TENNESSEE DEPARTMENT OF HEALTH
HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE PROGRAM
HAI Surveillance Definitions

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

(Last updated January 1, 2014)

IMPORTANT UPDATES: ***(Last updated January 1, 2014)***

1. A change from age-based surveillance to location-based surveillance has been implemented. VAE surveillance is restricted to adult inpatient locations only. VAE surveillance is not performed in pediatric, mixed age, or neonatal patient locations.
    a. In 20124, the VAE surveillance definition algorithm and protocol is ONLY applicable to mechanically-ventilated patients housed in adult inpatient units
    b. Patients who are under 18 years of age but who are cared for in adult locations conducting VAE surveillance are included in VAE surveillance in 2014.
    c. Pediatric and neonatal units are excluded from VAE surveillance (even in circumstances where a pediatric unit may occasionally care for patients who are 18 years of age and older).
    d. In 2014, ventilated patients who are 18 years of age and older and who are cared for in pediatric units are included in PedVAP surveillance.
        i. **Note:** It is NOT recommended to include VAE surveillance on young children housed in adult locations who are not thought to be physiologically similar to the locations' adult patient population. Facilities may want to evaluate location mapping to be sure that locations are mapped to the correct CDC location codes. In circumstances where the population of patients cared for in the same physical location is comprised of adults and children (e.g., 50% adult patients and 50% pediatric patients), it is recommended that facilities consider the possibility of establishing a virtual pediatric location for surveillance purposes. More information on virtual locations and location mapping can be found in Chapter 15 of the NHSN protocol.
2. The definitions of "daily minimum PEEP" and "daily minimum FiO_2" have been modified, so that in January 2014, the daily minimum PEEP or FiO_2 setting is defined as the lowest setting of PEEP or FiO_2 during a calendar day that is maintained for at least 1 hour.
    a. This is to standardize the surveillance approach in units where monitoring and recording of ventilator settings are performed hourly or more frequently than once per hour.
    b. In units where ventilator settings are monitored and recorded less frequently than once per hour, the daily minimum PEEP and FiO_2 values for VAE surveillance are simply the lowest values of PEEP and FiO_2 recorded for the calendar day.
3. Patients receiving helium-oxygen mixtures are INCLUDED in VAE surveillance.
4. The list of antimicrobial agents eligible for use in meeting the IVAC definition has been refined. Agents that have been eliminated from the list include oral cephalosporins and penicillins, chloramphenicol, erythromycin, erythromycin/sulfisoxazole, Nitrofurantoin, fidaxomicin, and enteral vancomycin. Note that intravenous vancomycin remains on the list of eligible agents.

DEFINITIONS:

VAE: VAEs are identified by using a combination of objective criteria: deterioration in respiratory status after a period of stability or improvement on the ventilator, evidence of infection or inflammation, and laboratory evidence of respiratory infection. The following checklist outlines the criteria that must be used for meeting the VAE surveillance definitions.

TENNESSEE DEPARTMENT OF HEALTH
HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE PROGRAM
HAI Surveillance Definitions

Ventilator-Associated Event (VAE)

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NOTES:

- **Patients must be mechanically ventilated for more than 2 calendar days to be eligible for VAE.** The earliest day on which VAE criteria can be fulfilled is day 4 of mechanical ventilation (where the day of intubation and initiation of mechanical ventilation is day 1). The earliest date of event for VAE (the date of onset of worsening oxygenation) is day 3 of mechanical ventilation. Line lists of VAE data elements demonstrating scenarios that meet and do not meet the VAE definitions are presented in "Frequently-Asked Questions (FAQs)" number (no.) 2 at the end of the checklist.
- The baseline period of stability or improvement on the ventilator is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or FiO_2, and must be characterized by ≥ 2 calendar days of stable or decreasing daily minimum FiO_2 or PEEP values (i.e., the daily minimum PEEP or FiO_2 on the second day of the baseline period of stability or improvement must be equal to or less than the daily minimum PEEP or FiO_2 on the first day of the baseline period of stability or improvement). The definition of "daily minimum PEEP" and "daily minimum FiO_2" are included below. Note that the minimum daily PEEP or FiO_2 used for VAE surveillance is the lowest setting during a calendar day that was maintained for at least 1 hour.

IMPORTANT UPDATE: ***(Last updated July 1, 2013)***

For the purposes of VAE surveillance, PEEP values between 0 cm H_2O and 5 cm H_2O will be considered equivalent. This means that patients with daily minimum PEEP values from 0 to 5 cm H_2O must then have an increase in the daily minimum PEEP to at least 8 cm H_2O, sustained for at least 2 calendar days, to meet the VAC definition.

EXAMPLES:

- In the example below, the baseline period is defined by mechanical ventilation (MV) days 1 through 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum PEEP is ≥3 cmH_2O greater than the daily minimum PEEP during the baseline period. Note that there is no VAC on MV day 3, because PEEP values 0-5 cmH_2O are considered equivalent for the purposes of this surveillance.

MV Day	Daily minimum PEEP (cmH_2O)	Daily minimum FiO_2 (oxygen concentration, %)	VAE
1	0	1.00 (100%)	
2	0	0.50 (50%)	
3	5	0.50 (50%)	
4	5	0.50 (50%)	
5	8	0.50 (50%)	VAC
6	8	0.50 (50%)	

- In the example below, the baseline period is defined by mechanical ventilation (MV) days 1 through 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum PEEP is ≥3 cmH_2O greater than the daily minimum PEEP during the baseline period. In this example, note that MV days 1-4 are considered a baseline period even though the daily minimum PEEP increases from 0 to 3 to 5 cmH_2O during this time period—because PEEP values from 0-5 cmH_2O are considered equivalent for the purposes of this surveillance.

MV Day	Daily minimum PEEP (cmH_2O)	Daily minimum FiO_2 (oxygen concentration, %)	VAE
1	0	1.00 (100%)	
2	0	0.50 (50%)	
3	3	0.50 (50%)	
4	5	0.50 (50%)	
5	8	0.50 (50%)	VAC
6	8	0.50 (50%)	

- In the example below, the baseline period is defined by mechanical ventilation (MV) days 3 and 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum FiO_2 is ≥0.20 (20 points) over the daily minimum FiO_2 during the baseline period.

MV Day	Daily minimum PEEP (cmH_2O)	Daily minimum FiO_2 (oxygen concentration, %)	VAE
1	8	1.00 (100%)	
2	6	0.50 (50%)	
3	5	**0.40 (40%)**	
4	5	**0.40 (40%)**	
5	6	**0.70 (70%)**	VAC
6	6	**0.70 (70%)**	

- In the example below, there is no VAC, because the FiO_2 on MV day 4 is higher than the FiO_2 on MV day 3 (and therefore not stable or decreasing) – even though the FiO_2 on MV days 3 and 4 meets the 20-point threshold when compared with the daily minimum FiO_2 on MV days 5 and 6.

MV Day	Daily minimum PEEP (cmH_2O)	Daily minimum FiO_2 (oxygen concentration, %)	VAE
1	8	1.0 (100%)	
2	6	0.50 (50%)	
3	5	0.35 (35%)	
4	5	0.40 (40%)	
5	6	0.70 (70%)	No event
6	6	0.70 (70%)	

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NOTES:

1. Patients on high frequency ventilation or extracorporeal life support are EXCLUDED from VAE surveillance.
2. Patients who are receiving a conventional mode of mechanical ventilation while in the prone position, and patients who are receiving a conventional mode of mechanical ventilation while receiving nitric oxide therapy, helium-oxygen mixtures (heliox) or epoprostenol therapy are INCLUDED in VAE surveillance.
3. Patients on Airway Pressure Release Ventilation (APRV) or related modes (see FAQ nos. 22 and 23), are INCLUDED, but the VAE period of stability or improvement on the ventilator and the period of worsening oxygenation should be determined by changes in FiO_2 only, since changes in PEEP as indicated in this surveillance algorithm may not be applicable to APRV. In addition, patients with VAE who are on APRV or related modes of mechanical ventilation should be indicated as such on the VAE Form (CDC 57.112).
4. VAEs are defined by a 14-day period, starting on the day of onset of worsening oxygenation (the event date, day 1). A new VAE cannot be identified or reported until this 14-day period has elapsed. See FAQ no. 4.

Date of event: The date of onset of worsening oxygenation. This is defined as the first calendar day in which the daily minimum PEEP or FiO_2 increases above the thresholds outlined in the VAE definition algorithm (i.e., day 1 of the required ≥2-day period of worsening oxygenation following a ≥2-day period of stability or improvement on the ventilator).

EXAMPLE:

A patient is intubated in the Emergency Room for severe community-acquired pneumonia and admitted to the MICU (day 1). The patient stabilizes and improves on days 2-5, with a daily minimum FiO_2 of 0.35 (35%) on days 4 and 5. On day 6, the patient experiences respiratory deterioration, and requires a minimum FiO_2 of 0.60 (60%) on days 6 and 7, meeting the criteria for a VAC. The date of the VAC event is day 6.

NOTE: The "date of event" is NOT the date on which all VAE criteria have been met. It is the first day (of a ≥2-day period) on which either of the worsening oxygenation thresholds (PEEP or FiO_2) is met.

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). 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).

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

Positive End-Expiratory Pressure (PEEP): "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". In patients on mechanical ventilation, PEEP is one of the key parameters that can be adjusted depending on the patient's oxygenation needs, and is typically in the range of 0 to 15 cmH_2O. A sustained increase (defined later in this protocol) in the daily minimum PEEP of ≥3 cmH_2O following a period of stability or improvement on the ventilator is one of two criteria that can be used in meeting the VAC definition. For the purposes of this surveillance, PEEP values from 0 to 5 cmH_2O are considered equivalent.

Fraction of inspired oxygen (FiO_2): The fraction of oxygen in inspired gas. For example, the FiO_2 of ambient air is 0.21; the oxygen concentration of ambient air is 21%. In patients on mechanical ventilation, the FiO_2 is one of the key parameters that can be adjusted depending on the patient's oxygenation needs, and is typically in the range of 0.30 (oxygen concentration of 30%) to 1.0 (oxygen concentration of 100%). A sustained increase (defined later in this protocol) in the daily minimum FiO_2 of ≥0.20 (20%) following a period of stability or improvement on the ventilator is the second of the two criteria that can be used in meeting the VAC definition.

Daily minimum PEEP: The lowest value of PEEP during a calendar day that is set on the ventilator and *maintained for at least 1 hour*. This requirement that the daily minimum PEEP be the lowest setting maintained for at least 1 hour will ensure that units monitoring and recording PEEP settings hourly or more frequently than once per hour are able to apply the VAE surveillance PEEP criterion in a standardized way. In the event that ventilator settings are monitored and recorded less frequently than once per hour, the daily minimum PEEP is simply the lowest value of PEEP set on the ventilator during the calendar day. In circumstances where the lowest value of PEEP is set late in the calendar day, that value may still be considered the daily minimum PEEP for VAE surveillance as long as that lowest PEEP setting is maintained for at least 1 hour, even if that 1 hour period goes into the next calendar day.

NOTE: In units tracking PEEP settings every hour or more frequently than every hour, there must be sufficient consecutive recordings of a specific PEEP setting to meet the minimum required duration of 1 hour. For example, in units tracking PEEP every 15 minutes, 5 consecutive recordings of PEEP at a certain level would be needed to meet the required 1 hour minimum duration (e.g., at 09:00, 09:15, 09:30, 09:45 and 10:00). In units tracking PEEP every 30 minutes, 3 consecutive recordings of PEEP at a certain level would be needed to meet the required 1 hour minimum duration (e.g., at 09:00, 09:30, and 10:00). In units tracking PEEP every hour, 2 consecutive recordings of PEEP at a certain level would be needed to meet the required 1 hour minimum duration (e.g., at 09:00 and 10:00).

EXAMPLE:

- The patient is intubated at 6 pm. PEEP is set at the following values through the remainder of 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

In this example, the daily minimum PEEP for the purposes of VAE surveillance is 5 cmH2O. PEEP settings are being monitored and recorded every hour. There are two consecutive hours where the PEEP setting is noted to be 5 cmH2O (8 pm and 9 pm), and therefore required minimum duration of 1 hour is met.

EXAMPLE:

- The patient is intubated at 6 pm. PEEP is set at the following values through the remainder of the calendar day:

Time	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
PEEP (cmH_2O)	10	8	5	8	8	5

In this example, the daily minimum PEEP for the purposes of VAE surveillance is 8 cmH2O. PEEP settings are being monitored and recorded every hour. Although the lowest PEEP is 5 cmH2O, it is recorded at two non-consecutive time points only (8 pm, then 11 pm)), and so the required 1 hour minimum duration is not met. There are two consecutive hours where the PEEP setting is noted to be 8 cmH2O (9 pm and 10 pm), and therefore the required minimum duration of 1 hour is met to allow use of this setting as the daily minimum value for VAE surveillance.

