Frequently Asked Questions: Ventilator-Associated Events (VAE)

	Topic	Question	Response
1	**Antimicrobial Agent Appendix**	What is the rationale for the antimicrobial agents included in the Appendix?	The antimicrobial criterion is one of the required criteria in the Infection-related Ventilator-Associated Complication (IVAC) definition. The IVAC definition was not originally developed to identify respiratory infections alone, and therefore, the list of antimicrobial agents eligible for meeting the IVAC antimicrobial criterion was broad, and included drugs that are not used to treat respiratory infections. This caused concern and confusion among some users—particularly in situations where the "new" antimicrobial agent that resulted in an IVAC determination and then subsequently a PVAP determination was not an agent used to treat a respiratory infection. To avoid increasing the complexity of this already complex criterion the list was refined and selected antimicrobial agents: oral cephalosporins and penicillins, erythromycin and erythromycin/sulfisoxazole, amantadine, rimantadine, chloramphenicol, tinidazole, fidaxomicin, nitrofurantoin, enteral vancomycin, and daptomycin were removed. These are agents that would not be used, or would be unlikely to be used, in treating a lower respiratory infection in a critically ill patient.
2	**Antimicrobial Agent**	Do I need to know why the antimicrobial agent was administered? Must it have been administered to treat a lower respiratory tract infection?	No. With the IVAC definition, the intent is not to specifically identify infectious events arising from the respiratory tract—it is to identify an event that may be infectious in nature (whether arising from the lungs or elsewhere) that is associated with a period of respiratory deterioration. Any antimicrobial agent that is found in the antimicrobial agent appendix and is administered within the correct timeframe and for the required period of time stated in the protocol will be used to satisfy the antimicrobial criteria for IVAC. Therefore, when determining if a patient satisfies the IVAC definition, there is no need to discern the reason for the administration of the antimicrobial.

	Topic	Question	Response
3	**QADs**	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?	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.
4	**APRV**	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 FiO2 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. Likewise, when using the online VAE Calculator, do not enter a daily minimum PEEP value on days when the patient was on APRV for the entire calendar day. Leave the PEEP field in the VAE Calculator empty/blank for these days. 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 FiO2 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 FiO2 data recorded for the entire calendar day when selecting the daily minimum FiO2, 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

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			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 FiO2 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 FiO2, based on each entire calendar day, and review both PEEP and FiO2 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 FiO2 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).

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5	**Excluded Ventilator Modes**	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 FiO2 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 FiO2 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 FiO2 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 FiO2 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 FiO2 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

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			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.
6	**Weaning/Mechanical Ventilation Liberation Trials and VAE**	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 FiO2 and PEEP data that are recorded each day to identify the daily minimum FiO2 and PEEP values—including FiO2 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 FiO2 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 the APRV FAQ), you will only review FiO2 data (not PEEP).

	Topic	Question	Response
7	**Daily Minimum Values**	What is meant by "daily minimum value" when referring to PEEP and FiO2?	Definitions of "daily minimum PEEP" and "daily minimum FiO2" can be found in the VAE Protocol. Please refer to the VAE Protocol for details. There will be multiple FiO2 and PEEP measurements documented each calendar day on mechanically ventilated patients. These FiO2 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 FiO2 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 that is maintained for at least 1 hour. To determine whether a PEEP or FiO2 setting has been maintained for at least 1 hour, you will need multiple consecutive recordings of that PEEP or FiO2 setting. For example, if PEEP/FiO2 settings are monitored and recorded every 15 minutes, you would need 5 consecutive recordings of a particular PEEP/FiO2 setting for that setting to be identified as the daily minimum setting (e.g., at 09:00, 09:15, 09:30, 09:45 and 10:00). If PEEP/FiO2 settings are monitored and recorded every 30 minutes, you would need 3 consecutive recordings (e.g., at 09:00, 09:30 and 10:00). If PEEP/FiO2 settings are monitored and recorded hourly, you would need 2 consecutive recordings (e.g., at 09:00 and 10:00). You are not comparing values that occur within a calendar day to determine stability, improvement or worsening. Operationally you will always be

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			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. You will compare the daily minimum value from day to day within the individual parameters (PEEP and FiO2), 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 FiO2 followed by a period of worsening in FiO2. Consider the following examples: **Example # 1** (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
FiO2	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 cmH2O. Note that the daily minimum FiO2 may have been documented at a different time than the daily minimum PEEP (as in the example above).

