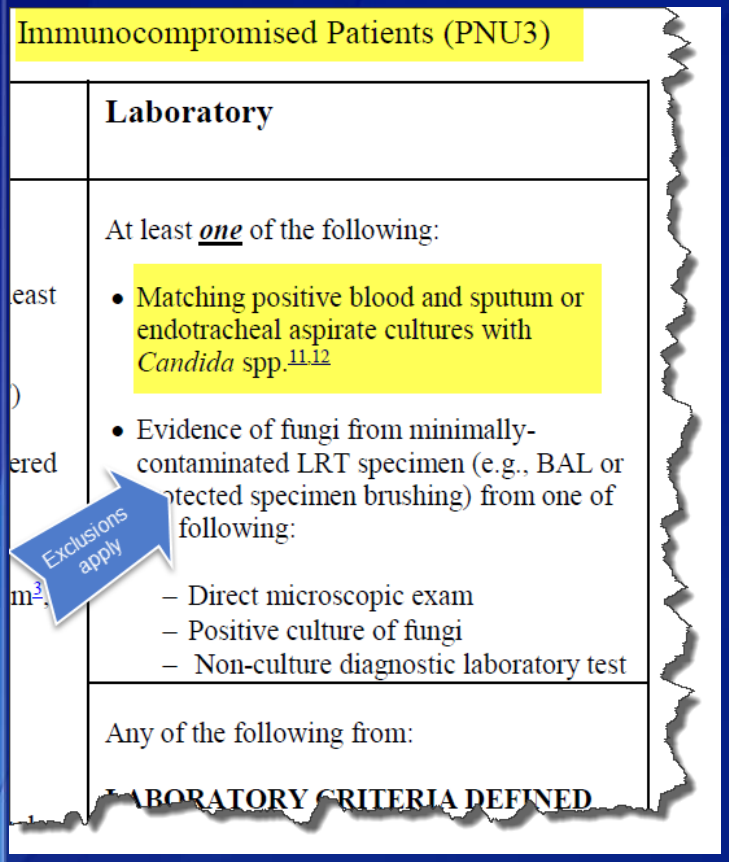
PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen*: A.baumannii*

BSI Secondary to PNEU

- **SPUTUM specimen is only useful when the patient is immunocompromised (footnote 10) and blood & sputum / endotracheal aspirate both are growing *Candida* species (PNU3)**



Immunocompromised Patients (PNU3)

	Laboratory
	At least ***one*** of the following: • Matching positive blood and sputum or endotracheal aspirate cultures with *Candida* spp.[11,12] • Evidence of fungi from minimally-contaminated LRT specimen (e.g., BAL or protected specimen brushing) from one of following: – Direct microscopic exam – Positive culture of fungi – Non-culture diagnostic laboratory test
	Any of the following from: LABORATORY CRITERIA DEFINED

Exclusions apply

10. Immunocompromised patients include those with neutropenia (absolute neutrophil count or total white blood cell count (WBC) <500/mm^3), leukemia, lymphoma, HIV with CD4 count <200, or splenectomy; those who are early post-transplant, are on cytotoxic chemotherapy, or are on high dose steroids (e.g., >40mg of prednisone or its equivalent (>160mg hydrocortisone, >32mg methylprednisolone, >6mg dexamethasone, >200mg cortisone) daily for >2weeks).

When should I use PNEU/VAP instead of VAE?

A. Never— always use VAE

B. When conducting in-plan surveillance on mechanically-ventilated children who are in pediatric locations

C. When surveillance is conducted for healthcare-associated pneumonia that is not associated with mechanical ventilation

D. When determining if a BSI is secondary to lower respiratory site

E. B, C and D

Pathogen Excluded for use in meeting PNEU/VAP and VAE

Pathogen exclusions protocol pathogen exclusions

- *Candida* species or yeast not otherwise specified, coagulase negative *Staphylococcus* species, and *Enterococcus* species are excluded unless isolated from lung tissue or pleural fluid
  - Indication of isolation of commensal flora of the oral cavity or upper respiratory tract
  - *Candida* species will continue to be included as a pathogen for meeting PNU3 (immunocompromised patients)
- *Cryptococcus, Histoplasma, Coccidioides, Paracoccidioides, Blastomyces, Pneumocystis*
  - Community associated fungal pathogens
  - Rarely cause or are not known to cause healthcare-associated infections

VAE SURVEILLANCE

Identifying Healthcare-associated Infections (HAI) for NHSN Surveillance …….

Table 1: Definition Application

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

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?

- Inpatients of facilities other than acute care hospitals, long-term acute care hospitals and inpatient rehabilitation facilities are not eligible.
- Patients who have been ventilated < 3 days are not eligible
- Patients on high frequency ventilation (HFV) or extracorporeal life support (ECLS) are not eligible for VAE surveillance (during the time they are receiving those therapies).

What about other alternative modes of mechanical ventilation?

- **<u>INCLUDE</u> patients who are receiving a conventional mode of mechanical ventilation and:**
  - Prone positioning
  - Nitric oxide therapy
  - Helium-oxygen mixture
  - Epoprostenol therapy
- **<u>INCLUDE</u> patients on Airway Pressure Release Ventilation (APRV) or related modes. VAC determinations made using FiO_2 only during periods of time in which the patient was receiving support from an APRV or related mode.**

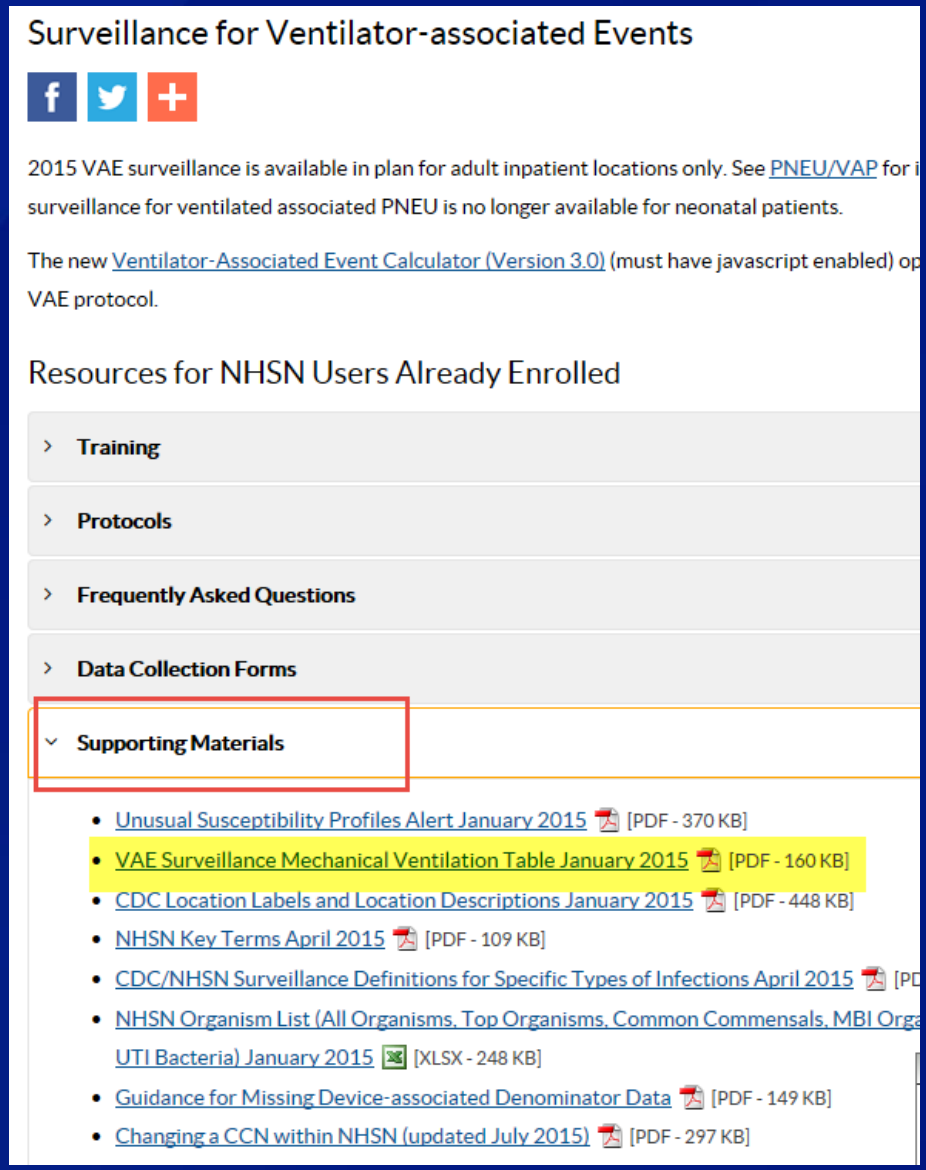
What is APRV ?

- 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

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



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**

If a patient is admitted to the facility with history of or a current pneumonia, they are excluded from VAE surveillance for 14 days.

1. True
2. False

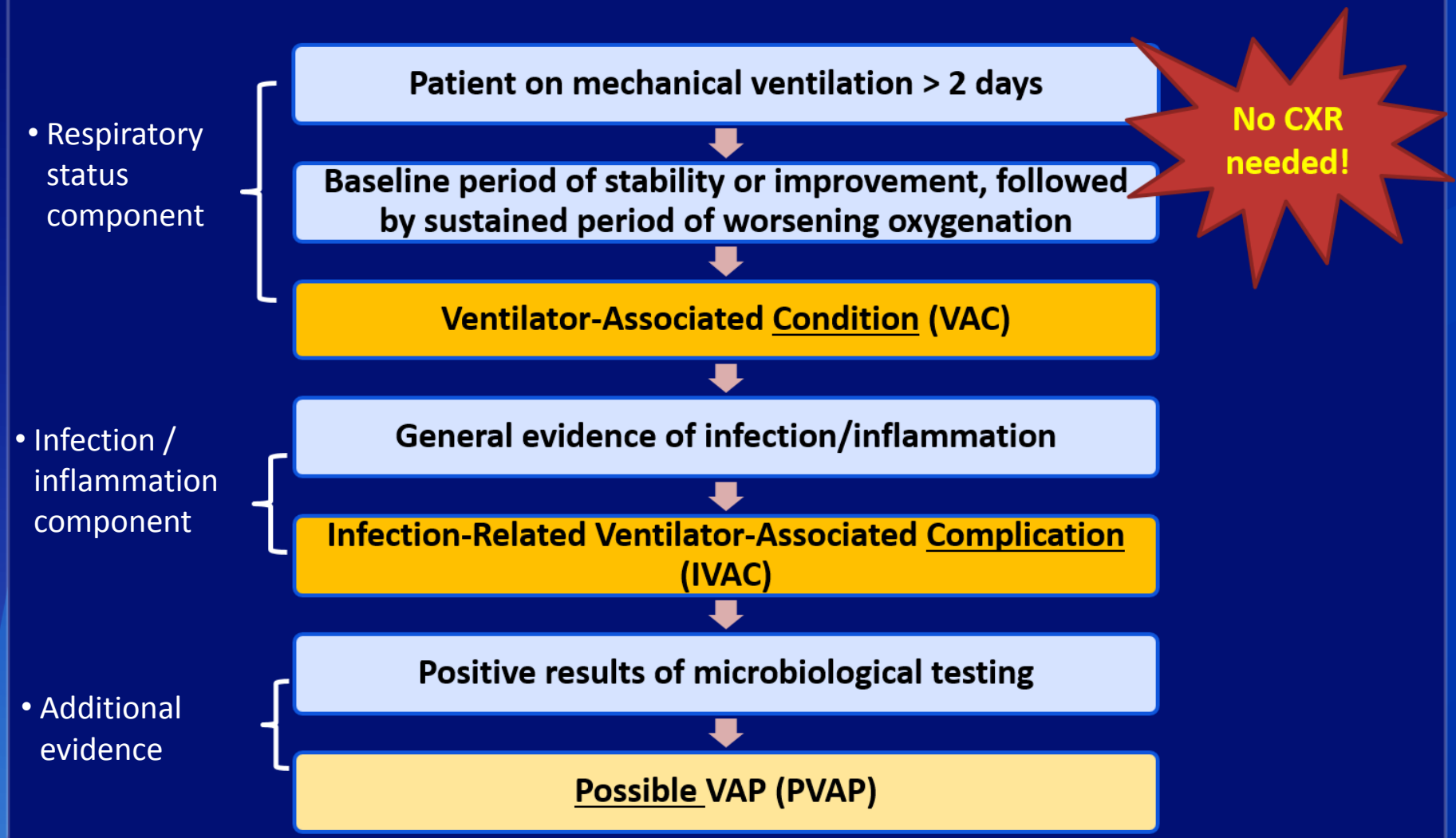
FALSE

- **All patients who are eligible for VAE surveillance are to be included in VAE surveillance**
- **There are no exclusions for specific admitting diagnoses or underlying illnesses. Remember the Present on Admission (POA) definition does not apply to VAE**
- **Algorithm requires a period of stability on the ventilator and typically should not be capturing events that represent ongoing worsening**
  - If patient stabilizes or improves then worsens again, this is a possible indication of a new ventilator-associated event
  - Patients with pneumonia, may truly experience complications related to mechanical ventilation that are preventable

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

- **Algorithm is progressive in terms of criteria to be met (from VAC to IVAC to PVAP), but this is not to imply that each subsequent tier is more clinically significant than the one before.**
  - 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

Ventilator Definition

- **<u>Ventilator</u> is defined as a device to assist or control respiration, inclusive of the weaning period, through a tracheostomy or by endotracheal intubation**
  - Intermittent positive-pressure breathing (IPPB); nasal positive end-expiratory pressure (nasal PEEP); and continuous nasal positive airway pressure (CPAP, hypoCPAP) are **<u>not</u>** considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g., ET-CPAP)

