Catheter-Associated Urinary Tract Infection (CAUTI) Event

**Introduction:** Urinary tract infections (UTIs) are tied with pneumonia as the second most common type of healthcare-associated infection, second only to SSIs. UTIs account for more than 15% of infections reported by acute care hospitals. Virtually all healthcare-associated UTIs are caused by instrumentation of the urinary tract.

CAUTI can lead to such complications as cystitis, pyelonephritis, gram-negative bacteremia, prostatitis, epididymitis, and orchitis in males and, less commonly, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis in all patients. Complications associated with CAUTI cause discomfort to the patient, prolonged hospital stay, and increased cost and mortality. Each year, more than 13,000 deaths are associated with UTIs.


**Settings:** Surveillance will occur in any inpatient locations where denominator data can be collected, which may include critical intensive care units (ICU), specialty care areas (SCA), step down units, and long term care wards. Neonatal ICUs may participate, but only off plan (not as a part of their monthly reporting plan). A complete listing of inpatient locations and instructions for mapping can be found in the CDC Locations and Descriptions chapter.

NOTE: It is not required to monitor for CAUTIs after the patient is discharged from the facility. However, if discovered, any CAUTI with the date of event on the day of discharge or the next day should be reported to NHSN; day of discharge is considered Day 1. No additional indwelling catheter days are reported.

**Requirements:** Surveillance for HAI CAUTI is performed in at least one inpatient location in the healthcare institution for at least one calendar month as indicated in the Patient Safety Monthly Reporting Plan (CDC 57.106).

**Definitions:**

Present on Admission (POA): Infections that are POA, as defined in Chapter 2, are not considered HAIs and therefore are never reported to NHSN.

Healthcare-associated infections (HAI): All NHSN site specific infections must first meet the HAI definition as defined in Chapter 2 before a site specific infection (e.g., CAUTI) can be reported to NHSN.
Urinary tract infections (UTI) are defined using Symptomatic Urinary Tract Infection (SUTI) criteria or Asymptomatic Bacteremic UTI (ABUTI) criteria (Table 1 and Figures 1-5).

**Date of event:** For a UTI the date of event is the date when the last element used to meet the UTI infection criterion occurred. Synonym: infection date.

**Indwelling catheter:** A drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a drainage bag (including leg bags). These devices are also called Foley catheters. Condom or straight in-and-out catheters are not included nor are nephrostomy tubes or suprapubic catheters unless a Foley catheter is also present. Indwelling urethral catheters that are used for intermittent or continuous irrigation are included in CAUTI surveillance.

**Catheter-associated UTI (CAUTI):** A UTI where an indwelling urinary catheter was in place for >2 calendar days on the date of event, with day of device placement being Day 1, and an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for >2 calendar days and then removed, the UTI criteria must be fully met on the day of discontinuation or the next day.

**EXAMPLE:** A patient has a Foley catheter inserted on an inpatient unit and the following morning the patient meets criteria for a UTI. Because the catheter has not been in place >2 calendar days when all elements of the infection criterion were first present together, this is not a CAUTI.

**NOTE:**
1. SUTI 1b and 2b and other UTI (OUTI), as defined in the Surveillance Definitions chapter cannot be catheter-associated.

**Location of attribution:** The inpatient location where the patient was assigned on the date of the UTI event, which is further defined as the date when the last element used to meet the UTI criterion occurred (see exception below).
**EXCEPTION TO LOCATION OF ATTRIBUTION:**

*Transfer Rule:* If all elements of a CAUTI are present within 2 calendar days of transfer from one inpatient location to another in the same facility or a new facility (i.e., on the day of transfer or the next day), the infection is attributed to the transferring location or facility. Receiving facilities should share information about such HAIs with the transferring facility to enable reporting. This is called the Transfer Rule and examples are shown below:

- Patient with a Foley catheter in place in the SICU is transferred to the surgical ward. On the next day, UTI criteria are met. This is reported to NHSN as a CAUTI for the SICU.
- Patient is transferred in the morning to the medical ward from the MSICU after having the Foley catheter removed. Later that night, UTI criteria are met. This is reported to NHSN as a CAUTI for the MSICU.
- On Monday, patient with a Foley catheter in place is transferred from the medical ward to the coronary care ICU (CCU). Wednesday in the CCU, UTI criteria are met. This is reported to NHSN as a CAUTI for the CCU, as the UTI event date is on the 3rd calendar day after transfer.
- Patient on the urology ward of Hospital A had the Foley catheter removed after it had been in place for 5 days and is discharged home a few hours later. The IP from Hospital B calls the next day to report that this patient has been admitted to Hospital B with a UTI. This CAUTI should be reported to NHSN for Hospital A and attributed to the urology ward.

- **NOTE:** Example of multiple transfers within the transfer rule time-frame:

<table>
<thead>
<tr>
<th>3.22</th>
<th>3/23</th>
<th>3/24</th>
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</thead>
<tbody>
<tr>
<td>Patient in Unit A</td>
<td>Patient transferred from Unit A to Unit B. Later that day, patient transferred from Unit B to Unit C. (day of transfer)</td>
<td>Patient transferred from Unit C to Unit D. Last element for CAUTI criteria met. CAUTI attributed to Unit A since Unit A was the original unit initiating the transfer in the 2 day time-frame. (day after transfer)</td>
</tr>
<tr>
<td>Criterion</td>
<td>Urinary Tract Infection (UTI)</td>
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<tr>
<td>-----------</td>
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</tr>
<tr>
<td><strong>Symptomatic UTI (SUTI)</strong></td>
<td>Must meet at least 1 of the following criteria:</td>
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<tr>
<td>1a</td>
<td>Patient had an indwelling urinary catheter in place for &gt;2 calendar days, with day of device placement being Day 1, and catheter was in place on the date of event and at least 1 of the following signs or symptoms: fever (&gt;38°C); suprapubic tenderness*; costovertebral angle pain or tenderness* and a positive urine culture of $\geq 10^5$ colony-forming units (CFU)/ml and with no more than 2 species of microorganisms. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.</td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>Patient did not have an indwelling urinary catheter that had been in place for &gt;2 calendar days and had it removed the day of or the day before the date of event and at least 1 of the following signs or symptoms: fever (&gt;38°C); urgency*; frequency*; dysuria*; suprapubic tenderness*; costovertebral angle pain or tenderness* and a positive urine culture of $\geq 10^5$ colony-forming units (CFU)/ml and with no more than 2 species of microorganisms. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.</td>
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*With no other recognized cause
<table>
<thead>
<tr>
<th>Criterion</th>
<th>Urinary Tract Infection (UTI)</th>
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<tbody>
<tr>
<td>2a</td>
<td>Patient had an indwelling urinary catheter in place for &gt;2 calendar days, with day of device placement being Day 1, and catheter was in place on the date of event. and at least 1 of the following signs or symptoms: fever (&gt;38°C); suprapubic tenderness*; costovertebral angle pain or tenderness* and at least 1 of the following findings: a. positive dipstick for leukocyte esterase and/or nitrite b. pyuria (urine specimen with ≥10 white blood cells [WBC]/mm³ of unspun urine or &gt;5 WBC/high power field of spun urine) c. microorganisms seen on Gram’s stain of unspun urine and a positive urine culture of ≥10³ and &lt;10⁵ CFU/ml and with no more than 2 species of microorganisms. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.</td>
</tr>
<tr>
<td>Criterion</td>
<td>Urinary Tract Infection (UTI)</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------</td>
</tr>
</tbody>
</table>
| 2b        | Patient did **not** have an indwelling urinary catheter that had been in place for >2 calendar days and in place at the time of, or the day before the date of event and has at least 1 of the following signs or symptoms: fever (>38°C) in a patient that is ≤65 years of age; urgency*; frequency*; dysuria*; suprapubic tenderness*; costovertebral angle pain or tenderness* and at least 1 of the following findings:  
  a. positive dipstick for leukocyte esterase and/or nitrite  
  b. pyuria (urine specimen with ≥10 WBC/mm³ of unspun urine or >5 WBC/high power field of spun urine  
  c. microorganisms seen on Gram’s stain of unspun urine and a positive urine culture of ≥10³ and <10⁵ CFU/ml and with no more than 2 species of microorganisms. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements. *With no other recognized cause |
| 3         | Patient ≤1 year of age with** or without an indwelling urinary catheter has at least 1 of the following signs or symptoms: fever (>38°C core); hypothermia (<36°C core); apnea*; bradycardia*; dysuria*; lethargy*; vomiting* and a positive urine culture of ≥10⁵ CFU/ml and with no more than 2 species of microorganisms. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements. *With no other recognized cause **Patient had an indwelling urinary catheter in place for >2 calendar days, with day of device placement being Day 1 and catheter was in place on the date of event. |
| 4         | Patient ≤1 year of age with** or without an indwelling urinary catheter has at least 1 of the following signs or symptoms: fever (>38°C core); hypothermia (<36°C core); apnea*; bradycardia*; dysuria*; lethargy*; vomiting* and at least 1 of the following findings:  
  a. positive dipstick for leukocyte esterase and/or nitrite  
  b. pyuria (urine specimen with ≥10 WBC/mm³ of unspun urine or >5 WBC/high power field of spun urine  
  c. microorganisms seen on Gram’s stain of unspun urine and a positive urine culture of between ≥10³ and <10⁵ CFU/ml and with no more than two species of microorganisms. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.
### Urinary Tract Infection (UTI)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>With no other recognized cause</em></td>
<td></td>
</tr>
<tr>
<td>*<em>Patient had an indwelling urinary catheter in place for &gt;2 calendar days, with day of device placement being Day 1 and catheter was in place on the date of event.</em></td>
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</tbody>
</table>

