



# NHSN Ventilator- Associated Event VAE is not VAP so what is VAE?

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**Guidance provided in this presentation is reflective of the  
NHSN 2018 Ventilator-Associated Event (VAE) protocol**

# Ventilated Patients and Surveillance Efforts



- Estimate: 157,000 healthcare-associated pneumonias occur in acute care hospitals in U.S. with 39% being ventilator-associated\*
- Ventilator-associated pneumonia (VAP) is an important complication of mechanical ventilation but other adverse events also happen to ventilated patients
- NHSN surveillance for VAP (PNEU-VAP) challenge
  - Includes subjective elements – Imaging and Signs/Symptoms
  - Neither sensitive nor specific for VAP
  - Not ideal in an era of public reporting of healthcare-associated infection (HAI) rates, inter-facility comparisons and pay-for-reporting and pay-for-performance programs

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

# Adult VAE Surveillance

- VAE Surveillance Working Group convened in 2011
- As of January 2013 Ventilator-Associated Event (VAE) is the only respiratory event available for in-plan surveillance in adult locations
  - Focus on objectivity, reliability and ability to automate
  - Identifies a broad range of conditions and complications occurring in mechanically ventilated patients **not just VAP to include ARDS, atelectasis, pulmonary edema**
  - All of which may be preventable—ALL HARMS PREVENTION
  - Enhance ability to use surveillance data to drive improvements in patient care and safety



# 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
  - NOTE: Non-acute care locations in acute care facilities are not eligible to participate in VAE surveillance.

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

# Who is NOT eligible for VAE surveillance?

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

- INCLUDE patients who are receiving a conventional mode of mechanical ventilation and:
  - Prone positioning
  - Nitric oxide therapy
  - Helium-oxygen mixture
  - Epoprostenol therapy
- INCLUDE patients on Airway Pressure Release Ventilation (APRV) or related modes. VAC determinations made using  $\text{FiO}_2$

# APRV and VAC Determinations

- Evaluation for VAC will be limited to the  $\text{FiO}_2$  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

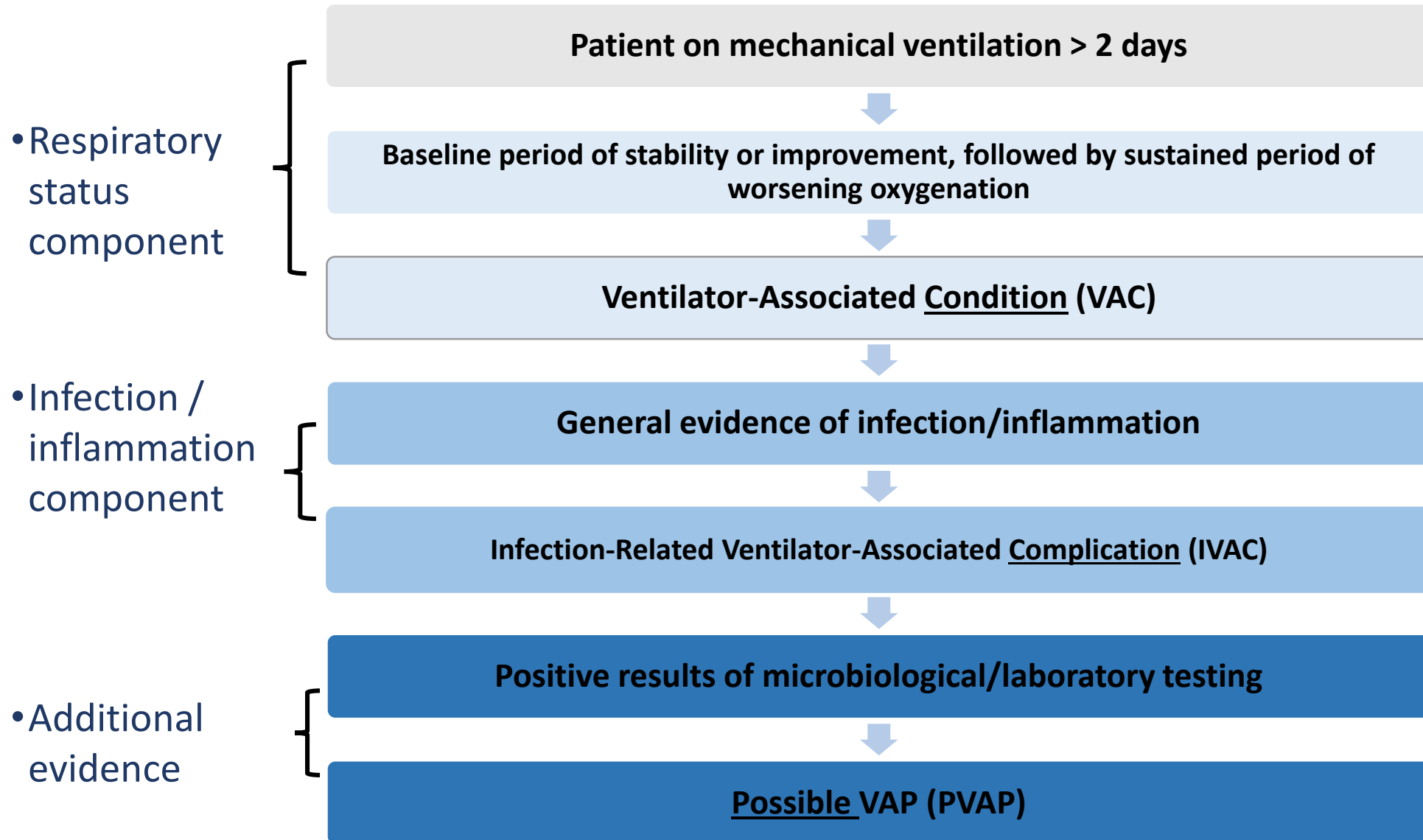


# VAE Algorithm Overview

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



# VAE Definition Algorithm



# VAE Algorithm

- Algorithm is progressive in terms of criteria to be met
  - VAC → IVAC → PVAP
  - Each subsequent tier is not more significant than the one before
  - All events start with VAC
    - IVAC is not necessarily “worse” than having VAC
    - PVAP is not necessarily “worse” than having IVAC
- The fundamental definition within the algorithm is the VAC defined on the basis of respiratory deterioration
  - IVAC - additional evidence that the event may be infectious vs. non-infectious
  - PVAP – additional evidence the infection may be respiratory related
- Detection of VAC is just as significant as detection of an IVAC or PVAP