Example # 2 (Mechanical ventilator data from a single day, May 11):

	12 am	1:30 am	2 am	3 am	6 am	9 am	12pm	3pm	6pm	9 pm
MV mode	ACV	ACV	ACV	ACV	ACV	ACV	ACV	ACV	ACV	ACV
FiO2	0.80	0.60	0.80	0.80	0.80	0.75	0.75	0.75	0.70	0.70
PEEP	5	5	10	10	10	5	5	5	5	5

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(70%), and the daily minimum PEEP would be recorded as 5 cmH2O. Note that even though the lowest recorded FiO2 value for the day was 0.60, it was only recorded at a single time point, with an interval indicating that it was not maintained for at least 1 hour.

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8	**Daily Minimum Values maintained for at least 1 hour**	Why is there a requirement that the daily minimum PEEP and FiO2 values must be maintained for at least 1 hour?	In some facilities or units, ventilator data monitoring may occur very frequently. This may lead to difficulties in determining the daily minimum PEEP and FiO2. Additionally, we have received feedback from users expressing concerns that adjustment to ventilator settings that are maintained for a short period of time (but long enough to be documented and therefore used when selecting the daily minimum values) may in some instances falsely establish what appears to be a period of stability, or negate the detection of sustained worsening in oxygenation. The requirement that the daily minimum PEEP and FiO2 values are to represent the lowest values for the calendar day that were maintained for at least one hour addresses this concern. This means in a unit that is documenting PEEP and FiO2 hourly, there must be two consecutive recordings of the lowest PEEP and FiO2 value (e.g., PEEP=8 cmH2O at 09:00 and 10:00). If documenting every 30 minutes, there must be 3 consecutive recordings (e.g., at 09:30, 10:00 and 10:30). If documenting every 15 minutes, there must be 5 consecutive recordings (e.g., at 09:00, 09:15, 09:30, 09:45, and 10:00). If a unit is documenting PEEP/FiO2 settings less frequently than once per hour, the lowest PEEP/FiO2 setting each calendar day would be selected as the daily minimum PEEP or FiO2 value. When there is no PEEP or FiO2 setting documented to have been maintained for at least one hour (e.g., ventilation was initiated late in the calendar day, ventilation was discontinued early in the calendar day, settings were changed frequently throughout the calendar day) the lowest setting for the calendar day will be used regardless of the duration of time that the setting was maintained.

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9	**PEEP values between 0 cmH2O and 5 cmH2O**	Why are PEEP values between 0 cmH20 and 5 cmH20 considered equivalent for VAE surveillance purposes?	After receiving feedback from users citing circumstances where VAC was detected in certain clinical scenarios or circumstances as a result of usual processes of care or ventilator management strategy differences between providers, rather than an actual clinical worsening of the patient, the VAE Surveillance Definition Working Group re-convened and reached the conclusion that PEEP values between 0 cmH20 and 5 cmH20 are considered equivalent as it relates to VAE surveillance. This means that patients with a daily minimum PEEP in the range of 0-5 cmH2O must have an increase in the daily minimum PEEP to at least 8 cmH20, sustained at or above 8 cmH20 for at least 2 calendar days, in order for the VAC definition to be met. In essence, think of values between 0-5 as all being equal to 5, and therefore an increase to 8 cm H20 is necessary to satisfy the required increase in daily minimum PEEP ≥ 3 cmH20 over the daily minimum PEEP in the baseline period. NOTE: The VAE calculator will automatically make this correction. PEEP values entered into the VAE calculation that are between 0-5 cmH2O will be interpreted by the calculator as equal to 5.
10	**Pneumonia present on admission or prior to initiation of ventilation and VAE surveillance**	If a patient is admitted with community-acquired pneumonia requiring intubation and mechanical ventilation or has a pneumonia identified during the inpatient stay prior to initiation of mechanical ventilation is that patient exempt from VAE surveillance until the pneumonia has resolved?	No. Tracking of daily minimum PEEP and FiO2 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 or the reason for initiation of mechanical ventilation.

