



NHSN Annual Training

Ventilator-Associated Event (VAE): Case Studies

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Case Example

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

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

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

Case Summary:

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

Answer: In the OR

A. In the ED

B. In the OR

C. In the SICU

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

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

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

Patient Ventilator Settings Example 1

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

Is a VAE identified for this patient?

- A. Yes, in the PEEP parameter
- B. Yes, in the FiO2 parameter
- C. No VAE identified

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

Answer: Is a VAE identified for this patient?

A. Yes, in the PEEP parameter

B. Yes, in the FiO2 parameter

C. No VAE identified

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

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

Patient Ventilator Settings Example 2


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

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

Is the VAC reported to NHSN?

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

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

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

Answer: Is the VAC reported to NHSN?

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

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



B. No.

Brain Death/Injury

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

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

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

Brain injury/ brain death in ventilated patients

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

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

Patient Ventilator Settings Example 3

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

Is a VAE identified for this patient?

- A. Yes, in the PEEP parameter
- B. Yes, in the FiO2 parameter
- C. No VAE identified

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

Answer: Is a VAE identified for this patient?

A. Yes, in the PEEP parameter

B. Yes, in the FiO2 parameter

C. No VAE identified

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

- There are 2 calendar days of stable daily minimum PEEP values on MV days 4 and 5 (baseline period of stability).
- On MV day 6, the daily minimum PEEP meets the threshold for **worsening oxygenation with an increase of at least 3 cmH2O over the daily minimum PEEP on the first day in the baseline period (from 5 to 8).**
- The increase is **maintained for at least 2 calendar days** (MV days 6 and 7).
- VAC is met in the PEEP parameter with a date of event on MV day 6 (date of onset of worsening oxygenation).

Let's continue look at this same example:

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

What level of the VAE algorithm is met?

- A. VAC
- B. IVAC
- C. PVAP

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

Answer: What level of the VAE algorithm is met?

A. VAC

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

B. IVAC

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

C. PVAP

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

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

Rationale: What level of the VAE algorithm is met?

Vent Day	PEEP min	FiO2 min	Temp	WBC	ABX	ABX	Spec	Org
3	5	50	37.2	13.2				
4	5	60	38.0	11.5	Meropenem			
5	5	40	38.3	11.1		Cefazolin		
6	8	40	38.1	9.6		Cefazolin	ETA	<i>S. aureus</i>
7	8	60	37.9	8.8		Cefazolin		
8	8	50	37.4	8.2				

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

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

Temperature requirement ($> 38^{\circ}\text{C}$ or $< 36^{\circ}\text{C}$) for IVAC is met on MV days 5 and 6.

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

Back to the Case Example

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- The patient is taken to the Operating Room (OR) for emergent surgery at 23:40.
- After surgery, the patient is admitted to the Surgical ICU (SICU) on 2/18 at 05:45.
- VAE surveillance is selected in the Monthly Reporting Plan for the SICU.
- **ECMO initiated in SICU on 2/22**

Patient Ventilator Settings Example 4

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

What level of the VAE algorithm is met?

- A. VAC
- B. IVAC
- C. No VAE identified

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

Answer: What level of the VAE algorithm is met?

A. VAC

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

B. IVAC


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

C. No VAE identified

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

VAE FAQ #5

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

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

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

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

Is this VAE reportable to NHSN?

- A. Yes – IVAC criteria are met while the patient was in an adult inpatient location where VAE is included in the Monthly Reporting Plan.
- B. No – the use of ECMO on MV days 6 and 7 excludes this VAE from reporting.

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

Answer: Is this VAE reportable to NHSN?

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

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

Questions

Thank you.

For any questions or concerns, contact the NHSN Helpdesk

- **NHSN-ServiceNow** to submit questions to the NHSN Help Desk.
- Access new portal at <https://servicedesk.cdc.gov/nhsncsp>.
- If you do not have a SAMS login, or are unable to access ServiceNow, you can still email the NHSN Help Desk at nhsn@cdc.gov.

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 <https://www.cdc.gov/>
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