# VAE $\neq$ VAP(PNEU) & PVAP $\neq$ VAP(PNEU)

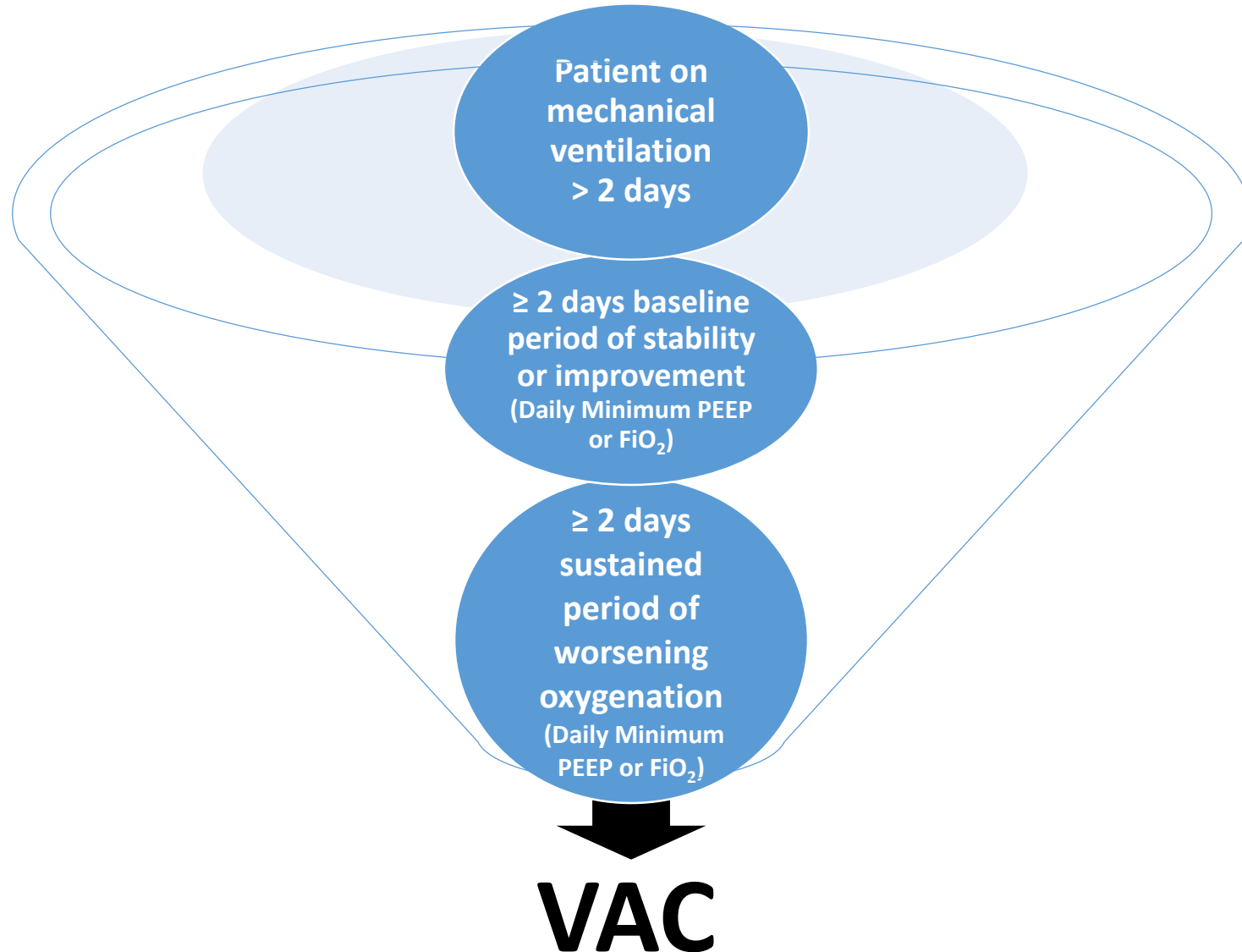
- VAE and PNEU protocols detect two separate and different events
  - It is possible to meet VAE and PNEU
  - It is possible to meet VAE and not PNEU
  - It is possible to meet PNEU and not VAE
  - May not meet either
- Educate your clinicians dispel the myth!
- VAE is designed to detect more than VAP

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

# VAE - Ventilator “Associated” Event

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

# VAC – Ventilator-Associated Condition



# Tier 1: VAC

Patient has a baseline period of stability or improvement on the ventilator, defined by  $\geq 2$  calendar days of stable or decreasing daily minimum\*  $\text{FiO}_2$  or PEEP values. The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or  $\text{FiO}_2$ .

\*Daily minimum defined by lowest value of  $\text{FiO}_2$  or PEEP during a calendar day that is maintained for  $> 1$  hour.

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

- 1) Increase in daily minimum\*  $\text{FiO}_2$  of  $\geq 0.20$  (20 points) over the daily minimum  $\text{FiO}_2$  of the first day in the baseline period, sustained for  $\geq 2$  calendar days.
- 2) Increase in daily minimum\* PEEP values of  $\geq 3$   $\text{cmH}_2\text{O}$  over the daily minimum PEEP of the first day in the baseline period<sup>†</sup>, sustained for  $\geq 2$  calendar days.

\*Daily minimum defined by lowest value of  $\text{FiO}_2$  or PEEP during a calendar day that is maintained for  $> 1$  hour.

<sup>†</sup>Daily minimum PEEP values of 0-5  $\text{cmH}_2\text{O}$  are considered equivalent for the purposes of VAE surveillance.

**Ventilator-Associated Condition (VAC)**

# What are Daily Minimum FiO<sub>2</sub> and PEEP

- FiO<sub>2</sub> and PEEP ventilator settings documented across the calendar day are used to identify the daily minimum FiO<sub>2</sub> and PEEP values
- FiO<sub>2</sub> and PEEP settings are typically recorded in the paper or electronic medical record, on respiratory therapy and/or nursing flow sheets, in the section of the flow sheet that pertains to respiratory status/mechanical ventilation
- Use a calendar day not some other “capture period” or other designated 24 hour time period





# Daily Minimum FiO<sub>2</sub> and PEEP

- When choosing the daily minimum PEEP and FiO<sub>2</sub>, use all eligible settings that are recorded throughout the calendar day during times when the patient is receiving support from an eligible mode of mechanical ventilation and the patient is eligible for VAE surveillance
  - Include settings collected during weaning/mechanical ventilation liberation trials as long as the patient is receiving ventilator support during those trials
  - Use all conventional mechanical ventilation settings
    - Include conventional MV settings during times when a patient is intermittently on an excluded mode of ventilation throughout a calendar day
    - Include recorded PEEP settings during times when a patient is not on APRV or a similar mode of ventilation

# Daily Minimum FiO<sub>2</sub> and PEEP

- Settings not eligible for use
  - 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<sub>2</sub> data (not PEEP).