### Asymptomatic Bacteremic Urinary Tract Infection (ABUTI)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Asymptomatic Bacteremic Urinary Tract Infection (ABUTI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient with* or without an indwelling urinary catheter has no signs or symptoms (i.e., for any age patient, no fever (&gt;38°C); urgency; frequency; dysuria; suprapubic tenderness; costovertebral angle pain or tenderness OR for a patient ≤1 year of age; no fever (&gt;38°C core); hypothermia (&lt;36°C core); apnea; bradycardia; dysuria; lethargy; or vomiting) and a positive urine culture of ≥10^5 CFU/ml and with no more than 2 species of uropathogen microorganisms** (see Comments section below) and a positive blood culture with at least 1 matching uropathogen microorganism to the urine culture, or at least 2 matching blood cultures drawn on separate occasions if the matching pathogen is a common skin commensal. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.</td>
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</table>

*Patient had an indwelling urinary catheter in place for >2 calendar days, with day of device placement being Day 1, and catheter was in place on the date of event.

**Uropathogen microorganisms are: Gram-negative bacilli, *Staphylococcus* spp., yeasts, beta-hemolytic *Streptococcus* spp., *Enterococcus* spp., *G. vaginalis*, *Aerococcus urinae*, and *Corynebacterium* (urease positive)*

*Report *Corynebacterium* (urease positive) as either *Corynebacterium species unspecified* (COS) or as *C. urealyticum* (CORUR) if so speciated.

(See complete list of uropathogen microorganisms at [http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-Lists.xlsx#uropathogens](http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-Lists.xlsx#uropathogens))

### Comments

- Laboratory cultures reported as “mixed flora” represent at least 2 species of organisms. Therefore an additional organism recovered from the same culture, would represent >2 species of microorganisms. Such a specimen cannot be used to meet the UTI criteria.
- Urinary catheter tips should not be cultured and are not acceptable for the diagnosis of a urinary tract infection.
- Urine cultures must be obtained using appropriate technique, such as clean catch collection or catheterization. Specimens from indwelling catheters...
should be aspirated through the disinfected sampling ports.

- In infants, urine cultures should be obtained by bladder catheterization or suprapubic aspiration; positive urine cultures from bag specimens are unreliable and should be confirmed by specimens aseptically obtained by catheterization or suprapubic aspiration.
- Urine specimens for culture should be processed as soon as possible, preferably within 1 to 2 hours. If urine specimens cannot be processed within 30 minutes of collection, they should be refrigerated, or inoculated into primary isolation medium before transport, or transported in an appropriate urine preservative. Refrigerated specimens should be cultured within 24 hours.
- Urine specimen labels should indicate whether or not the patient is symptomatic.
- Report only pathogens in both blood and urine specimens for ABUTI.
- Report *Corynebacterium* (urease positive) as either *Corynebacterium* species unspecified (COS) or as *C. urealyticum* (CORUR) if speciated.
Patient had an indwelling urinary catheter in place for >2 calendar days, with day of device placement being Day 1, and catheter was in place on the date of event. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.

**Signs and Symptoms**
- At least 1 of the following:
  - fever (>$38^\circ$C)
  - suprapubic tenderness*
  - costovertebral angle pain or tenderness*
- *With no other recognized cause

**Laboratory Evidence**
- At least 1 of the following findings:
  - positive dipstick for leukocyte esterase and/or nitrite
  - pyuria (urine specimen with ≥10 WBC/mm³ of unspun urine or >5 WBC/high power field of spun urine)
  - microorganisms seen on Gram’s stain of unspun urine

A positive urine culture of $\geq 10^5$ CFU/ml and with no more than 2 species of microorganisms

A positive urine culture of $\geq 10^4$ and $<10^5$ CFU/ml and with no more than 2 species of microorganisms

**SUTI-Criterion 1a**

**SUTI-Criterion 2a**

**CAUTI**
Figure 2: Identification and Categorization of SUTI When Indwelling Catheter has been removed (see comments section page 7-7 thru 7-8 for important details)

Patient had an indwelling urinary catheter removed the day of or the day before the date of event. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.

At least 1 of the following:
- fever (>38°C)
- dysuria*
- urgency*
- suprapubic tenderness*
- frequency*
- costovertebral angle pain or tenderness*

*With no other recognized cause

At least 1 of the following findings:
- positive dipstick for leukocyte esterase and/or nitrite
- pyuria (urine specimen with $\geq 10$ WBC/mm³ of unspun urine or $>5$ WBC/high power field of spun urine
- microorganisms seen on Gram’s stain of unspun urine

A positive urine culture of $\geq 10^5$ CFU/ml and with no more than 2 species of microorganisms

A positive urine culture of $\geq 10^3$ and $<10^5$ CFU/ml and with no more than 2 species of microorganisms

SUTI-Criterion 1a

Was an indwelling urinary catheter in place for $>2$ calendar days on the date of or the day before the date of event?

Yes

CAUTI SUTI

No

SUTI (not catheter-associated)
Figure 3: Identification and Categorization of SUTI without Indwelling Catheter (see comments section page 7-7 thru 7-8 for important details)

Patient did not have an indwelling urinary catheter that had been in place for >2 calendar days and in place at the time of or the day before the date of event. Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.

**Signs and Symptoms**

At least 1 of the following:
- □ fever (>38°C) in a patient that is ≤65 years of age
- □ urgency*
- □ frequency*
- □ suprapubic tenderness*
- □ dysuria*

*With no other recognized cause

**Laboratory Evidence**

At least 1 of the following findings:
- □ positive dipstick for leukocyte esterase and/or nitrite
- □ pyuria (urine specimen with ≥10 WBC/mm³ of unspun urine or >5 WBC/high power field of spun urine)
- □ microorganisms seen on Gram’s stain of unspun urine

A positive urine culture of ≥10⁵ CFU/ml and with no more than 2 species of microorganisms

A positive urine culture of ≥10³ and <10⁵ CFU/ml and with no more than 2 species of microorganisms
Figure 4: Identification and Categorization of SUTI in Patient ≤1 Year of Age (see comments section page 7-7 thru 7-8 for important details)

Patient ≤1 year of age (with or without an indwelling urinary catheter)

Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.