	Topic	Question	Response
11	**Lower Respiratory Tract Events**	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. .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. 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 have 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"?* 1) VAE: This is the ONLY in-plan respiratory event surveillance for patients in adult locations. The VAE algorithm is ONLY applicable to mechanically-ventilated patients housed in adult inpatient units (regardless of the age of the patient). Pediatric and neonatal units are excluded from VAE surveillance (even in circumstances where a pediatric unit may occasionally care for adult patients).

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			2) Pediatric VAP: This is the ONLY in-plan respiratory event surveillance for patients in pediatric locations. Pediatric VAP surveillance using the PNEU/VAP definitions continues to be available for in-plan surveillance of VAP in pediatric locations (regardless of the age of the patient). In-plan surveillance for ventilator-associated PNEU is no longer available for patients in neonatal locations. **NOTE:** When conducting CLABSI surveillance, the PNEU definition is available for use as a site specific infection to which a bloodstream infection can be assigned as a secondary BSI for all patients (i.e., adults, children, neonates, ventilated or non-ventilated). *What lower respiratory tract event surveillance can be done "off-plan"?* 1) VAE: VAE surveillance can also be done "off-plan" in adult patient locations. 2) VAP: Surveillance for PNEU/VAP continues to be available for off-plan surveillance in all mechanically-ventilated patients (adults, children or neonates). 3) PNEU: Surveillance for PNEU is available for off-plan surveillance in non-mechanically-ventilated adults, children and neonates. 4) LRI: Surveillance for non-pneumonia lower respiratory infections (using LUNG definition) continues to be available for off-plan surveillance in adults, children and neonates. *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 there are reporting requirements such that patients who met a PNEU definition as well as the LRI-LUNG definition are to be reported as PNEU.

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12	**Secondary BSI to lower respiratory events in locations performing VAE surveillance**	How do I identify a secondary BSI for lower respiratory events in ventilated patients in adult locations where VAE surveillance is being conducted?	Please note, for purposes of NHSN, for a bloodstream infection to be determined to be secondary to a primary infection site, (i.e. related to an infection at another site, such that primary site of infection may have seeded the bloodstream secondarily) the patient must first meet one of the NHSN site specific definitions. For example, for a secondary bloodstream infection to be deemed secondary to PNEU, the PNU2 or PNU3 definition must be met first. You cannot attribute a bloodstream infection secondary to PNEU based on a clinical diagnosis of pneumonia or solely based on recovery of a matching pathogen from a lower respiratory tract specimen and blood culture. To determine if a positive blood culture can be attributed as 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 PVAP 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 PVAP 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 (as per the VAE surveillance protocol BSIs cannot be deemed secondary to VAC or to IVAC). 2) If the PVAP definition is met, a positive blood culture can 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 major HAI sites (i.e., another Chapter 17 definition, PNEU, UTI or SSI definition), 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 or PNEU, UTI or SSI event protocols. If

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			the patient does not meet one of these other definitions, the BSI may need to be reported as a primary BSI/CLABSI.
13	**Temperature and WBC**	VAC definition is met and when assessing to determine if the IVAC definition can be met, it is noted that the patient has had an elevated temperature (or abnormal white blood cell count) since admission. If the elevated temperature (or abnormal white blood cell count) is still present during the VAE Window Period are these findings eligible for use 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/mm3 or ≤ 4,000 cells/mm3) documented during the VAE Window Period, it should be used in determining whether the patient meets the IVAC definition or not, regardless of whether an abnormal temperature or white blood cell count was also present on admission or outside the VAE window period.