EXAMPLE:

- PEEP is set at the following values through the course of a calendar day:

Time	12 am	4 am	8 am	12 pm	4 pm	8 pm
PEEP (cmH_2O)	5	8	5	8	8	10

In this example, the daily minimum PEEP is 5 cmH2O. PEEP settings are being monitored and recorded every 4 hours; therefore the lowest recorded PEEP setting for the calendar day is the value used in VAE surveillance.

EXAMPLE:

- You are reviewing a patient's ventilator settings on Wednesday morning to determine the daily minimum PEEP values for Monday and Tuesday. The MICU monitors and records PEEP settings for mechanically ventilated patients every 30 minutes. You see that the lowest PEEP setting on Monday (5 cmH2O) was recorded at 11:30 pm; the patient remained at this PEEP setting for an additional 30 minutes on Tuesday morning, and was then maintained on PEEP 10 cmH2O for the rest of the day on Tuesday. What do you record as the daily minimum PEEP for Monday and for Tuesday? In this example, the PEEP setting of 5 cmH2O was instituted Monday night, and maintained for one hour, into Tuesday morning. Because the PEEP setting was set on Monday night and was maintained for at least 1 hour, the daily minimum PEEP for Monday should be recorded as 5 cmH2O. On Tuesday, the daily minimum PEEP should be recorded as 10 cmH2O, which is the lowest PEEP setting maintained for at least 1 hour on Tuesday.

Day	Time	PEEP (cmH_2O)
Monday	23:30	5
Tuesday	00:00	5
Tuesday	00:30	5
Tuesday	01:00	10
Tuesday	01:30	10
Tuesday	02:00 through 23:30	10

Daily minimum FiO2: The lowest value of FiO2 during a calendar day that is set on the ventilator and *maintained for at least 1 hour*. This requirement that the daily minimum FiO2 be the lowest setting maintained for at least 1 hour will ensure that units monitoring and recording FiO2 settings hourly or more frequently than once per hour are able to apply the VAE surveillance FiO2 criterion in a standardized way. In the event that ventilator settings are monitored and recorded less frequently than once per hour, the daily minimum FiO2 is simply the lowest value of FiO2 set on the ventilator during the calendar day.

NOTE: In units tracking FiO2 settings every hour or more frequently than every hour, there must be sufficient consecutive recordings of a specific FiO2 setting to meet the minimum required duration of 1 hour. For example, in units tracking FiO2 every 15 minutes, 5 consecutive recordings of FiO2 at a certain level would be needed to meet the required 1 hour minimum duration (e.g., 09:00, 09:15, 09:30, 09:45 and 10:00). In units tracking FiO2 every 30 minutes, 3 consecutive recordings of FiO2 at a certain level would be needed to meet the required 1 hour minimum duration (e.g., 09:00, 09:30, and 10:00). In units tracking FiO2 every hour, 2 consecutive recordings of FiO2 at a certain level would be needed to meet the required 1 hour minimum duration (e.g., 09:00 and 10:00).

EXAMPLE:

- The patient is intubated at 6 pm. FiO2 is set at the following values through the remainder of the calendar day:

Time	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
PEEP (cmH_2O)	1.0	0.8	0.5	0.5	0.8	0.8

In this example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.5. FiO2 settings are being monitored and recorded every hour. There are two consecutive hours where the FiO2 setting is noted to be 0.5 (8 pm and 9 pm), and therefore required minimum duration of 1 hour is met.

EXAMPLE:

- The patient is intubated at 6 pm. FiO2 is set at the following values through the remainder of the calendar day:

Time	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
PEEP (cmH_2O)	1.0	0.8	0.5	0.8	0.8	0.5

In this example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.8. FiO2 settings are being monitored and recorded every hour. Although the lowest FiO2 is 0.5, it is recorded at two non-consecutive time points only (8 pm, and then 11 pm), and so the required 1 hour minimum duration is not met. There are two consecutive hours where the FiO2 setting is noted to be 0.8 (9 pm and 10 pm), and therefore the required minimum duration of 1 hour is met to allow use of this setting as the daily minimum value for VAE surveillance.

EXAMPLE:

- FiO2 is set at the following values through the course of a calendar day:

Time	2 pm	4 pm	6 pm	8 pm	10 pm	12 am
FiO_2	1.0	0.60	0.40	0.50	0.55	0.60

In this example, the patient was intubated at 2 pm. The daily minimum FiO2 is 0.40. FiO2 settings are being monitored and recorded every 2 hours; therefore, the lowest recorded FiO2 setting for the calendar day is the value used in VAE surveillance.

EXAMPLE:

- You are reviewing a patient's ventilator settings on Friday morning to determine the daily minimum FiO2 value for Thursday. The ICU monitors and records FiO2 settings for mechanically ventilated patients every 15 minutes. Based on the information recorded in the table below, what should you record as the daily minimum FiO2 for Thursday? In this example, the lowest FiO2 setting on Thursday *that was maintained for at least 1 hour* is 0.55 (55%). Note that FiO2 0.50 was recorded from 09:45 until 10:30, but since the FiO2 setting increased to 0.55 (55%) at 10:45, 0.50 cannot be considered the daily minimum FiO2 for the purposes of VAE surveillance.

Day	Time	FiO_2
Thursday	00:00 to 09:00	0.80
	09:15	0.60
	09:30	0.60
	09:45	0.50
	10:00	0.50
	10:15	0.50
	10:30	0.50
	10:45	0.55
	11:00	0.55
	11:15	0.55
	11:30	0.55
	11:45	0.55
	12:00 to 23:45	0.60

Ventilator: A device to assist or control respiration continuously, inclusive of the weaning period, through a tracheostomy or by endotracheal intubation.

NOTE: Lung expansion devices such as intermittent positive-pressure breathing (IPPB); nasal positive end-expiratory pressure (nasal PEEP); and continuous nasal positive airway pressure (CPAP, hypoCPAP) are not considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g., ET-CPAP).

Episode of mechanical ventilation: Defined as a period of days during which the patient was mechanically ventilated for some portion of each consecutive day.

NOTE: A break in mechanical ventilation of at least one full calendar day, followed by reintubation and/or reinitiation of mechanical ventilation during the same hospitalization, defines a new episode of mechanical ventilation.

EXAMPLE:

- A patient is intubated and mechanical ventilation is initiated at 11 pm on hospital day 1. The patient remains intubated and mechanically ventilated from hospital days 2-10. The patient is extubated at 9 am on hospital day 11, and remains extubated on hospital day 12. The patient is reintubated and mechanical ventilation is reinitiated on hospital day 13. The patient remains intubated and mechanically ventilated from hospital day 14-18. This patient has had two episodes of mechanical ventilation (days 1-11 and days 13-18), separated by at least one full calendar day off of mechanical ventilation.

New antimicrobial agent: Defined as any agent listed in table titled "List of Antimicrobial Agents Eligible for IVAC, Possible and Probable VAP" 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.**

EXAMPLE:

- A patient is intubated and mechanically ventilated on hospital day 1 in the MSICU. Ceftriaxone and azithromycin are started on day 1 and administered daily. After 3 days of improving respiratory status, the patient's oxygenation deteriorates on days 4 and 5, with a daily minimum PEEP that is 4 cmH_2O higher than it was on days 2 and 3. Criteria for the VAC definition are met; the date of the event is hospital day 4. Ceftriaxone is discontinued and meropenem is begun on day 5. Azithromycin is continued. In this case, meropenem is a new antimicrobial agent: 1) it was begun on day 5 of mechanical ventilation, and 2) within the VAE Window Period (on the day after VAE onset), and 3) it was not given to the patient on either of the 2 days preceding the current start date. By contrast, ceftriaxone and azithromycin would not be considered new antimicrobial agents, since they were begun on day 1 of mechanical ventilation and continued daily into the VAE Window Period.

The antimicrobial agent(s) must have been given by one of the routes of administration outlined in the table titled "Definitions of routes of administration", and therapy with one or more new antimicrobial agents must be continued for at least 4 calendar days (referred to as 4 "qualifying antimicrobial days" or "QADs"). For further guidance on identification of new antimicrobial agents and on how to determine whether the requirement for 4 QADs is met, refer to FAQs nos. 6-10 at the end of this checklist.

Definitions of routes of administration

Route of Administration [a]	Definition [b]
Intravenous	An intravascular route that begins with a vein.
Intramuscular	A route that begins within a muscle.
Digestive Tract	A route that begins anywhere in the digestive tract extending from the mouth through rectum.
Respiratory Tract	A route that begins within the respiratory tract, including the oropharynx and nasopharynx.

[a] Other routes of administration are excluded (e.g., antibiotic locks, intraperitoneal, intraventricular, irrigation, topical).
[b] Definitions per SNOMED Reference Terminology

Qualifying Antimicrobial Day (QAD): A day on which the patient was administered an antimicrobial agent that was determined to be "new" within the VAE Window Period. Four consecutive QADs are needed to meet the IVAC antimicrobial criterion—starting within the VAE Window Period. Days on which a new antimicrobial agent is administered count as QADs. **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.** 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. By contrast, days between administrations of different 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 not 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.

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].

NOTE: Some clinical laboratories may use different results reporting formats for direct examinations of respiratory secretions. Additional instructions for using the purulent respiratory secretions criterion are provided in the table titled ”Instructions for using the purulent respiratory secretions criterion, based on laboratory reporting of respiratory secretion direct examination results.”

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Instructions for using the purulent respiratory secretions criterion, based on laboratory reporting of respiratory secretion direct examination results.

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].
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.

Location of attribution: The inpatient location where the patient was assigned on the date of the VAE, which is further defined as the date of onset of worsening oxygenation.

EXAMPLE:

- Patient is intubated and ventilated in the Operating Room on hospital day 1, and then is admitted post-operatively to the SICU on hospital day 1, still on the ventilator. On hospital day 3, the patient experiences the onset of worsening oxygenation, manifested by an

increase in the daily minimum FiO_2 of ≥0.20 (20%). On day 4 (also the 4th day of mechanical ventilation) the patient meets criteria for a VAC. This is reported to NHSN as a VAC for the SICU.

EXCEPTION:

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. This is called the Transfer Rule, and examples are shown below:

EXAMPLES:

- Patient on a ventilator in the SICU who has had improving oxygenation for 3 days is transferred to the MICU, still on the ventilator. On the day of transfer, after the patient has arrived in the MICU, the patient experiences an acute decompensation, requiring an increase of 0.30 (30 points) in FiO_2 that persists during the following calendar day. VAC criteria are met on calendar day 2 in the MICU. Because the onset of worsening oxygenation occurred on the day of transfer to the MICU, the VAC event is attributed to the SICU.
- Patient is extubated in the MICU and transferred to the medical stepdown unit on hospital day 6. The next day, while in the stepdown unit (day 7), the patient experiences worsening oxygenation and is reintubated and transferred back to the MICU. Criteria for VAC are met the next day (day 8). In this case, the day prior to extubation and the day of extubation (hospital days 5 and 6) count as the required 2-day period of stability or improvement. The day of reintubation (day 7) and the following day (day 8) count as the required 2-day period of worsening oxygenation. Because the onset of worsening oxygenation occurred on the day following transfer out of the MICU, the event is reported to NHSN as a VAC for the MICU.
- Patient intubated and mechanically ventilated for 8 days in the MSICU of Hospital A is transferred for further care on day 8 to the MSICU of Hospital B. The patient was stable on the ventilator in Hospital A from days 3-8. On the day of transfer to Hospital B (day 1 in Hospital B), the patient's respiratory status deteriorates. The day after transfer (day 2 in Hospital B), the patient meets criteria for VAC. The date of the event is day 1 in Hospital B, the first day of the period of worsening oxygenation meeting VAE PEEP or FiO_2 thresholds. The infection preventionist (IP) from Hospital B calls the Hospital A IP to report that this patient was admitted to Hospital B with a VAC. This VAC should be reported to NHSN for and by Hospital A, and attributed to the Hospital A MSICU. No additional ventilator days are reported by Hospital A.

TENNESSEE DEPARTMENT OF HEALTH
HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE PROGRAM
HAI Surveillance Definitions

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

New: Ventilator-Associated Event (VAE) Calculator Version 2.1

(Last updated January 1, 2014)

Version 2.1 of the VAE Calculator is now available. Version 2.1 operates based upon the currently posted (January 2014) 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.