**Signs and Symptoms**

At least 1 of the following:

- Fever (>38°C core)
- Hypothermia (<36°C core)
- Dysuria*
- Lethargy*
- Apnea*
- Vomiting*
- Bradycardia*

*With no other recognized cause

**Laboratory Evidence**

At least 1 of the following findings:

- Positive dipstick for leukocyte esterase and/or nitrite
- Pyuria (urine specimen with \( \geq 10 \text{ WBC/mm}^3 \) of unspun urine or \( >5 \text{ WBC/high power field of spun urine} \))
- Microorganisms seen on Gram’s stain of unspun urine

A positive urine culture of \( \geq 10^5 \text{ CFU/ml} \) and with no more than 2 species of microorganisms

A positive urine culture of \( \geq 10^3 \text{ and } <10^5 \text{ CFU/ml} \) and with no more than 2 species of microorganisms

**SUTI - Criterion 3**

Was an indwelling urinary catheter in place for >2 calendar days, with day of device placement being Day 1, and the catheter was in place on the day of or the day before the date of event?

- Yes
  - CAUTI
- No
  - SUTI
Figure 5: Identification of Asymptomatic Bacteremic Urinary Tract Infection (ABUTI) 
(see comments section page 7-7 thru 7-8 for important details)

Patient with or without an indwelling urinary catheter

Elements of the criterion must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements.

Patient of any age
- NONE of the following:
  - fever (>38°C)
  - urgency
  - frequency
  - dysuria
  - suprapubic tenderness
  - costovertebral angle pain or tenderness

Patient ≤ 1 year of age
- NONE of the following:
  - fever (>38°C core)
  - hypothermia (<36°C core)
  - apnea
  - bradycardia
  - lethargy
  - vomiting
  - dysuria

A positive urine culture of $\geq 10^5$ CFU/ml and with no more than 2 species of microorganisms*

A positive blood culture with at least 1 matching uropathogen microorganism* to the urine culture or at least 2 matching blood cultures*** drawn on separate occasions if the matching pathogen is a common skin commensal.

Asymptomatic Bacteremic Urinary Tract Infection (ABUTI)

Was an indwelling urinary catheter in place for >2 calendar days, with day of device placement being Day 1, and the catheter was in place on the day of or the day before the date of event?

Yes
ABUTI (catheter-associated)

No
ABUTI (not catheter-associated)

*(See complete list of uropathogen microorganisms at http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-Lists.xlsx#uropathogen)

Uropathogen microorganisms are: Gram-negative bacilli, Staphylococcus spp., yeasts, beta-hemolytic Streptococcus spp., Enterococcus spp., G. vaginalis, Aerococcus urinae, Corynebacterium (urease positive)†.

Only genus and species identification should be utilized to determine the sameness of organisms (i.e. matching organisms). No additional comparative methods should be used (e.g., morphology or antibiograms) because laboratory testing capabilities and protocols may vary between facilities.

†Report Corynebacterium (urease positive) as either Corynebacterium species unspecified (COS) or as C. urealyticum (CORUR) if speciated.
Numerator Data: The Urinary Tract Infection (UTI) form is used to collect and report each CAUTI that is identified during the month selected for surveillance. The Instructions for Completion of Urinary Tract Infection form include brief instructions for collection and entry of each data element on the form. The UTI form includes patient demographic information and information on whether or not an indwelling urinary catheter was present. Additional data include the specific criteria met for identifying the UTI, whether the patient developed a secondary bloodstream infection, whether the patient died, and the organisms isolated from cultures and their antimicrobial susceptibilities.

REPORTING INSTRUCTIONS:

- If no CAUTIs are identified during the month of surveillance, the Report No Events box must be checked on the appropriate denominator summary screen, e.g., Denominators for Intensive Care Unit (ICU)/Other Locations (Not NICU or SCA/ONC).

Denominator Data: Device days and patient days are used for denominators (See Key Terms chapter). Indwelling urinary catheter days, which are the number of patients with an indwelling urinary catheter device, are collected daily, at the same time each day, according to the chosen location using the appropriate form (CDC 57.117 and 57.118). These daily counts are summed and only the total for the month is entered into NHSN. Indwelling urinary catheter days and patient days are collected separately for each of the locations monitored. When denominator data are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from manually collected counts, pre-validated for a minimum of 3 months.

Data Analyses: The Standardized Infection Ratio (SIR) is calculated by dividing the number of observed infections by the number of predicted infections. The number of predicted infections is calculated using CAUTI rates from a standard population during a baseline time period, which represents a standard population’s CAUTI experience.5

NOTE: The SIR will be calculated only if the number of expected HAIs (numExp) is ≥1 to help enforce a minimum precision criterion.

NOTE: In the NHSN application, “predicted” is referred to as “expected”.

\[ SIR = \frac{\text{Observed (O) HAIs}}{\text{Expected (E) HAIs}} \]

While the CAUTI SIR can be calculated for single locations, the measure also allows you to summarize your data by multiple locations, adjusting for differences in the incidence of infection among the location types. For example, you will be able to obtain one
CAUTI SIR adjusting for all locations reported. Similarly, you can obtain one CAUTI SIR for all specialty care areas in your facility.

NOTE: Only those locations for which baseline data have been published will be included in the SIR calculations.

The CAUTI rate per 1000 urinary catheter days is calculated by dividing the number of CAUTIs by the number of catheter days and multiplying the result by 1000. The Urinary Catheter Utilization Ratio is calculated by dividing the number of urinary catheter days by the number of patient days. These calculations will be performed separately for the different types of ICUs, specialty care areas, and other locations in the institution, except for neonatal locations.

Descriptive analysis options of numerator and denominator data are available in the NHSN application, such as line listings, frequency tables, and bar and pie charts. SIRs and CAUTI rates and run charts are also available. Guides on using NHSN analysis features are available from: [http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html](http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html).

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2Scott Rd. The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention, 2009. Division of Healthcare Quality Promotion, National Center for Preparedness, Detection, and Control of Infectious Diseases, Coordinating Center for Infectious Diseases, Centers for Disease Control and Prevention, February 2009.


Central Line-Associated Bloodstream Infection (CLABSI) Event

**Introduction:** An estimated 41,000 central line-associated bloodstream infections (CLABSI) occur in U.S. hospitals each year. These infections are usually serious infections typically causing a prolongation of hospital stay and increased cost and risk of mortality.

CLABSI can be prevented through proper insertion techniques and management of the central line. These techniques are addressed in the CDC’s Healthcare Infection Control Practices Advisory Committee (CDC/HIPAC) Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011.

**Settings:** Surveillance will occur in any inpatient location where denominator data can be collected, which may include critical/intensive care units (ICU), specialty care areas (SCA), neonatal units including neonatal intensive care units (NICUs), step down units, wards, and long term care units. A complete listing of inpatient locations and instructions for mapping can be found in the CDC Locations and Descriptions chapter.

**NOTE:** Surveillance for CLABSIs after the patient is discharged from the facility is not required. However, if discovered, any CLABSIs with event date on the day of discharge or the next day should be reported to NHSN (see Transfer Rule). No additional central line days are reported.

**Requirements:** Surveillance for HAI CLABSI is performed in at least one inpatient location in the healthcare institution for at least one calendar month as indicated in the Patient Safety Monthly Reporting Plan (CDC 57.106).

**Definitions:**

- **Present on Admission (POA):** Infections that are POA, as defined in Chapter 2, are not considered HAIs and therefore are never reported to NHSN.

- **Healthcare-associated infections (HAI):** All NHSN site specific infections must first meet the HAI definition as defined in Chapter 2 before a site specific infection (e.g., CLABSI) can be reported to NHSN.

- **Primary bloodstream infections (BSI):** Laboratory-confirmed bloodstream infections (LCBI) that are not secondary to an infection at another body site (see Appendix 1, Secondary Bloodstream Infection (BSI) Guide and Surveillance Definitions chapter).

- **Date of event:** For a BSI the date of event is the date when the last element used to meet the laboratory-confirmed bloodstream infection (LCBI) criterion occurred. Synonym: infection date.
Central line: An intravascular catheter that terminates at or close to the heart or in one of the great vessels which is used for infusion, withdrawal of blood, or hemodynamic monitoring. The following are considered great vessels for the purpose of reporting central-line BSI and counting central-line days in the NHSN system:

- Aorta
- Pulmonary artery
- Superior vena cava
- Inferior vena cava
- Brachiocephalic veins
- Internal jugular veins
- Subclavian veins
- External iliac veins
- Common iliac veins
- Femoral veins
- In neonates, the umbilical artery/vein.