	Topic	Question	Response
14	**Culture Results**	Can you explain exactly what qualitative, semi-quantitative and quantitative mean in the VAE criteria that are based on purulent respiratory secretions and respiratory culture results (in the PVAP definitions)?	For purposes of the VAE surveillance protocol, qualitative refers to identification of an organism or cells without a quantity descriptor: for example, "*Staphylococcus aureus* present" or "white blood cells seen". Semi-quantitative refers to a text description of the amount or quantity of organism or cells present, without a specific numeric value: for example, "occasional," "few," "moderate," "many," "heavy" or 1+, 2+, 3+, 4+. An example of semi-quantitative reporting would be a result indicating "many *Pseudomonas aeruginosa*" or "few epithelial cells." Quantitative refers to a specific numeric description of the amount of organism or cells present: for example, 10^5 CFU/ml *Klebsiella pneumoniae*.
15	**Culture Results**	Can an eligible pathogen recovered from a respiratory culture that was collected within the VAE Window Period be used to meet PVAP if the same pathogen was recovered from a previous respiratory culture that was collected outside the VAE Window Period?	Yes, it does not matter if the patient had previous positive cultures for certain organisms—if an eligible pathogen is recovered from an eligible specimen with a collection date during the VAE window period, it should be used in determining if PVAP is met.
16	***Candida* species - excluded pathogens**	When referencing the pathogens that are excluded for meeting PVAP definition, what does *Candida* species or yeast not otherwise specified refer to?	This means all *Candida* species—those that have been identified to the species level such as *Candida albicans*, those that are reported as *Candida* species and also to include culture reports that may simply say for example, "many yeast isolated".

	Topic	Question	Response
17	**Specimen**	If I have a culture result from a specimen that was labeled and reported by the laboratory as a "bronchial wash," can this specimen be used to satisfy the PVAP definition criteria?	Yes. For the purposes of VAE surveillance, a "bronchial wash" is considered the same type of specimen as a bronchoalveolar lavage (BAL).
18	**Specimen**	When respiratory secretions are collected from a patient who is eligible for VAE surveillance, and the specimen is labeled and submitted to the microbiology laboratory as a "sputum" specimen, if I know that the patient was intubated at the time the specimen was collected, and the specimen should have been labeled "endotracheal aspirate," should the documentation of the specimen type on the microbiology report be used when making a VAE determination, or can I interpret the result as if it were an endotracheal aspirate?	Specimens may frequently be labeled as "sputum" when they are really "endotracheal aspirates." Making the automatic substitution is not advised. If, however, you can verify with the patient's caregiver that the specimen was indeed an endotracheal aspirate, and also confirm that your microbiology laboratory does not process specimens labeled as "sputum" differently than those labeled as "endotracheal aspirate," the culture result can be used to meet the requirements for the PVAP definition. Additionally, take the opportunity to address improving specimen labeling.

	Topic	Question	Response
19	**Episode of Mechanical Ventilation**	If a VAE is detected during a first episode of mechanical ventilation, and then the patient is extubated and re-intubated later during the 14 day event period (defining a second episode of mechanical ventilation), can a new VAE be identified and reported?	Per the VAE surveillance protocol, the 14 day event period is to be observed even if a new episode of mechanical ventilation is established during that event period. The 14 day rule for VAE surveillance is governed by the event date (date of onset of worsening oxygenation), not the date of initiation of mechanical ventilation. So if a patient is removed from mechanical ventilator for one full calendar day or more and is then returned to the ventilator within the 14 day event period, a new VAE cannot be detected or reported until the 14 days have elapsed. When the patient is returned to the ventilator, a new episode of mechanical ventilation would begin, and the mechanical ventilation day count would start over again. The earliest a new VAE could be identified would be day 3 of the new episode. In the example presented in the table below, you will see that there is a VAC detected during the first episode of mechanical ventilation, on hospital day 4. The patient is extubated on hospital day 6, and remains off MV for one full calendar day (hospital day 7). On hospital day 8, the patient is re-intubated, thereby starting a second episode of MV. The patient is observed to meet VAC criteria, with a baseline period of stability or improvement on hospitals days 8 and 9 and a period of worsening on hospitals days 10 and 11—but because the patient is still within the 14 day event period for the VAE detected on hospital day 4, a new VAE cannot be detected or reported.