Same definition used for NHSN pedVAP surveillance

Episode of Mechanical Ventilation

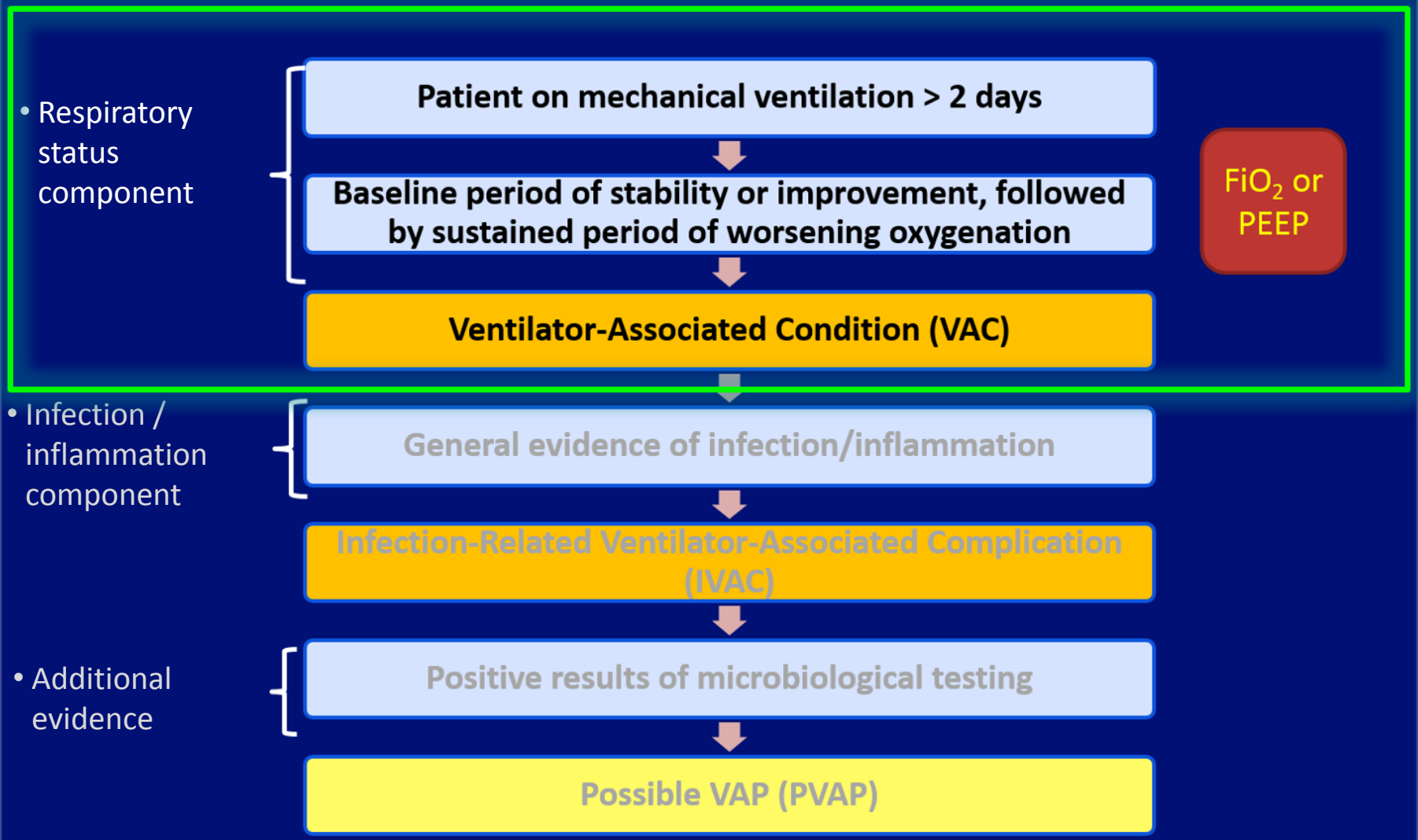
- A period of days during which the patient was mechanically ventilated for some portion of each consecutive day. A break in mechanical ventilation of at least one full calendar day followed by re-intubation or re-initiation of mechanical ventilation during the same hospitalization is a new episode.

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 FiO2 of ambient air is 0.21; the oxygen concentration of ambient air is 21%.
A sustained increase in the daily minimum PEEP of **≥ 3 cmH2O** 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 FiO2 of **≥ 0.20 (20%)** following a period of stability or improvement on the ventilator is the second of the two criteria that can be used in meeting the VAC definition.

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

VAE Definition Algorithm Summary



Tier 1: VAC

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 at least 1 hour.

AND

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

1) Increase in daily minimum* FiO_2 of ≥ 0.20 (20 points) over the daily minimum FiO_2 in the baseline period, sustained for ≥ 2 calendar days.

2) Increase in daily minimum* PEEP values of ≥ 3 cmH_2O over the daily minimum PEEP 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 at least 1 hour.

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

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 FiO2 and PEEP

- **When choosing the daily minimum PEEP and FiO_2, use all settings that are recorded 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

- **Exclude PEEP and FiO_2**
  - Periods of time when the patient is on HFV, 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 at least 1 hour**
- **If there is no value that has been maintained for at least 1 hour then select the lowest value available regardless of the period of time in which the setting was maintained**
  - Examples when this may occur
    - 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 PEEP and FiO2 when settings are recorded < 1 hour intervals

- **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 PEEP 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 at least 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	O.80	0.80	0.75	0.70	0.70
PEEP	8	8	8	8	8	5	5	8

Note: FiO_2 and PEEP values are maintained for at least 1 hour

Identifying the Daily Minimum FiO_2 and PEEP

(Select the lowest value recorded for each calendar day that is maintained for at least 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	0.80	O.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	8	8	8	8	8	8	8

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

Daily Minimum Values

The patient is intubated at 2 pm. PEEP and FiO_2 are set at the following values through the remainder of the calendar day. What are the daily minimum PEEP and FiO_2 values for the calendar day?

Time	2 pm	4 pm	6pm	8 pm	10 pm	12 am
PEEP (cmH_2O)	5	8	5	8	8	10
FiO_2	1.0	0.60	0.40	0.50	0.55	0.60

What are the daily minimum PEEP and FiO2?

1. 5 and 0.40
2. 8 and 0.60
3. 5 and 0.50
4. 10 and 1.0

Time	2 pm	4 pm	6pm	8 pm	10 pm	12 am
PEEP (cmH_2O)	5	8	5	8	8	10
FiO_2	1.0	0.60	0.40	0.50	0.55	0.60

Daily Minimum Values

The patient is intubated at 6 pm. PEEP and FiO_2 are set at the following values through the remainder of the calendar day. What are the daily minimum PEEP and FiO_2 for the calendar day?

Time	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
PEEP (cmH_2O)	10	8	5	5	8	8
FiO_2	1.0	0.60	0.40	0.50	0.60	0.60

What are the daily minimum PEEP and FiO2?

1. 5 and 0.40
2. 8 and 0.60
3. 10 and 1.0
4. 5 and 0.60

Time	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
PEEP (cmH_2O)	10	8	5	5	8	8
FiO_2	1.0	0.60	0.40	0.50	0.60	0.60

In general, when selecting the daily minimum PEEP and FiO_2 for each calendar day…..

1. Throw out the lowest value
2. Choose the most consistent value
3. Select the value using any 24 hour time period
4. Choose the lowest value that has been maintained for at least 1 hour

Daily Minimum FiO_2 and PEEP

- 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

PEEP values of 0-5 cmH_2O = 5

	Daily Min PEEP	Daily Min
Monday	10	
Tuesday	8	
Wednesday	5	
Thursday	*5* (0)	
Friday	*5* (0)	
Saturday	5	
Sunday	5	

Ventilator-Associated Event (VAE) Calculator Ver. 3.0

Calculate VAC | Start Over | Explain...

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

MV Day	Date	Min. PEEP (cmH_2O)	Min. FiO_2 (30 - 100)	VAE
1	1/5/2015	10	50	
2	1/6/2015	8	50	
3	1/7/2015	5	45	
4	1/8/2015	5 (0)*	40	
5	1/9/2015	5 (0)*	40	
6	1/10/2015	5	40	
7	1/11/2015	5	40	
8	1/12/2015			
9	1/13/2015			

Period of Stability or Improvement

- Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 2 calendar days of stable or decreasing daily minimum* FiO_2 or PEEP values.
- The baseline period is defined as the two calendar days immediately preceding the first day of increased daily minimum PEEP or FiO_2.

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

Evidence of Worsening Oxygenation

- **After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation (occurring in the same parameter):**
  - Increase in daily minimum* FiO_2 of ≥ 0.20 (20 points) over the daily minimum FiO_2 in the baseline period, sustained for ≥ 2 calendar days.

OR

  - Increase in daily minimum* PEEP values of ≥ 3 cmH_2O over the daily minimum PEEP in the baseline period**, sustained for ≥ 2 calendar days.

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

****Daily minimum PEEP values of 0 to 5 cmH_2O are considered equivalent for 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”

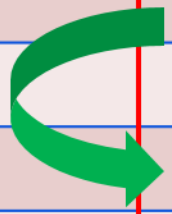
MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	10	35
2	10	35
3	8	30
4	8	70
5	8	70
6	8	60

VAC

Baseline period of improvement

Define "Baseline"

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



NO VAC

No baseline period of stability or improvement

Meeting VAC Definition

What if the increase over the baseline period meets the requirement relative to 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

VAC Definition Not Met

A. VAC

B. NO VAC

Meeting VAC Definition

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

A. VAC

B. NO VAC

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

VAC Definition Not Met (increase is not sustained)

Meeting VAC Definition

VAC or No VAC?

1. Yes
2. No

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

VAC Definition Met

Discrepant changes

PEEP goes up but FiO_2 goes down

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

VAC Definition is Met

Discrepant changes

Baseline in one parameter & Worsening in another

MV Day	Daily min	Daily minimum FiO_2
1	[illegible]	30
[illegible]	7	40
[illegible]	7	50
4	7	80
5	8	80
6	8	90

VAC Definition is NOT Met

Operationalizing VAE

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								

Operationalizing VAE

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								

Operationalizing VAE

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	60								
2	5	40								
3	5	40								
4	8	60								
5	8	50								
6	7	40								
7	5	40								
8	5	40								

Operationalizing VAE

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

Operationalizing VAE

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								

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

Operationalizing VAE

Vent Day	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Poly/E pis	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 other VAE criteria must be met. It is usually a 5-day period and includes the 2 days before, the day of, and the 2 days after the VAE event date (i.e., the first day of worsening oxygenation, the day of VAE onset).

VAE Window Period

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

When the event occurs early in course of mechanical ventilation

Event Date

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

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 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→				

Defining the VAE Window Period

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

2-day period … set of worsening

… nt Date, day 1 of worsening

2-day period after onset of worsening

What's wrong with this VAE Window Period?

Defining the VAE Window

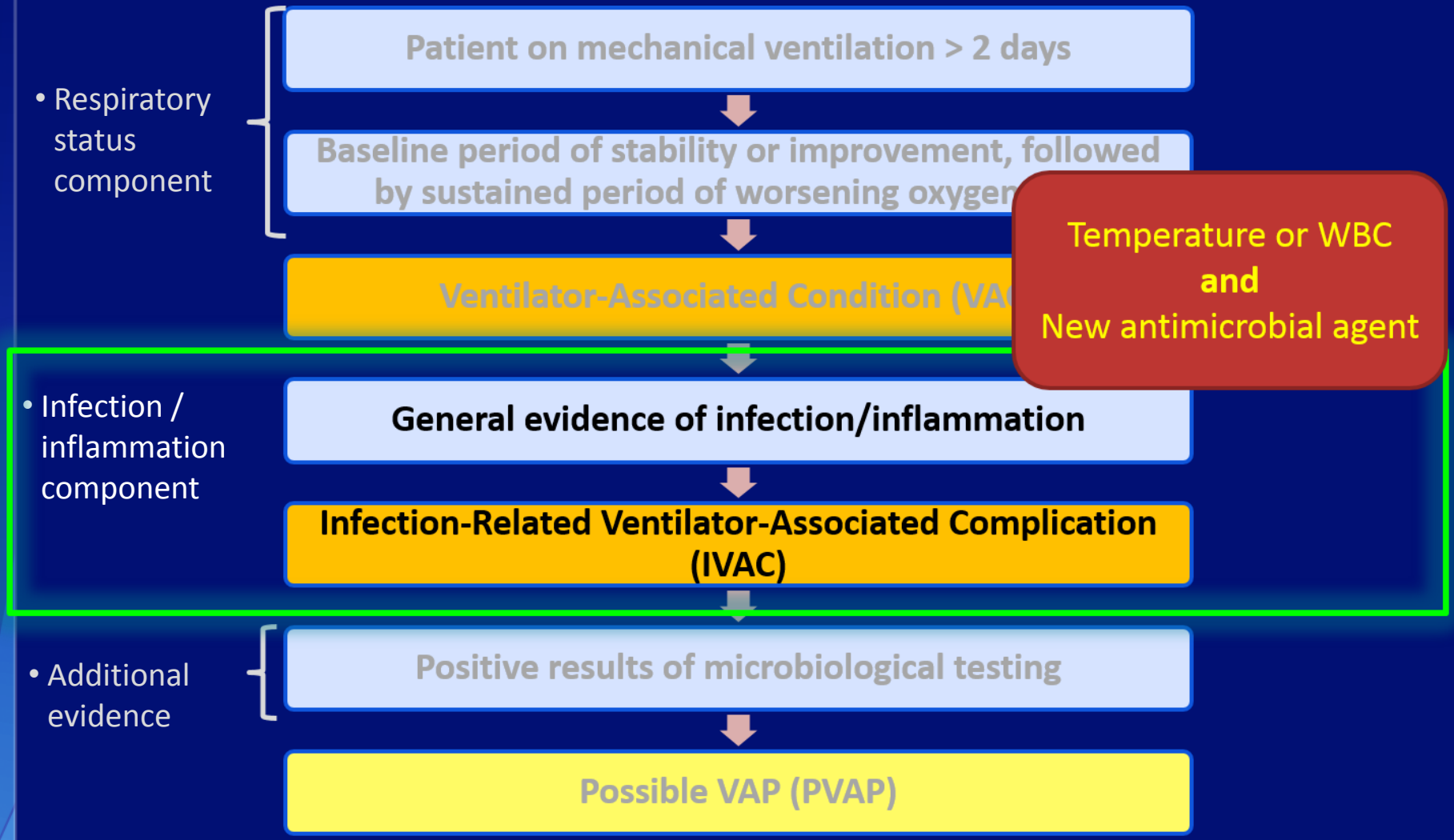
Vent Day	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Polys/ Epis	Org
1	10	60								
2	5	40								
3	5	40								
4	8	60								
5	8	50								
6	7	40								
7	5	40								
8	5	40								

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

Event Date, day 1 of worsening

2-day period after onset of worsening

VAE Definition Algorithm Summary



Tier 2: IVAC

Patient meets criteria for VAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets <u>both</u> 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)* is started, and is continued for ≥ 4 calendar days.

*See Appendix for eligible agents.

Infection-related Ventilator-Associated Complication (IVAC)

Patient meets criteria for VAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:

1) Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm^3 or ≤ 4,000 cells/mm^3.

AND

2) A new antimicrobial agent(s)* is started, and is continued for ≥ 4 calendar days.

*See Appendix for eligible agents.