NOTES:
1. Neither the insertion site nor the type of device may be used to determine if a line qualifies as a central line. The device must terminate in one of the great vessels or in or near the heart and be used for one of the purposes outlined above, to qualify as a central line.
2. An introducer is considered an intravascular catheter, and depending on the location of its tip and use, may be a central line.
3. Pacemaker wires and other non-lumened devices inserted into central blood vessels or the heart are not considered central lines, because fluids are not infused, pushed, nor withdrawn through such devices.
4. The following devices are not considered central lines:
   - Extracorporeal membrane oxygenation (ECMO)
   - Femoral arterial catheters
   - Intraaortic balloon pump (IABP) devices.
   - Hemodialysis reliable outflow (HeRO) dialysis catheters

Infusion: The introduction of a solution through a blood vessel via a catheter lumen. This may include continuous infusions such as nutritional fluids or medications, or it may include intermittent infusions such as flushes, IV antimicrobial administration, or blood transfusion or hemodialysis.

Umbilical catheter: A central vascular device inserted through the umbilical artery or vein in a neonate.

Temporary central line: A non-tunneled, non-implanted catheter.
Permanent central line: Includes
- Tunneled catheters, including certain dialysis catheters
- Implanted catheters (including ports)
Central line-associated BSI (CLABSI): A laboratory-confirmed bloodstream infection (LCBI) where central line (CL) or umbilical catheter (UC) was in place for >2 calendar days on the date of event, with day of device placement being Day 1, and a CL or UC was in place on the date of event or the day before. If a CL or UC was in place for >2 calendar days and then removed, the LCBI criteria must be fully met on the day of discontinuation or the next day. If the patient is admitted or transferred into a facility with a central line in place (e.g., tunneled or implanted central line), and that is the patient’s only central line, day of first access as an inpatient is considered Day 1. “Access” is defined as line placement, infusion or withdrawal through the line.

Notes:
- To distinguish subsequent LCBI from a previously unresolved LCBI, see Note following HAI definition in Chapter 2.
- Patients suspected or known to have accessed their own IV lines are not excluded from CLABSI surveillance. A facility must protect the line as best they can. Prevention efforts may include providing a patient sitter and/or removal of the catheter as soon as is clinically possible.

EXAMPLES:
- Patient in MICU has central line inserted/accessed on June 1. On June 3, the central line is still in place and the patient has positive blood culture with *S. aureus*. This is a CLABSI because the central line was in place for >2 calendar days on the date of event.
- Patient has a central line inserted on June 1. On June 3, the central line is removed and on June 4 the patient has a positive blood culture with *S. aureus*. This is a CLABSI because the central line was in place for >2 calendar days (June 1, 2, and 3), and was in place the day before the date of event.
- A central line is placed in the facility on May 30th. On June 3, the central line is removed and on June 4 patient spikes a fever of 38.3°C. Two blood culture sets collected on June 5 are positive for *S. epidermidis*. This is may be a healthcare-associated bloodstream infection but it is not a CLABSI because the central line was not place the day of or the day before LCBI Criterion 2 was met (June 5).

Location of attribution: The inpatient location where the patient was assigned on the date of the LCBI event, which is further defined as the date when the last element used to meet the LCBI criterion occurred (see exception below).

INPATIENT DIALYSIS:
Inpatients receiving dialysis are included in any CLABSI surveillance in the location in which they are housed, regardless of whether or not the central line is the only central line and only accessed for dialysis. This also applies to patients in Long-Term Acute Care (LTAC) facilities within Acute Care Facilities when dialysis is received from the Acute Care Facility staff.
EXAMPLES: CLABSIs in the following examples will be attributed to Unit A

- Patient on Unit A receives onsite dialysis by contracted dialysis staff
- Dialysis staff travels to Unit A to provide dialysis to Unit A patient
- Patient resides on Unit A for inpatient care, but is transported to dialysis unit within the facility for dialysis. Since CLABSIs cannot be attributed to non-bedded locations, such an event must be attributed to the inpatient location housing the patient.
- Facilities may choose to capture information about the presence of a dialysis catheter in patients with LCBI. The BSI collection form includes a data field “Any hemodialysis catheter present,” which may be marked yes or no, and utilized internally by facility to identify association of dialysis to LCBI.

EXCEPTION TO LOCATION OF ATTRIBUTION:

Transfer Rule: If all elements of a CLABSI are present on the day of transfer or the next day, in the same facility or a new facility the infection is attributed to the transferring location or facility. Receiving facilities should share information about such HAIs with the transferring facility to enable reporting. This is called the Transfer Rule and examples are shown below:

- Patient with a central line in place in the SICU is transferred to the surgical ward. On the next day, the patient meets criterion for an LCBI. This is reported to NHSN as a CLABSI for the SICU.
- Patient without a central line is transferred from the medical ward on hospital day 3 to MICU. Later that day a central line is inserted. The next day, LCBI criteria are met. This would be considered a BSI and attributed to the medical ward; however, it is not a CLABSI because the central line was not in place >2 days on the date of event.
- Patient with a central line in place is transferred from the medical ward to the coronary care ICU (CCU). After 4 days in the CCU and with the central line still in place, all elements of LCBI are met. This is reported to NHSN as a CLABSI for the CCU.
- After a two week hospital stay, a patient on the urology ward of Hospital A has his only central line removed and is discharged home a few hours later. The IP from Hospital B calls the next day to report that this patient has been admitted to Hospital B and meets LCBI criteria. This CLABSI should be reported to NHSN for, and by, Hospital A and attributed to the urology ward.
NOTE: Example of multiple transfers within the transfer rule time-frame:

<table>
<thead>
<tr>
<th>Date</th>
<th>Transfer Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/22</td>
<td>Patient in Unit A</td>
</tr>
<tr>
<td>3/23</td>
<td>Patient transferred from Unit A to Unit B. Later that day, patient transferred to Unit C. (day of transfer)</td>
</tr>
<tr>
<td>3/24</td>
<td>Patient transferred from Unit C to Unit D. Last element for CLABSI criteria met. CLABSI attributed to Unit A since Unit A was the original unit initiating the transfer in the 2 day time-frame. (day after transfer)</td>
</tr>
</tbody>
</table>

Table 1. Laboratory-Confirmed Bloodstream Infection Criteria

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Laboratory-Confirmed Bloodstream Infection (LCBI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCBI 1</td>
<td>Patient has a recognized pathogen cultured from one or more blood cultures and organism cultured from blood is not related to an infection at another site. (See Appendix 1 Secondary BSI Guide)</td>
</tr>
</tbody>
</table>
| LCBI 2    | Patient has at least one of the following signs or symptoms: fever (>38°C), chills, or hypotension and positive laboratory results are not related to an infection at another site (See Appendix 1 Secondary BSI Guide) and the same common commensal (i.e., diphtheroids [Corynebacterium spp. not C. diphtheriae], Bacillus spp. [not B. anthracis], Propionibacterium spp., coagulase-negative staphylococci [including S. epidermidis], viridans group streptococci, Aerococcus spp., and Micrococcus spp.) is cultured from two or more blood cultures drawn on separate occasions (see comment 3a below). Criterion elements must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements. (See complete list of common commensals at http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-
**NOTE:** The matching common commensals represent a single element; therefore, the collection date of the first common commensal is the date of the element used to determine the Date of Event.