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<tr><td>Hosp Day No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr>
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<tr><td>MV Day No.</td><td>1
Intubated at noon</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6
Extubated at noon</td><td>-</td><td>1
Re-intubated at 0800</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>VAE Criterion</td><td>--</td><td>Baseline Day 1</td><td>Baseline Day 2</td><td>Worsening Day 1</td><td>Worsening Day 2</td><td></td><td>-</td><td>Baseline Day 1</td><td>Baseline Day 2</td><td>Worsening Day 1</td><td>Worsening Day 2</td><td></td></tr>
<tr><td>VAE</td><td></td><td></td><td></td><td>VAC</td><td></td><td></td><td></td><td></td><td></td><td>NO VAC</td><td></td><td></td></tr>
<tr><td>Event Period</td><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
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<tr><td>20</td><td>Location of Mechanical Ventilation</td><td>Does the field in the NHSN application that is labeled “location of mechanical ventilation” refer to where the patient was placed on mechanical ventilator or where the patient was intubated?</td><td>This field should reflect the location where the patient was intubated. So for example, if the patient was intubated by first responder personnel in the field prior to arrival in the facility where mechanical ventilation was eventually initiated, the location chosen should be Mobile Emergency Services/EMS.</td></tr>
<tr><td>21</td><td>Date of Mechanical Ventilation Initiation</td><td>When a patient is admitted to a facility and mechanical ventilation was initiated prior to the admission at another facility, for example, what date of mechanical ventilation should be used?</td><td>Because the date of mechanical ventilation is used to determine the VAE window period determination, when a patient is admitted to a facility on a ventilator the date of mechanical ventilation initiation should reflect the actual date of mechanical ventilation initiation not the date of admission to the facility. If necessary an estimate of the actual date of mechanical ventilation can be used. In the situation where a patient’s mechanical ventilation initiation is begun prior to admission to a facility, only in circumstances where the actual date or an estimate of the actual date cannot be determined should the date of mechanical ventilation initiation default to the date of admission to the facility.</td></tr>
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	Topic	Question	Response
22	**Home Ventilators**	My facility/unit takes care of adult patients who are on home mechanical ventilators, or who are on a BiPAP machine (or other device typically used for providing non-invasive ventilator support) via a tracheostomy tube. These patients are being cared for in units where I am conducting VAE surveillance, and they are otherwise eligible for VAE surveillance (e.g., they are not on extracorporeal life support). Should these patients be included in VAE surveillance?	The first step in determining whether such patients should be included in VAE surveillance is to decide whether the patient is on invasive mechanical ventilation, as defined by the NHSN. The NHSN definition of a ventilator is: "A device to assist or control respiration, 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)." Based on this definition, patients on home mechanical ventilators or patients supported by devices typically considered non-invasive ventilator devices should be included in VAE surveillance if the ventilator support is administered via an endotracheal or tracheostomy tube, even if the support is administered only for portions of each day (e.g., overnight). Patients receiving non-invasive ventilation (e.g., BiPAP via a face mask or nasal mask) should not be included in VAE surveillance. The second step in determining whether such patients can be included in VAE surveillance is to determine whether the FiO2 or PEEP can be set at a specific level on the home mechanical ventilator or other ventilator device. Our current understanding is that some brands of home mechanical ventilators and devices typically used for non-invasive ventilation do not have the capability of setting a specific FiO2 or PEEP level. In these circumstances, a patient could not be included in VAE surveillance, because it would not be feasible to assess changes in the set level of FiO2 or PEEP. If the FiO2 or PEEP can be set at a specific value and monitored, then these patients should be included in VAE surveillance. If the patient is switched from a home mechanical ventilator or other device to a critical care unit mechanical ventilator, then they can be included in VAE surveillance at that time (taking into account that a baseline period of stability or improvement will need to be established on the critical care mechanical ventilator). **NOTE:** Patients on home ventilators in locations where in-plan VAE

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			surveillance is being performed will be included in the ventilator day denominator count regardless of their eligibility for VAE surveillance.
23	**Ventilator Data**	How does one use ventilator data obtained in pre-hospital or Emergency Department (ED) settings, or in other transferring units within the same hospital, or in transferring hospitals, when making VAE determinations?	See Scenarios A through E below.