# Daily Minimum FiO<sub>2</sub> and PEEP

- Choose the lowest FiO<sub>2</sub> and PEEP setting during the calendar day that was maintained for > 1 hour
- If there is no value that has been maintained for >1 hour then select the lowest value available regardless of the period of time in which the setting was maintained
  - Ventilation initiated late in the calendar day
  - Ventilation discontinued early in the calendar day
  - Ventilator settings very unstable throughout the day

# Define “Baseline”

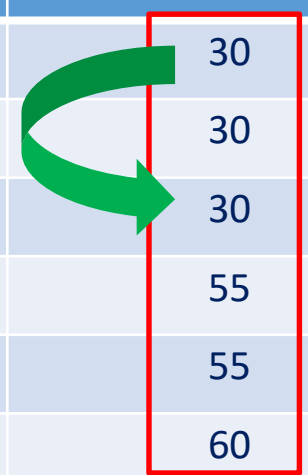
MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
1	10	30
2	10	30
3	8	30
4	8	55
5	8	55
6	8	60

**VAC**

**Baseline period of stability**

# Define “Baseline”

MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
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”

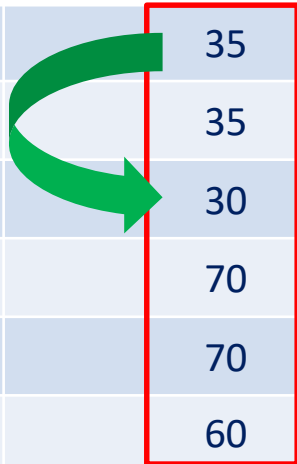
MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
1	10	35
2	10	35
3	8	30
4	8	70
5	8	70
6	8	60

# VAC

Baseline period of improvement

# Define “Baseline”

MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
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 <sub>2</sub>
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**



# Define “Baseline”

MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
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?

- A. VAC
- B. NO VAC

MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
1	10	100
2	7	90
3	5	90
4	8	50
5	8	50
6	8	50

# Meeting VAC Definition

What if the increase over the baseline period meets the requirement relative to one baseline day?

- A. VAC
- ✓ B. NO VAC

**VAC Definition Not Met**

MV D	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
	10	100
2	7	90
3	5	90
4	8	50
5	8	50
6	8	50

# Meeting VAC Definition

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

- A. VAC
- B. NO VAC

MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
1	10	100
2	5	90
3	5	90
4	8	50
5	7	50
6	8	50

# Meeting VAC Definition

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

A. VAC

✓ B. NO VAC

VAC Definition Not Met  
(increase is not sustained)

	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
1	10	100
2	5	90
3	5	90
4	8	50
5	7	50
6	8	50

# Meeting VAC Definition

## VAC or No VAC?

- A. Yes
- B. No

MV Day	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
1	10	100
2	5	90
3	5	90
4	10	50
5	8	50
6	8	50

# Meeting VAC Definition

## VAC or No VAC?

- ✓ A. Yes
- B. No

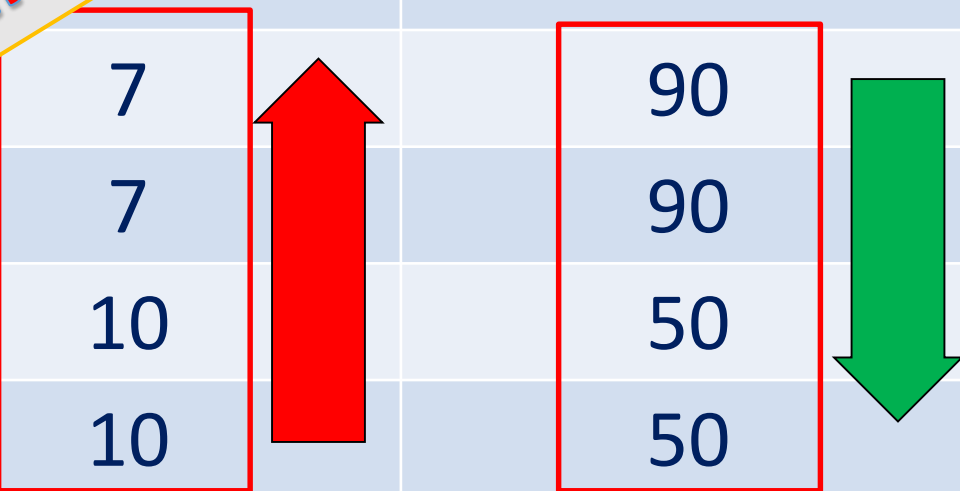
	Daily minimum PEEP	Daily minimum FiO <sub>2</sub>
1	10	100
2	5	90
3	5	90
4	10	50
5	8	50
6	8	50

# Discrepant changes

PEEP goes up but  $\text{FiO}_2$  goes down

MV Day	Daily minimum PEEP	Daily minimum $\text{FiO}_2$
1	8	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 minimum PEEP	Daily minimum FiO <sub>2</sub>
1		30
2	7	40
3	7	50
4	7	80
5	8	80
6	8	90

VAC Definition is NOT Met

## Date of Event / Event Date

- The date of onset of worsening oxygenation (day 1 of the required  $\geq 2$  day period of worsening oxygenation)
  - It is not the date of the first day of the baseline period
  - It is not the date on which all VAE criteria are met
- Earliest date of event for VAE is mechanical ventilation day 3 (first day of worsening oxygenation)
- First possible day that VAC criteria can be fulfilled is mechanical ventilation day 4

# Why is the Event Date important?

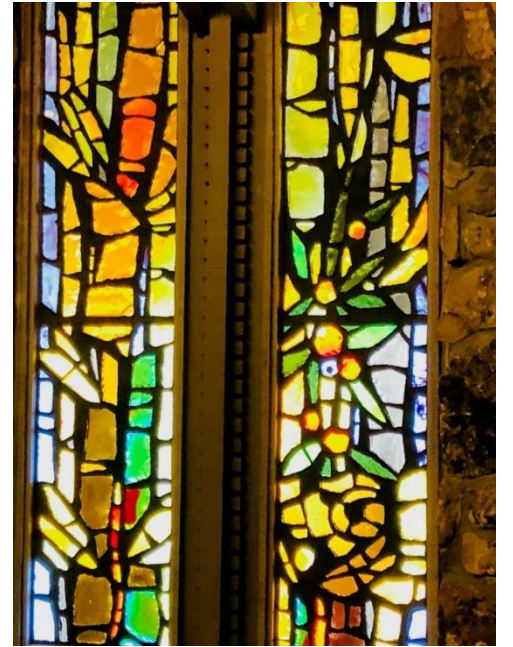
## Defines the VAE Window Period

Period during which criteria for other events—IVAC, PVAP—must be met

The period of days around the event date within which all other VAE criteria must be met. It is usually a 5-day period and includes the 2 days before, the day of, and the 2 days after the VAE event date