<table>
<thead>
<tr>
<th>Date</th>
<th>Elements</th>
<th>Common Commensal</th>
<th>Result</th>
<th>Date of LCBI Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/1/2013</td>
<td>Fever &gt;38°C</td>
<td>No LCBI elements</td>
<td></td>
<td>6/3/2013</td>
</tr>
<tr>
<td>6/2/2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6/3/2103</td>
<td></td>
<td>S. epidermidis</td>
<td>(1 of 2)</td>
<td></td>
</tr>
<tr>
<td>6/4/2013</td>
<td></td>
<td>S. epidermidis</td>
<td>(1 of 2)</td>
<td></td>
</tr>
</tbody>
</table>

**LCBI 3**

Patient ≤ 1 year of age has at least one of the following signs or symptoms: fever (>38°C core), hypothermia (<36°C core), apnea, or bradycardia

and positive laboratory results are not related to an infection at another site (See [Appendix 1 Secondary BSI Guide](#))

and

the same common commensal (i.e., diphtheroids [*Corynebacterium* spp. not *C. diphtheriae*], *Bacillus* spp. [not *B. anthracis*], *Propionibacterium* spp., coagulase-negative staphylococci [including *S. epidermidis*], viridans group streptococci, *Aerococcus* spp., *Micrococcus* spp.) is cultured from two or more blood cultures drawn on the same or consecutive days and separate occasions (see Comment 3a below). Criterion elements must occur within a timeframe that does not exceed a gap of 1 calendar day between two adjacent elements. (See complete list of common commensals at [http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-Lists.xlsx](http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-Lists.xlsx))

**NOTE:** The matching common commensals represent a single element; therefore, the collection date of the first common commensal is the date of the element.

<table>
<thead>
<tr>
<th>Date</th>
<th>Elements</th>
<th>Common Commensal</th>
<th>Result</th>
<th>Date of LCBI Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/1/2013</td>
<td>Fever &gt;38°C</td>
<td>No LCBI elements</td>
<td></td>
<td>6/3/2013</td>
</tr>
<tr>
<td>6/2/2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6/3/2103</td>
<td></td>
<td>S. epidermidis</td>
<td>(1 of 2)</td>
<td></td>
</tr>
<tr>
<td>6/4/2013</td>
<td></td>
<td>S. epidermidis</td>
<td>(1 of 2)</td>
<td></td>
</tr>
</tbody>
</table>
**Criterion | Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection (MBI-LCBI)**

*In 2014 when reporting an LCBI, it is required to indicate which of the underlying conditions of the MBI-LCBI criterion was met, if any. All CLABSI, whether LCBI or MBI-LCBI, must be reported if CLABSI is part of your Monthly Reporting Plan.*

Must meet one of the following criteria:

| MBI-LCBI 1 | Patient of any age meets criterion 1 for LCBI with at least one blood culture growing any of the following intestinal organisms with no other organisms isolated (See Comment #5): Bacteroides spp., Candida spp., Clostridium spp., Enterococcus spp., Fusobacterium spp., Peptostreptococcus spp., Prevotella spp., Veillonella spp., or Enterobacteriaceae* and patient meets at least one of the following:

1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood culture:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD] (See Comment #6)
   b. ≥1 liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within 7 calendar days before the date the positive blood culture was collected.

2. Is neutropenic, defined as at least 2 separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm³ within a seven-day time period which includes the date the positive blood culture was collected (Day 1), the 3 calendar days before and the 3 calendar days after (See Table 4 for example).

*See Table 3 for partial list of eligible Enterobacteriaceae genera.*

| MBI-LCBI 2 | Patient of any age meets criterion 2 for LCBI when the blood cultures are growing only viridans group streptococci with no other organisms isolated and patient meets at least one of the following:

1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented

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January 2014
during same hospitalization as positive blood culture:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD] (See Comment #6)
   b. ≥1 liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within 7 calendar days before the date the first positive blood culture was collected.

2. Is neutropenic, defined as at least 2 separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm$^3$ within a seven-day time period which includes the date the positive blood culture was collected (Day 1), the 3 calendar days before and the 3 calendar days after (See Table 4 for example).

### Patient ≤1 year of age meets criterion 3 for LCBI when the blood cultures are growing only viridans group streptococci with no other organisms isolated

and

patient meets at least one of the following:

1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood culture:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD] (See Comment #6)
   b. ≥20 mL/kg diarrhea in a 24-hour period with onset on or within 7 calendar days before the date the first positive blood culture is collected.

2. Is neutropenic, defined as at least 2 separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm$^3$ on or within a seven-day time period which includes the date the positive blood culture was collected (Day 1), the 3 calendar days before and the 3 calendar days after. (See Table 4 for example)

### Comments

1. In LCBI criterion 1, the term “recognized pathogen” includes any organism not included on the common commensal list (see criteria 2 and 3 or Supporting Material section at [http://www.cdc.gov/nhsn/acute-care-hospital/clabsi/index.html](http://www.cdc.gov/nhsn/acute-care-hospital/clabsi/index.html) for the list of common commensals).

2. LCBI criteria 1 and 2 and MCI-LCBI criteria 1 and 2 may be used for patients of any age, including those patients ≤1 year of age.
3. In LCBI criteria 2 and 3, if the pathogen or common commensal is identified to the species level from one blood culture, and a companion blood culture is identified with only a descriptive name, which is complementary to the companion culture (e.g., to the genus level), then it is assumed that the organisms are the same. The organism identified to the species level should be reported as the infecting organism along with its antibiogram if available (see Table 2 below). Only genus and species identification should be utilized to determine the sameness of organisms (i.e., matching organisms). No additional comparative methods should be used (e.g., morphology or antibiograms) because laboratory testing capabilities and protocols may vary between facilities. This will reduce reporting variability, solely due to laboratory practice, between facilities reporting LCBI meeting criterion 2. Report the organism to the genus/species level only once, and if antibiogram data are available, report the results from the most resistant panel.

   a. In LCBI criteria 2 and 3, the phrase “two or more blood cultures drawn on separate occasions” means 1) that blood from at least two blood draws were collected on the same or consecutive calendar days and 2) were collected in a manner which suggests that 2 separate blood draw site preparations were performed. This will reduce misidentification of contaminated blood cultures as LCBI.

   b. A blood culture may consist of a single bottle for a pediatric blood draw due to volume constraints. Therefore, to meet this part of the criterion, each bottle from two or single bottle blood draws would have to be culture-positive for the same commensal.

4. Specimen Collection Considerations: Although blood cultures drawn through central lines can have a higher rate of contamination than blood cultures collected through peripheral venipuncture, all positive blood cultures, regardless of the sites from which they were collected, must be included when conducting in-plan CLABSI surveillance.

5. In MBI-LCBI 1, 2 and 3, “No other organisms isolated” means there is not isolation in a blood culture of another recognized pathogen (e.g., \textit{S. aureus}) or common commensal (e.g., coagulase-negative staphylococci) other than listed in MBI-LCBI.
criterion 1, 2 or 3 that would otherwise meet LCBI criteria. If this occurs, the infection should not be classified as MBI-LCBI.

6. Grade III/IV GI GVHD is defined as follows:
   • In adults: ≥1 L diarrhea/day or ileus with abdominal pain
   • In pediatric patients: ≥20 cc/kg/day of diarrhea

REPORTING INSTRUCTIONS

2. Catheter tip cultures are not used to determine whether a patient has a primary BSI.
3. When there is a positive blood culture and clinical signs or symptoms of localized infection at a vascular access site, but no other infection can be found, the infection is considered a primary BSI.
4. Purulent phlebitis confirmed with a positive semiquantitative culture of a catheter tip, but with either negative or no blood culture is considered a CVS-VASC, not a BSI, SST-SKIN, or a ST infection.
5. Occasionally a patient with both peripheral and central IV lines develops a primary bloodstream infection (LCBI) that can clearly be attributed to the peripheral line (e.g., pus at the insertion site and/or matching pathogen from pus and blood). In this situation, enter “Central Line = No” in the NHSN application. You should, however, include the patient’s central line days in the summary denominator count.
6. If your state or facility requires that you report healthcare-associated BSIs that are not central line-associated, enter “Central Line = No” in the NHSN application when reporting these BSIs. You should, however, include all of the patient’s central line days in the summary denominator count.