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		Scenario A: Patient is intubated by the EMS in the field, or is intubated in the ED. FiO2 and PEEP data are available from the time the patient spent in the ED, prior to the patient being transferred to the ICU as an inpatient. Should I use the pre-hospital/ED ventilator data when making my VAE determinations for that patient?	No. Ventilator data that is obtained from patients in the Emergency Department or other pre-hospital/pre-inpatient locations should not be included in VAE surveillance. Therefore, VAE surveillance begins for patients who are intubated in the pre-hospital or ED setting upon transfer to an inpatient location where VAE surveillance is being conducted. Day 1 of ventilator data consists of data collected during the first calendar day of inpatient care.
		Scenario B: Patient is intubated and mechanically ventilated in an inpatient unit where VAE surveillance is not occurring. The patient is transferred to another inpatient unit in the same hospital where VAE surveillance is occurring. Do I use ventilator data from the transferring unit, even though VAE surveillance was not occurring in that unit?	Yes—to an extent. Since the transferring unit is in the same hospital, and since ventilator data from that transferring unit should be readily available, we advise that you go back 2 calendar days prior to transfer and utilize minimum daily PEEP and FiO2 data from the transferring unit to determine whether a VAE has occurred during the first 2 days in the receiving unit. If a VAE is detected with an onset date on calendar day 1 or 2 in the receiving unit, that VAE would be attributable to the transferring unit and so would not be reported (since the transferring unit was not doing VAE surveillance).

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		Scenario C: Patient is intubated and mechanically ventilated in an inpatient unit where VAE surveillance IS occurring. The patient is transferred to another inpatient unit in the same hospital where VAE surveillance is also occurring. Do I use ventilator data from the transferring unit?	Yes. When transferring a patient between units that are both participating in VAE surveillance, surveillance should continue in a continuous, ongoing fashion. In other words, if the patient had a VAE in the transferring unit on August 1, and was transferred to the receiving unit on August 4, a new VAE could not be detected in the receiving unit until the 14-day event period for the August 1 VAE had elapsed (so, August 15 in this case).
		Scenario D: Patient is intubated and mechanically ventilated in another hospital or healthcare facility and then transferred to my facility. It is unknown whether the transferring facility was performing VAE surveillance or not. Should I use ventilator data from the transferring facility (if available) when making my VAE determinations?	When ventilator data are available from a transferring facility, you may use the ventilator data from the 2 calendar days prior to transfer to determine whether a VAE has occurred early in the course of the inpatient stay in your receiving hospital/facility. As in Scenario B, above, if a VAE is detected with onset date on calendar day 1 or 2 in your receiving hospital/facility, the VAE would be attributable to the transferring facility. If no ventilator data are available from the transferring facility, VAE surveillance begins on admission to the receiving facility/unit where VAE surveillance is taking place.

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		Scenario E: Patient is intubated and mechanically ventilated in another hospital or healthcare facility and then transferred to my facility. The transferring facility was performing VAE surveillance, and I have been informed that a VAE was detected in the transferring facility five days prior to transfer. Upon arrival in my receiving facility, does the 14-day event period apply, or do I need to "start fresh" with ventilator data available in my facility?	You should "start fresh," although as noted above in Scenario D, you can use ventilator data from the 2 calendar days prior to transfer to determine whether there is a VAE early in the course of hospitalization in the receiving facility that would be attributed back to the transferring facility.