There is an exception, however, when 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 3<sup>rd</sup> 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 3<sup>rd</sup> day of MV)



# Exception: VAE Window Period

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

Patient is not eligible for VAE surveillance

**Event Date**

2 days after Event Date

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

# VAE Window Period

		2 days before Event Date		Event Date	2 days after Event Date		
<b>MV Day</b>	10	11	12	13	14	15	16
<b>VAE Day</b>	-3	-2	-1	1	2	3	4
<b>Worsening oxygenation</b>	--	Day 1 of Stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
<b>Temperature or WBC abnormality</b>		← Documented within this shaded period →					
<b>Antimicrobial agent</b>		← Started on within this shaded period, and then continued for at least 4 days →					
<b>Purulent respiratory secretions, positive culture, positive histopathology</b>		← Collected within this shaded period →					

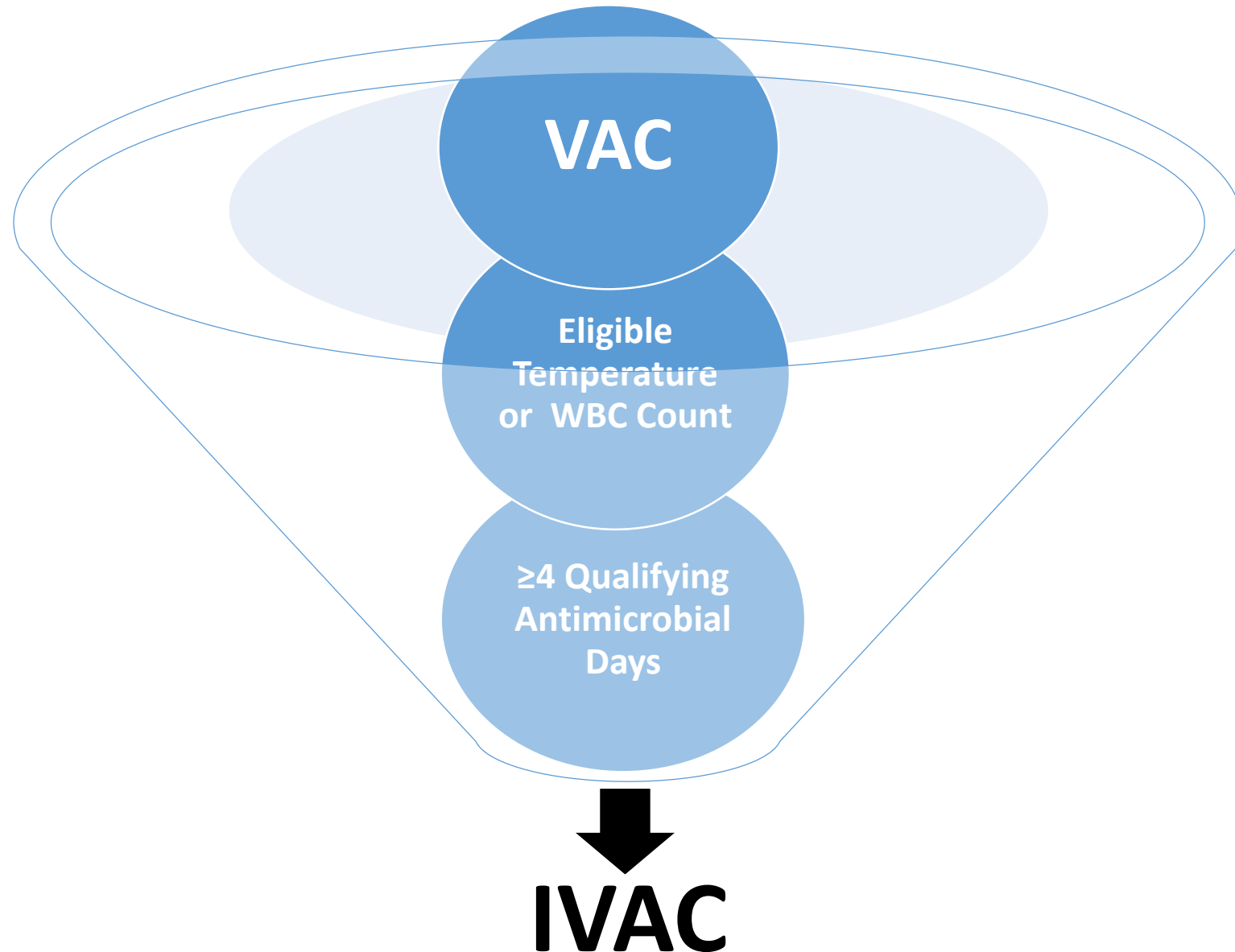
# 14 Day Event Period

- Each VAE is 14 days in duration
- Date of Event is Day 1 or the Event Period—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
- **No new VAEs are to be reported until that 14 day period has elapsed**
- **During the Event Period do not “upgrade” a VAE based on data collected outside the VAE Window Period but within the 14-day event period**
- **NHSN Application limits reporting**
- Blood cultures must be collected within the 14 day event period for a BSI to be secondary to VAE

# 14 Day Event Period

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

# IVAC – Infection-related Ventilator-Associated Complication





# Tier 2: IVAC

## Ventilator-Associated Condition (VAC)

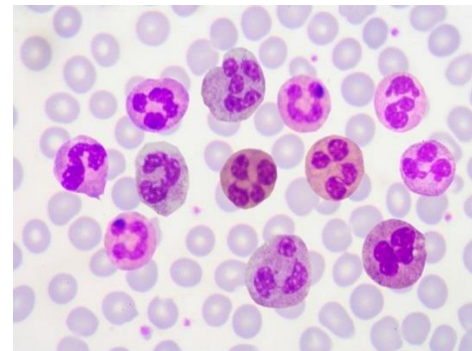
On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:

- 1) Temperature  $> 38^{\circ}\text{C}$  or  $< 36^{\circ}\text{C}$ , **OR** white blood cell count  $\geq 12,000$  cells/mm<sup>3</sup> or  $\leq 4,000$  cells/mm<sup>3</sup>.
- 2) A new antimicrobial agent(s) (see Appendix for eligible antimicrobial agents) is started, and is continued for  $\geq 4$  calendar days.