Table 2. Examples of How to Report Speciated and Unspected Organisms Isolated from Blood Cultures

<table>
<thead>
<tr>
<th>Culture Report</th>
<th>Companion Culture Report</th>
<th>Report as…</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coagulase-positive staphylococci</strong></td>
<td><strong>S. aureus</strong></td>
<td><strong>S. aureus</strong></td>
</tr>
<tr>
<td><strong>S. epidermidis</strong></td>
<td>Coagulase-negative staphylococci</td>
<td><strong>S. epidermidis</strong></td>
</tr>
<tr>
<td><strong>Enterococcus spp.</strong></td>
<td><strong>E. faecium</strong></td>
<td><strong>E. faecium</strong></td>
</tr>
<tr>
<td><strong>Bacillus spp. (not anthracis)</strong></td>
<td><strong>B. cereus</strong></td>
<td><strong>B. cereus</strong></td>
</tr>
<tr>
<td><strong>S. salivarius</strong></td>
<td>Strep viridans</td>
<td><strong>S. salivarius</strong></td>
</tr>
</tbody>
</table>
Table 3. Partial List of Criterion 1 MBI-LCBI Eligible Enterobacteriaceae Genera
(See complete list of MBI Pathogens at [NHSN Organisms Lists](#) (All Organisms, Top Organisms, Common Commensals, MBI Organisms, & Uropathogens)

<table>
<thead>
<tr>
<th>Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citrobacter</td>
</tr>
<tr>
<td>Enterobacter</td>
</tr>
<tr>
<td>Escherichia</td>
</tr>
<tr>
<td>Klebsiella</td>
</tr>
<tr>
<td>Proteus</td>
</tr>
<tr>
<td>Providencia</td>
</tr>
<tr>
<td>Salmonella</td>
</tr>
<tr>
<td>Serratia</td>
</tr>
<tr>
<td>Shigella</td>
</tr>
<tr>
<td>Yersina</td>
</tr>
</tbody>
</table>
### Table 4. Examples Illustrating the MBI-LCBI Criteria for Neutropenia

<table>
<thead>
<tr>
<th>Pt. A</th>
<th>WB C</th>
<th>Day -7</th>
<th>Day -6</th>
<th>Day -5</th>
<th>Day -4</th>
<th>Day -3</th>
<th>Day -2</th>
<th>Day -1</th>
<th>Day 1*</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>100</td>
<td>800</td>
<td>400</td>
<td>300</td>
<td>ND</td>
<td>ND</td>
<td>320</td>
<td>400</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+ BC* w/ Candida spp. x1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pt. B</td>
<td>ANC</td>
<td>ND</td>
<td>410</td>
<td>130</td>
<td>ND</td>
<td>ND</td>
<td>120</td>
<td>110</td>
<td>ND</td>
<td>110</td>
<td>300</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+BC* w/ viridans strep x2 and fever &gt;38°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pt. C</td>
<td>WB C</td>
<td>100</td>
<td>800</td>
<td>400</td>
<td>300</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>600</td>
<td>230</td>
<td>ND</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+ BC* w/ Candida spp. x1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ND = not done**

*Day the blood specimen that was positive was collected

Patient A meets MBI-LCBI criterion 1, sub-criterion 2: Positive blood culture with intestinal organism (*Candida* spp.) and neutropenia (2 separate days of WBC <500 cells/mm³ occurring on the date the positive blood culture was collected [Day 1] or during the 3 days before or the 3 days after that date). In this case, the Day 1 value = 400, and Day -1 value = 320.

Patient B meets MBI-LCBI criterion 2, sub-criterion 2: At least 2 positive blood cultures with viridans group streptococci (in this case, 2 positive), and fever >38°C and neutropenia (2 separate days of ANC <500 cells/mm³ occurring on the date the positive blood culture was collected [Day 1] or during the 3 days before or the 3 days after that date). In this case, the Day -1 value = 110 and
Day -2 value = 120. Note: any two of Days -2,-1, 2, 3, and 4 could be used to meet this requirement since WBC or ANC under 500 were present on those days.

Patient C meets MBI-LCBI criterion 1, sub-criterion 2: Positive blood culture with intestinal organism (*Candida* spp.) and neutropenia (2 separate days of WBC <500 cells/mm³ occurring on the date the positive blood culture was collected [Day 1] or during the 3 days before or the 3 days after that date). In this case, Day 2 value =230 and Day 4 value = 400).

**Numerator Data:** The *Primary Bloodstream Infection (BSI)* form (CDC 57.108) is used to collect and report each CLABSI that is identified during the month selected for surveillance. The *Instructions for Completion of Primary Bloodstream Infection (BSI)* form contains brief instructions for collection and entry of each data element on the form. The *Primary BSI* form includes patient demographic information and whether a central line was present, and, if so, the type of central line the patient had if appropriate to the location; these data will be used to calculate line-specific infection rates. Additional data include the specific criteria met for identifying the primary BSI, whether the patient died, the organisms isolated from blood cultures, and the organisms’ antimicrobial susceptibilities.

**REPORTING INSTRUCTION:**
- If no CLABSIs are identified during the month of surveillance, the Report No Events box must be checked on the appropriate denominator summary screen, e.g., Denominators for Intensive Care Unit (ICU)/Other locations (Not NICU or SCA), etc.

**Denominator Data:** Device days and patient days are used for denominators (see Key Terms chapter). Device-day denominator data that are collected differ according to the location of the patients being monitored; however, within a location, they should be collected at the same time each day. When denominator data are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from manually-collected counts, pre-validated for a minimum of 3 months.

For locations other than specialty care areas/oncology (SCA/ONC) and NICUs, the number of patients with one or more central lines of any type is collected daily, at the same time each day, during the month and recorded on the *Denominators for Intensive Care Unit (ICU)/Other Locations (Not NICU or SCA/ONC)* form (CDC 57.118). Only the totals for the month are entered into NHSN. When denominator data are available from electronic sources (e.g., central line days from electronic charting), these sources may be used as long as the counts are not substantially different (+/- 5%) from manually-collected counts, pre-validated for a minimum of 3 months.

For specialty care areas/oncology, the number of patients with one or more central lines is dichotomized into those with permanent central lines and those with temporary central
lines on the *Denominators for Specialty Care Area (SCA)/Oncology (ONC)* form (CDC 57.117). Each is collected daily, at the same time each day. Only the totals for the month are entered into NHSN. This distinction in lines is made because permanent lines are commonly used in patients frequenting these areas and may be associated with lower rates of BSI than central lines inserted for temporary use. If a patient has both a temporary and a permanent central line, count the day only as a temporary line day. The *Instructions for Completion of Denominators for Intensive Care Unit (ICU)/Other Locations (Not NICU and SCA/ONC)* and *Instructions for Completion of Denominators for Specialty Care Areas (SCA)/Oncology (ONC)* contain brief instructions for collection and entry of each data element on the forms.

In NICUs, the number of patients with one or more central lines is stratified by birthweight in five categories since risk of BSI varies by birthweight. These data are collected on the *Denominators for Neonatal Intensive Care Unit (NICU)* form (CDC 57.116).

NOTE: The weight of the infant at the time of BSI is not used and should not be reported. For example, if a neonate weighs 1006 grams at birth but remains in the NICU for two months and has a body weight of 1650 grams when a CLABSI develops, record the birthweight of 1006 grams on the BSI form. The *Instructions for Completion of Denominators for Neonatal Intensive Care Unit (NICU)* form contains brief instructions for collection and entry of each data element on the forms.

**Data Analyses:** The Standardized Infection Ratio (SIR) is calculated by dividing the number of observed infections by the number of predicted infections. The number of predicted infections, is calculated using CLABSI rates from a standard population during a baseline time period, which represents a standard population’s CLABSI experience. NOTE: The SIR will be calculated only if the number of expected HAIs (numExp) is ≥1 to help enforce a minimum precision criterion.

NOTE: In the NHSN application, “predicted” is referred to as “expected”.

\[
\text{SIR} = \frac{\text{Observed (O) HAIs}}{\text{Expected (E) HAIs}}
\]

While the CLABSI SIR can be calculated for single locations, the measure also allows you to summarize your data across multiple locations, adjusting for differences in the incidence of infection among the location types. For example, you will be able to obtain one CLABSI SIR adjusting for all locations reported. Similarly, you can obtain one CLABSI SIR for all specialty care areas in your facility. NOTE: Only those locations for which baseline data have been published will be included in the SIR calculations.
The CLABSI rate per 1000 central line days is calculated by dividing the number of CLABSI by the number of central line days and multiplying the result by 1000. The Central Line Utilization Ratio is calculated by dividing the number of central line days by the number of patient days. These calculations will be performed separately for different types of ICUs, specialty care areas, and other locations in the institution. Separate rates and ratios will also be calculated for different types of catheters in specialty care areas/oncology locations and for birthweight categories in NICUs.