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	36.9	37.6	12.1	12.1				
4	8	60	38.1	39.2	14.5	16.8				
5	8	50	38.4	38.9	12.6	15.9				
6	7	40	36.5	37.8	11.1	13.6				
7	5	40								
8	5	40								

Temperature / WBC

- As long as there is an abnormal temperature (> 38 °C or < 36°C) or white blood cell count (≥ 12,000 cells/mm3 or ≤ 4,000 cells/mm3) documented during the VAE Window Period, it should be used in determining whether the patient meets the IVAC definition or not, regardless of whether the temperature or white blood cell count was also present on admission or outside the VAE Window Period.

If temperature, WBC or laboratory criteria are present prior to detection of a VAE and also present within the VAE Window Period, they can be used to meet the IVAC definition.

1. True
2. False

If I am conducting in-plan VAE surveillance in my ICU, I will need to assess daily minimum and maximum temperatures for the following patients:

1. All patients in the ICU
2. All patients in the ICU who are on a ventilator
3. Patients who I have determined meet the VAC definition
4. Patients who have met the VAC definition and also have an abnormal white blood cell count
5. Patients who the clinical care providers have diagnosed with VAP

Infection-related Ventilator-Associated Complication (IVAC)

Patient meets criteria for VAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets <u>both</u> 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)* is started, and is continued for ≥ 4 calendar days.

*See Appendix for eligible agents.

IVAC Antimicrobial Criterion

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

What 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, agents used to treat herpes virus infections, anti-parasitics
- Broad range of agents that could be used to treat healthcare-associated infections—not just respiratory related infections.

IVAC Antimicrobials

- Concern when an antimicrobial agent results in an IVAC determination and then subsequently a PVAP determination but the agent was not used to treat a respiratory infection
- 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 included in the Appendix
- IVAC may still be detected (and should be reported) in patients who have non-respiratory sources of infection
- If IVAC definition is met it is to be report.

"New" antimicrobial agent(s)

- any agent listed in the protocol Appendix that is initiated on or after the third calendar day of mechanical ventilation AND in the VAE Window Period (i.e., the period typically defined by the 2 calendar days before, the day of, and the 2 calendar days after the onset date of the VAE)
- The agent is considered new for the purposes of this definition if it was NOT given to the patient on either of the 2 days preceding the current start date
- New agent must be administered IV, IM, via digestive tract or via respiratory tract

Qualifying Antimicrobial Days (QAD)

- A day on which the patient was administered an antimicrobial agent that was determined to be “new”
- Four consecutive QADs are needed to meet the IVAC antimicrobial criterion—starting within the VAE Window Period.
- A new agent must be continued for ≥ 4 consecutive Qualifying Antimicrobial Days (QADs)
- There is no requirement that the same antimicrobial agent be given on the ≥ 4 days

QADs: Same Agent

- **Days between administrations of a new antimicrobial agent also count as QADs as long as there is a gap of no more than 1 calendar day between administrations of the same drug.**
  - For example, if levofloxacin is given on VAE Day 1, has not been given in the 2 preceding calendar days, and is given again on VAE Days 3, 5 and 7, there are 7 QADs—because the days between levofloxacin doses also count as QADs.

Same agent, given every other day = 7 consecutive QADs

VAE Day	-2	-1	1	2	3	4	5	6	7
Abx	--	--	**Levo**	--	**Levo**	--	**Levo**	--	**Levo**
QAD	--	--	Yes	Yes	Yes	Yes	Yes	Yes	Yes

QADs: Different Agents

- **By contrast, days between administrations of <u>different</u> antimicrobial agents do NOT count as QADs**
  - For example, if levofloxacin is given to the patient on VAE Days -2 and -1 only, no antimicrobials are given on VAE Day 1, and meropenem is given only on VAE Day 2 (remember there is no VAE Day 0), then there are <u>not</u> 4 consecutive QADs. VAE Days -2 and -1 count as 2 consecutive QADs, but VAE Day 1 cannot be counted as a QAD because it is a day between different antimicrobial agents.

Different agents, with gap between agents: only 2 consecutive QADs

VAE Day	-4	-3	-2	-1	1	2	3	4	5
Abx #1	--	--	**Levo**	**Levo**	--	--	--	--	--
Abx #2	--	--	--	--	--	**Mero**	--	--	--
QAD	--	--	Yes	Yes	--	Yes	--	--	--

Operationalizing VAE

New antimicrobial agent started and continued for 4 days

Vent Day	PEEP min	FiO_2 min	Temp min	Temp max	WBC min	WBC max	Abx	Spec	Poly/E pis	Org
1	10	60					None			
2	5	40					None			
3	5	40	36.9	37.6	12.1	12.1	None			
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					Yes			

= IVAC

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.

When evaluating patient data to see if the IVAC definition is met, I should focus only on antibiotics that are used to treat respiratory infections

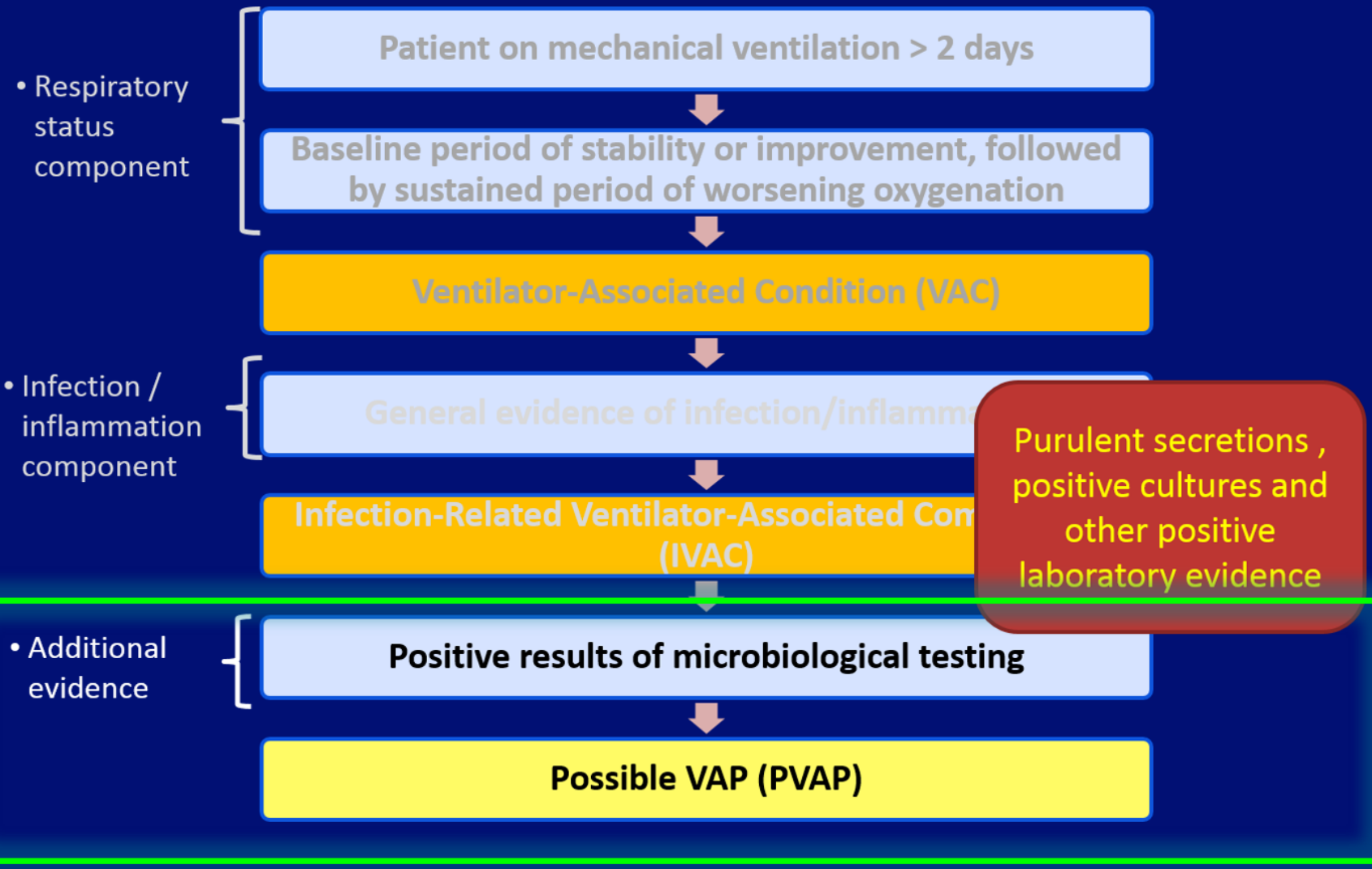
A. True

B. False

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.**
- **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

VAE Definition Algorithm Summary



PVAP

- **VAC, IVAC must be met**
- **Laboratory test collection dates must occur**
  - On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation (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: Possible VAP (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, $\geq 10^5$ CFU/ml or corresponding semi-quantitative result
   - Bronchoalveolar lavage, $\geq 10^4$ CFU/ml or corresponding semi-quantitative result
   - Lung tissue, $\geq 10^4$ CFU/g or corresponding semi-quantitative result
   - Protected specimen brush, $\geq 10^3$ CFU/ml or corresponding semi-quantitative result
2) Criterion 2: Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain $\geq$25 neutrophils and $\leq$10 squamous epithelial cells per low power field [lpf, x100])† plus 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

   † 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:
   - 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, 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

*Excludes the following: Normal respiratory/oral flora, mixed respiratory/oral flora or equivalent; *Candida* species or yeast not otherwise specified; coagulase-negative *Staphylococcus* species, *Enterococcus* species. Also excludes the following community-associated respiratory pathogens: *Blastomyces, Histoplasma, Coccidioides, Paracoccidioides, Cryptococcus and Pneumocystis.*

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.

*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 you facility's reporting method to the purulent respiratory secretions quantitative definition then refer to Table 2

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

Purulent Respiratory Secretions

Some clinical laboratories use different result reporting formats for respiratory secretion direct examination result (refer to 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 (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.

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

Histopathology (Lung) Results

- Identification of abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli
- Evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms)
- Evidence of infection with viral pathogens (immunohistochemical assays, cytology, microscopy)

Non-Culture-Based Results: PVAP

- **Pathogens (*Legionella* spp., selected viruses) identified utilizing non-culture-based diagnostic testing may qualify as criterion for meeting Criterion 3 of the PVAP definition.**
  - Antigen testing
  - PCR
  - Direct Fluorescent Antibody Testing
  - Serology

NOTE: Many other pathogens (including respiratory pathogens such as *Mycoplasma* and *Chlamydophila*) that may be detected using non-culture-based techniques are not currently included in PVAP criteria.

Pathogen Reporting

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

What does *Candida* species or yeast not otherwise specified refer to?

All *Candida* species—those that have been identified to the species level such as *Candida albicans*, those that are reported as *Candida* species and also to include culture reports that may simply say for example, " many yeast isolated"

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 may by an ineligible pathogen or in the presence of normal oral flora be used to satisfy the PVAP criteria.**
- **How are we meeting Criterion 1 ???**
  - The report is not a quantitative report, however, the "Many" quantity is acceptable as a semi-quantitative equivalent

Operationalizing VAE

Positive quantitative or semi-quantitative* ETA culture *(meeting specified threshold)*

Vent Day	min	min	min	max	min	max	Abx	Spe	/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.

Operationalizing VAE

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	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)

Operationalizing VAE

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	Abx	Spe	Polys/ Epis	Org
1	10	60								
2	5	40					None			
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 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 BSIs are not reported for VAC or IVAC.**
- **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 to include the PNEU or LRI/Lung definitions**
- **Remember, for a bloodstream infection to be determined as secondary to a primary infection site (e.g. related to an infection at another site) the patient must first meet one of the NHSN site specific definitions AND the Secondary BSI Guide must be adhered to.**
  - Blood culture as an element of the definition

  OR

  - Blood & site-specific specimen cultures (used to meet the infection criterion) must match for at least one organism.

Secondary BSI and Lower Respiratory Site Infections

- Matching pathogens found in a site culture and blood culture alone do not allow for secondary BSI assignment
- Physician diagnosis of secondary BSI does not allow for secondary BSI assignment
- 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.

A patient in my ICU met the IVAC definition. On the VAE Event Date, there was also a positive blood culture that grew *Pseudomonas aeruginosa*. The patient has a central line that has been in place for 5 days. Other than fever, there are no other signs/symptoms of a respiratory infection. How should I report this event?

A. Report an IVAC (no pathogen) and evaluate to see if the positive blood culture is secondary to another HAI or if it is a CLABSI

B. Report an IVAC and secondary BSI

C. Report a PVAP

D. None of the above

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.

Operationalizing VAE

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								

Operationalizing VAE

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								

PREPARING TO CONDUCT VAE SURVEILLANCE AND REPORTING EVENTS INTO NHSN

VAE Reporting

- **VAE will be in included in CMS Hospital Inpatient Quality Reporting program for Long Term Care Hospital (CMS) /Long Term Acute Care Hospital (NHSN)**
- **What rates are appropriate for use in public reporting, inter-facility comparisons, etc. ?**
  - Overall VAE rate = rate of ALL events meeting at least the VAC definition
  - "IVAC-plus" rate = rate of ALL events meeting at least the IVAC definition
- **Individual events may be useful for internal use**
  - Rates of individual events: VAC only, IVAC only, PVAP only

Reporting Events In NHSN

- **Conducting in-plan VAE surveillance requires assessing patients for ALL events:**
  - VAC
  - IVAC
  - PVAP
- **Hierarchy of definitions:**
  - If a patient meets criteria for VAC and IVAC, report as IVAC.
  - If a patient meets criteria for VAC, IVAC and PVAP, report PVAP.