The VAE Calculator (2014 Version 2.1) can be found at the following URL: http://www.cdc.gov/nhsn/VAE-calculator/vae_multi_v1.html Please note that you must have JavaScript enabled in order for the tool to work.

VAC – Ventilator-Associated Condition

DEFINITION: Patient must meet **CRITERION 1**:

☐ **Criterion 1**: ***(Last updated January 1, 2014)***

- ○ Patent has **ONE** Δ of the following:
  - Δ Baseline period of stability* on the ventilator
  - Δ Baseline period of improvement* on the ventilator

  AND

- ○ After a period of stability or improvement (as above), patient has at least **ONE** Δ of the following indicators of worsening oxygenation:
  - Δ **BOTH** ☐ of the following:
    - ☐ increase in daily minimum* FiO_2 of ≥0.20 (20 points) over daily minimum FiO_2 in the baseline period
    - ☐ sustained for ≥2 calendar days
  - Δ **BOTH** ☐ of the following:
    - ☐ increase in daily minimum* PEEP values of ≥3 cmH_2O over daily minimum PEEP in the baseline period**
    - ☐ sustained for ≥2 calendar days

* Defined by ≥2 calendar days of stable or decreasing daily minimum+ FiO_2 or PEEP values immediately preceding the first day of increased daily minimum PEEP or FiO_2.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 low 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.

TENNESSEE DEPARTMENT OF HEALTH
HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE PROGRAM
HAI Surveillance Definitions

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

IVAC – Infection-Related Ventilator-Associated Complication

DEFINITION: Patient must meet **BOTH** ☐ criteria:

☐ **Criterion 1**: **Definition met as above.**

AND

☐ **Criterion 2**: ***(Last updated January 1, 2014)***

- Establish VAE window period to determine if Criterion 2 conditions occur within a time period which is **BOTH** Δ:
  - Δ on or after calendar day 3 of mechanical ventilation
  - Δ within 2 calendar days before or after the onset of worsening oxygenation

AND

- Patient has **ONE** Δ of the following objective indications of an infection:
  - Δ **ONE** ☐ of the following:
    - ☐ temperature >38°C (>100.4°F)
    - ☐ temperature <36°C <96.8°F)
  - Δ **ONE** ☐ of the following:
    - ☐ white blood cell count ≥ 12,000 cells/mm^3
    - ☐ white blood cell count ≤4,000 cells/mm^3

AND

- Patient meets **BOTH** Δ of the following treatment conditions:
  - Δ a new antimicrobial agent(s)* is started
  - Δ the new antimicrobial agent(s)* is continued for ≥4 days

* See table titled "List of Antimicrobial Agents Eligible for IVAC, Possible and Probably VAP" for eligible agents.

TENNESSEE DEPARTMENT OF HEALTH
HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE PROGRAM
HAI Surveillance Definitions

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

Possible Ventilator-Associated Pneumonia

DEFINITION: Patient must meet **ALL** ☐ criteria:

☐ **Criterion 1**: **Definition met as above.**

AND

☐ **Criterion 2**: **Definition met as above.**

AND

☐ **Criterion 3**: ***(Last updated January 1, 2014)***

- ○ Use VAE window period to determine if Criterion 3 conditions occur within a time period which is **BOTH** Δ**:**
  - Δ on or after calendar day 3 of mechanical ventilation
  - Δ within 2 calendar days before or after the onset of worsening oxygenation

AND

- ○ Patient has **ONE** Δ of the following:
  - Δ purulent respiratory secretions (from one or more specimen collections), defined as **ONE** ☐ of the following:
    - ☐ **BOTH** ○ of the following:
      - ○ secretions that contain ≥25 neutrophils per low power field [lpf, x100] from **ONE** Δ of the following:
        - Δ **l**ungs
        - Δ bronchi
        - Δ trachea
      - ○ secretions that contain ≤10 squamous epithelial cells per low power field [lpf, x100] from **ONE** Δ of the following:
        - Δ **l**ungs
        - Δ bronchi
        - Δ trachea
    - ☐ If the laboratory reports semi-quantitative results the patient must have **BOTH** ○ of the following:
      - ○ secretions with a semi-quantitative result equivalent to ≥25 neutrophils per low power field [lpf, x100] from **ONE** Δ of the following:
        - Δ **l**ungs

- Δ bronchi
- Δ trachea

- secretions with a semi-quantitative result equivalent to ≤10 squamous epithelial cells per low power field [lpf, x100] from **ONE** Δ of the following:
  - Δ lungs
  - Δ bronchi
  - Δ trachea

Δ positive culture (qualitative, semi-quantitative or quantitative) of **ONE** ☐ of the following:

- ☐ sputum*
- ☐ endotracheal aspirate*
- ☐ bronchoalveolar lavage*
- ☐ lung tissue
- ☐ protected specimen brushing*

* 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

Probable Ventilator-Associated Pneumonia

DEFINITION: Patient must meet **ALL** ☐ criteria:

☐ **Criterion 1**: **Definition met as above.**

AND

☐ **Criterion 2**: **Definition met as above.**

AND

☐ **Criterion 4**: ***(Last updated January 1, 2014)***

- Use VAE window period to determine if Criterion 4 conditions occur within a time period which is **BOTH** Δ**:**
  - Δ on or after calendar day 3 of mechanical ventilation
  - Δ within 2 calendar days before or after the onset of worsening oxygenation

AND

TENNESSEE DEPARTMENT OF HEALTH
HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE PROGRAM
HAI Surveillance Definitions

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

- Patient meets **ONE** Δ of the following:

  Δ purulent respiratory secretions (from one or more specimen collections), defined as **BOTH** ☐ of the following:

  ☐ **BOTH** ○ of the following:

  - ○ secretions that contain ≥25 neutrophils per low power field [lpf, x100] from **ONE** Δ of the following:
    - Δ **l**ungs
    - Δ bronchi
    - Δ trachea
  - ○ secretions that contain ≤10 squamous epithelial cells per low power field [lpf, x100] from **ONE** Δ of the following:
    - Δ **l**ungs
    - Δ bronchi
    - Δ trachea
  - ○ if the laboratory reports semi-quantitative results, those results must be equivalent to the above quantitative thresholds.

  AND

  ☐ **ONE** ○ of the following:

  - ○ positive culture of endotracheal aspirate*, ≥10^5 CFU/ml or equivalent semi-quantitative result*
  - ○ positive culture of bronchoalveolar lavage*, ≥10^4 CFU/ml or equivalent semi-quantitative result
  - ○ positive culture of lung tissue, ≥ 10^4 CFU/g or equivalent semi-quantitative result
  - ○ positive culture of protected specimen brush*, ≥10^3 CFU/ml or equivalent semi-quantitative result

  **Same organism exclusions as noted for Possible VAP.*
  - normal respiratory/oral flora, mixed respiratory/oral flora or equivalent
  - *Candida* species or yeast not otherwise specified
  - Coagulase-negative *Staphylococcus* species
  - *Enterococcus* species

Δ patient has **ONE** ☐ of the following (without requirement for purulent respiratory secretions):

- ☐ positive pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
- ☐ positive lung histopathology
- ☐ positive diagnostic test for *Legionella* spp.
- ☐ positive diagnostic test on respiratory secretions for ONE ○ of the following:
  - ○ influenza virus
  - ○ respiratory syncytial virus
  - ○ adenovirus
  - ○ parainfluenza virus
  - ○ rhinovirus
  - ○ human metapneumovirus
  - ○ coronavirus

KEY FOR VENTILATOR ASSOCIATED EVENTS: ***(Last updated January 1, 2013)***

- **Ventilator-Associated Condition (VAC) =** Criterion **1**
- **Infection-related Ventilator-Associated Complication (IVAC) =** Criteria **1 AND 2**
- **Possible Ventilator-Associated Pneumonia =** Criteria **1 AND 2 AND 3**
- **Probable Ventilator-Associated Pneumonia =** Criteria **1 AND 2 AND 4**

REPORTING INSTRUCTIONS: ***(Last updated July 1, 2013)***

NOTE: *(Additional guidance may be found in the FAQs at the end of this checklist.)*

- Conducting in-plan VAE surveillance means assessing patients for the presence of ALL events included in the algorithm — from VAC to IVAC to Possible and Probable VAP. At this time, a unit conducting in-plan VAE surveillance cannot decide, for example, that only surveillance for VAC (and not for IVAC or possible or probable VAP) will be performed.
- There is a hierarchy of definitions within VAE:
  - If a patient meets criteria for VAC and IVAC, report as IVAC.
  - If a patient meets criteria for VAC, IVAC and Possible VAP, report Possible VAP.
  - If a patient meets criteria for VAC, IVAC and Probable VAP, report Probable VAP.
  - If a patient meets criteria for VAC, IVAC, Possible VAP and Probable VAP, report Probable VAP.
- Pathogens are not reported for VAC or IVAC events.
- Secondary BSIs are not reported for VAC or IVAC events.
- Pathogens may be reported for Possible and Probable VAP events, provided they are isolated or identified from appropriate specimen types according to the requirements of the algorithm and are NOT on the list of excluded organisms and culture results:

- Excluded organisms and culture results that cannot be used to meet the Possible or Probable VAP definitions are as follows: "Normal respiratory flora," "normal oral flora," "mixed respiratory flora," "mixed oral flora," "altered oral flora" or other similar results indicating isolation of commensal flora of the oral cavity or upper respiratory tract; *Candida* species or yeast not otherwise specified; coagulase-negative *Staphylococcus* species; and *Enterococcus* species, when isolated from cultures of sputum, endotracheal aspirates, bronchoalveolar lavage, or protected specimen brushings.

> ***NOTE:*** **ANY organism isolated from cultures of lung tissue or pleural fluid**, including *Candida* species or yeast not otherwise specified, coagulase-negative *Staphylococcus* species or *Enterococcus* species may be reported as pathogens for Possible or Probable VAP.

- See table titled "Threshold values for cultured specimens used in the Probable VAP definition" for the required quantitative culture thresholds associated with various specimen types in the Probable VAP definition. Note that if your laboratory reports semi-quantitative culture results, you should check with your laboratory to confirm that semi-quantitative results match the quantitative thresholds noted in that table.

Threshold values for cultured specimens used in the Probable VAP definition

Specimen collection/technique	Values
Lung tissue	$\geq 10^4$ cfu/g tissue*
Bronchoscopically (B) obtained specimens	
Bronchoalveolar lavage (B-BAL)	$\geq 10^4$ cfu/ml*
Protected BAL (B-PBAL)	$\geq 10^4$ cfu/ml*
Protected specimen brushing (B-PSB)	$\geq 10^3$ cfu/ml*
Nonbronchoscopically (NB) obtained (blind) specimens	
NB-BAL	$> 10^4$ cfu/ml*
NB-PSB	$\geq 10^3$ cfu/ml*
Endotracheal aspirate (ETA)	$\geq 10^5$ cfu/ml*

cfu = colony forming units, g = gram, ml = milliliter
*Or equivalent semi-quantitative result.

- Secondary BSIs may be reported for Possible and Probable VAP events, provided that at least one organism isolated from the blood culture matches an organism isolated from an appropriate respiratory tract specimen (including respiratory secretions, pleural fluid and lung tissue). The respiratory tract specimen must have been collected on or after the 3rd day of mechanical ventilation and within 2 calendar days before or after the day of onset of worsening oxygenation to be considered as a criterion for meeting the Possible or Probable VAP definitions. In addition, **the positive blood culture must have been collected during the 14-day event period, where day 1 is the day of onset of worsening oxygenation.**
  - In cases where Possible VAP is met with only the purulent respiratory secretions criterion and no culture is performed, and there is also a positive blood culture during the 14-day

event period, a secondary BSI is not reported because there was no matching respiratory tract culture.

- In cases where Probable VAP is met with only the histopathology criterion and no culture is performed, and there is also a positive blood culture, a secondary BSI is not reported.
- In cases where a culture of respiratory secretions, pleural fluid or lung tissue is performed but is negative or does not grow an organism that matches an organism isolated from blood, a secondary BSI is *not* reported.

NOTE: *Candida* species or yeast not otherwise specified, coagulase-negative *Staphylococcus* species, and *Enterococcus* species cultured from blood cannot be deemed secondary to a Possible or Probable VAP, unless the organism was also cultured from pleural fluid or lung tissue.