## Infection-related Ventilator-Associated Complication (IVAC)

# Temperature & WBC Count

- As long as there is an abnormal temperature ( $> 38^{\circ}\text{C}$  or  $< 36^{\circ}\text{C}$ ) OR WBC count ( $\geq 12,000$  or  $\leq 4,000$  cells/mm<sup>3</sup>) documented during the VAE Window Period, it is eligible for use in determining whether the patient meets the IVAC
  - Regardless of whether an abnormal temperature or WBC count was also present on admission or outside the VAE Window Period.
  - Regardless of whether it is thought the temperature or WBC count is caused by something unrelated to the respiratory tract.



# Tier 2: IVAC

## Ventilator-Associated Condition (VAC)

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

1) Temperature  $> 38^{\circ}\text{C}$  or  $< 36^{\circ}\text{C}$ , **OR** white blood cell count  $\geq 12,000$  cells/mm<sup>3</sup> or  $\leq 4,000$  cells/mm<sup>3</sup>.

2) A new antimicrobial agent(s) (see Appendix for eligible antimicrobial agents) is started, and is continued for  $\geq 4$  calendar days.

## Infection-related Ventilator-Associated Complication (IVAC)

# IVAC Antimicrobial Criterion

- Probably the most complicated portion of the VAE surveillance definition algorithm
- Rules for meeting this criterion are not perfect—but provides a standardized method for assessment of antimicrobial therapy, without needing knowledge of dosing, renal function, indication for therapy, etc.
- Includes a broad range of agents that could be used to treat healthcare-associated infections—not just respiratory related infections

# “New” Antimicrobial Agent

## No QADs – VAC Determination

MV Day	Date	Hide... Min. PEEP (cmH <sub>2</sub> O)	Hide... Min. FiO <sub>2</sub> (20 - 100)	VAE	T<36° or T>38°	WBC ≤ 4,000 or WBC ≥ 12,000 cells/mm <sup>3</sup>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Add... Remove... Choose a Drug: CEFTAZIDIME	QAD
1	1/30/2018	5 (2)*					<input type="checkbox"/>		
2	1/31/2018	5 (2)*					<input checked="" type="checkbox"/>		
† 3	2/1/2018	5 (4)*			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
† 4	2/2/2018	5 (4)*			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
† 5	2/3/2018	10		± VAC	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
† 6	2/4/2018	10			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
† 7	2/5/2018				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
8	2/6/2018						<input type="checkbox"/>		

← Ceftazidime is not new

**NEW** - initiated on or after the third calendar day of mechanical ventilation AND in the VAE Window Period

# QADs: Same Agent

- Days between administrations of the SAME new antimicrobial agent count as QADs as long as there is a gap of no more than 1 calendar day between administrations of the same drug
- Ceftazidime is administered on MV days 5,7,9 but not MV days 6 & 8. This represents 5 consecutive QADs

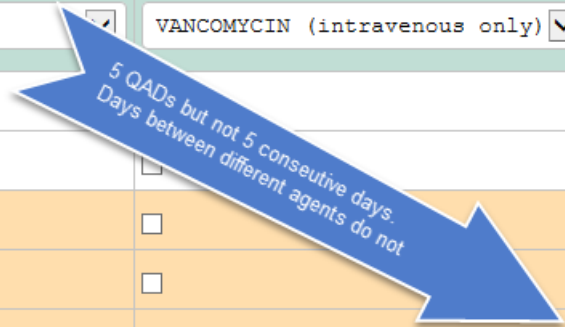
MV Day	Date	Hide... Min. PEEP (cmH <sub>2</sub> O)	Hide... Min. FiO <sub>2</sub> (20 - 100)	VAE	T<36° or T>38°	WBC ≤ 4,000 or WBC ≥ 12,000 cells/mm <sup>3</sup>	Add... Remove... Choose a Drug: CEFTAZIDIME	QAD
2	1/30/2018	5 (2)*						
3	1/31/2018	5 (2)*						
† 4	2/1/2018	5 (4)*			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
† 5	2/2/2018	5 (4)*			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
† 6	2/3/2018	10		‡ IVAC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	† yes
† 7	2/4/2018	10			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
† 8	2/5/2018				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	† yes
9	2/6/2018						<input checked="" type="checkbox"/>	† yes



# QADs: Different Agents

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

MV Day	Date	Hide...	Min.	Hide...	Min.	VAE	T<36° or T>38°	WBC ≤ 4,000 or WBC ≥ 12,000 cells/mm <sup>3</sup>	Choose a Drug:		QAD
		PEEP (cmH <sub>2</sub> O)	FiO <sub>2</sub> (20 - 100)	Add... Remove...	Add... Remove...						
2	1/30/2018	5 (2)*							CEFTAZIDIME	VANCOMYCIN (intravenous only)	
3	1/31/2018	5 (2)*									
† 4	2/1/2018	5 (4)*					<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	† yes
† 5	2/2/2018	5 (4)*					<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	† yes
† 6	2/3/2018	10				‡ VAC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
† 7	2/4/2018	10					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
† 8	2/5/2018						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
9	2/6/2018								<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes



# IVAC and Antimicrobial Agents

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



**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?**

# 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
- Difficult to operationalize in a way that is understandable, standardized and implementable by any facility
- De-escalation may result in identifying “new” antimicrobial agent resulting in identification of IVACs and PVAPs which is what is intended to take place
- Whether de-escalation or not the patient met VAC, has an eligible WBC or temperature AND is on an antibiotic