Tips for Getting Started

- **Get familiar with the protocol & review the FAQs**
  - http://www.cdc.gov/nhsn/ltach/vae/index.html
- **Experiment with the VAE Calculator Version 3.0**
  - http://www.cdc.gov/nhsn/VAE-calculator/index.html

Collaboration

Preparing for VAE Surveillance

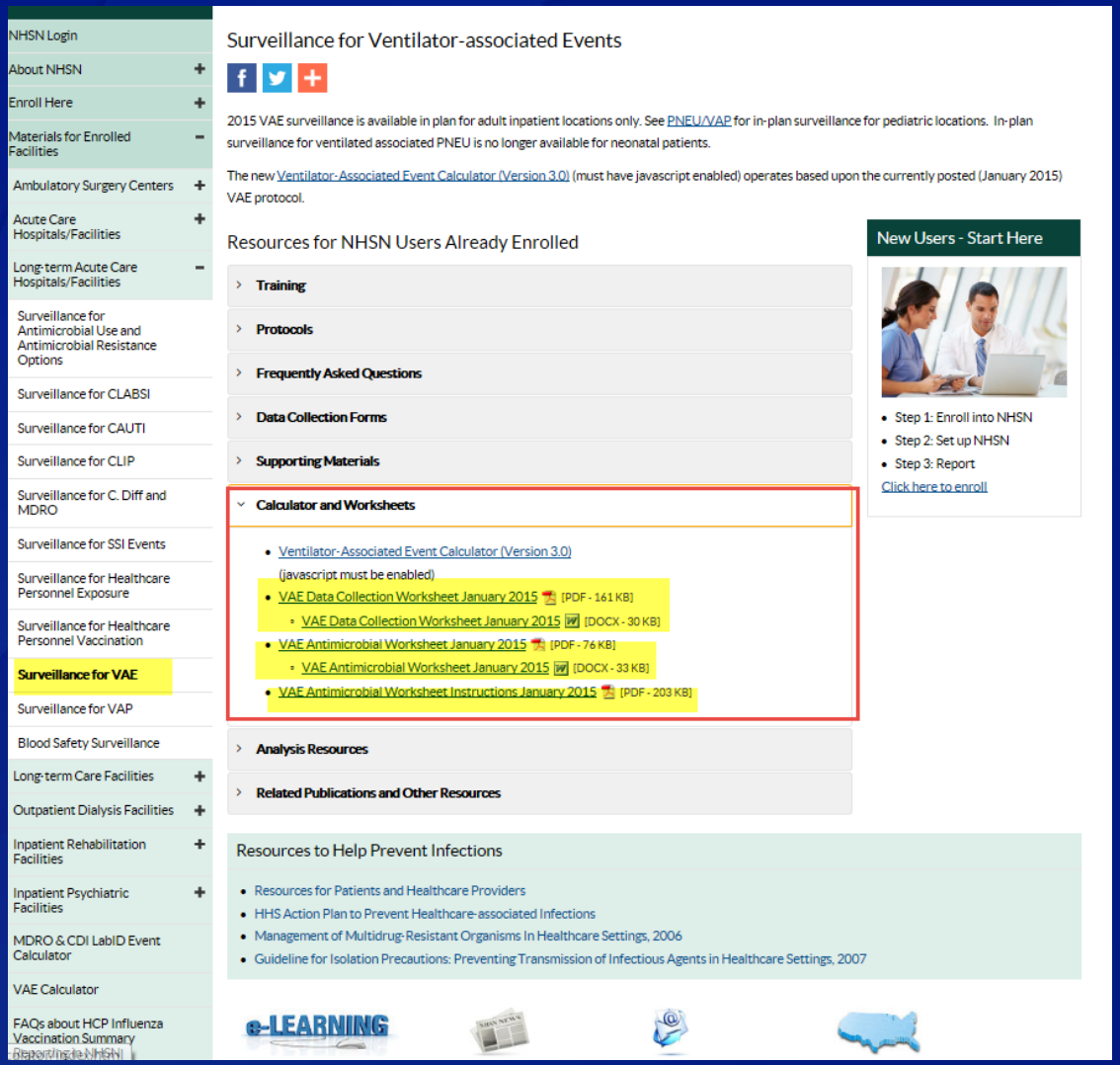
- **Establish relationships with Respiratory Therapy and/or Critical Care colleagues:**
  - Share the protocol
  - Discuss options for collection of minimum daily PEEP and FiO_2 for each MV day (IP, RT, electronically generated)
  - Inquire about frequency with which excluded therapies (HFV, ECLS) and APRV are used
- **Determine your laboratory's approach to Gram stain and culture result reporting.**
  - How does your facility's laboratory report Gram stain results?
  - Does your facility's laboratory report culture results quantitatively?
  - What quantitative ranges correspond to the semi-quantitative reports?

Preparing for VAE Surveillance

- **Develop a plan for organizing the data elements needed to identify VAEs**
  - PEEP and FiO2
  - WBC / Temperature
  - Antimicrobials agents (administration not orders)
  - Laboratory results

- **Explore use of tools for data collection**

Calculator and Worksheets



VAE Worksheets

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.*			
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,e] (✓)	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)

Abbreviations: Vent = ventilator; PEEP = Positive End-Expiratory Pressure; FiO_2 = fraction of inspired oxygen; Min = daily minimum; Max = daily maximum; ≤4K = ≤4,000 WBC/mm^3; ≥12K = ≥12,000 WBC/ mm^3; QAD = Qualifying Antimicrobial Day (see Antimicrobial Worksheet or protocol for details); cx = culture; BAL = bronchoalveolar lavage; PSB = protected specimen brush; ETA = endotracheal aspirate; qual = qualitative (non-quantitative); quant = quantitative; Path = pathology/histopathology; VAC = Ventilator-Associated Condition; IVAC = Infection-related Ventilator-Associated Complication; PVAP = Possible VAP.

[a]Semi-quantitative and quantitative culture criteria apply to BAL, PSB, ETA and lung tissue cultures only (not to sputum cultures).

[b]ETA: quantitative threshold ≥10^5 CFU/ml (or moderate-heavy, 2+-4+ growth); BAL: quantitative threshold ≥10^4 CFU/ml (or moderate-heavy, 2+-4+ growth); Lung tissue: quantitative threshold ≥10^4 CFU/g (or moderate-heavy, 2+-4+ growth); PSB: quantitative threshold ≥10^3 CFU/ml (or moderate-heavy, 2+-4+ growth)

[c]Excludes the following, when cultured from sputum, ETA, BAL, PSB: Normal respiratory/oral flora, mixed respiratory/oral flora or equivalent, *Candida* species or yeast not otherwise specified, coagulase-negative *Staphylococcus* species, *Enterococcus* species. Exclusions do not apply to cultures of lung tissue or pleural fluid.

[d]≥25 neutrophils per low power field [lpf, x 100] (or heavy, 4+) and ≤10 squamous epithelial cells per low power field [lpf, x 100] (or rare, occasional, few, 1+ or 2+)

[e]Any of the following can be used to meet the PVAP definition: 1) positive pleural fluid culture where specimen was obtained during thoracentesis or initial placement of chest tube; 2) lung histopathology (see protocol for guidance); 3) positive diagnostic test for *Legionella* spp. or for the following respiratory viruses: influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

VAE Worksheets

Ventilator-Associated Events (VAE) Antimicrobial Worksheet

Patient ID: _____ Date of Mechanical Ventilation (MV) Initiation: _____

VAE Day		-- (-4)	-- (-3)	Baseline (-2)	Baseline (-1)	Event Date: VAE Day 1	2	3	4	5	6	7	8	9	
Date (mm/dd)															
MV Day (1, 2, 3, etc.)															
List antimicrobials:	New?														
1															
2															
3															
4															
5															
6															
7															
8															Total consec-utive QADs:
9															
10															
Qualifying Antimicrobial Days (QADs)															

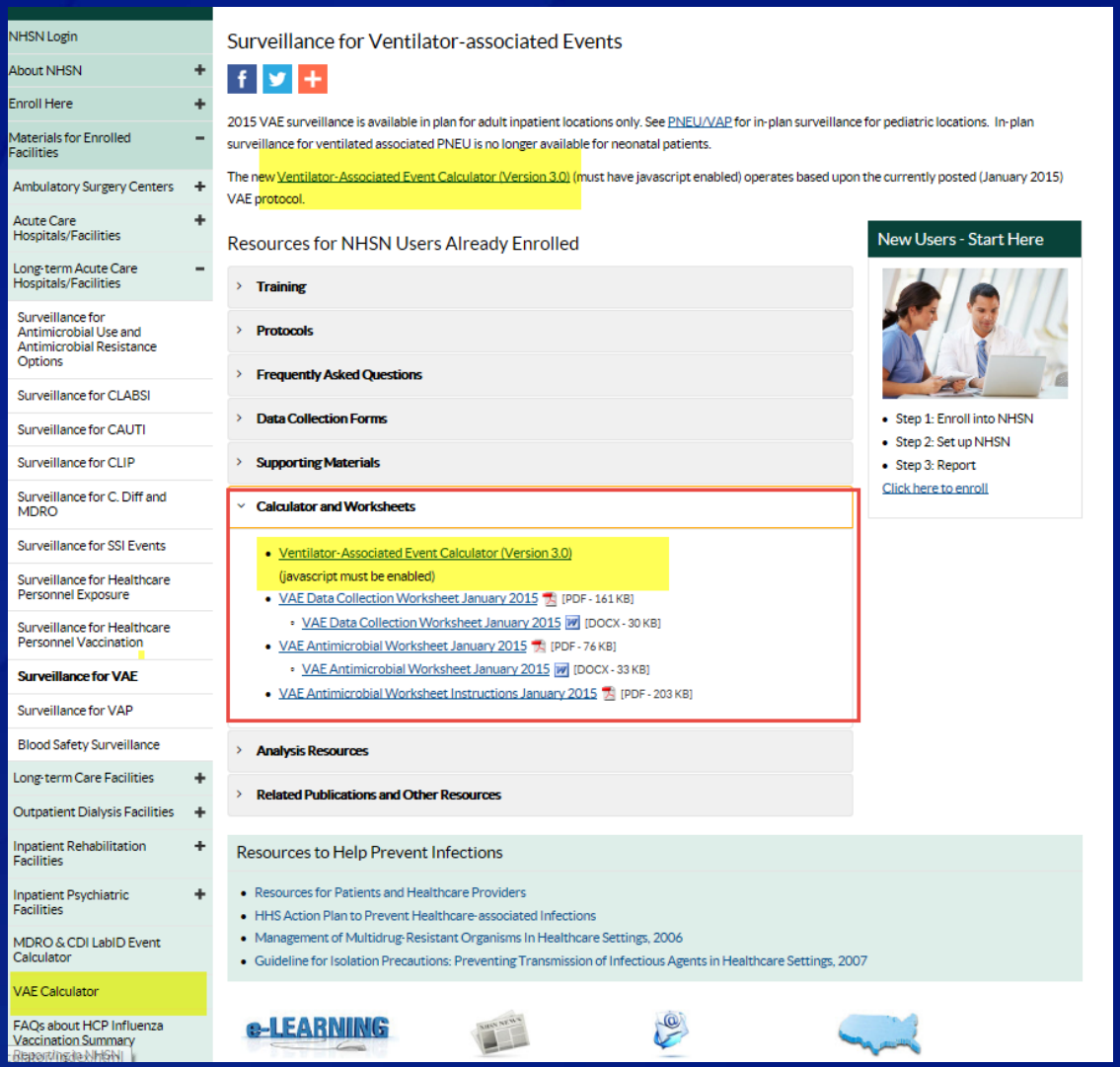
Are there at least 4 consecutive QADs, starting in the VAE Window Period?