List of Antimicrobials Agents Eligible for IVAC, Possible and Probable VAP*: (Last updated January 1, 2014)*

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class [a]	Antimicrobial Subclass [a]
AMIKACIN	Antibacterial	Aminoglycosides	
AMPHOTERICIN B	Antifungal	Polyenes	
AMPHOTERICIN B LIPOSOMAL	Antifungal	Polyenes	
AMPICILLIN	Antibacterial	Penicillins	Aminopenicillin
AMPICILLIN/ SULBACTAM	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
ANIDULAFUNGIN	Antifungal	Echinocandins	
AZITHROMYCIN	Antibacterial	Macrolides	
AZTREONAM	Antibacterial	Monobactams	
CASPOFUNGIN	Antifungal	Echinocandins	
CEFAZOLIN	Antibacterial	Cephalosporins	Cephalosporin 1st generation
CEFEPIME	Antibacterial	Cephalosporins	Cephalosporin 4th generation
CEFOTAXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFOTETAN	Antibacterial	Cephalosporins	Cephamycin
CEFOXITIN	Antibacterial	Cephalosporins	Cephamycin
CEFTAROLINE	Antibacterial	Cephalosporins	Cephalosporin with anti-MRSA activity
CEFTAZIDIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFTIZOXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFTRIAXONE	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFUROXIME	Antibacterial	Cephalosporins	Cephalosporin 2rd generation
CIPROFLOXACIN	Antibacterial	Fluoroquinolones	
CLARITHROMYCIN	Antibacterial	Macrolides	
CLINDAMYCIN	Antibacterial	Lincosamides	
COLISTIMETHATE	Antibacterial	Polymyxins	
DORIPENEM	Antibacterial	Carbapenems	
DOXYCYCLINE	Antibacterial	Tetracyclines	

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class [a]	Antimicrobial Subclass [a]
ERTAPENEM	Antibacterial	Carbapenems	
FLUCONAZOLE	Antifungal	Azoles	
FOSFOMYCIN	Antibacterial	Fosfomycins	
GEMIFLOXACIN	Antibacterial	Fluoroquinolones	
GENTAMICIN	Antibacterial	Aminoglycosides	
IMIPENEM/ CILASTATIN	Antibacterial	Carbapenems	
ITRACONAZOLE	Antifungal	Azoles	
LEVOFLOXACIN	Antibacterial	Fluoroquinolones	
LINEZOLID	Antibacterial	Oxazolidinones	
MEROPENEM	Antibacterial	Carbapenems	
METRONIDAZOLE	Antibacterial	Nitroimidazoles	
MICAFUNGIN	Antifungal	Echinocandins	
MINOCYCLINE	Antibacterial	Tetracyclines	
MOXIFLOXACIN	Antibacterial	Fluoroquinolones	
NAFCILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
OSELTAMIVIR	Anti-influenza	Neuraminidase inhibitors	
OXACILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
PENICILLIN G	Antibacterial	Penicillins	Penicillin
PIPERACILLIN	Antibacterial	Penicillins	Ureidopenicillin
PIPERACILLIN/ TAZOBACTAM	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
POLYMYXIN B	Antibacterial	Polymyxins	
POSACONAZOLE	Antifungal	Azoles	
QUINUPRISTIN/ DALFOPRISTIN	Antibacterial	Streptogramins	
RIFAMPIN	Antibacterial	Rifampin	
SULFAMETHOXAZOLE/ TRIMETHOPRIM	Antibacterial	Folate pathway inhibitors	
SULFISOXAZOLE	Antibacterial	Folate pathway inhibitors	
TELAVANCIN	Antibacterial	Lipo-glycopeptides	
TELITHROMYCIN	Antibacterial	Ketolides	
TETRACYCLINE	Antibacterial	Tetracyclines	
TICARCILLIN/ CLAVULANATE	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
TIGECYCLINE	Antibacterial	Glycylcyclines	
TOBRAMYCIN	Antibacterial	Aminoglycosides	
VANCOMYCIN	Antibacterial	Glycopeptides	
VORICONAZOLE	Antifungal	Azoles	
ZANAMIVIR	Anti-influenza	Neuraminidase inhibitors	

TENNESSEE DEPARTMENT OF HEALTH
HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE PROGRAM
HAI Surveillance Definitions

Ventilator-Associated Event (VAE)

Note: For Use on Adult Patients ≥ 18 years]

VAE FREQUENTLY-ASKED QUESTIONS: *(Last updated January 1, 2014)*

1. *When should I use VAE? Are there circumstances in which I should still use PNEU?*

- VAE surveillance is location based, and restricted to adult inpatient units only.
- Pediatric and neonatal units are excluded from VAE surveillance (even in circumstances where a pediatric unit may occasionally care for patients who are 18 years of age and older).
- Locations mapped to mixed age CDC location codes are excluded from VAE surveillance
- Ventilated patients who are 19 years of age and older and who are cared for in pediatric units should be included in PedVAP surveillance.

NOTE:
it is 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. Facilities may want to evaluate their location mapping to be sure that locations are mapped appropriately to the correct CDC location codes. In circumstances where the populations of adults and children cared for in the same physical location is more mixed (e.g., 50% adult patients and 50% pediatric patients), it is recommended that facilities weigh the possibility of establishing a virtual pediatric location for the purposes of surveillance. More information on virtual locations and location mapping can be found here:
http://www.cdc.gov/nhsn/PDFs/pscManual/15LocationsDescriptions_current.pdf

- Patients on high frequency ventilation or extracorporeal life support are EXCLUDED from VAE surveillance.

NOTE:

- Patients who are receiving a conventional mode of mechanical ventilation while in the prone position, and patients who are receiving a conventional mode of mechanical ventilation while receiving nitric oxide therapy, helium-oxygen mixtures (heliox), or epoprostenol therapy are INCLUDED.
- Patients on Airway Pressure Release Ventilation (APRV) and related modes of mechanical ventilation (see FAQ nos. 22 and 23) are INCLUDED, but the VAE period of stability or improvement on the ventilator and the period of worsening oxygenation should be determined by changes in FiO_2 only, since changes in PEEP as indicated in this surveillance algorithm may not be applicable to APRV. In addition, patients with VAE who are on APRV or a related mode of mechanical ventilation at the time of VAE onset should be indicated as such on the VAE Form (CDC 57.112).

- In-plan surveillance for ventilator-associated PNEU may still be conducted for neonatal and pediatric patients ONLY ("PedVAP" surveillance).
- The PNEU definitions are still available for those units seeking to conduct off-plan PNEU/VAP surveillance for patients of any age.

2. *I am having difficulty visualizing how to arrange the VAE data elements to facilitate easy identification of events. Can you provide some additional guidance?*

- For units in which VAE surveillance will be conducted manually, we recommend that you organize the necessary data elements in a table or spreadsheet to assist in identifying VAEs. There are a number of different ways in which to organize the data – you may consider limiting your spreadsheet to just include the daily minimum PEEP and FiO_2 values, and then, if a VAC event is identified, utilize other data sources to gather information on the data elements included in the IVAC, Possible VAP, and Probable VAP definitions. Alternatively, you may choose to include columns for all data elements (from VAC through Probable VAP) in a single spreadsheet.

NOTE:

- For most patients under surveillance for VAE, the only data elements you will need to record are the ventilator days, minimum daily PEEP, and minimum daily FiO_2. The maximum and minimum daily temperatures and white blood cell counts only need to be recorded for those patients who are identified as having met criteria for VAC. The

NOTE *(cont.)*:

antimicrobial criterion only needs to be assessed for those patients with VAC and with an abnormal temperature or white blood cell count that meets the criteria within the IVAC definition. Microbiology and related data elements included as criteria in the Possible and Probable VAP definitions only need to be assessed for those patients who have met the IVAC definition.

- Keep in mind that the baseline period of stability or improvement on the ventilator is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or FiO_2, and must be characterized by ≥ 2 calendar days of stable or decreasing daily minimum FiO_2 or PEEP values (i.e., the daily minimum PEEP or FiO2 on the second day of the baseline period of stability or improvement must be equal to or less than the daily minimum PEEP or FiO_2 on the first day of the baseline period of stability or improvement). Keep in mind, too, that PEEP values of 0 to 5 cmH_2O are considered equivalent for the purposes of VAE surveillance. This means that any daily minimum value of 0 to 5 cmH_2O will be evaluated as if it were 5 cmH_2O when determining whether a VAC has occurred or not. Also, the daily minimum PEEP or xx is defined as the lowest setting during the calendar day that is maintained for at least 1 hour.

EXAMPLE:

- In the table below, the data elements used to meet VAC, IVAC and Possible VAP definitions are organized in a fashion that facilitates identification of an event, highlighted in the shaded region. In this example, MV days 3 and 4 constitute the baseline period, with stable minimum PEEP of 5 cmH_2O on each day. On MV days 5 and 6, the daily minimum PEEP is 8 cmH_2O, which meets the VAC criterion for worsening oxygenation. If we scan across the table, we can see that the IVAC temperature/white blood cell count criterion is not met (there are no temperatures <36°C or >38°C, and no white blood cell counts ≤4,000 cells/mm^3 or ≥12,000

cells/mm^3) – so even though the patient was started on a new antimicrobial agent and continued on that agent for 4 calendar days, IVAC is not met. Therefore, this event would be reported as a VAC, with the date of event being MV day 5.

Patient	MV Day	$PEEP_{min}$	FiO_{2min}	$Temp_{min}$	$Temp_{max}$	WBC_{min}	WBC_{max}	Abx	Specimen	Polys / Epis	Organism	VAE
1	1	10	1.0	37.1	37.6	4.3	4.3	None	--	--	--	--
1	2	5	0.60	36.8	37.2	4.6	4.6	None	--	--	--	--
1	3	5	0.40	37.0	37.9	5.4	5.4	None	--	--	--	--
1	4	5	0.40	36.5	37.3	9.2	9.2	Yes	--	--	--	--
1	5	8	0.50	36.3	36.9	8.4	8.4	Yes	ETA	≥ 25 / ≤ 10	Mixed flora	VAC
1	6	8	0.40	37.2	37.5	8.5	8.8	Yes	--	--	--	
1	7	5	0.40	37.8	37.9	7.6	7.6	Yes	--	--	--	

MV = mechanical ventilation. $PEEP_{min}$ = Daily minimum PEEP. FiO_{2min} = Daily minimum FiO_2. $Temp_{min}$ = Daily minimum temperature. $Temp_{max}$ = Daily maximum temperature. WBC_{min} = Daily minimum white blood cell count. WBC_{max} = Daily maximum white blood cell count. Abx = antimicrobial agents. Polys / epis = Polymorphonuclear leukocytes and squamous epithelial cells from respiratory specimen.

EXAMPLE:

- In the table below, by scanning across the data elements, you can see that there are no periods in which there is a stable, 2-day baseline period followed by a 2-day period where the PEEP or FiO_2 are increased 3 cmH_2O or 20 points over baseline. On MV days 2 and 3, the PEEP values are 7 cmH_2O and 6 cmH_2O respectively, and then increase to 9 cmH_2O on MV days 4 and 5 – **but the difference between day 4 or day 5 and day 2 is only 2 cmH_2O, rather than the required 3 cmH_2O.** Also, the gradual increase in FiO_2 from the time of initiation of mechanical ventilation means that there are not two days on which the FiO_2 is at least 20 points higher than on the 2 previous days. Therefore, although the temperature and white blood cell counts exceed the required thresholds for IVAC on several occasions, and the patient appears to have received a new antimicrobial agent for several days in the setting of a positive blood culture, the VAC definition is not met, and so no VAE is reported.

Patient	MV Day	$PEEP_{min}$	FiO_{2min}	$Temp_{min}$	$Temp_{max}$	WBC_{min}	WBC_{max}	Abx	Specimen	Polys / Epis	Organism	VAE
2	1	5	0.30	37.1	37.6	4.3	4.3	None	--	--	--	--
2	2	7	0.30	36.8	37.2	4.6	4.6	None	--	--	--	--
2	3	6	0.45	37.0	37.9	5.4	5.4	None	--	--	--	--
2	4	9	0.45	36.5	37.3	9.2	9.2	None	--	--	--	--
2	5	9	0.60	36.3	36.9	8.4	8.4	None	ETA	≥ 25 / ≤ 10	Mixed flora	--
2	6	8	0.60	37.2	37.5	8.5	8.8	None	--	--	--	--
2	7	6	0.75	37.8	37.9	7.6	7.6	None	--	--	--	--
2	8	6	0.75	38.2	38.4	10.5	11.9	Yes	Blood	--	*S. aureus*	--
2	9	5	0.80	38.5	38.9	12.7	12.7	Yes	--	--	--	--
2	10	5	0.75	37.4	38.1	12.9	12.9	Yes	--	--	--	--
2	11	5	0.70	37.2	37.9	9.4	9.4	Yes	--	--	--	--
2	12	5	0.60	37.3	37.5	9.5	9.5	Yes	--	--	--	--
2	13	7	0.60	37.2	37.8	8.2	8.2	Yes	--	--	--	--
2	14	8	0.60	37.0	37.7	8.6	8.6	Yes	--	--	--	--

3. *How do I determine the duration of a VAE? Can a patient have more than one VAE during a hospitalization?*

   - Patients may have multiple VAEs during a single hospitalization. **The event period is defined by the 14-day period that starts on the date of onset of worsening oxygenation. VAE criteria met during that 14-day period are attributed to the current VAE.**

   EXAMPLE:

   - Patient is intubated and mechanical ventilation is initiated in the MICU (day 1). The patient is stable during the following 4 calendar days (days 2 through 5). On days 6 and 7 the patient's minimum daily FiO_2 is increased more than 0.20 (20 points) over baseline, therefore meeting the VAC FiO_2 threshold. The VAC episode is defined by the period encompassing days 6 through 19 (14 days, starting on day 1 of worsening oxygenation, which in this case is day 6). If the patient were to experience a period of stability or improvement on the ventilator on days 18 and 19, followed by another 2-day period of worsening on days 20 and 21, a new VAE would be reported, since the second period of worsening oxygenation has occurred more than 14 days after the start of the initial period of worsening oxygenation.