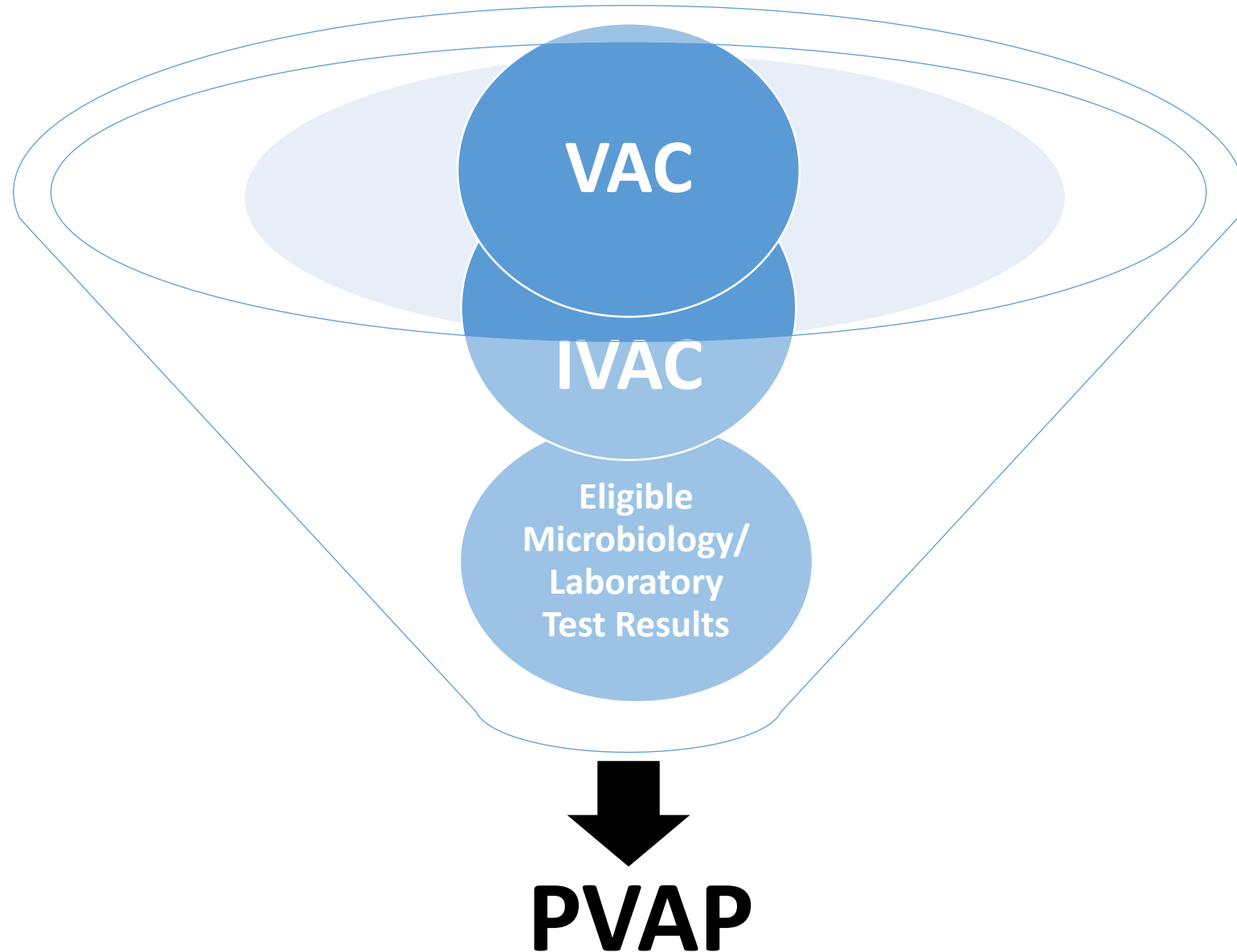
# VAE Analysis

- Overall VAE Rate/SIR (VAC + IVAC + PVAP) is referenced in the protocol as appropriate for use in public reporting, inter-facility comparisons, and pay-for-reporting/pay-for-performance programs. IVAC plus rate/SIR (IVAC + PVAPS) is no longer included in that recommendation
- Rates and SIRs that may be appropriate for internal use within an individual unit or facility
  - “IVAC-plus” rate (where the numerator consists of all events meeting at least the IVAC definition --IVAC + PVAP)
  - Rates of specific event types
    - events meeting only the VAC definition
    - events meeting only the IVAC definition
    - events meeting only the PVAP definition

<https://academic.oup.com/cid/article-abstract/65/7/1248/3862170>

<https://academic.oup.com/cid/article/65/7/1249/3862169>

# PVAP – Possible Ventilator Associated Pneumonia



# Tier 3: PVAP

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met (taking into account organism exclusions specified in the protocol):

- 1) Criterion 1: Positive culture of one of the following specimens, meeting quantitative or semi-quantitative thresholds as outlined in protocol, without requirement for purulent respiratory secretions:
  - Endotracheal aspirate,  $\geq 10^5$  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])<sup>†</sup> **PLUS** organism identified from one of the following specimens (to include qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet criterion #1):
  - Sputum
  - Endotracheal aspirate
  - Bronchoalveolar lavage
  - Lung tissue
  - Protected specimen brush

<sup>†</sup> If the laboratory reports semi-quantitative results, those results must correspond to the above quantitative thresholds. See additional instructions for using the purulent respiratory secretions criterion in the VAE Protocol.
- 3) Criterion 3: One of the following positive tests:
  - Organism identified from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
  - Lung histopathology, defined as: 1) abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli; 2) evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms); 3) evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue
  - Diagnostic test for *Legionella* species
  - Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

January 2018

Possible Ventilator-Associated Pneumonia (PVAP)

# Performing VAE Surveillance

- Get familiar with the protocol & review the FAQs
  - <http://www.cdc.gov/nhsn/acute-care-hospital/vae/index.html>
  - <http://www.cdc.gov/nhsn/inpatient-rehab/vae/index.html>
  - <http://www.cdc.gov/nhsn/ltach/vae/index.html>
- Develop a plan for organizing the data elements needed to identify VAEs
  - PEEP and  $\text{FiO}_2$
  - WBC / Temperature
  - Antimicrobials agents (administration not orders)
  - Laboratory results
- Explore use of tools for data collection
- Experiment with the VAE Calculator Version 5.0
  - <http://www.cdc.gov/nhsn/VAE-calculator/index.html>

## Surveillance for Ventilator-associated Events



VAE surveillance is available in plan for adult inpatient locations only. See [PNEU/VAP](#) for in-plan surveillance for pediatric locations. In-plan surveillance for ventilated associated PNEU is no longer available for neonatal patients.

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

### Resources for NHSN Users Already Enrolled

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



# Surveillance for Ventilator-associated Events



VAE surveillance is available in plan for adult inpatient locations only. See [PNEU/VAP](#) for in-plan surveillance for pediatric locations. In-plan surveillance for ventilated associated PNEU is no longer available for neonatal patients.