☐ Yes→meets IVAC, evaluate for PVAP

☐ No→does not meet IVAC, report as VAC

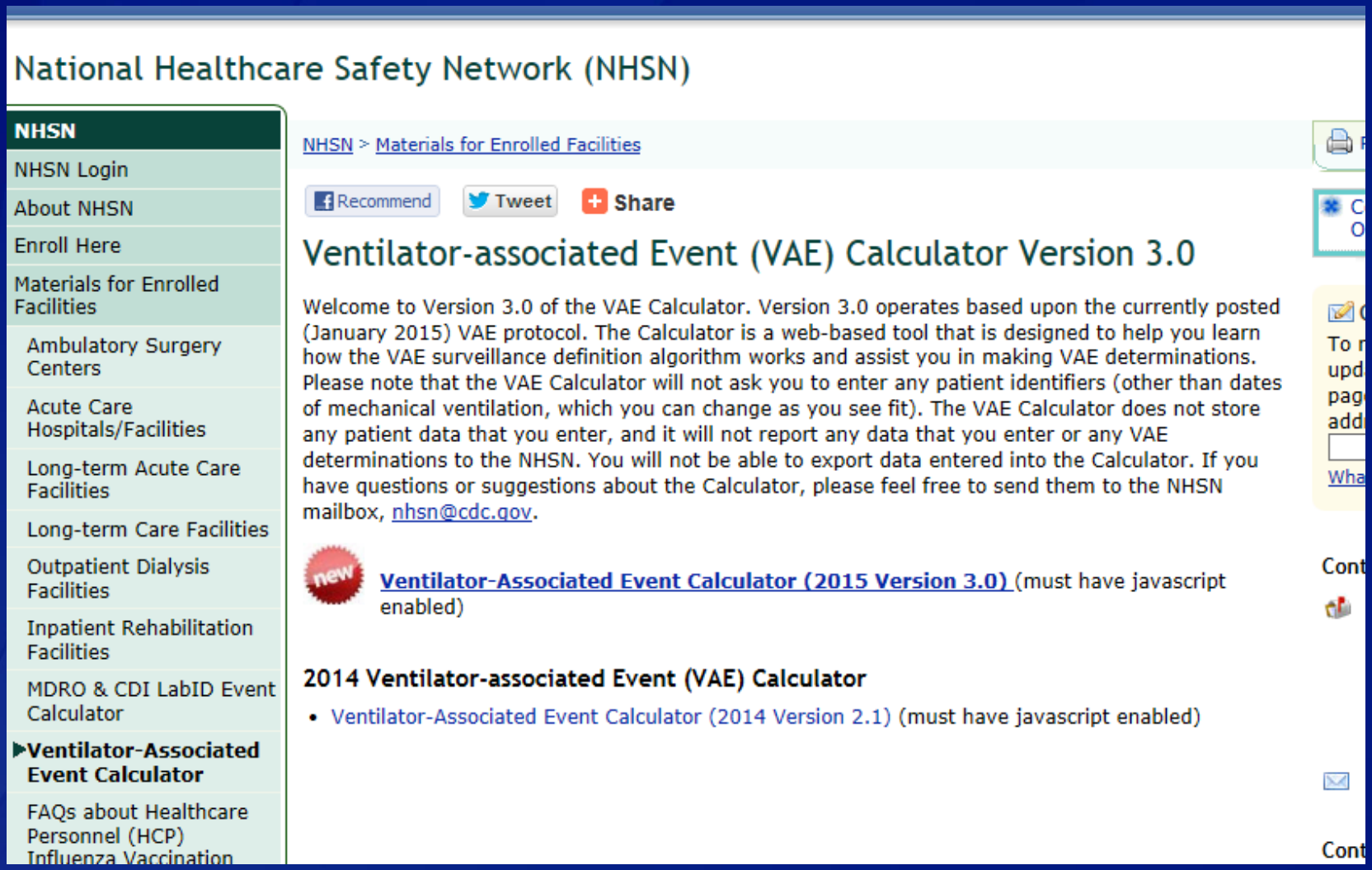
VAE_AntimicrobialWorksheet_v6_2015

VAE Calculator

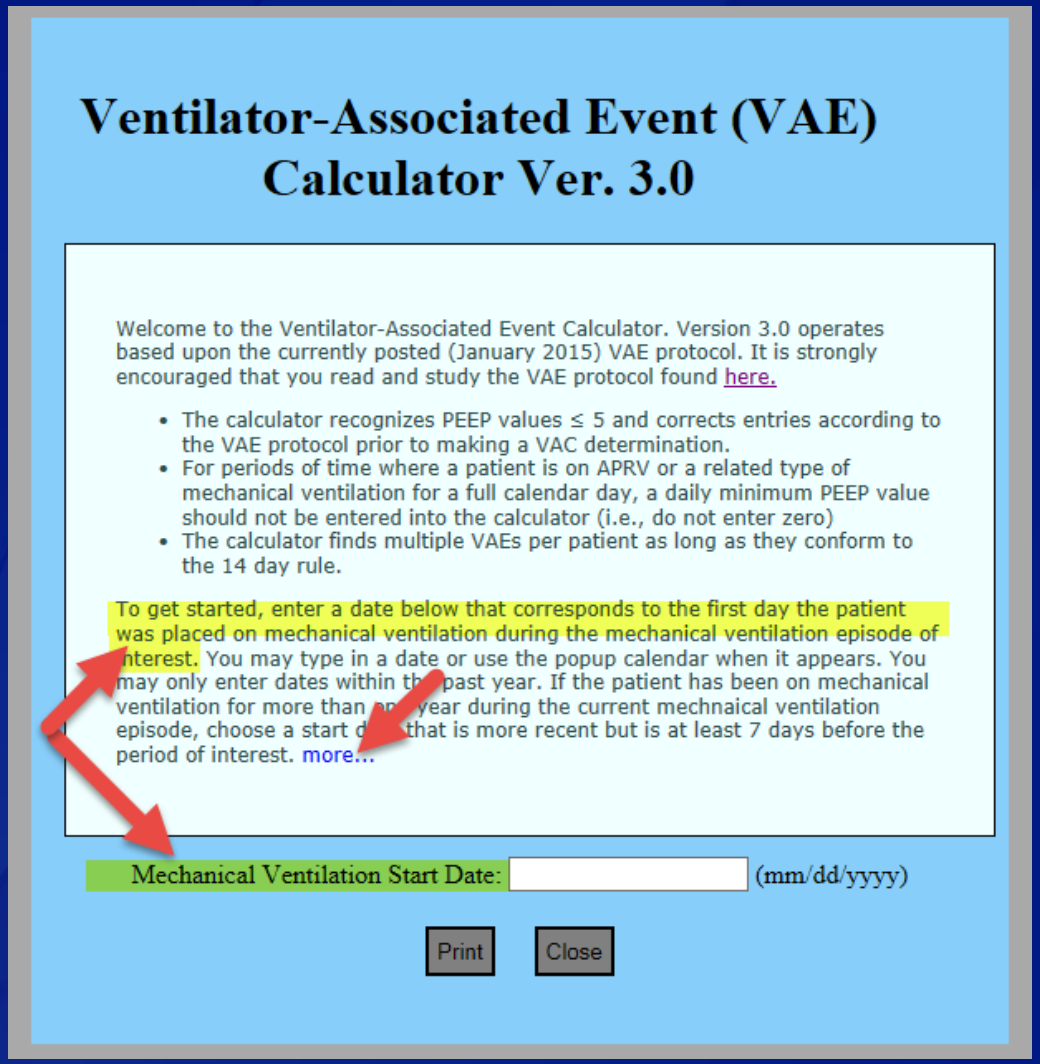


http://www.cdc.gov/nhsn/VAE-calculator/index.html

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



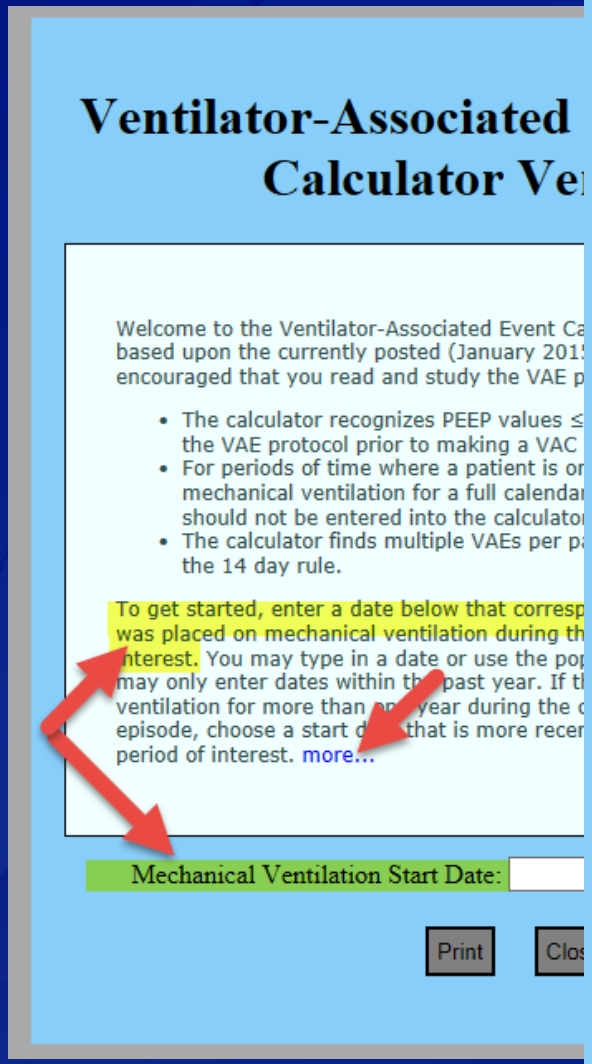
Landing Page

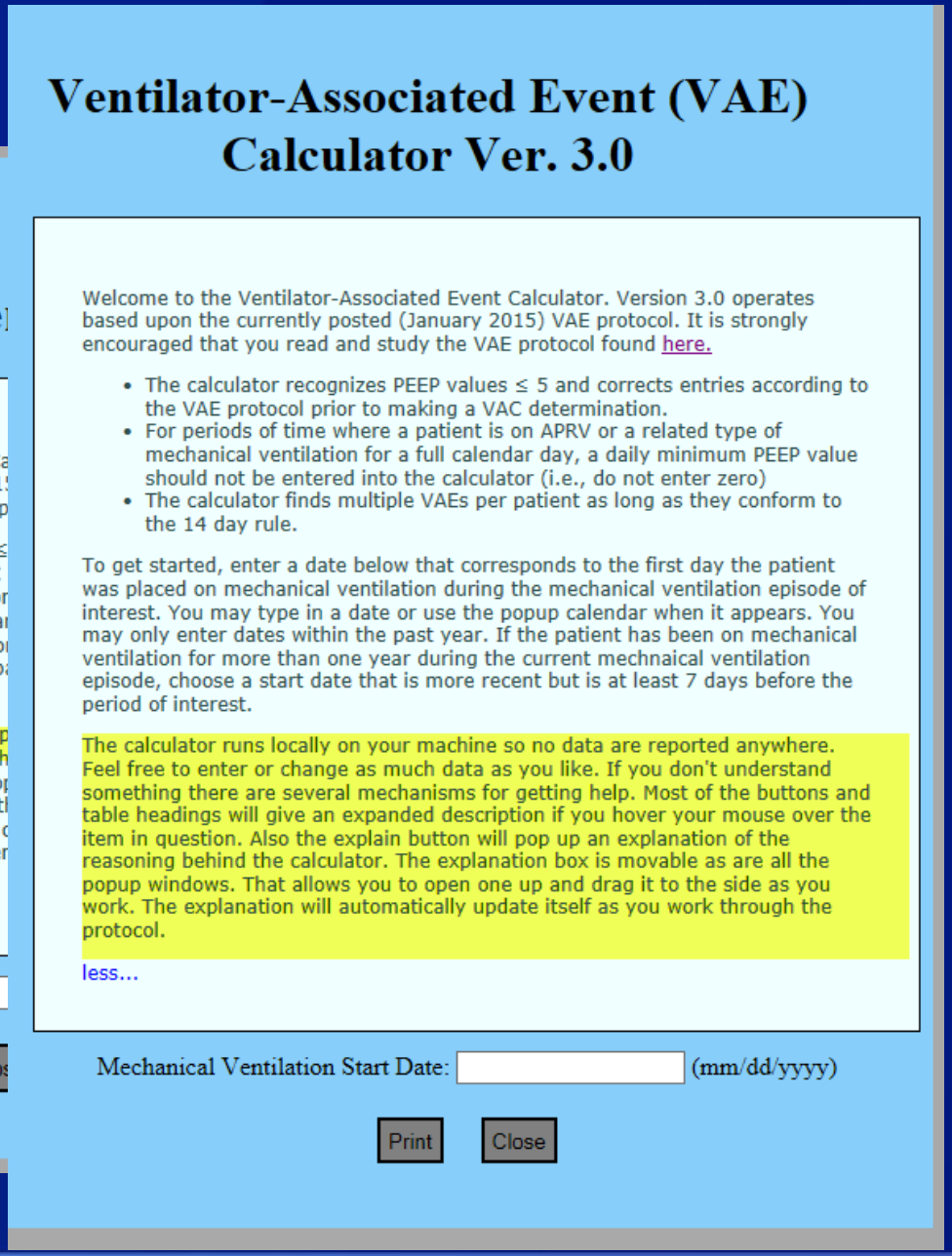


Date Mechanical Ventilation Initiated

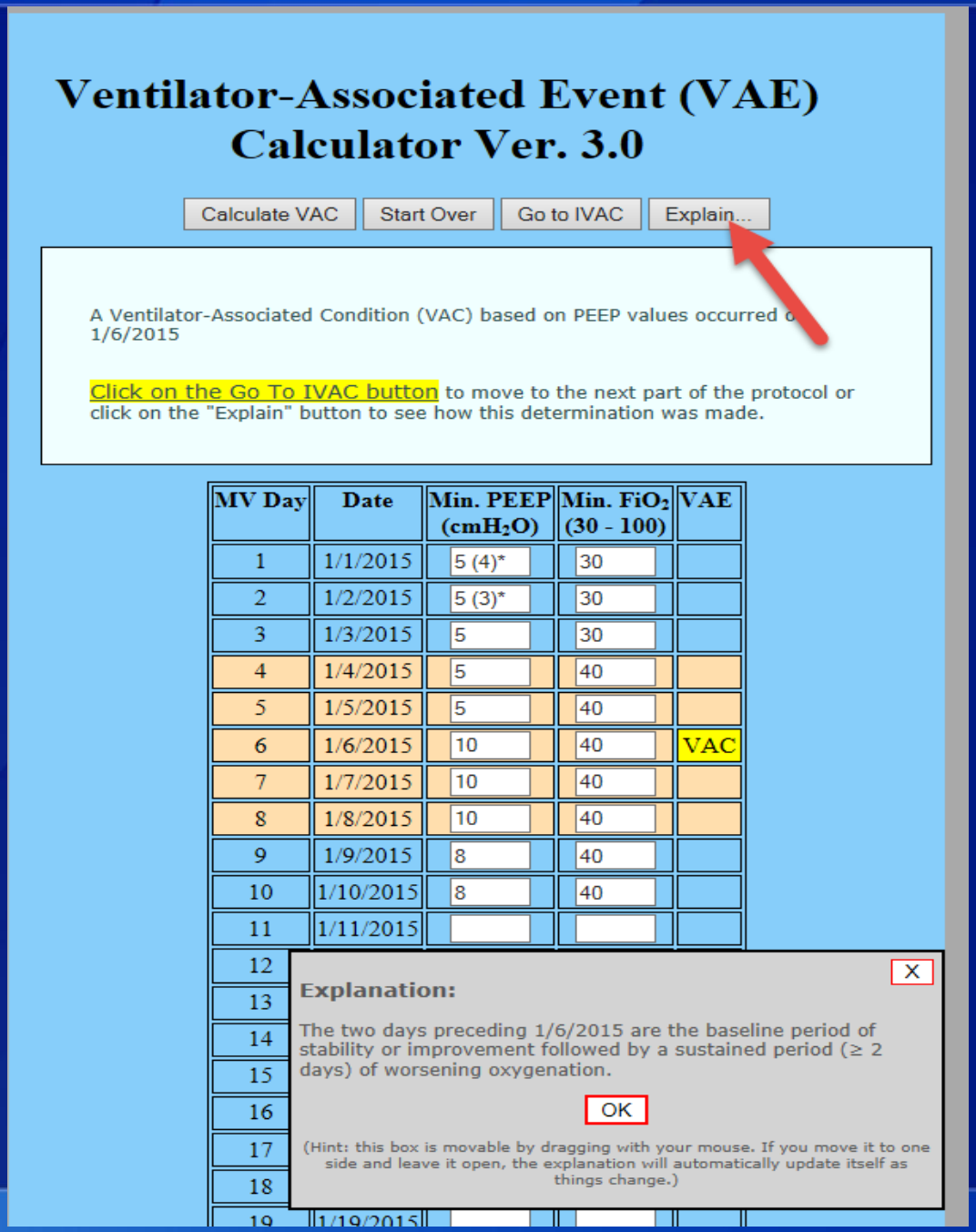
- Enter the actual date of the initiation of mechanical ventilation
- NOT the date of admission to the facility (unless, of course, they are the same)
- Estimate if necessary
- MV initiation date impacts the VAE window period determination for VAEs detected early on in the hospitalization
- MV initiation date may impact the determination of HAI attribution as it relates to the Transfer Rule

Landing Page





VAC


Ventilator-Associated Event (VAE) Calculator Ver. 3.0
Calculate VAC
Start Over
Go to IVAC
Explain...
A Ventilator-Associated Condition (VAC) based on PEEP values occurred o
1/6/2015
Click on the Go To IVAC button to move to the next part of the protocol or click on the "Explain" button to see how this determination was made.
MV Day
Date
Min. PEEP (cmH2O)
Min. FiO2 (30 - 100)
VAE
1 1/1/2015 5 (4)* 30
2 1/2/2015 5 (3)* 30
3 1/3/2015 5 30
4 1/4/2015 5 40
5 1/5/2015 5 40
6 1/6/2015 10 40 VAC
7 1/7/2015 10 40
8 1/8/2015 10 40
9 1/9/2015 8 40
10 1/10/2015 8 40
11 1/11/2015
12
13
14
15
16
17
18
19 1/19/2015
X
Explanation:
The two days preceding 1/6/2015 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.)