Descriptive analysis options of numerator and denominator data are available in the NHSN application, such as line listings, frequency tables, and bar and pie charts. SIRs and CLABSI rates and run charts are also available. Guides on using NHSN analysis features are available from: http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html.

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Appendix 1. Secondary Bloodstream Infection (BSI) Guide (not applicable to Ventilator-associated Events [VAE])

What is the meaning of the statement “not related to infection at another site” in relation to a positive blood culture?

The purpose of using the CDC/NHSN infection criteria is to identify and consistently categorize infections that are healthcare-associated into major and specific infection sites or types. LCBI criteria include the caveat that the organism(s) cultured from the blood cannot be related to infection at another site (i.e., must be a primary BSI). One must be sure that there is no other CDC-defined primary site of infection that may have seeded the bloodstream secondarily; otherwise the bloodstream infection may be misclassified as a primary BSI or erroneously associated with the use of a central line, i.e., called a CLABSI. For locations participating in in-plan VAE surveillance, refer to the VAE chapter for specific guidance on assigning a secondary BSI to a VAE.

Below are listed several scenarios that may occur with guidance on how to distinguish between the primary or secondary nature of a BSI, along with the definition of “matching organisms”, and important notes and reporting instructions.

1. **Blood and site-specific specimen cultures match for at least one organism**: In a patient suspected of having an infection, blood and a site-specific specimen are collected for culture and both are positive for at least one matching organism. If the site-specific culture is an element used to meet the infection site criterion, then the BSI is considered secondary to that site-specific infection.
   a. Example: Patient meets HAI criteria for a symptomatic urinary tract infection (suprapubic tenderness and >10^5 CFU/ml of *E. coli*) and blood culture from the same date grows *E. coli*. This is an HAI SUTI with a secondary BSI and the reported organism is *E. coli*.
   b. Example: Patient meets HAI criteria for a symptomatic urinary tract infection (suprapubic tenderness and >10^5 CFU/ml of *E. coli*) and blood culture from the same date grows *E. coli* and *P. aeruginosa*. This is an HAI SUTI with a secondary BSI and the reported organisms are *E. coli* and *P. aeruginosa*, since *P. aeruginosa* is a logical pathogen for this site of infection.
   c. Example: Patient meets HAI criteria for a symptomatic urinary tract infection (suprapubic tenderness and >10^5 CFU/ml of *E. coli*) and blood culture from the same date grows *E. coli* and *S. epidermidis*. This is an HAI SUTI with a secondary BSI and the reported organism is only *E. coli*, since the single common commensal *S. epidermidis* positive blood culture by itself does not meet BSI criteria.

2. **Blood and site-specific specimen cultures do not match**: There are two scenarios that can occur when a patient suspected of having an infection has blood and a site-specific specimen cultured but the organisms do not match.
a. If the site-specific culture is an element used to meet the infection site criterion and the blood isolate is also an element used to meet another criterion at the same infection site, then the BSI is considered secondary to that site-specific infection.
   i. Example: Postoperative patient becomes febrile and complains of nausea and abdominal pain. Blood and an aseptically-obtained T-tube drainage specimen are collected for culture. A CT scan done that day shows fluid collection suggestive of infection. Culture results show *Escherichia coli* from the purulent drainage specimen but the blood grows *Bacteroides fragilis*. Because the patient meets IAB criteria by positive site-specific culture (IAB criterion 3a) and by positive blood culture as an element of a different criterion of the same infection site (IAB 3c), the blood is considered a secondary BSI to an IAB and both organisms would be listed as the IAB infection pathogens. No primary BSI would be reported.

b. If the site-specific culture is an element used to meet the infection site criterion and the blood isolate is not, then the BSI is considered a primary infection.
   i. Example: Postoperative patient has an intraabdominal abscess (IAB) noted during reoperation and purulent material is obtained at that time which grows *Escherichia coli*. The patient spikes a fever two days later and blood culture shows *Bacteroides fragilis*. Because the organisms from the site and blood cultures do not match, and no site-specific criterion that includes positive blood culture as an element is met, both a site-specific infection (criteria 1 and 2) and a primary BSI would be reported.
   ii. Example: Unconscious ICU patient with a Foley catheter and central line for past 4 days spikes a fever; blood, urine and sputum specimens are collected for culture. The urine culture grows >100,000 CFU/ml of *Escherichia coli*, blood culture grows *Enterococcus faecium*, and sputum shows oral flora only. Because the organisms from the urine and blood cultures do not match, and a UTI criterion that includes positive blood culture as an element is not met, both a SUTI (SUTI criterion 1a) and a primary BSI would be reported. This infection does not meet the ABUTI criterion since that requires at least one matching uropathogen organism in urine and blood in an asymptomatic patient.

3. **No site-specific specimen culture, only a positive blood culture**: In a patient suspected of having an infection, if the only specimen cultured is blood and it grows a logical pathogen for the suspected body site of infection, and a site-specific infection criterion is met, an element of which may or may not include a positive blood culture, the BSI is considered secondary to that site-specific infection.
a. Example: Postoperative patient has an abscess in the small bowel noted during reoperation. The only specimen cultured is blood which grows *B. fragilis*. Because gastrointestinal tract infection (GIT) criterion 1 is met with the surgically-identified abscess alone and because *B. fragilis* is a logical pathogen for this site of infection, the BSI is considered secondary to a GIT and *B. fragilis* is listed as the GIT infection pathogen.

b. Example: Patient has a positive blood culture with *E. coli* proximal in time with fever, abdominal pain, and CT scan evidence of intraabdominal abscess (IAB). This patient meets IAB criterion 3c, which includes a positive blood culture as one of its elements. The BSI is considered secondary to the IAB and *E. coli* is listed as the IAB infection pathogen.

4. **Negative site-specific specimen culture with positive blood culture:** In a patient suspected of having an infection, if a specimen from the suspected site of infection is cultured and yields no growth, but a blood specimen collected as part of the infection work-up is positive, that BSI is only considered a secondary BSI if another of the site-specific criteria that includes positive blood culture as an element is met. Otherwise, the BSI is considered a primary BSI, even if another criterion for that site is met and the blood isolate is a logical pathogen for the infection.

   a. Example: Patient has purulent material from the IAB space cultured and it yields no growth. The patient also has fever, abdominal pain, a positive blood culture with *Pseudomonas aeruginosa*, and radiographic evidence of IAB infection. This patient does not meet IAB criterion 1 (positive culture from purulent material) but does meet IAB criterion 3c, an element of which is a positive blood culture (signs/symptoms plus positive blood culture plus radiographic evidence). This BSI is considered secondary to the IAB and *P. aeruginosa* is listed as the IAB infection pathogen.

   b. Example: Postoperative knee replacement patient with a central line spikes a fever; blood and knee joint fluid are cultured. Only the blood cultures from at least two separate blood draws are positive for *S. epidermidis*. No other JNT infection criteria are met. This BSI should be reported as a CLABSI.

   c. Example: Patient has a central line in place for 10 days. Patient complains of knee joint tenderness and limited range of motion. CT scan findings suggest joint (JNT) infection but culture of a needle-aspirated joint fluid is negative. However, a blood culture from the same time period grows *S. aureus*. While this patient does not meet JNT criterion 1 (positive joint fluid culture), he does meet JNT criterion 3d (signs/symptoms plus positive laboratory test on blood [blood culture]). Since a positive blood culture is part of the criterion met for JNT infection, this BSI is considered secondary to the JNT infection and not reported as a CLABSI. *S. aureus* is reported as the pathogen for the JNT infection.
A matching organism is defined as one of the following:

1. If genus and species are identified in both cultures, they must be the same.
   a. Example: A blood culture reported as *Enterobacter cloacae* and an intraabdominal specimen of *Enterobacter cloacae* are matching organisms.
   b. Example: A blood culture reported as *Enterobacter cloacae* and an intraabdominal specimen of *Enterobacter aerogenes* are NOT matching organisms as the species are different.