4. *Sometimes patients are intubated, extubated, and reintubated several times during a single hospitalization. How do I define an episode of mechanical ventilation, and can a VAE occur in a patient who has recently been extubated?*

   - An episode of mechanical ventilation is defined as a period of days during which the patient was mechanically ventilated for **some portion of each consecutive day** during the period.

   EXAMPLE:

   - A patient is intubated and mechanically ventilated on hospital day 1. The patient remains on mechanical ventilation from hospital day 2 through 12 noon on hospital day 6. At noon on hospital day 6, the patient is extubated. The patient remains extubated on hospital day 7, and is then reintubated on hospital day 8. In this case, the first episode of mechanical ventilation is defined by days 1 through 6. Since the patient was extubated on day 6 and remained extubated for a full calendar day on day 7, the re-intubation of the patient on day 8 defines the start of a second episode of mechanical ventilation. See figure, below.

Hosp Day No.	1	2	3	4	5	6	7	8	9	10
MV Episode	1	1	1	1	1	1	--	2	2	2
MV Day No.	1	2	3	4	5	6—extubated at noon	--	1--reintubated	2	3

1 full calendar day off mechanical ventilation, followed by reintubation, defines a new episode of mechanical ventilation.

EXAMPLE:

   - A patient is intubated and mechanically ventilated on hospital day 1. The patient remains on mechanical ventilation from hospital day 2 through hospital day 6 at 12

noon. At noon on day 6, the patient is extubated. The patient is reintubated at 9 pm on hospital day 7, and remains intubated and mechanically ventilated till 2 pm on day 10. The patient is extubated at 2 pm on day 10 and remains extubated until hospital discharge on day 15. In this case, there is only a single episode of mechanical ventilation, defined by days 1 through 10, because the patient was extubated on day 6 but reintubated the next calendar day (day 7). See figure, below.

Hosp Day No.	1	2	3	4	5	6	7	8	9	10
MV Episode	1	1	1	1	1	1	1	1	1	1
MV Day No.	1	2	3	4	5	6—extubated at noon	7—reintubated at 9 pm	8	9	10—extubated at 2 pm

Patient was reintubated on the calendar day following extubation (days 6-7). Because there is not 1 calendar day off mechanical ventilation, there is only 1 episode of mechanical ventilation.

- A VAE can occur in a patient who has been extubated and is then reintubated, subject to the amount of time the patient was off the ventilator, as noted in the examples below.

EXAMPLE:

- A patient is intubated and mechanically ventilated on hospital day 1. The patient remains on mechanical ventilation from hospital day 2 through 12 noon on hospital day 6. At noon on hospital day 6, the patient is extubated. The patient remains extubated on hospital day 7, and is then reintubated on hospital day 8. In this case, because the patient has been extubated for 1 full calendar day (day 7), the "VAE clock" starts over with reintubation on hospital day 8. To meet VAE during this second episode of mechanical ventilation, the patient would have to have at least 2 days of stability or improvement and at least 2 days of worsening oxygenation on the ventilator; therefore, the earliest date on which the patient could meet VAE criteria would be hospital day 11 (stable or improving settings on days 8 and 9, increased ventilator settings on days 10 and 11). The VAE event date would be reported as day 10—the first day of worsening oxygenation meeting VAE criteria. See figure, below.

Hosp Day No.	1	2	3	4	5	6	7	8	9	10	11
MV Episode	1	1	1	1	1	1	--	2	2	2	2
MV Day No.	1	2	3	4	5	6—extubated at noon	--	1--reintubated	2	3	4
VAE Criterion	--	--	--	--	--	--	--	Day 1 of stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation

EXAMPLE:

- A patient is intubated and mechanically ventilated on hospital day 1. The patient remains on mechanical ventilation from hospital day 2 through 12 noon on hospital day 6, when the patient is extubated. The patient is reintubated at 9 pm on hospital day 7. In this case, there is no "new" episode of mechanical ventilation, since there was not a full, ventilator-free calendar day. Therefore, the period of worsening oxygenation may be determined to have started on day 7, the day of reintubation, as long as PEEP or FiO_2 criteria are met. PEEP and FiO_2 data from hospital days 5 and

6 (through the time of extubation) may be used to determine whether a period of stability and improvement occurred, and these data may be compared to PEEP and FiO_2 data obtained from the time of reintubation on day 7 and beyond to determine whether at least 2 days of worsening oxygenation occurred. The earliest that the patient could meet VAE criteria would be day 8 (assuming stable or improving ventilator settings on days 5 and 6, and two days of worsening oxygenation meeting criteria on days 7 and 8). The VAE event date would be reported as day 7—the first day of worsening oxygenation meeting VAE criteria. See figure, below.

Hosp Day No.	1	2	3	4	5	6	7	8	9	10
MV Episode	1	1	1	1	1	1	1	1	1	1
MV Day No.	1	2	3	4	5	6—extubated at noon	7—reintubated at 9 pm	8	9	10
VAE Criterion					Day 1 of stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		

- A patient may also meet criteria for VAC while intubated, and then meet criteria for IVAC (or Possible or Probable VAP) following extubation.

EXAMPLE:

- A patient is intubated and mechanically ventilated on hospital day 1. The patient remains on mechanical ventilation till 11 am on hospital day 10, when the patient is extubated. Criteria for VAC are met during the episode of mechanical ventilation, based on 2 days of stability or improvement (MV days 5 and 6) followed by 2 days of worsening oxygenation (MV days 7 and 8). The date of the event is MV day 7, the day of onset of worsening oxygenation. Within the 2 days before and 2 days after the day of onset of worsening oxygenation, the patient has a temperature of 38.4°C, and a new antimicrobial agent is started (meropenem, on MV day 9—see FAQ no. 6-10). The new antimicrobial agent is continued for at least 4 days (hospital days 8 through 11). Therefore, even though the patient was extubated on hospital day 10 and remained extubated on hospital day 11 (the day on which all IVAC criteria were fulfilled), the event should be reported as an IVAC. See figure, below.

Hosp Day No.	4	5	6	7	8	9	10	11
MV Day No.	4	5	6	7	8	9	Extubated at 11 am	--
VAE Criterion	--	Day 1 of stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation	Temp 38.4°C	--	--
Antimicrobial agent	Ceftriaxone	Ceftriaxone	Ceftriaxone	Ceftriaxone	Meropenem	Meropenem	Meropenem	Meropenem

Patient has fulfilled all IVAC criteria, and IVAC should be reported. Date of the IVAC event is hospital day/MV day 7.

5. *What antimicrobial agents are included in the IVAC definition?*

   - See table titled "List of Antimicrobial Agents Eligible for IVAC, Possible and Probable VAP" for a list of the antimicrobial agents eligible for consideration in the IVAC definition (as well as the Possible and Probable VAP definitions).
   - Under definitions section of checklist, see table titled "Definitions of Routes of Administration" for eligible routes of administration.

6. *How do I figure out if an antimicrobial agent is "new" for the IVAC definition?*

   - A new antimicrobial agent is defined as any agent listed in the table titled "List of Antimicrobial Agents Eligible for IVAC, Possible and Probable VAP" that is initiated on or after 3 days of mechanical ventilation AND in the VAE Window Period **(defined by the two days before, the day of, and the two days after the onset date of the VAE—as long as all of these days are on or after the 3rd day of mechanical ventilation).** 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**. The agent must be administered via one of the routes listed in table titled "Definitions of Routes of Administration". See the example in the figure below:

MV Day No.	4	5	6	7	8	9	10	11
VAE Criterion				Onset (day 1) of worsening oxygenation meeting VAE PEEP or FiO_2 thresholds	Day 2 of worsening oxygenation meeting VAE PEEP or FiO_2 thresholds			

Example of the 5-day period during which the first dose of a new antimicrobial agent must be given to meet requirements of IVAC definition

EXAMPLE:

   - A single dose of vancomycin is given to a patient on the VAE onset date (which is the day of onset of worsening oxygenation meeting VAE criteria, in this case MV day 7), and was not given to the patient during the 2 previous days (MV days 5 and 6). Vancomycin is therefore considered a new antimicrobial agent (see figure below).

MV Day No.	4	5	6	7	8	9	10
VAE Criterion	--	Day 1 of stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
Antimicrobial agent	None	None	None	Single dose of vancomycin ordered and administered	None	None	Single dose of vancomycin ordered and administered

A single dose of vancomycin is ordered and administered to the patient within the period defined by the two days before, the day of, and the two days after the VAE onset date. Note that no vancomycin was given in the 2 preceding days, and so vancomycin is a "new" antimicrobial agent for the purposes of the VAE definition.

EXAMPLE:

- If meropenem is given to a patient on the VAE onset date (which is the day of onset of worsening oxygenation meeting VAE criteria, in this case MV day 7), and was not given to the patient during the 2 previous days (MV days 5 and 6), then meropenem is considered a new antimicrobial agent (see figure below). Note that the patient is also receiving ceftriaxone, and receives doses during the 5-day period around the onset of worsening oxygenation (first dose during the 5-day period was on MV day 5). However, because ceftriaxone was given to the patient the day before the 5-day period (on MV day 4), ceftriaxone does not count as a new antimicrobial agent for the purposes of the IVAC definition.

MV Day No.	4	5	6	7	8	9	10
VAE Criterion	--	Day 1 of stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
Antimicrobial agent	Ceftriaxone	Ceftriaxone	Ceftriaxone	Meropenem	Meropenem	Meropenem	Meropenem

First dose of meropenem during the 5-day period around the onset of worsening oxygenation. Note that no meropenem was given in the 2 preceding days, and so meropenem is a "new" antimicrobial agent for the purposes of the VAE definition.

7. *I have figured out that a new antimicrobial agent was given to the patient. How do I determine whether it was continued for 4 days?*

- Make sure you are using the Medication Administration Record. You need to know which antimicrobial agents were actually administered to the patient. Antimicrobial orders or dispensing information is not sufficient.
- You do not need to know the dose or frequency of administration.
- Four consecutive Qualifying Antimicrobial Days (QADs)—starting within the VAE Window Period—are needed to meet the IVAC criterion. A QAD is a day on which the patient was administered an antimicrobial agent that was determined to be "new" within the VAE Window Period. **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 antimicrobial agent.** 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.
- The requirement for 4 consecutive QADs can be met with 4 days of therapy with the same antimicrobial (with a gap of no more than 1 calendar day between administrations of that antimicrobial)—or **it can be met with 4 days of therapy with multiple antimicrobial agents, as long as each antimicrobial was started within the VAE Window Period.**

EXAMPLE:

- In the figure below, meropenem would meet the antimicrobial criterion of the IVAC definition because at least one dose was given on 4 consecutive days.

MV Day No.	1	2	3	4	5	6	7
VAE Criterion	--	Day 1 of Stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
Antimicrobial agent	Ceftriaxone	Ceftriaxone	Ceftriaxone	Meropenem	Meropenem	Meropenem	Meropenem
QAD	No	No	No	Yes	Yes	Yes	Yes

EXAMPLE:

- In the figure below, the 3 drugs shown in bold lettering all qualify as new antimicrobial agents, and therefore the antimicrobial criterion of IVAC is met, since the patient is given 4 consecutive days of new antimicrobial agents.

MV Day No.	1	2	3	4	5	6	7
VAE Criterion	--	Day 1 of Stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
Antimicrobial agent	Ceftriaxone	Ceftriaxone	Ceftriaxone	Meropenem	Imipenem	Piperacillin/ tazobactam	Piperacillin/ Tazobactam
QAD	No	No	No	Yes	Yes	Yes	Yes

EXAMPLE:

- In the figure below, levofloxacin is a new antimicrobial agent (it was started during the VAE Window Period, on MV day 3, and was not given in the 2 days preceding the first day of administration). There are gaps of no more than 1 calendar days between days on which levofloxacin is given, and so the intervening days also count as QADs. In this example, there are 5 QADs (MV days 3-7); therefore the antimicrobial criterion of IVAC is met.