IVAC

Ventilator-Associated Event (VAE) Calculator Ver. 3.0

Start Over | Calculate IVAC | Explain...

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.

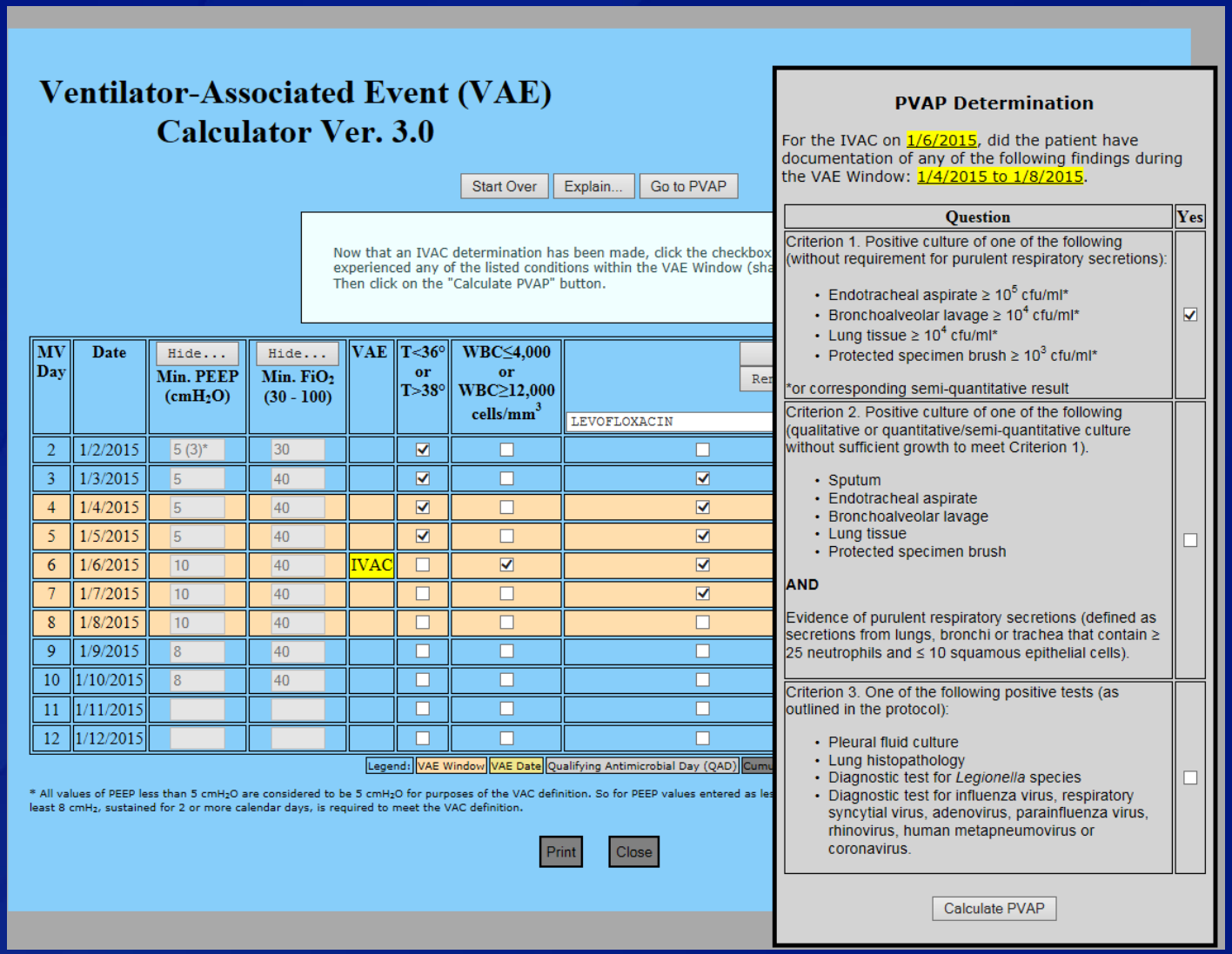
MV Day	Date	Hide... Min. PEEP (cmH_2O)	Hide... Min. FiO_2 (30 - 100)	VAE	T<36° or T>38°	WBC≤4,000 or WBC≥12,000 cells/mm^3	Add... Remove... Choose a Drug	QAD
2	1/2/2015	5 (3)*	30		☐	☐	☐	
3	1/3/2015	5	40		☐	☐	☐	
4	1/4/2015	5	40		☐	☐	☐	
5	1/5/2015	5	40		☐	☐	☐	
6	1/6/2015	10	40	VAC	☐	☐	☐	
7	1/7/2015	10	40		☐	☐	☐	
8	1/8/2015	10	40		☐	☐	☐	
9	1/9/2015	8	40		☐	☐	☐	
10	1/10/2015	8	40		☐	☐	☐	
11	1/11/2015				☐	☐	☐	
12	1/12/2015				☐	☐	☐	

Legend: VAE Window | VAE Date | Qualifying Antimicrobial Day (QAD) | Cumulative 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.

Print | Close

PVAP



Ventilator-Associated Event (VAE) Calculator Ver. 3.0

Start Over | Explain... | Go to PVAP

Now that an IVAC determination has been made, click the checkbox
experienced any of the listed conditions within the VAE Window (sha
Then click on the "Calculate PVAP" button.

MV Day	Date	Hide... Min. PEEP (cmH_2O)	Hide... Min. FiO_2 (30 - 100)	VAE	T<36° or T>38°	WBC≤4,000 or WBC≥12,000 cells/mm^3	Re... LEVOFLOXACIN
2	1/2/2015	5 (3)*	30		☑	☐	☐
3	1/3/2015	5	40		☑	☐	☑
4	1/4/2015	5	40		☑	☐	☑
5	1/5/2015	5	40		☑	☐	☑
6	1/6/2015	10	40	IVAC	☐	☑	☑
7	1/7/2015	10	40		☐	☐	☑
8	1/8/2015	10	40		☐	☐	☐
9	1/9/2015	8	40		☐	☐	☐
10	1/10/2015	8	40		☐	☐	☐
11	1/11/2015				☐	☐	☐
12	1/12/2015				☐	☐	☐

Legend: VAE Window | VAE Date | Qualifying Antimicrobial Day (QAD) | Cumu

* 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 les
least 8 cmH_2, sustained for 2 or more calendar days, is required to meet the VAC definition.

Print | Close

PVAP Determination

For the IVAC on 1/6/2015, did the patient have documentation of any of the following findings during the VAE Window: 1/4/2015 to 1/8/2015.

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

PVAP

Ventilator-Associated Event (VAE) Calculator Ver. 3.0

The event on 1/6/2015 conforms to a Possible Ventilator-Associated Pneumonia (PVAP) definition. For a discussion of why, click on the Explain button.

Close

Start Over | Explain...

The event on 1/6/2015 conforms to a Possible Ventilator-Associated Pneumonia (PVAP) definition. For a discussion of why, click on the Explain button.

X

Criterion 1 is checked. Clicking "Yes" to any of the three criteria is sufficient to meet the definition of a Possible Ventilator-Associated Pneumonia (PVAP) for the event on 1/6/2015.

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.)

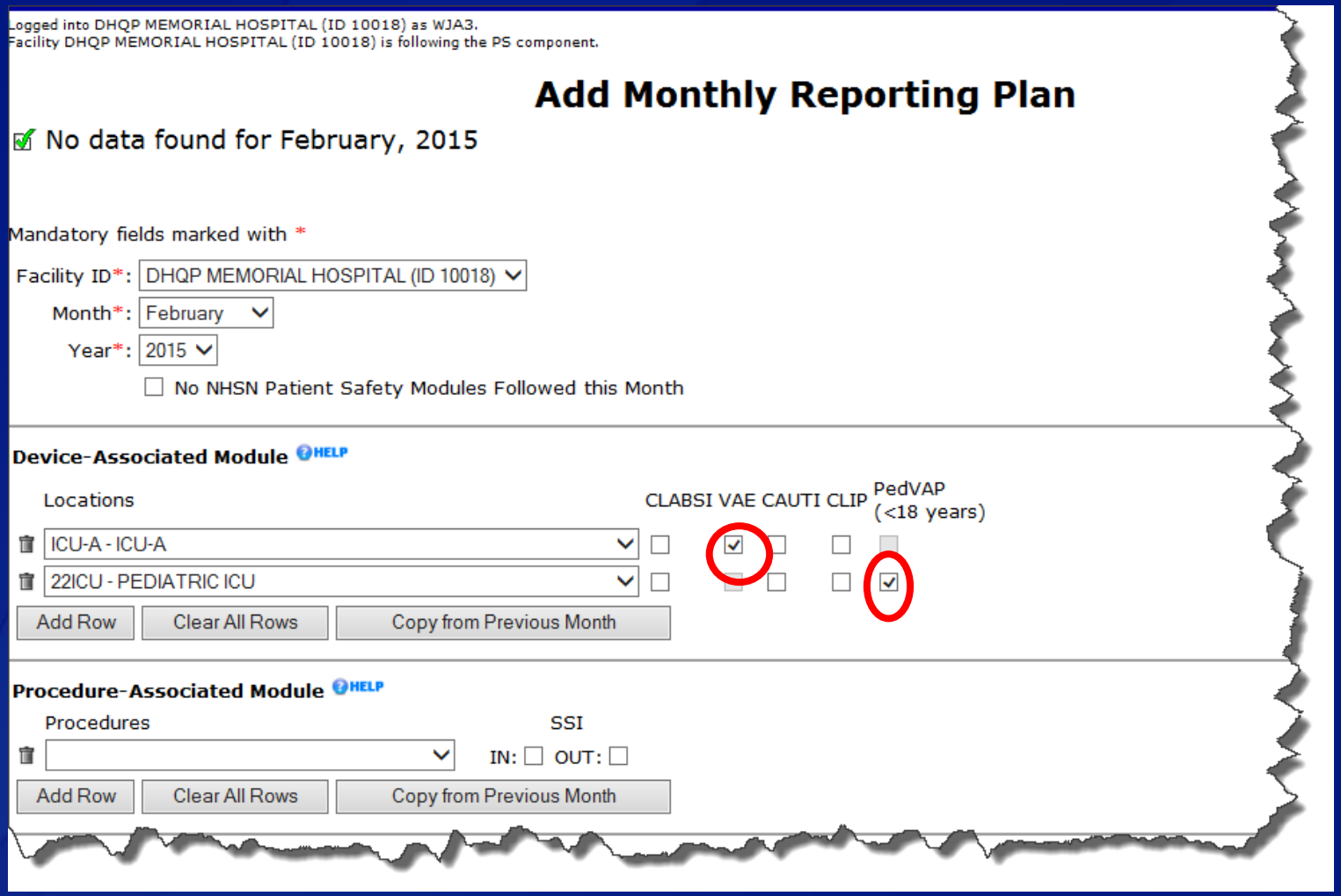
MV Day	Date	Hide... Min. PEEP (cmH_2O)	Hide... Min. FiO_2 (30 - 100)	VAE	T<36° or T>38°	WBC≤4,000 or WBC≥12,000 cells/mm^3	Add... Remove... LEVOFLOXACIN	Remove... IMIPENEM/CILASTATIN	
2	1/2/2015	5 (3)*	30		☑	☐	☐	☐	
3	1/3/2015	5	40		☑	☐	☑	☐	
4	1/4/2015	5	40		☑	☐	☑	☐	
5	1/5/2015	5	40		☑	☐	☑	☑	yes
6	1/6/2015	10	40	PVAP	☐	☑	☑	☐	yes
7	1/7/2015	10	40		☐	☐	☑	☑	yes
8	1/8/2015	10	40		☐	☐	☐	☐	yes
9	1/9/2015	8	40		☐	☐	☐	☑	yes
10	1/10/2015	8	40		☐	☐	☐	☐	
11	1/11/2015				☐	☐	☐	☐	
12	1/12/2015				☐	☐	☐	☐	

Legend: VAE Window | VAE Date | Qualifying Antimicrobial Day (QAD) | Cumulative QAD

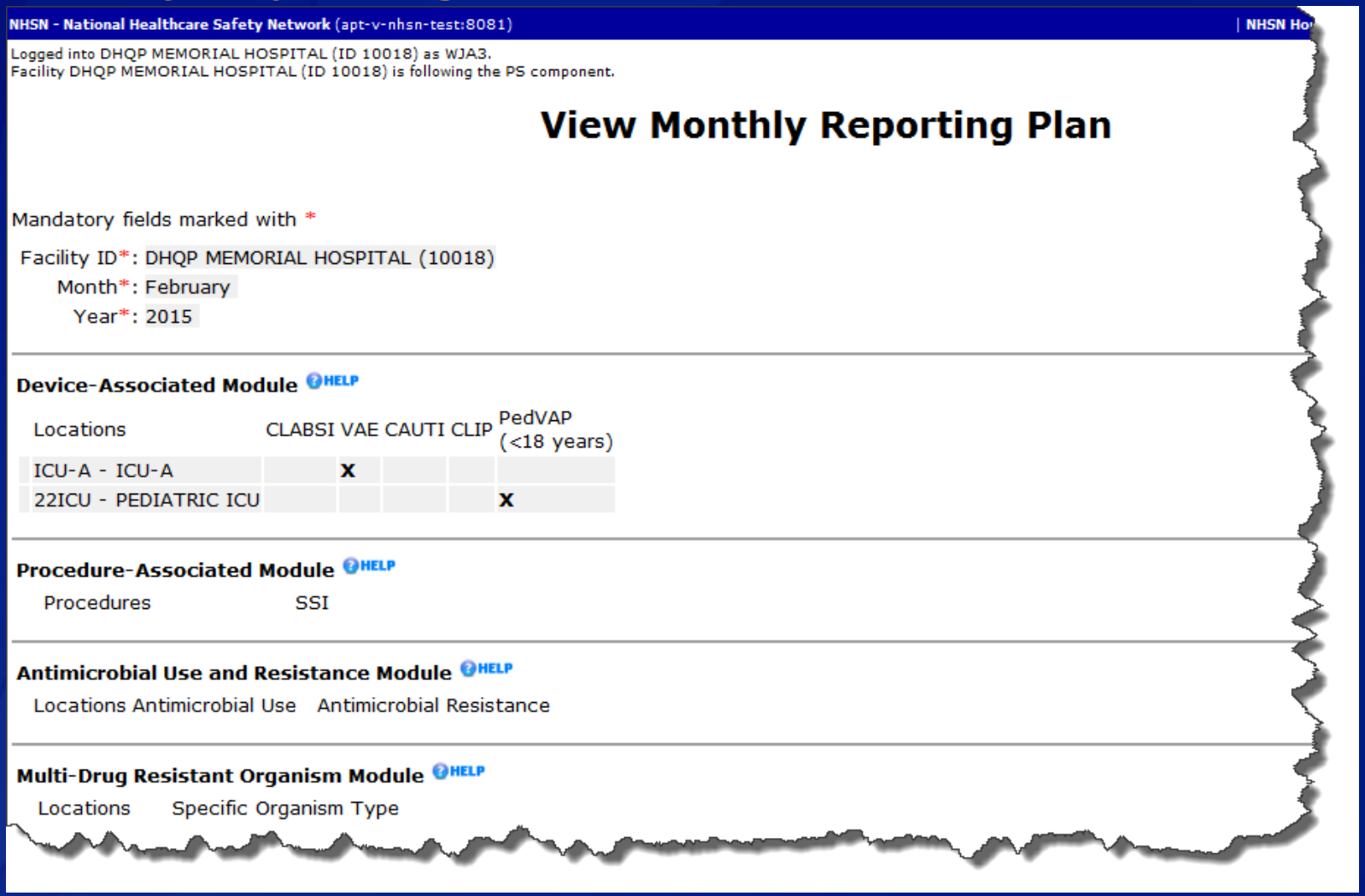
* All values of PEEP less than 5 cmH_2O are considered to be 5 cmH_2O for purposes of the VAC definition. So for PEEP values entered as less than or equal to 5 cmH_2O, an increase in the daily minimum PEEP to at least 8 cmH_2, sustained for 2 or more calendar days, is required to meet the VAC definition.