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24	**Secondary BSI Pathogens**	How does one handle the situation where a blood culture meets criteria for being a secondary BSI to a PVAP, but the blood culture is polymicrobial and one or more organisms isolated from that blood culture were not also isolated from an eligible respiratory tract specimen?	When a bloodstream infection is deemed secondary to a PVAP (i.e., BSI diagnosed by blood culture collected during the 14-day VAE event period, with at least one organism from blood matching an organism isolated from an eligible respiratory tract specimen obtained during the VAE window period), organisms isolated from that same blood culture that do not match an organism in the eligible respiratory tract specimen MAY be reported as a PVAP pathogen—EXCEPT when they are one of the excluded organisms (i.e., Candida or yeast NOS, Enterococcus, coagulase-negative Staphylococcus species). An exception to the excluded organism rule is made when the eligible respiratory tract specimen is pleural fluid or lung tissue. Excluded organisms isolated from positive blood cultures must be accounted for as a secondary bloodstream infection to an infection present on admission, another hospital acquired infection (HAI) or a primary bloodstream infection. Please see the examples 1-4 below. **NOTE:** When multiple, separate blood cultures are positive during the 14-day PVAP event period, ONLY those blood cultures that are positive for at least one organism matching an organism isolated from an eligible respiratory tract specimen obtained during the VAE window period may be considered secondary to the PVAP.
			Example 1 A PVAP was detected in a patient in the MICU, with an event date of August 1. The PVAP determination was made on the basis of an endotracheal aspirate culture collected on August 2 (within the VAE window period) that was positive for Pseudomonas aeruginosa (PA). On August 9, within the 14-day event period, the patient has a positive blood culture for PA and E. coli (EC). This positive blood culture should be reported as a secondary BSI for the PVAP event, because it occurred within the 14-day event period, and because at least one of the pathogens isolated from blood matches an organism isolated from the respiratory tract specimen. Pathogens reported for this PVAP should include PA and EC.

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			Example 2 A PVAP was detected in a patient in the MICU with an event date of August 1. The PVAP determination was made on the basis of an endotracheal aspirate culture collected on August 2 (within the VAE window period) that was positive for ≥ 105 CFU/ml Pseudomonas aeruginosa (PA) and Candida albicans (CA). On August 9, within the 14-day event period, the patient has a positive blood culture for PA and CA. This positive blood culture should be reported as a secondary BSI for the PVAP event, because it occurred within the 14-day event period, and because at least one of the pathogens isolated from blood matches an organism isolated from the respiratory tract specimen. Pathogens reported for this PVAP should be limited to PA. CA CANNOT be reported as a pathogen for PVAP because it is an excluded pathogen when isolated from an endotracheal aspirate. CA must be accounted for as either a secondary bloodstream infection to another primary site specific infection or as a primary bloodstream infection.
			Example 3 A PVAP was detected in a patient in the MICU with an event date of August 1. The PVAP determination was made on the basis of a lung biopsy obtained for culture on August 2 (within the VAE window period) that was positive for Pseudomonas aeruginosa (PA) and Candida albicans (CA). On August 9, within the 14-day event period, the patient has a positive blood culture for PA and CA. This positive blood culture should be reported as a secondary BSI for the PVAP event, because it occurred within the 14-day event period, and because at least one of the pathogens isolated from blood matches an organism isolated from the respiratory tract specimen. Pathogens reported for this PVAP should include PA and CA. CA in this instance CAN be reported as a pathogen for this VAE because it is isolated from a culture of lung tissue.

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			Example 4 A PVAP was detected in a patient in the MICU with an event date of August 1. The PVAP determination was made on the basis of a lung biopsy obtained for culture on August 2 (within the VAE window period) that was positive for Pseudomonas aeruginosa (PA). On August 9, within the 14-day event period, the patient has a positive blood culture for PA and Candida albicans (CA). This positive blood culture should be reported as a secondary BSI for the PVAP event, because it occurred within the 14-day event period, and because at least one of the pathogens isolated from blood matches an organism isolated from the respiratory tract specimen. Pathogens reported for this PVAP should be limited to PA. CA CANNOT be reported as a pathogen for this VAE because it is an excluded pathogen, unless isolated from pleural fluid or lung tissue. The lung tissue culture in this case did NOT grow CA. As an excluded organism, isolated from positive blood culture, CA must be accounted for as either a secondary bloodstream infection to another primary site specific infection or as a primary bloodstream infection.