MV Day No.	1	2	3	4	5	6	7
VAE Criterion	--	Day 1 of Stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
Antimicrobial agent			Levofloxacin		Levofloxacin		Levofloxacin
QAD	No	No	Yes	Yes	Yes	Yes	Yes

8. *There are many patients in my ICU with renal insufficiency and/or who are receiving hemodialysis. These patients may receive certain antimicrobial agents on an infrequent dosing schedule (for example, every 48 hours). How do I determine whether they have received 4 consecutive days of new antimicrobial therapy?*

   - See above. You do not need to know the patient's renal function, the dose of the antimicrobial agent, or the frequency of administration. The antimicrobial criterion rules remain the same, regardless of whether patients have renal dysfunction or not.

9. *What if the patient is being given one-time doses of vancomycin? How do I take that into account when using the IVAC surveillance definition?*

- The rules for determining whether the antimicrobial criterion is met do not require that you know the dose or frequency of administration.
- Make sure that vancomycin qualifies as a new antimicrobial agent—that it was not given in the 2 days preceding the day on which vancomycin was given during the VAE Window Period.
- Check to see whether there are 4 consecutive QADs with vancomycin; if there are gaps of no more than 1 calendar day between days on which vancomycin is given, the intervening days may be counted as QADs. If there are gaps of longer than 1 calendar day between days of vancomycin therapy, the requirement for 4 consecutive QADs cannot be met using vancomycin alone—but make sure to check whether the 4 consecutive QAD requirement is met by considering any other antimicrobials being administered to the patient.

EXAMPLE:

- A patient is given a single dose of vancomycin 1 gram IV on MV day 5. Since vancomycin was started on or after day 3 of mechanical ventilation, and no vancomycin was administered on MV days 2, 3 or 4, vancomycin qualifies as a new antimicrobial agent. A second, single dose of vancomycin 1 gram IV is administered on MV day 8. Because there is a gap of more than 1 calendar day between days of vancomycin administration (there is a gap of 2 days in this example), the requirement for 4 consecutive QADs is not met, and therefore the IVAC antimicrobial criterion is not met.

MV Day No.	2	3	4	5	6	7	8	9
VAE Criterion	--	--	Day 1 of Stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
Antimicrobial agent	None	None	None	Vancomycin 1 gram IV x 1 dose	None	None	Vancomycin 1 gram IV x 1 dose	None
QAD	No	No	No	Yes	No	No	Yes	No

10. *Can I report pathogens or secondary BSIs for VAC and IVAC?*

- Pathogens are NOT reported for VAC or IVAC events.
- Secondary BSIs are NOT reported for VAC or IVAC events.

EXAMPLE:

- A patient hospitalized and mechanically-ventilated in the MICU for 14 days develops worsening oxygenation following a 7-day period of stability on the ventilator. VAC criteria are met on hospital day 15 (stable ventilator settings on days 12 and 13, increased ventilator settings on days 14 and 15). The onset date is day 14. The white blood cell count is noted to be 15,500 cells/mm^3 on day 14. Meropenem and vancomycin are begun on day 15, administered through the patient's right-sided central line, which was inserted on ICU admission. The antibiotics continue to be administered on day 18, meeting IVAC criteria. Endotracheal aspirate cultures done

on days 15 and 16 grow scant upper respiratory flora. A blood culture collected on day 15 is positive for *Klebsiella oxytoca*. There are no other signs or symptoms of infection. This patient should be reported as having an IVAC and a central line-associated BSI. The BSI cannot be reported as secondary to the IVAC event.

11. *Can I report pathogens for Possible and Probable VAP?*

- Pathogens may be reported for Possible and Probable VAP events, provided they are isolated or identified from appropriate specimen types according to the requirements of the algorithm and are NOT on the list of excluded organisms and culture results:
  - Excluded organisms and culture results that cannot be used to meet the Possible or Probable VAP definitions are as follows: "Normal respiratory flora," "normal oral flora," "mixed respiratory flora," "mixed oral flora," "altered oral flora" or other similar results indicating isolation of commensal flora of the oral cavity or upper respiratory tract; *Candida* species or yeast not otherwise specified; coagulase-negative *Staphylococcus* species; and *Enterococcus* species, when isolated from cultures of sputum, endotracheal aspirates, bronchoalveolar lavage, or protected specimen brushings.

NOTE: When *Candida* species or yeast not otherwise specified, coagulase-negative *Staphylococcus* species or *Enterococcus* species are isolated from cultures of lung tissue or pleural fluid, these organisms may be reported as Possible or Probable VAP pathogens.

- See table titled "Threshold Values for Cultured Specimens Used in the Probable VAP Definition" for the required quantitative culture thresholds associated with various specimen types in the Probable VAP definition. Note that if your laboratory reports semi-quantitative culture results, you should check with your laboratory to confirm that semi-quantitative results match the quantitative thresholds noted in the table titled "Threshold Values for Cultured Specimens Used in the Probable VAP Definition".

12. *Can I report secondary BSIs for Possible and Probable VAP?*

- Secondary BSIs may be reported for Possible and Probable VAP events, provided that the organism isolated from the blood culture matches an organism isolated from an appropriate respiratory tract specimen (including respiratory secretions, pleural fluid and lung tissue). The respiratory tract specimen must have been collected within 2 calendar days before or after the day of onset of worsening oxygenation to be considered as a criterion for meeting the Possible or Probable VAP definitions. In addition, **the positive blood culture must have been collected during the 14-day event period, where day 1 is the day of onset of worsening oxygenation.**
  - In cases where Possible VAP is met with only the purulent respiratory secretions criterion and no culture is performed, and there is also a positive blood culture during the 14-day event period, a secondary BSI is not reported because there was no matching respiratory tract culture.
  - In cases where Probable VAP is met with only the histopathology criterion and no culture is performed, and there is also a positive blood culture, a secondary BSI is not reported.

- In cases where a culture of respiratory secretions, pleural fluid or lung tissue is performed but is negative or does not grow an organism that matches an organism isolated from blood, a secondary BSI is not reported.

NOTE: *Candida* species or yeast not otherwise specified, coagulase-negative *Staphylococcus* species, and *Enterococcus* species cultured from blood cannot be deemed secondary to a Possible or Probable VAP, unless the organism was also cultured from pleural fluid or lung tissue.

EXAMPLE:

- Patient hospitalized and mechanically ventilated in the MICU for 14 days develops worsening oxygenation following a 7-day period of stability on the ventilator. VAC criteria are met on hospital day 15 (stable ventilator settings on days 12 and 13, increased ventilator settings on days 14 and 15). The onset date is day 14. The white blood cell count is noted to be 15,500 cells/mm^3 on day 14. Meropenem and vancomycin are begun on day 15, administered through the patient's right-sided central line (inserted on ICU admission). The antibiotics continue to be administered on day 18, meeting IVAC criteria. Endotracheal aspirate specimens collected on days 15 and 16 grow heavy *Klebsiella oxytoca*. Endotracheal aspirate quality is not reported. A blood culture collected on day 15 is positive for *K. oxytoca*. This patient should be reported as having a Possible VAP with a secondary BSI due to *K. oxytoca*.
- Patient hospitalized and mechanically ventilated in the MICU for 14 days develops worsening oxygenation following a 7-day period of stability on the ventilator. VAC criteria are met on hospital day 15 (stable ventilator settings on days 12 and 13, increased ventilator settings on days 14 and 15). The onset date is day 14. The white blood cell count is noted to be 15,500 cells/mm^3 on day 14. Meropenem and vancomycin are begun on day 15, administered through the patient's right-sided central line (inserted on ICU admission). The antibiotics continue to be administered on day 18, meeting IVAC criteria. A thoracentesis is performed on day 15 at the patient's bedside using aseptic technique. Pleural fluid is sent for culture and grows *Candida albicans*. A blood culture collected on day 16 is positive for *C. albicans*. This patient should be reported as having a Probable VAP with a secondary BSI due to *C. albicans.*
- Patient hospitalized and mechanically ventilated in the MICU for 14 days develops worsening oxygenation following a 7-day period of stability on the ventilator. VAC criteria are met on hospital day 15 (stable ventilator settings on days 12 and 13, increased ventilator settings on days 14 and 15). The onset date is day 14. The white blood cell count is noted to be 15,500 cells/mm^3 on day 14. Meropenem and vancomycin are begun on day 15, administered through the patient's right-sided central line (inserted on ICU admission). The antibiotics continue to be administered on day 18, meeting IVAC criteria. An endotracheal aspirate collected on day 15 is a good quality specimen, with ≥ 25 neutrophils and ≤ 10 squamous epithelial cells per low power field, and grows *Staphylococcus aureus* (qualitative result). A blood culture collected on day 24 is positive for *S. aureus* and for coagulase-negative

staphylococci (CoNS). This patient should be reported as having a Possible VAP, with *S. aureus* reported as the pathogen. A secondary BSI should also be reported for the Possible VAP, since the positive blood culture was collected within the 14-day period of the VAE, and an organism isolated from blood (*S. aureus*) matched an organism isolated from culture of the endotracheal aspirate. The CoNS also isolated from the blood culture on day 24 is not reported as a pathogen for the Possible VAP because it is an excluded organism.

13. *Can I only report pathogens if they are isolated in cultures of appropriate specimens? What about pathogens identified by non-culture-based diagnostic testing?*

- Probable VAP is the only VAE definition that incorporates results of non-culture-based microbiological diagnostic testing. For Probable VAP, pathogens that are grown in culture OR that are identified as a result of other laboratory testing (e.g., antigen testing, PCR, immunohistochemistry, etc.) should be reported. Do not limit reporting to just those organisms isolated in culture. For example, influenza A identified by polymerase chain reaction (PCR) in a patient meeting probable VAP criteria should be reported as a pathogen for that event.

14. *The "Probable VAP" criteria include "positive diagnostic tests" for Legionella species, and selected viruses. What kinds of diagnostic tests can be used to meet the definition?*

- Diagnostic testing practices may vary from facility to facility and change over time as better tests are developed. Listed here are some examples of diagnostic tests for specific pathogens included in the Probable VAP definition. Positive results of these tests may be used in meeting the Probable VAP definition. Your facility may use other testing methods; positive results obtained using these methods may also be appropriate for use in meeting the Probable VAP definition. If you have a question regarding a diagnostic test method, check with your laboratory.
- For *Legionella* species, positive results of any of the following, performed on the appropriate specimen: urinary antigen, *Legionella*-specific respiratory culture, paired serology (4-fold rise in titer between acute and convalescent specimens), direct fluorescent antibody stain, immunohistochemistry stain, or nucleic acid detection assays (such as PCR) performed on a respiratory specimen.
- For respiratory viruses (influenza, respiratory syncytial virus [RSV], parainfluenza viruses, human metapneumovirus, coronaviruses, rhinoviruses and adenovirus), positive results for any of the following:
  - Performed on an appropriate respiratory specimens – PCR or other viral nucleic acid detection methods, antigen detection methods, including rapid tests, viral cell culture, or
  - Performed on appropriate pathologic specimens – immunohistochemical assays, cytology, microscopy, or
  - Performed on appropriately timed paired sera (acute and convalescent) – serological assays demonstrating seroconversion or a significant rise in antibody titer.

15. *What about pneumonitis that occurs in a mechanically-ventilated patient and is determined to be due to herpes simplex virus (HSV) or cytomegalovirus (CMV)? Can these infections be reported as VAEs?*

    - In most cases pneumonitis due to HSV and CMV represents reactivation of a latent infection, and therefore would not be considered healthcare-associated, according to the NHSN definition of a healthcare-associated infection.

16. *Are there any culture results or microorganisms that CANNOT be used to meet the Possible and Probable VAP definitions?*

    - The following pathogens and culture results may NOT be used to meet the definitions and may NOT be reported as causes of Possible or Probable VAP when they are obtained from cultures of sputum, endotracheal aspirates, bronchoalveolar lavages or protected specimen brushings:
      - Culture results reported as “Normal respiratory flora,” “normal oral flora,” “mixed respiratory flora,” “mixed oral flora,” “altered oral flora” or other similar results indicating isolation of commensal flora of the oral cavity or upper respiratory tract.
      - *Candida* species or yeast not otherwise specified
      - Coagulase-negative *Staphylococcus* species
      - *Enterococcus* species

    NOTE:

    - These organisms are excluded because they are common upper respiratory tract commensals, colonizers or contaminants, and are unusual causes of VAP. Their exclusion from the surveillance definitions should NOT be used in clinical decision-making regarding patient treatment. Providers must independently determine the clinical significance of these organisms isolated from respiratory specimen cultures and the need for treatment.
    - When *Candida* species or yeast not otherwise specified, coagulase-negative *Staphylococcus* species or *Enterococcus* species are isolated from cultures of lung tissue or pleural fluid, these organisms may be reported as Possible or Probable VAP pathogens.