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

## Resources for NHSN Users Already Enrolled



### Training







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





> Training

∨ Protocols

- [Ventilator-Associated Event \(VAE\) Protocol, January 2018](#)  [PDF - 1M]
- [NHSN Overview January, 2018](#)  [PDF - 250K]
- [Identifying Healthcare-associated Infections \(HAIs\) in NHSN, January 2018](#)  [PDF - 1M]
- [Patient Safety Monthly Reporting Plan, January 2018](#)  [PDF - 65K]

> **Training**

∨ **Protocols**

∨ **Frequently Asked Questions**

**New! 2018 FAQs:**

- [FAQs: Ventilator-Associated Events \(VAE\)](#)
- [FAQs: Analysis](#)
- [FAQs: Annual Surveys](#)
- [FAQs: Locations](#)
- [FAQs: Miscellaneous](#)
- [FAQs: CDA](#)




> Training

∨ Protocols

∨ Frequently Asked Questions

∨ Data Collection Forms

**All Data Collection Forms are Print-only**

- [57.112 Ventilator-Associated Event \(VAE\) form January 2017](#)  [PDF - 109K]
  - [Customizable form](#)  [DOCX - 44K]
  - [Table of Instructions for VAE form 57.112](#)  [PDF - 144K]

> **Training**

∨ **Protocols**

∨ **Frequently Asked Questions**

∨ **Data Collection Forms**

∨ **Supporting Materials**

- [NHSN Patient Safety Component Alerts](#)  [PDF - 1M]
- [Unusual Susceptibility Profiles Alert January 2015](#)  [PDF - 362K]
- [VAE Surveillance Mechanical Ventilation Table January 2015](#)  [PDF - 154K]
- [CDC Location Labels and Location Descriptions, January 2018](#)  [PDF - 1M]
- [NHSN Key Terms, January 2018](#)  [PDF - 255K]
- [CDC/NHSN Surveillance Definitions for Specific Types of Infections, January 2018](#)  [PDF - 1M]
- [NHSN Organism List \(All Organisms, Common Commensals, MBI Organisms, and UTI Bacteria\) January 2018](#)  [XLSX - 296K]
- [Guidance for Missing Device-associated Denominator Data](#)  [PDF - 145K]
- [Changing a CCN within NHSN \(updated July 2015\)](#)  [PDF - 290K]

> **Training**






∨ **Protocols**

∨ **Frequently Asked Questions**

∨ **Data Collection Forms**

∨ **Supporting Materials**

∨ **Calculator and Worksheets**

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

> **Related Publications and Other Resources**

> **Analysis Resources**

## Ventilator-Associated Event Calculator (Version 5.0)



Welcome to Version 5.0 of the VAE Calculator. Version 5.0 operates based upon the currently posted VAE protocol. The Calculator is a web-based tool that is designed to help you learn how the VAE surveillance definition algorithm works and assist you in making VAE determinations. Please note that the VAE Calculator will not ask you to enter any patient identifiers (other than dates of mechanical ventilation, which you can change as you see fit). The VAE Calculator does not store any patient data that you enter, and it will not report any data that you enter or any VAE determinations to the NHSN. You will not be able to export data entered into the Calculator. If you have questions or suggestions about the Calculator, please feel free to send them to the NHSN mailbox, [nhsn@cdc.gov](mailto:nhsn@cdc.gov).

[Ventilator-Associated Event \(VAE\) Calculator v5.0](#) (must have javascript enabled)

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## National Healthcare Safety Network (NHSN)

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Welcome to the Ventilator-Associated Event Calculator. Version 5.0 operates based upon the currently posted VAE protocol. It is strongly encouraged that you read and study the [VAE protocol](#).

- The calculator recognizes PEEP values  $\leq 5$  and corrects entries according to the VAE protocol prior to making a VAC determination.
- For periods of time where a patient is on APRV or a related type of mechanical ventilation for a full calendar day, a daily minimum PEEP value should not be entered into the calculator (i.e., do not enter zero)
- The calculator finds multiple VAEs per patient as long as they conform to the 14 day rule.

To get started, enter a date below that corresponds to the first day the patient was placed on mechanical ventilation during the mechanical ventilation episode of interest. You may type in a date or use the popup calendar when it appears. You may only enter dates within the past year. If the patient has been on mechanical ventilation for more than one year during the current mechanical ventilation episode, choose a start date that is more recent but is at least 7 days before the period of interest. [t. more...](#)

Mechanical Ventilation Start Date:   (mm/dd/yyyy)

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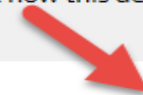
a date

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### NHSN Ventilator-Associated Event (VAE) Calculator Ver. 5.0

A Ventilator-Associated Condition (VAC) based on PEEP values occurred on 6/5/2018

Click on the Go To IVAC button to move to the next part of the protocol or click on the "Explain" button to see how this determination was made.



Calculate VAC   Start Over   Go to IVAC   Explain...

MV Day	Date	Min. PEEP (cmH <sub>2</sub> O)	Min. FiO <sub>2</sub> (20 - 100)	VAE
1	6/1/2018	<input type="text" value="5"/>	<input type="text" value="40"/>	
2	6/2/2018	<input type="text" value="5"/>	<input type="text" value="40"/>	
3	6/3/2018	<input type="text" value="5"/>	<input type="text" value="40"/>	
4	6/4/2018	<input type="text" value="5"/>	<input type="text" value="50"/>	
5	6/5/2018	<input type="text" value="8"/>	<input type="text" value="40"/>	± VAC
6	6/6/2018	<input type="text" value="8"/>	<input type="text" value="40"/>	
7	6/7/2018	<input type="text" value="8"/>	<input type="text" value="40"/>	



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## NHSN Ventilator-Associated Event (VAE) Calculator Ver. 5.0

### NHSN Ventilator-Associated Event (VAE) Calculator Ver. 5.0

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**Click**

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<sup>3</sup> or ≤ 4,000 cells/mm<sup>3</sup> within the VAE Window Period. Choose a drug from the drop down list and **check all the corresponding days shown on the screen** that the agent was administered. If more than one drug was given over the course of treatment, click on the "Add..." button in the drug column header and do the same. Once all data have been entered, **click the "Calculate IVAC" button.**

Start Over

Calculate IVAC

Explain...

MV Day	Date	Hide... Min. PEEP (cmH <sub>2</sub> O)	Hide... Min. FiO <sub>2</sub> (20 - 100)	VAE	T<36° or T>38°	WBC ≤ 4,000 or WBC ≥ 12,000 cells/mm <sup>3</sup>	Choose a Drug: Choose a Drug	QAD
1	6/1/2018	5	40				<input type="checkbox"/>	
2	6/2/2018	5	40				<input type="checkbox"/>	
† 3	6/3/2018	5	40		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
† 4	6/4/2018	5	50		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
† 5	6/5/2018	8	40	‡ VAC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
† 6	6/6/2018	8	40		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
† 7	6/7/2018	8	40		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Required to make "new" determination

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## NHSN Ventilator-Associated Event (VAE) Calculator Ver. 5.0

### NHSN Ventilator-Associated Event (VAE) Calculator Ver. 5.0

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**Click**

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<sup>3</sup> or ≤ 4,000 cells/mm<sup>3</sup> within the VAE Window Period. Choose a drug from the drop down list and **check all the corresponding days shown on the screen** that the agent was administered. If more than one drug was given over the course of treatment, click on the "Add..." button in the drug column header and do the same. Once all data have been entered, **click the "Calculate IVAC" button.**