Print | Close

Monthly Reporting Plan



Monthly Reporting Plan



NHSN - National Healthcare Safety Network (apt-v-nhsn-test:8081) | NHSN Ho

Logged into DHQP MEMORIAL HOSPITAL (ID 10018) as WJA3.
Facility DHQP MEMORIAL HOSPITAL (ID 10018) is following the PS component.

View Monthly Reporting Plan

Mandatory fields marked with *

Facility ID*: DHQP MEMORIAL HOSPITAL (10018)
Month*: February
Year*: 2015

Device-Associated Module HELP

Locations	CLABSI	VAE	CAUTI	CLIP	PedVAP (<18 years)
ICU-A - ICU-A		X			
22ICU - PEDIATRIC ICU					X

Procedure-Associated Module HELP

Procedures	SSI

Antimicrobial Use and Resistance Module HELP

Locations	Antimicrobial Use	Antimicrobial Resistance

Multi-Drug Resistant Organism Module HELP

Locations	Specific Organism Type

VAE Paper Form

*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
- ☐ Bronchoalveolar lavage
- ☐ Lung tissue
- ☐ Protected specimen brush

OR

☐ Criterion #2: Purulent respiratory secretions‡ (defined in the protocol) plus 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

OR

☐ 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 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

Assurance of Confidentiality: The voluntarily provided information obtained in this surveillance system that would permit identification of any individual or institution is collected with a guarantee that it will be held in strict confidence, will be used only for the purposes stated, and will not otherwise be disclosed or released without the consent of the individual or the institution in accordance with Sections 304, 306 and 308(d) of the Public Health Service Act (42 USC 242b, 242k, and 242m(d)).

Public reporting burden of this collection of information is estimated to average 25 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to CDC, Reports Clearance Officer, 1600 Clifton Rd., MS D-74, Atlanta, GA 30333, ATTN: PRA (0920-0666).

CDC 57.112 (Front), Rev 3 v6.3

NHSN Application

Location of Mechanical Ventilation * ICU/CCU - ICU/CCU

Date Mechanical Ventilation Initiated * 01/06/2015

APRV * N - No

Event Details HELP

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: ‡

☐ Endotracheal aspirate ☐ Lung tissue

☐ Bronchoalveolar lavage ☐ Protected specimen brush

OR

Criterion #2:

☐ Purulent respiratory secretions (defined in the protocol) **plus** a positive culture of one of the following specimens (qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet criterion #1): ‡

☐ Sputum ☐ Lung tissue

☐ Endotracheal aspirate ☐ Protected specimen brush

☐ Bronchoalveolar lavage

OR

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

☐ Pleural fluid culture ☐ 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

Denominator Data

- **Device (ventilator) days and patient days are used for denominators.**
  - Collect data daily at the same time each day
  - Sum daily counts and report the total for the month
  - Ventilator days – number of patients in the chosen location who are ventilated at the time of the count
  - Ventilator days for 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: also count of the number of patients on APRV (or related) modes of ventilation
    - APRV count reported separately
    - APRV count is included in the total count
- **Patient days = number of patients in the chosen location**

Denominator Data

- **Optional denominator reporting for VAE in 2015**
- **Total of the number of episodes occurring during a month**
- **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

Denominator Form

NHSN National Healthcare Safety Network

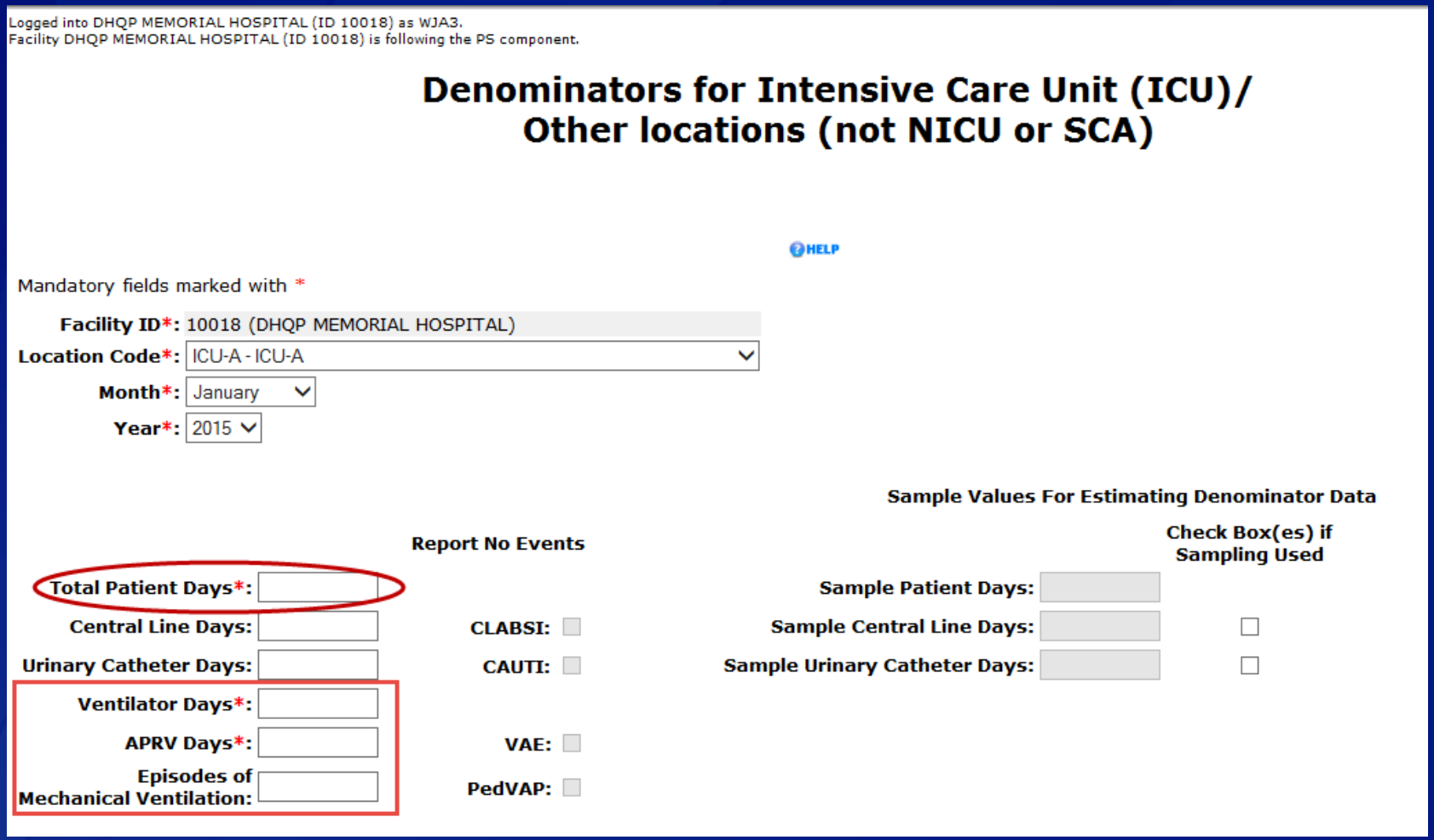
Form Approved
OMB No. 0920-0666
Exp. Date: 12/31/2017
www.cdc.gov/nhsn

Denominators for Specialty Care Area (SCA)/Oncology (ONC)

*required for saving
Facility ID: *Location Code: *Month: *Year:

Date	*Number of Patients	**Number of patients with 1 or more central lines (if patient has both, count as Temporary)		**Number of patients with a urinary catheter	**Number of patients on a ventilator		Number of Episodes of Mechanical Ventilation
		Temporary	Permanent		Total Patients	Number on APRV	
1					8	2	8
2					10	2	2
3					8	2	0
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							

Denominator



VAE CASE STUDIES

Case Study 1

A 69-year old female in your ICU a diagnosis of pneumonia . Review her ventilator settings and determine if the VAC definition is met.

MV Day	Daily minimum PEEP	Daily minimum FiO_2
1	8	100
2	6	50
3	5	50
4	8	40
5	8	70
6	6	70
7	5	60
8	5	70
9	5	60

A. Yes

B. No

What specific event should be reported for this patient?

MV DAY	Daily minimum PEEP	Daily minimum FiO_2	Temp	WBC	ABX	ABX	Speci-men	Polys/ Epis	Organism
1	8	100	38.0		Pip / Tazo				
	6	50	39.0		Pip / Tazo				NF with Few *Staph aureus*
3	5	50	37.6	4.9	Pip / Tazo	Vanco-IV	Sputum		
4	8	40	38.6	5.8					
5	8	70	39	5.8		Vanco-IV			Scant NF, Many *Staph. aureus*
6	6	70	38.8	5.4			BAL		$\geq 10^4$ cfu/ml *S. aureus*
7	5	60	38.0	5.4		Vanco-IV			
8	5	70							
9	5	60				Vanco- IV			

What specific event should be reported for this patient?

A. None, the patient had CAP present on admission

B. PVAP (pathogen SA)

C. IVAC

D. VAC only

What criterion of the PVAP definition is met?

A. Criterion 1

B. Criterion 2

C. Criterion 1 & 2

D. I don't know I guessed that it met PVAP

PVAP - Criterion 1

MV DAY	Daily minimum PEEP	Daily minimum FiO_2	Temp	WBC	ABX	ABX	Speci-men	Polys /Epis	Organism
1	8	100	**38.0**		Pip / Tazo				
2	6	50	**39.0**		Pip / Tazo		Sputum		*NF with few Staph aureus*
3	5	**50**	37.6	4.9	Pip / Tazo	**Vanco-IV**			
4	8	**40**	**38.6**	5.8					
5	8	**70**	**39**	5.8		**Vanco-IV**	Sputum		Scant NF, Many *Staph. aureus*
6	6	**70**	**38.8**	5.4			BAL		**≥10^4 cfu/ml *S. aureus***
7	5	**60**	**38.0**	5.4		**Vanco-IV**			
8	5	70							
9	5	60				**Vanco-IV**			

CASE 1 Recap

- Patients are not excluded from VAE surveillance due to diagnosis or presence of underlying conditions.
- Eligible pathogens identified during the VAE window period are to be used to determine if PVAP definition can be met even if the same or similar pathogen was identified prior to the event detection
- Days between administration of the same new antimicrobial agent count as QADs as long as there is a gap of no more than 1 calendar day
- Criterion 1: Positive culture meeting quantitative threshold (note purulent respiratory secretions is not required for criterion 1)

Case Study 2

A 17 year old female with cystic fibrosis is admitted to the adult ICU where in-plan VAE surveillance has been selected in the monthly reporting plan.

She is placed on the ventilator on hospital day 5 and had a central line placed on the second day of her hospital stay. Based on the following findings do you need to report anything to NHSN.

Case Study 2

Do you need to report anything to NHSN?

MV Day	PEEP $_{min}$	FiO_{2min}	Temp $_{min}$	Temp $_{max}$	WBC $_{min}$	WBC $_{max}$	Abx	Speci-men	Polys / Epis	Organism
1	6	50					None	--	--	--
2	6	50					None	--	--	--
3	6	50	37.0	37.9	5.4	5.4	None	--	--	--
4	7	80	36.5	37.3	7.2	9.2	None	--	--	--
5	7	80	36.3	38.9	7.4	8.4	None	Sputum	≥ 25 / ≤ 10	NF & 4+ *Pseudomonas aeruginosa*
6	7	75	37.2	38.5	8.5	8.8	Yes	--	--	--
7	6	75					Yes	--	--	--
8	6	75					Yes	Blood	--	*Staph aureus*
9	6	60					Yes	--	--	--
10	8	80					Yes	--	--	--
11	8	80					Yes	--	--	--
12	6	60					Yes	--	--	--
13	6	60					Yes	--	--	--
14	6	60					Yes	--	--	--
15	6	60					No	--	--	--
16	7	85					No	--	--	--
17	7	85					No	--	--	--

Case Study 2

1. Nothing to report to NHSN
2. PVAP with a secondary BSI (pathogens PA, SA)
3. PVAP (pathogen PA)
4. PVAP (pathogen PA) and perhaps a secondary BSI to another HAI site or CLABSI (pathogen SA)

PVAP

MV Day	PEEP min	FiO_{2min}	Temp min	Temp max	WBC min	WBC max	Abx	Speci-men	Polys / Epis	Organism
1	6	50					None	--	--	--
2	6	**50**					None	--	--	--
3	6	**50**	37.0	37.9	5.4	5.4	None	--	--	--
4	7	**80**	36.5	37.3	7.2	9.2	None	--	--	--
5	7	**80**	36.3	**38.9**	7.4	8.4	None	Sputum	**≥ 25 / ≤ 10**	**NF & 4+ *Pseudomonas aeruginosa***
6	7	75	37.2	**38.5**	8.5	8.8	**Yes**	--	--	--
7	6	75					**Yes**	--	--	--
8	6	75					**Yes**	**Blood**	--	***Staph aureus***
9	6	60					**Yes**	--	--	--
10	8	80					**Yes**	--	--	--
11	8	80					**Yes**	--	--	--
12	6	60					**Yes**	--	--	--
13	6	60					**Yes**	--	--	--
14	6	60					**Yes**	--	--	--
15	6	60					No	--	--	--
16	7	85					No	--	--	--
17	7	85					No	--	--	--

Event Period (14 Days)

Case Study 2 Recap

- All patients in an adult location where VAE was selected in the monthly reporting plan are included
- Event Day 4 (first day of onset of worsening oxygenation) VAC met in FiO_2 parameter
- VAE Window Period is limited to 4 days, VAC and IVAC definitions are met
- Both purulent respiratory secretions and the semi-quantitative culture criteria are met to satisfy Criterion 2 of PVAP. Note sputum is not an acceptable specimen for meeting Criterion 1 of PVAP
- Blood culture is collected within the 14 day Event Period but the respiratory and blood culture pathogens do not match therefore, look to determine if another HAI definition is met for secondary bloodstream infection attribution and if not then report as Primary BSI/CLABSI

Case Study 2 (cont'd)

Upon further chart review the IP finds imaging test evidence of an infiltrate present on MV day 6 and 7.