    - When sputum, endotracheal aspirate, bronchoalveolar lavage or protected specimen brushing culture results are mixed and contain one or more of the excluded pathogens in addition to one or more non-excluded pathogens, the culture may be used to meet the Possible or Probable VAP definition (depending on whether a qualitative, semi-quantitative or quantitative culture was performed, and whether the semi-quantitative or quantitative cfu/ml thresholds were met) BUT only the non-excluded pathogen(s) should be reported.

    EXAMPLE:

    - Patient intubated and mechanically ventilated in the MSICU meets IVAC criteria on day 8 of mechanical ventilation. On the day after the onset of worsening

oxygenation, an endotracheal aspirate is collected. The gram stain shows ≥25 neutrophils and ≤10 squamous epithelial cells per low power field, and the culture grows "heavy *Staphylococcus aureus*" and "heavy *Candida albicans*." This patient should be reported as having a Probable VAP due to *Staphylococcus aureus* – as long as the semi-quantitative result "heavy" is equivalent to the quantitative threshold of ≥105 cfu/ml for endotracheal aspirates. *Candida albicans* from the endotracheal aspirate culture is not reported, because it is an excluded result.

17. *What about pleural fluid cultures and lung tissue cultures? Can I report any pathogen isolated from a lung tissue culture, or from a pleural fluid culture, assuming the specimen was obtained during thoracentesis or at the time of chest tube insertion?*

- Any pathogen cultured from lung tissue, when that lung tissue was obtained during an open lung biopsy, video-assisted thoracoscopic surgery, or via other transthoracic or transbronchial biopsy approach, may be reported.
- Any pathogen cultured from pleural fluid, when that fluid was obtained during thoracentesis or at the time of initial chest tube insertion, may be reported.

18. *How are "purulent respiratory secretions" defined?*

- Purulent respiratory secretions used to meet Possible and Probable VAP definitions are specifically defined as:
  - Defined as secretions from the lungs, bronchi, or trachea with ≥25 neutrophils and ≤10 squamous epithelial cells per low power field [lpf, x100].
  - If the laboratory reports semi-quantitative results, you should check with your laboratory to be certain that the semi-quantitative results match the quantitative thresholds noted above.
- if your laboratory is not able to provide additional information on how a semi-quantitative reporting system corresponds to quantitative reporting ranges for neutrophils and squamous epithelial cells, here is some guidance from the *Clinical Microbiology Procedures Handbook* (3rd ed., 2010)*:

  1+ = occasional or rare = <1 cell per low power field [lpf, x100]
  2+ = few = 1-9 cells per low power field [lpf, x100]
  3+ = moderate = 10-25 cells per low power field [lpf, x100]
  4+ = heavy = >25 cells per low power field [lpf, x100]

  - With this range in mind, and in the absence of additional information from your laboratory, "purulent respiratory secretions" are defined as secretions that contain heavy, 4+ or ≥25 neutrophils per low power field [lpf, x100] AND rare, occasional, few, 1+ or 2+, or ≤10 squamous epithelial cells per low power field

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

- If your laboratory uses a different reporting format for results of direct examination of respiratory secretions, you may still be able to use the purulent respiratory secretions in meeting the Possible and Probable VAP definitions. See the instructions available in

the table titled "instructions for using the purulent respiratory secretions criterion, based on laboratory reporting of respiratory secretion direct examination results."

19. *What is the definition of "positive lung histopathology" that can be used to meet the Probable VAP definition?*

- if the lung tissue specimen was obtained via open lung biopsy, video-assisted thoracoscopic surgery, or via other transthoracic or transbronchial biopsy approach, it is eligible for consideration in meeting the Probable VAP definition.
- Histopathological findings that can be used to meet the possible and probable VAP definitions include:
  - 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 the viral pathogens listed in FAQ no. 14 based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue.

20. *I am still having trouble understanding the time frame that defines a VAE. Can you explain what is meant by this statement that appears in the algorithm:* "On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation"?

- The intent of these criteria is to determine whether a VAC is due to an infectious process (IVAC) and/or pneumonia (Possible or Probable VAP) by looking for corroborating inflammatory and infectious signs at the time of VAC onset. The criterion, "on or after calendar day 3" is intended to exclude inflammatory and infectious signs present on the first two days of mechanical ventilation because they are more likely to be due to pre-existing conditions than ventilator-acquired complications. The criterion, "within 2 calendar days before or after the onset of worsening oxygenation," is intended to identify infectious and inflammatory signs that arise at the same time as VAC and may therefore point to the cause of the VAC.
- The figures below illustrate the time frame that defines a VAE. The event date is the first day of worsening oxygenation, defined by the PEEP and FiO_2 thresholds outlined in the algorithm. The event date defines the time frame within which all other criteria must be met. In the examples below, the shaded area defines the VAE Window Period in which IVAC criteria (temperature or white count abnormalities, plus a new antimicrobial agent started and continued for at least 4 days) must be met, and in which Possible or Probable VAP criteria must be met.

NOTE: Keep in mind that VAE criteria must be met based on specimens collected or antimicrobial agents started after day 2 of mechanical ventilation.

EXAMPLE 1:

- When the onset date of the VAE occurs early in the course of mechanical ventilation (e.g., day 3 or 4 of mechanical ventilation), the period in which certain

inflammatory and infectious criteria are sought for IVAC and possible or probable VAP is shorter, because the first 2 days of mechanical ventilation are excluded from the normal 5 day window surrounding the day of increased ventilator support.

MV Day No.	1	2	3	4	5	6	7
Worsening oxygenation	--	Day 1 of Stability or improvement	Day 2 of stability or improvement	Day 1 of worsening oxygenation	Day 2 of worsening oxygenation		
Temperature abnormality or white blood cell count abnormality			←An abnormal temperature or white blood cell count, according to the algorithm parameters, must be documented within this shaded period→				
Antimicrobial agent			←New agent must be started on any day within this shaded period, and then continued for at least 4 days→				
Purulent respiratory secretions, positive culture, positive histopathology			←Specimen must be collected on any day within this shaded period→				

EXAMPLE 2:

- When the onset date of the VAE occurs later in the course of mechanical ventilation, the period in which certain criteria must be met is a day longer, because the patient has already been on mechanical ventilation for more than 3 days and therefore inflammatory and infectious signs arising anywhere in the full 5-day window surrounding the day of increased ventilator settings can count towards IVAC and possible or probable VAP.

MV Day No.	10	11	12	13	14	15	16
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 abnormality or white blood cell count abnormality		←An abnormal temperature or white blood cell count, according to the algorithm parameters, must be documented within this shaded period→					
Antimicrobial agent		←New agent must be started on any day within this shaded period, and then continued for at least 4 days→					
Purulent respiratory secretions, positive culture, positive histopathology		←Specimen must be collected on any day within this shaded period→					

21. *Providers in my ICU use different types of mechanical ventilation for different patients. Can you explain the circumstances in which mechanically-ventilated patients are to be excluded from VAE surveillance, and the circumstances in which mechanically-ventilated patients should be included in VAE surveillance?*

- Remember that the VAE surveillance algorithm is for surveillance of adult patients on mechanical ventilation, in acute care and long-term acute care hospitals and inpatient rehabilitation facilities. Children (<18 years of age) are excluded from surveillance.
- Patients are excluded from surveillance if they are receiving high frequency ventilation, or if they are receiving extracorporeal life support (extracorporeal membrane oxygenation).
- Patients are included in surveillance if they are on a ventilator (as defined in the VAE surveillance protocol), and are being mechanically ventilated through an endotracheal or tracheostomy tube using a conventional mode of mechanical ventilation (such as volume controlled, pressure controlled, or pressure support mechanical ventilation).

- Patients on conventional mechanical ventilation who are receiving nitric oxide or epoprostenol therapy are included in surveillance.
- Patients on conventional mechanical ventilation who are being ventilated in the prone position are included in surveillance.

- Patients are also included in surveillance if they are on a ventilator (as defined in the VAE surveillance protocol), and are being mechanically ventilated through an endotracheal or tracheostomy tube using Airway Pressure Release Ventilation (APRV) or related modes. Some terms that are used to indicate APRV or a related mode of mechanical ventilation include (but may not be limited to): BiLevel, Bi Vent, BiPhasic, PCV+, and DuoPAP.
  - For patients on APRV or related modes, the period of worsening oxygenation following a period of stability or improvement on the ventilator that is required for identification of a VAE will be defined by the FiO_2 criterion within the VAE surveillance definition algorithm. The PEEP criterion may not be applicable in patients on APRV or related modes of mechanical ventilation.
- If you have questions about mechanical ventilation, you should check with the Respiratory Care or Respiratory Therapy and/or Critical Care departments in your facility.

22. *Why do I need to indicate if a patient was on APRV at the time of VAE onset, and why do I need to indicate the number of patients on APRV in my ICU for each day of VAE surveillance?*

- We are trying to find out more about how frequently APRV and related modes of mechanical ventilation are being used, and the frequency with which VAEs are identified in patients on APRV and related modes, to determine whether the VAE surveillance definition algorithm may need to be modified in the future.
- If the VAE occurred in a patient on Airway Pressure Release Ventilation (APRV) or a related mode of mechanical ventilation (e.g., BiLevel, Bi Vent, BiPhasic, PCV+, DuoPAP) at the time of VAE onset, indicate "Yes" in the "APRV" field on the VAE Form (CDC 57.112). Otherwise, indicate "No."
- On the appropriate denominator form (CDC 57.117 or 57.118), in the column for "Number of patients on a ventilator," you will see that there are two sub-columns. In the sub-column, "Total patients," enter the total number of patients on a ventilator on that day. In the sub-column, "Number on APRV," enter the number for the subset of patients on a ventilator on that day who are on the APRV mode of mechanical ventilation or related modes (e.g., BiLevel, Bi Vent, BiPhasic, PCV+, DuoPAP) at the time the count is performed. If there are no patients on APRV or a related mode of mechanical ventilation, enter "0" (zero).

23. *My laboratory only performs semi-quantitative cultures of lower respiratory tract specimens, and cannot provide me with additional guidance to help me know what semi-quantitative culture result corresponds to the quantitative thresholds specified in the Probable VAP definition. Can you provide more information?*

- For the purposes of this surveillance, and 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, meets the Probable VAP definition when accompanied by purulent respiratory secretions as defined in the protocol (see FAQ no. 19).

Ventilator-Associated Events (VAE) Supplemental Frequently-Asked Questions: ***(Last updated March 2013)***

1. *If a patient is receiving mechanical ventilator support using Airway Pressure Release Ventilation (APRV) or a related type of mechanical ventilation intermittently (i.e., for less than an entire calendar day), how do I determine the daily minimum FiO_2 and PEEP values? Do I totally disregard PEEP?*

   You would only disregard PEEP values on calendar days when the patient was mechanically ventilated using APRV or a related type of mechanical ventilation for the entire calendar day (i.e. from midnight through 11:59 pm). On calendar days when the patient was on APRV for the entire day, you will not record a daily minimum PEEP—you will enter "Not applicable" in your worksheet column for daily minimum PEEP for that particular day.

   Note that while patients are mechanically ventilated using APRV or a related strategy (including modes such as BiLevel, Bi Vent, BiPhasic, PCV+, and DuoPAP), they are not excluded from VAE surveillance—but when assessing these patients for VAE, you will use only FiO_2 data to identify periods of stabilization or improvement and worsening. In some cases, patients may be mechanically ventilated using APRV or a related strategy for a portion of a calendar day, but not for the entire calendar day. In these instances, you should look at all FiO_2 data recorded for the entire calendar day when selecting the daily minimum FiO_2, and you should look at the portion of the calendar day when the patient was NOT on APRV or a related mechanical ventilation (strategy) to select the daily minimum PEEP. In other words, when recording the daily minimum PEEP for a patient who spent part of the day on APRV and part of the day on a conventional type of mechanical ventilation (e.g., Assist Control Ventilation, Intermittent Mandatory Ventilation, etc.), you will review PEEP values just from the portion of the day when the patient was on a conventional type of mechanical ventilation.