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25	**VAE Upgrades**	If the VAC definition is met, and later within the 14 day event period other criteria that will help to satisfy IVAC, PVAP definitions become available, should I upgrade the VAC to the specific event that is met using the new information?	Per the VAE surveillance protocol, only one VAE can be reported during each 14 day event period (where day 1 is the onset of worsening oxygenation). A previously detected VAE cannot be "upgraded" using information obtained outside of the original VAE window period. Once the VAC definition is met the other criteria needed to satisfy the IVAC, PVAP definitions must all be present within the VAE window period timeframe, according to the protocol. The temperature, white blood cell count, and laboratory test collection dates must occur within the VAE Window Period, and the antimicrobial agent(s) that help to satisfy the ≥ 4 qualifying antimicrobial days (QADs) criterion must be "new" within the VAE window period. Keep in mind that while the antimicrobial agent must be new within the VAE window period, QADs that count toward satisfying the IVAC antimicrobial criterion may occur outside the VAE Window Period. Here is an example: A VAC is detected in a medical ICU patient, with the day of onset of worsening oxygenation occurring on mechanical ventilation (MV) day 10. The VAE window period is therefore determined to be from MV day 8 (2 days before the onset of worsening oxygenation) through MV day 12 (2 days after the onset of worsening oxygenation). The patient has a temperature of 39°C on MV day 10, and is started on a new antimicrobial agent on MV day 11 (with that new agent continued for 7 consecutive days, from MV day 11 through MV days 17). The IVAC definition is therefore met. On MV day 15, a BAL is performed, and it grows 105 CFU/ml Pseudomonas aeruginosa. Because the BAL specimen was collected OUTSIDE of the VAE window period (even though it was collected during the 14 day event period), it cannot be used to upgrade the VAE from an IVAC to a PVAP.
26	**Reporting Requirement**	Is VAE surveillance and reporting mandatory?	The CDC/NHSN does not determine what HAIs or other healthcare-associated events you are required to report. VAE is currently included in the Centers for Medicare and Medicaid Services' Hospital Inpatient Quality Reporting (IQR) program for Long Term Care Hospital facilities only. If you are not a Long Term Care Hospital facility, the requirement to participate in VAE surveillance depends on whether you have selected VAE surveillance as a part of your monthly reporting plan and/or if you have a local or state requirement to participate.

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27	**Benchmarking**	What VAE rates are appropriate for benchmarking or making comparisons between units or facilities?	The rates that are potentially appropriate for these purposes include the overall VAE rate or Total VAE (where the numerator includes all events meeting at least the VAC definition - VAC + IVAC + PVAP) and what we are calling the "IVAC-plus" rate (where the numerator includes all events meeting at least the IVAC definition – IVAC + PVAP). You may find rates of the individual specific sites (e.g., VAC only, IVAC only, and PVAP only) useful for internal quality improvement purposes.
28	**Cytology Findings**	Can Cytology findings be used to meet PVAP Criterion 3?	Yes, lower respiratory tract specimen cytology findings in support of identification of infection can be used to satisfy PVAP Criterion 3.
29	**VAE specific events**	Which is worse VAC, IVAC or PVAP?	It is important to note that having an IVAC or PVAP is not necessarily "worse" than having a VAC—the algorithm is progressive in terms of criteria to be met (from VAC to IVAC to PVAP), but this is not to imply that each subsequent tier is more clinically significant than the one before. The fundamental definition within the algorithm is the VAC definition (which is defined on the basis of respiratory deterioration)—so even in those circumstances where an IVAC or PVAP is detected, the event still met the VAC definition. It's just that there is some additional evidence that the event may be infectious in nature (IVAC), as opposed to non-infectious and if infectious in nature the infection may be related to the lower respiratory tract (PVAP).