In addition to the increase in FiO_2 on MV day 4 and 5 the patient also had increase in respiratory secretions and as noted she is febrile on MV day 5 and 6.

Can the BSI be assigned as secondary to PNEU or must it be reported as a primary CLABSI?

Can the BSI be assigned as secondary to PNEU or must it be reported as a primary CLABSI?

A. Secondary BSI to PNU1

B. Secondary BSI to PNU2

C. Primary BSI

D. I don't know and
BTW…what happened to
the BRON definition?

BSI Secondary to PNU2

Date of event

Hospital Day	MV DAY	PNU2 Elements
5	1	
6	2	
7	3	
8	4	↑ FiO_2, resp. secretions
9	5	↑ FiO_2, resp. secretions, temp 38.9,
10	6	CXR: infiltrate, temp 38.5
11	7	CXR: infiltrate
12	8	BLD CX: *S. aureus*
13	9	
14	10	

7 Day Infection Window Period

PNU1 → PNU2

Hospital Day	MV DAY	PNU1 Elements met initially. Edit to PNU2
5	1	
6	2	
7	3	
8	4	↑ FiO_2, resp. secretions
9	5	↑ FiO_2, resp. secretions, temp 38.9
10	6	temp 38.5, CXR: infiltrate
11	7	CXR: infiltrate
12	8	
13	9	
14	10	
15	11	
16	12	
17	13	BLD CX: *S. aureus*, Temp 39
18	14	Resp. secretions, CXR: infiltrate
19	15	
20	16	
21	17	
22	18	

Date of event

7 Day Infection Window Period

Secondary BSI Attribution Period

Blood culture positive within the PNU1 RIT. There is on going evidence of infection found during PNU1 RIT such that PNU2 definition can be met. Therefore event is edited to PNU2 and BSI is reported as a secondary BSI. The date of event and RIT do not change.

Case Study 3

An elderly gentleman is admitted to the LTACH on September 1. He has been ventilated since August 4th. Given the following information, identify all events.

Case Study 3

Identify event(s) and MV day of event(s)

Day	PEEP min	FiO_{2min}	Temp min	Temp max	WBC min	WBC max	Abx	Specimen	Polys / Epis	Organism
1	6	30	37.1	37.6	4.3	4.3	None	--	--	--
2	6	30	36.8	37.2	4.6	4.6	None	--	--	--
3	6	30	37.0	37.9	5.4	5.4	None	--	--	--
4	8	30	36.5	37.3	7.2	9.2	None	--	--	--
5	8	35	36.3	37.2	7.4	12.5	None	--	--	--
6	8	50	37.2	37.9	8.5	13.0	Yes	BAL	≥ 25 / ≤ 10	10^4 *C. albicans*
7	6	50	37.8	37.3	--	--	Yes	BC x2	--	*C. albicans*
8	6	40	37.2	37.9	--	--	Yes	--	--	--
9	6	40	37.5	37.9	9.7	11.7	Yes	--	--	--
10	8	40	37.4	37.1	9.6	10.9	Yes	--	--	--
11	8	40	37.2	37.9	9.4	9.4	Yes	--	--	--
12	6	30	37.3	37.5	9.5	9.5	Yes	--	--	--
13	6	30	37.2	37.8	8.2	8.2	None	--	--	--
14	6	30	37.0	37.7	8.6	8.6	None	--	--	--
15	6	60	37.2	37.9	9.4	12.1	Yes	--	--	--
16	7	60	37.3	37.5	13.0	13..5	Yes	--	--	--
17	7	85	37.2	37.8	--	---	Yes	--	--	--
18	PATIENT EXPIRES			-----	-----	-----	-----	--	--	--

Identify the event(s) and MV day

1. MV Day 6 - PVAP and
   MV Day 15 - VAC
2. MV Day 6 - IVAC
3. MV Day 15 - VAC
4. MV Day 6 - PVAP

Case Study 3

VAC MV Day 15

MV Day	PEEP min	FiO_{2min}	Temp min	Temp max	WBC min	WBC max	Abx	Specimen	Polys / Epis	Organism
1	6	30	37.1	37.6	4.3	4.3	None	--	--	--
2	6	30	36.8	37.2	4.6	4.6	None	--	--	--
3	6	**30**	37.0	37.9	5.4	5.4	None	--	--	--
4	8	**30**	36.5	37.3	7.2	9.2	None	--	--	--
5	8	**35**	36.3	37.2	7.4	12.5	None	BAL	≥ 25 / ≤ 10	10^4 *C. albicans*
6	8	**50**	37.2	37.9	8.5	13.0	Yes	--	--	--
7	6	**50**	37.8	37.3	--	--	Yes	BC x2	--	*C. albicans*
8	6	40	37.2	37.9	--	--	Yes	--	--	--
9	6	40	37.5	37.9	9.7	11.7	Yes	--	--	--
10	8	40	37.4	37.1	9.6	10.9	Yes	--	--	--
11	8	40	37.2	37.9	9.4	9.4	Yes	--	--	--
12	6	30	37.3	37.5	9.5	9.5	Yes	--	--	--
13	6	**30**	37.2	37.8	8.2	8.2	None	--	--	--
14	6	**30**	37.0	37.7	8.6	8.6	None	--	--	--
15	6	**60**	37.2	37.9	9.4	**12.1**	Yes	--	--	--
16	7	**60**	37.3	37.5	**13.0**	**13.5**	Yes	--	--	--
17	7	85	37.2	37.8	--	---	Yes	--	--	--
18	PATIENT EXPIRES		-----	-----	-----	-----	-----	--	--	--

≥ 4 QAD requirement not met

Case Study 3 Recap

- Event Day 15 (first day of onset of worsening oxygenation)
- VAE Window Period is Day 13, 14 (two days before), Day 15 (event day), Day 16,17 (two days after)
- Abnormal WBC documented during VAE Window Period but only 3 QADs are observed prior to the patient expiring
- Baseline period of stability is not established early in mechanical ventilation episode
  - No VAC, No IVAC, No PVAP

Case Study 3

- Focus on identifying VAC
- No need to collect other parameters in advance
- Culture driven surveillance approach is not useful for VAE

MV Day	PEEP min	FiO_2 min
1	6	30
2	6	30
3	6	30
4	8	30
5	8	35
6	8	50
7	6	50
8	6	40
9	6	40
10	8	40
11	8	40
12	6	30
13	6	30
14	6	30
15	6	60
16	7	60
17	7	85
18	PATIENT	EXPIRES

Case Study 3

MV Day	PEEP min	FiO_{2min}	Temp min	Temp max	WBC min	WBC max	Abx	Specimen	Polys / Epis	Organism
1	6	30	37.1	37.6	4.3	4.3	None	--	--	--
2	6	30	36.8	37.2	4.6	4.6	None	--	--	--
3	6	30	37.0	37.9	5.4	5.4	None	--	--	--
4	8	30	36.5	37.3	7.2	9.2	None	--	--	--
5	8	30	36.3	37.2	7.4	12.5	N	BAL	≥ 25 / ≤ 10	10^4 *C. albi*
6	8	50	37.2	37.9	8.5	13	es	--	--	--
7	6	50	37.8	37.3	--		Yes	BC x2	--	*C. albicans*
8	6	40	37.2	37.9		--	Yes	--	--	--
9	6	40	37.5	37.9		11.7	Yes	--	--	--
10	8	40	37.4		9.6	10.9	Yes	--	--	--
11	8	40	37.2		9.4	9.4	Yes	--	--	--
12	6	30	37.3	37.5	9.5	9.5	Yes	--	--	--
13	6	30	37.2	37.8	8.2	8.2	None	--	--	--
14	6	30	37.0	37.7	8.6	8.6	None	--	--	--
15	6	30	37.2	37.9	9.4	12.1	Yes	--	--	--
16	7	60	37.3	37.5	13.0	13.5	Yes	--	--	--
17	7	85	37.2	37.8	--	---	Yes	--	--	--
18	PATIENT EXPIRES		-----	-----	-----	-----	-----	--	--	--

IVAC MV Day 6

Key Points to Remember

- Patient must be ventilated more than 2 calendar days to be eligible for VAE surveillance.
- Patient must have ≥2 calendar days of stability or improvement of oxygenation immediately followed by ≥2 calendar days of worsening oxygenation.
- VAE is a progressive algorithm. Must meet VAC to proceed to IVAC must meet IVAC to proceed to PVAP
- Pathogens can only be reported for PVAP and BSI can only be secondary if PVAP is met

Key Points to Remember

- **For most patients—only need to determine and record daily minimum PEEP and FiO_2 while on ventilator. Nothing else!**
  - Assess temperature and white blood cell count information only for patients who meet the VAC definition
    - Limited to values during the VAE Window Period (3-5 days)
  - Determine antimicrobial administrations for patients with VAC ***AND*** abnormal temp or white count
  - Assess microbiology/pathology data only for patients who meet the IVAC definition
    - Specimen collection dates during the VAE Window Period (3-5 days)

NHSN@cdc.gov

QUESTIONS?

Questions: email user support
nhsn@cdc.gov

NHSN Website:
http://www.cdc.gov/nhsn/

ADDITIONAL SLIDES

Episode of Mechanical Ventilation

- Make counts one day in arrears
- On the second day of the month count all patients that were mechanically ventilated the previous calendar day (day 1 EMV)
- For each subsequent day of the month count any new mechanically ventilated patients and any new episodes of mechanical ventilation in a patient previously counted (subsequent day EMV)
- Total all counts (Day 1 EMV + All Subsequent Day EMV)

Prevention of VAEs: What do we know?

- **Most important knowledge gap**
- **Patients who have VAC and IVAC do worse than patients who do not meet these definitions[1,3]**
  - Need to know more about PVAP
- **VAC definition detects important clinical conditions[1,2]**
  - More work to be done for IVAC, PVAP
- **Emerging evidence that VAC rates may be responsive to evidence-based interventions in mechanically-ventilated patients[3]**
  - More evidence needed

[1]Klompas M et al. PLoS ONE 2011;6: e18062; [2]Hayashi et al. Clin Infect Dis 2013;56:471-477
[3]Muscedere J, Sinuff T, et al. Chest 2013 Sept. 12.

VAE Window Period

- Admission Date 8/1
- MV Initiation Date 8/1
- Date of Event 8/3

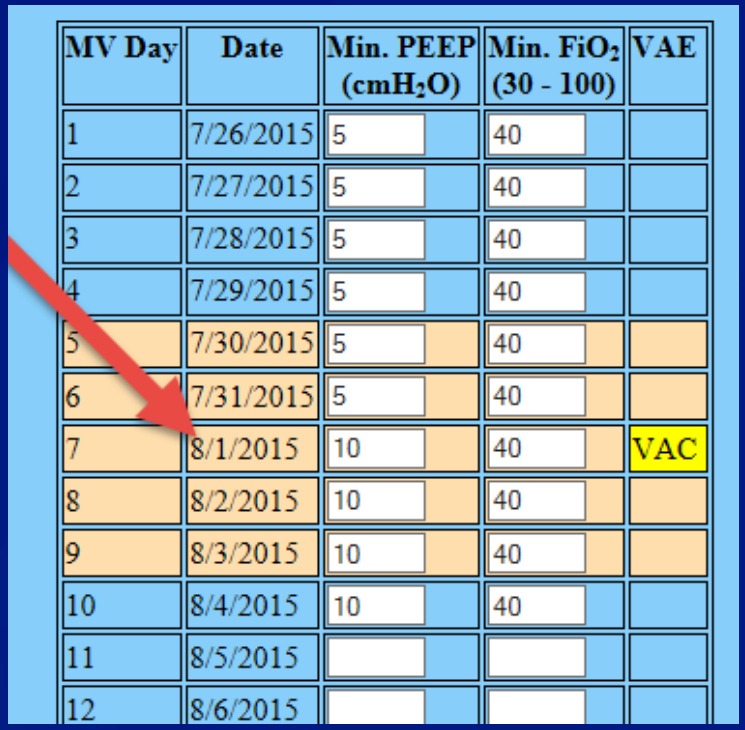
MV Day	Date	Min. PEEP (cmH_2O)	Min. FiO_2 (30 - 100)	VAE
1	8/1/2015	5	40	
2	8/2/2015	5	40	
3	8/3/2015	10	40	VAC
4	8/4/2015	10	40	
5	8/5/2015			
6	8/6/2015			
7	8/7/2015			

- Admission Date 8/1
- MV Initiation Date 7/26
- Date of Event 8/3

MV Day	Date	Min. PEEP (cmH_2O)	Min. FiO_2 (30 - 100)	VAE
1	7/26/2015			
2	7/27/2015			
3	7/28/2015			
4	7/29/2015			
5	7/30/2015			
6	7/31/2015			
7	8/1/2015	5	40	
8	8/2/2015	5	40	
9	8/3/2015	10	40	VAC
10	8/4/2015	10	40	
11	8/5/2015			

HAI Attribution

- Admission Date 8/1
- MV Initiation Date 7/26
- Date of Event 8/1
- Per the transfer rule this would be attributed to the transferring location as the date of event is the day of transfer



MV Day	Date	Min. PEEP (cmH_2O)	Min. FiO_2 (30 - 100)	VAE
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3	7/28/2015	5	40	
4	7/29/2015	5	40	
5	7/30/2015	5	40	
6	7/31/2015	5	40	
7	8/1/2015	10	40	VAC
8	8/2/2015	10	40	
9	8/3/2015	10	40	
10	8/4/2015	10	40	
11	8/5/2015			
12	8/6/2015			

Transfer Rule: If a VAE develops 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 (where the day of transfer is day 1), the event is attributed to the transferring location.