   For example, on January 1 a patient is switched from conventional mechanical ventilation at 11:00 am to APRV. The patient stays on APRV until January 2 at 11 pm, when he is switched back to conventional mechanical ventilation. You will review the FiO_2 data from the entire day on January 1 and January 2, and the PEEP data that were recorded for the period from midnight to 10:59 am on January 1 (since the patient was on conventional mechanical ventilation during this time) and from 11:00 pm to 11:59 pm on January 2 (since the patient was back on conventional mechanical ventilation at this time). You will be able to assign a daily minimum PEEP for each of these days, based on the time spent on conventional mechanical ventilation, and a daily minimum FiO_2, based on each entire calendar day, and review both PEEP and FiO_2 data to determine whether there is a VAE.

   Here is another example: On January 1 a patient is switched from conventional mechanical ventilation at 11:00 am to APRV. The patient stays on APRV all day on January 2, and on January 3 until 11 pm, when he is switched back to conventional mechanical ventilation. In this example, you will (as above) have PEEP data to review for January 1 and for January 3, based on the amount of time the patient was on conventional mechanical ventilation. But because the patient was on APRV all day on January 2, the reality is that you will need to rely on the FiO_2 to determine whether there is a VAE during that period of days (because there is a gap in PEEP data, you'd have to start over looking for a baseline period in PEEP on January 3).

2. *I know patients on high frequency ventilation (HFV) and extracorporeal life support (ECLS, such as ECMO) are excluded from VAE surveillance—but what if they are on HFV or ECLS for part (but not all) of a calendar day? How do I determine when such patients are eligible for inclusion in VAE surveillance?*

   In some cases, patients may be on HFV or ECLS for a portion of a calendar day, but not for the entire calendar day. In these instances, the patient is eligible for inclusion in VAE surveillance during the portion of the calendar day when the patient was being mechanically ventilated using a conventional type of mechanical ventilation (not HFV) and was not on ECLS. You should review the FiO_2 and PEEP data recorded for the portion of the calendar day when the patient was NOT on HFV or ECLS to select the daily minimum FiO_2 and PEEP. Once the patient has been switched to HFV or placed on ECLS, he/she is no longer included in VAE surveillance. On calendar days when the patient was on HFV or ECLS for the entire day (i.e., midnight to 11:59 pm), you will not record a daily minimum FiO_2 or PEEP—you will enter "Not applicable" or "Not eligible for surveillance" in your worksheet column for daily minimum FiO2 and PEEP for that particular day. Once the patient has been switched back from HFV to a conventional type of mechanical ventilation, or once the patient is no longer on ECLS, VAE surveillance may resume. If the patient has been on HFV or ECLS for one or more calendar days (such that there is a gap in recording of the daily minimum FiO_2 and PEEP), then you will essentially need to start over with VAE surveillance and identify a baseline period of stability or improvement on the ventilator before you can detect a VAE.

   For example, if the patient was on conventional mechanical ventilation on January 10 until 10:00 am, switched to HFV at 10:00 am, remained on HFV till 1:00 pm on January 11 and was then placed back on a conventional mode of mechanical ventilation, you would be able to evaluate the PEEP and FiO2 values recorded for the patient from midnight to 10:00 am on January 10 (period on conventional mechanical ventilation) and from 1:00 pm to 11:59 pm on January 11 (period on conventional mechanical ventilation) when looking for VAEs.

   If a patient was on HFV for the entire calendar day on January 10 and January 11, then you would exclude them from VAE surveillance. Once the patient returns to conventional mechanical ventilation for some portion of each calendar day you could again begin to include in VAE surveillance and once again begin daily assessment for the minimum daily PEEP and FiO_2 values obtained when the patient was on the conventional mode of ventilation. Upon return to conventional mode of mechanical ventilation, note that a new episode of mechanical ventilation would begin. To meet VAE during this new episode of mechanical ventilation, the patient would have to have at least 2 days of stability or improvement and at least 2 days of worsening oxygenation on the ventilator identified.

3. *Are patients included in VAE surveillance during periods of time when they are undergoing weaning/mechanical ventilation liberation trials?*

   Yes. As long as the patient is receiving support from a mechanical ventilator and is eligible for VAE surveillance, then you should review all FiO_2 and PEEP data that are recorded each day to identify the daily minimum FiO_2 and PEEP values—including FiO_2 and PEEP values that are recorded during periods of time when the patient is undergoing spontaneous awakening or spontaneous breathing trials (or other forms of weaning from mechanical ventilation). The only periods of time that are not taken into consideration when identifying the daily minimum PEEP and FiO_2 values are times when the patient is on HFV, ECLS, or times 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). Keep in mind, too, that during periods of time when the patient is being mechanically-ventilated using APRV or a related strategy (see FAQ #1, above), you will only review FiO_2 data (not PEEP).

4. *I have a patient who meets the VAC definition, and I am now assessing the patient's information to see if the IVAC definition is met. The patient has had an elevated temperature (or white blood cell count) since admission. The patient also has an elevated temperature (or white blood cell count) during the VAE Window Period. Since the abnormal temperature (or white blood cell count) was present on admission, do I still count the abnormal temperature (or white blood cell count) during the VAE Window Period when determining if the patient meets the IVAC definition?*

   Yes. As long as there is an abnormal temperature (>38°C or <36°C) or white blood cell count (≥12,000 cells/mm^3 or ≤4,000 cells/mm^3) documented during the VAE Window Period, it should be used in determining whether the patient meets the IVAC definition or not, regardless of whether the temperature or white blood cell count was also present on admission.

5. *What happens if a patient dies before ≥4 Qualifying Antimicrobial Days (QADs) are met? If the antimicrobial agent was intended to be given such that the requirement for ≥4 QADs would have been satisfied, do I report an IVAC or VAC?*

   No. In a patient who has met the VAC definition and has additionally met the temperature and/or WBC requirement for IVAC but dies prior to meeting the requirement for ≥4 Qualifying Antimicrobial Days, the IVAC criteria are not fulfilled. In this instance a VAC (not an IVAC) would be reported to NHSN.

6. *What is meant by "minimum daily value" when referring to PEEP and FiO_2?*

   There will be multiple FiO_2 and PEEP measurements documented each calendar day on mechanically ventilated patients. These FiO_2 and PEEP values 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. Please note that the VAE surveillance protocol specifies to 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. From the multiple readings that will be documented each calendar day, you will identify the minimum (i.e., lowest) value for that calendar day. You are not comparing values that occur within a calendar day to determine stability, improvement or worsening. Operationally you will always be collecting/recording/evaluating those values, at the earliest, one day in arrears so that you can allow for the values obtained for the full 24 hour calendar day to be assessed.

   Here is an example of mechanical ventilator data from a single day, May 10:

	12 am	3 am	6 am	9 am	12 pm	3 pm	6 pm	9 pm
MV mode	ACV	ACV	ACV	ACV	ACV	ACV	ACV	ACV
FiO_2	1.0	1.0	0.80	0.80	0.80	0.75	0.80	0.70
PEEP	8	8	8	8	8	5	5	8

In this example, the daily minimum FiO2 for May 10 would be recorded as 0.70 (70%), and the daily minimum PEEP would be recorded as 5 cmH_2O. Note that the daily minimum FiO_2 may have been documented at a different time than the daily minimum PEEP (as in the example above). You will compare the minimum daily value from day to day within the individual parameters (PEEP and FiO_2), looking for a period of stabilization or improvement in PEEP followed by a period of worsening oxygenation in PEEP, or a period of stabilization or improvement in FiO_2 followed by a period of worsening in FiO_2.

7. *If a patient is admitted with community-acquired pneumonia requiring intubation and mechanical ventilation, is that patient exempt from VAE surveillance until the pneumonia has resolved?*

   No. Tracking of daily minimum PEEP and FiO_2 should be done for all patients who are eligible for VAE surveillance in units in which in-plan VAE surveillance is being conducted, regardless of the reason for which the patient was admitted.

8. *I am confused about the different lower respiratory tract events that have definitions in NHSN—PNEU, LRI and VAE. Can you explain to me how these do (or do not) relate to one another?*

   We know this can be an area of confusion. Revising surveillance definitions for respiratory events is a big undertaking, because we need to consider events occurring in patients on mechanical ventilation and events occurring in patients NOT on mechanical ventilation, and we have to consider events that occur in adults and events that occur in neonates and in children. The first area that we decided to work on is respiratory events in adult patients on mechanical ventilation. We still have a lot of work to do to revamp surveillance for respiratory events occurring in patients not on mechanical ventilation, and respiratory events occurring in neonates and children.

   Let's review what is available for in-plan or off-plan surveillance of lower respiratory tract events in NHSN. Keep in mind that "in-plan" surveillance means that you have committed to following the NHSN surveillance protocol for that particular event in your NHSN monthly reporting plan. "Off-plan" surveillance is surveillance that is done because you/your facility has decided to track a particular event for internal use. Data that are entered into NHSN "off-plan" are not used or reported on in NSHN annual reports or other NHSN publications. A facility makes no commitment to follow the protocol for "off-plan" events.

   What lower respiratory tract event surveillance can be done "in-plan" in 2013"?

   1) VAE: VAE surveillance in 2013 is what NHSN has available for in-plan surveillance of respiratory events occurring in patients on mechanical ventilation who are being cared for in adult patient locations. This is currently the ONLY in-plan respiratory event surveillance for adults.
   2) Pediatric VAP: Pediatric VAP surveillance using the PNEU/VAP definitions continues to be available in 2013 for in-plan surveillance of VAP in neonatal or pediatric locations. This is currently the ONLY in-plan respiratory event surveillance for children.

   What lower respiratory tract event surveillance can be done "off-plan" in 2013?

   1) VAE: VAE surveillance can also be done "off-plan" in adult patient locations.
   2) VAP: Surveillance for PNEU/VAP (using the "old" definitions) continues to be available in 2013 for off-plan surveillance in mechanically-ventilated adults or children, for those units who have a particular need to continue monitoring these events. NHSN encourages facilities to switch to VAE for surveillance in adult patient locations.

3) PNEU: Surveillance for PNEU (using the "old" definitions) continues to be available in 2013 for off-plan surveillance in non-mechanically-ventilated adults and children. 4) LRI: Surveillance for non-pneumonia lower respiratory infections (using the BRON and LUNG definitions) continues to be available in 2013 for off-plan surveillance in adults and children.

Can I conduct surveillance for VAE and PNEU and LRI in the same unit?

In theory, yes, although you may wish to consider whether this is the best use of resources. For example, it is possible for a particular unit to be conducting simultaneous in-plan VAE surveillance and off-plan PNEU and LRI surveillance. These are considered separate events; in other words, detection of one type of event (such as a VAE) in a particular patient would have no bearing on the conduct of surveillance for the other event types in the same patient. Keep in mind that there are specific reporting requirements for the older definitions, PNEU and LRI, such that patients with radiographic evidence of pneumonia are not eligible to meet the LRI-BRON definition, and patients who meet a PNEU definition as well as the LRI-LUNG definition are to be reported as PNEU. Patients who meet a VAE definition and a PNEU definition, or a VAE definition and an LRI definition, would have both events entered into NHSN in units where surveillance for multiple respiratory events is occurring.

9. *What about bloodstream infections occurring in patients who are also under surveillance for lower respiratory tract events? How do I handle the reporting of secondary bloodstream infections in these patients?*

We know this can be an area of confusion. Revising surveillance definitions for respiratory We understand this is also an area of confusion. To figure out whether a positive blood culture can be called a secondary bloodstream infection (BSI) related to a lower respiratory tract event, consider the following steps:

1) Does the patient meet any of the VAE definitions?

a. If the Possible or Probable VAP definition is met, then you may attribute the blood culture to the VAE (as a secondary BSI) IF the blood culture meets the various requirements as outlined in the VAE protocol—the organism isolated from blood must match an organism isolated from the respiratory tract culture used in meeting the Possible or Probable VAP definition AND the blood culture must be collected during the 14-day VAE event period.

b. If only the VAC or IVAC definition is met, then the positive blood culture CANNOT be secondary to the VAE (because recall that according to the VAE surveillance protocol, BSIs cannot be deemed secondary to VAC or to IVAC).

2) If the Possible VAP or Probable VAP definition is met, then the positive blood culture cannot be secondary to a PNEU or an LRI. It must either be secondary to the VAE (if it meets the VAE secondary BSI criteria outlined in the protocol and summarized in 1a, above), or secondary to one of the other non-respiratory major sites, or it may be a primary BSI/CLABSI.

3) If only the VAC or IVAC definition is met, or if no VAE definition is met, then the positive blood culture can be evaluated to see if it is secondary to any of the major sites as defined in Chapter 17 — including PNEU or LRI. If the patient does not meet one of these other definitions, the BSI may need to be reported as a primary BSI/CLABSI.