Start Over Calculate IVAC Explain... Go to PVAP

MV Day	Date	Hide... (cmH <sub>2</sub> O)	Min. PEEP	Hide... (20 - 100)	Min. FiO <sub>2</sub>	VAE	T<36° or T>38°	WBC ≤ 4,000 or WBC ≥ 12,000 cells/mm <sup>3</sup>	Choose a Drug: CEFEPIME	QAD
1	6/1/2018	5		40						
2	6/2/2018	5		40						
† 3	6/3/2018	5		40			<input type="checkbox"/>	<input checked="" type="checkbox"/>		
† 4	6/4/2018	5		50			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
† 5	6/5/2018	8		40		‡ IVAC	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
† 6	6/6/2018	8		40			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
† 7	6/7/2018	8		40			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	† yes
8	6/8/2018								<input type="checkbox"/>	
9	6/9/2018								<input type="checkbox"/>	
10	6/10/2018								<input type="checkbox"/>	
11	6/11/2018								<input type="checkbox"/>	

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



# Multidisciplinary Approach

- Establish relationships with **Respiratory Therapy and/or Critical Care colleagues:**
  - Share the protocol and FAQs
  - Discuss options for collection of minimum daily PEEP and  $\text{FiO}_2$  for each MV day (IP, RT, electronically generated)
  - Inquire about the frequency of use of excluded therapies (HFV, ECLS) and APRV



# Multidisciplinary Approach

- Determine your **laboratory's** approach to Gram stain and culture result reporting
  - Share the protocol and FAQs
  - How does your hospital laboratory report Gram stain results?
  - Does your hospital laboratory report culture results quantitatively?
  - What quantitative ranges correspond to the semi-quantitative reports?
  - Where will you find histopathology/cytology reports?

# VAE Reporting

- NHSN requirement to report VAE is determined by selection of this event in your monthly reporting plan
  - VAE is included in CMS Hospital Inpatient Quality Reporting program for LTACH facilities (wards and ICUs)
  - VAE is not included in CMS Hospital Inpatient Quality Reporting program for acute care or inpatient rehabilitation facilities
- You may have other entities that require you to report

# VAE Reporting

- When conducting in – plan reporting (selected in your monthly reporting plan) you must report all events detected and at the highest level of the algorithm that is met
- Assess patients for ALL events:
  - VAC
  - IVAC
  - PVAP
- Hierarchy of definitions:
  - If a patient meets VAC only, report as VAC
  - If a patient meets criteria for VAC and IVAC, report as IVAC only
  - If a patient meets criteria for VAC, IVAC and PVAP, report PVAP only
- Remember they are all VAEs!

# VAE Analysis

- Overall VAE Rate/SIR (VAC + IVAC + PVAP) is referenced in the protocol as appropriate for use in public reporting, inter-facility comparisons, and pay-for-reporting/pay-for-performance programs. IVAC plus rate/SIR (IVAC + PVAPS) is no longer included in that recommendation
- Rates and SIRs that may be appropriate for internal use within an individual unit or facility
  - “IVAC-plus” rate (where the numerator consists of all events meeting at least the IVAC definition --IVAC + PVAP)
  - rates of specific event types
    - events meeting only the VAC definition
    - events meeting only the IVAC definition
    - events meeting only the PVAP definition



# Incidence and Characteristics of Ventilator-Associated Events Reported to the National Healthcare Safety Network in 2014\*

Shelley S. Magill, MD, PhD; Qunna Li, MSPH, MMs, MB; Cindy Gross, MT, SM (ASCP), CIC;  
Margaret Dudeck, MPH, CPH; Katherine Allen-Bridson, RN, BSN, MScPH, CIC;  
Jonathan R. Edwards, MStat

**Objective:** Ventilator-associated event surveillance was introduced in the National Healthcare Safety Network in 2013, replacing surveillance for ventilator-associated pneumonia in adult inpatient locations. We determined incidence rates and characteristics of ventilator-associated events reported to the National Healthcare

**Measurements and Main Results:** A total of 1,824 healthcare facilities reported 32,772 location months of ventilator-associated event surveillance data to the National Healthcare Safety Network in 2014. Critical care unit pooled mean ventilator-associated event incidence rates ranged from 2.00 to 11.79 per 1,000 ven-

17) Koulapas M, Magill S, Roubicek A, et al. Objective surveillance definitions for ventilator-associated pneumonia. Crit Care Med;2012:3154-61.

18) Magill SS, Li Q, Gross C, et al. Incidence and characteristics of ventilator-associated events reported to the National Healthcare Safety Network in 2014. Crit Care Med 2016; online ahead of print, available at: <http://journals.lww.com/ccmjournal/pages/articleviewer.aspx?year=9000&issue=00000&article=96814&type=abstract>

19) Stedman's medical dictionary. (28<sup>th</sup> ed). (2005). Philadelphia: Lippincott, Williams, & Wilkins.

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

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5113232/>

# Healthcare-associated Infections

## Healthcare-associated Infections (HAI)

Data and Statistics -

HAI Data Reports -

Data Summary: Assessing Progress 2006-2016

**2015 HAI Data Report**

2015 SIRs Using Historical Baselines

2014 HAI Progress Report

FAQs: 2014 HAI Progress Report

Previous HAI Progress Reports

[CDC](#) > [Healthcare-associated Infections \(HAI\)](#) > [Data and Statistics](#) > [HAI Data Reports](#)

## The 2015 National and State Healthcare-associated Infection Data Report



### Executive Summary

The Centers for Disease Control and Prevention (CDC) is committed to helping all Americans receive the best and safest care. Preventing healthcare-associated infections (HAIs) is a top priority for CDC and its partners in public health and healthcare. The following 2015 *National and State Healthcare-Associated Infections Data Report (2015 HAI Data Report)* uses the [updated national baseline](#) to provide a summary of select HAIs across four healthcare settings; acute care hospitals (ACHs), inpatient rehabilitation facilities (IRFs), long-term acute care hospitals (LTACHs) and critical access hospitals (CAHs). IRFs include hospitals, or part of a hospital, that provide intensive rehabilitation services using an interdisciplinary team approach. LTACHs provide treatment for patients who are generally very sick and stay, on average, more than 25 days. The designation of CAH is assigned by the Centers for Medicare and Medicaid Services (CMS) to hospitals which have

### Table Of Contents

- [Executive Summary](#)
- [2015 HAI Data Report](#)
- [Data Tables](#)
- [Technical Appendix](#)
- [References](#)
- [Glossary](#)

<https://www.cdc.gov/hai/surveillance/data-reports/2015-HAI-data-report.html>

# Thank you



[NHSN@cdc.gov](mailto:NHSN@cdc.gov)