2. If the organism is less definitively identified in one culture than the other, the identifications must be complementary.
   a. Example: A surgical wound growing *Pseudomonas* spp. and a blood culture growing *Pseudomonas aeruginosa* are considered a match at the genus level and therefore the BSI is reported as secondary to the SSI.
   b. Example: A blood culture reported as *Candida albicans* and a urine culture reported as yeast are considered to have matching organisms because the organisms are complementary, i.e. Candida is a type of yeast.

Notes:
1. If the blood isolate by itself does not meet BSI criteria (e.g., only one positive blood culture of a common commensal), then that isolate may not be used to indicate the presence of a secondary BSI (see example 1c).
2. Antibiograms of the blood and potential primary site isolates do not have to match.
3. Blood and site-specific specimens do not have to be collected on the same day but there must be evidence of infection at the specific site at the time of blood culture collection.

Reporting Instructions:
1. For reporting secondary BSI for possible and probable VAP, see Chapter 10.
2. Do not report secondary bloodstream infection for vascular (VASC) infections, clinically-defined pneumonia (PNU1), Ventilator-Associated Conditions (VAC), or Infection-related Ventilator-Associated Complications (IVAC).
3. If a site-specific criterion requiring positive culture results is met, be sure to check the positive culture box when specifying the criteria used when adding the event, even if another criterion that does not include culture results is also met. For example, using the scenario in 2.a.i above, the following boxes for criteria used would be checked when entering the SSI into the NHSN application: fever, nausea, pain or tenderness, positive culture, positive blood culture, imaging test evidence of infection.
Ventilator-Associated Event (VAE)
For use in adult locations only

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Introduction: Mechanical ventilation is an essential, life-saving therapy for patients with critical illness and respiratory failure. Studies have estimated that more than 300,000 patients receive mechanical ventilation in the United States each year [1-3]. These patients are at high risk for complications and poor outcomes, including death [1-5]. Ventilator-associated pneumonia (VAP), sepsis, Acute Respiratory Distress Syndrome (ARDS), pulmonary embolism, barotrauma, and pulmonary edema are among the complications that can occur in patients receiving mechanical ventilation; such complications can lead to longer duration of mechanical ventilation, longer stays in the ICU and hospital, increased healthcare costs, and increased risk of disability and death. Mortality in patients with acute lung injury on mechanical ventilation has been estimated to range from 24% in persons 15-19 years of age to 60% for patients 85 years and older [4].

Surveillance for ventilator-associated events in the National Healthcare Safety Network (NHSN) prior to 2013 was limited to VAP. For the year 2010, NHSN facilities reported more than 3,525 VAPs, and the VAP incidence for various types of hospital units ranged from 0.0-5.8 per 1,000 ventilator days [6]. However, there is currently no valid, reliable definition for VAP, and even the most widely-used VAP criteria and definitions are neither sensitive nor specific [7-10].

A particular difficulty with many commonly-used VAP definitions, including the NHSN PNEU definitions (revised in 2002), is that they require radiographic findings of pneumonia. Evidence suggests that chest radiograph findings do not accurately identify VAP. The subjectivity and
variability inherent in chest radiograph technique, interpretation, and reporting make chest imaging ill-suited for inclusion in a definition algorithm to be used for the potential purposes of public reporting, inter-facility comparisons, and pay-for-reporting and pay-for-performance programs. Another major difficulty with available VAP definitions is their reliance on specific clinical signs or symptoms, which are subjective and may be poorly or inconsistently documented in the medical record. The NHSN PNEU protocol includes multiple definition pathways and special criteria for selected patient populations (e.g., children, immunocompromised patients), increasing its complexity.

The limitations of VAP surveillance definitions have implications for prevention. Valid and reliable surveillance data are necessary for assessing the effectiveness of prevention strategies. It is notable that some of the most effective measures for improving outcomes of patients on mechanical ventilation do not specifically target pneumonia prevention [11-14].

In 2011 CDC convened a Working Group composed of members of several stakeholder organizations to address the limitations of the NHSN PNEU definitions and propose a new approach to surveillance for Ventilator-Associated Events (VAE) for NHSN [15]. The organizations represented in the Working Group include: the Critical Care Societies Collaborative (the American Association of Critical-Care Nurses, the American College of Chest Physicians, the American Thoracic Society, and the Society for Critical Care Medicine); the American Association for Respiratory Care; the Association of Professionals in Infection Control and Epidemiology; the Council of State and Territorial Epidemiologists; the Healthcare Infection Control Practices Advisory Committee’s Surveillance Working Group; the Infectious Diseases Society of America; and the Society for Healthcare Epidemiology of America.

The VAE surveillance definition algorithm developed by the Working Group and implemented in the NHSN in January 2013 is based on objective, streamlined, and potentially automatable criteria that will intentionally identify a broad range of conditions and complications occurring in mechanically-ventilated adult patients [16]. There are three definition tiers within the VAE algorithm: 1) Ventilator-Associated Condition (VAC); 2) Infection-related Ventilator-Associated Complication (IVAC); and 3) Possible and Probable VAP. Data indicate that streamlined, objective algorithms to detect ventilator-associated complications (similar to the VAC tier of the VAE algorithm) are easily implemented, can make use of electronic health record systems to automate event detection, and identify events that are clinically important and associated with outcomes such as ICU and hospital length of stay and mortality [16,17]. Research suggests that most VACs are due to pneumonia, ARDS, atelectasis, and pulmonary edema [16]. These are significant clinical conditions that may be preventable.

NOTE: The VAE definition algorithm is for use in surveillance; it is not a clinical definition algorithm and is not intended for use in the clinical management of patients. Examples provided throughout this protocol and in the VAE “Frequently-Asked Questions” are for illustration purposes only and are not intended to represent actual clinical scenarios.
Settings: Inpatient locations eligible to participate in VAE surveillance are those adult locations in acute care hospitals, long term acute care hospitals, and inpatient rehabilitation facilities where denominator data (ventilator and patient days) can be collected for patients. Such locations may include critical/intensive care units (ICU), specialty care areas (SCA), step-down units, wards, and long term care units. A complete listing of adult inpatient locations can be found in Chapter 15.

NOTE: It is not required to monitor for VAEs after discharge if a patient is transferred to another facility while still on mechanical ventilation. However, VAEs discovered within 2 calendar days of discharge (where the day of discharge is day 1) should be reported to NHSN. No additional ventilator days are reported.

Requirements: Surveillance for VAE in at least one inpatient location in the healthcare institution for at least one calendar month as indicated in the Patient Safety Monthly Reporting Plan (CDC 57.106). The VAE algorithm is only applicable to mechanically-ventilated patients in adult locations.

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 pages outline the criteria that must be used for meeting the VAE surveillance definitions (Figures 1-5). To report VAEs, use the Ventilator-Associated Event form (CDC 57.112) and Instructions for Completion.

NOTE: 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 this chapter.

NOTE: 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 FiO₂ and must be characterized by ≥ 2 calendar days of stable or decreasing daily minimum FiO₂ 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 FiO₂ on the first day of the baseline period of stability or improvement). The definitions of “daily minimum PEEP” and “daily minimum FiO₂” are included below. Note that the minimum daily PEEP or FiO₂ used for VAE surveillance is the lowest setting during a calendar day that was maintained for at least 1 hour.
For the purposes of VAE surveillance, PEEP values between 0 cmH₂O and 5 cmH₂O will be considered equivalent. This means that patients with daily minimum PEEP values from 0 to 5 cmH₂O must then have an increase in the daily minimum PEEP to at least 8 cmH₂O, sustained for at least 2 calendar days, to meet the VAC definition.

EXAMPLE: 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 cmH₂O 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 cmH₂O are considered equivalent for the purposes of this surveillance.

```
<table>
<thead>
<tr>
<th>MV Day</th>
<th>Daily minimum PEEP (cmH₂O)</th>
<th>Daily minimum FiO₂ (oxygen concentration, %)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1.00 (100%)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>0.50 (50%)</td>
<td>VAC</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
</tbody>
</table>
```

EXAMPLE: 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 cmH₂O 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 cmH₂O during this time period—because PEEP values from 0-5 cmH₂O are considered equivalent for the purposes of this surveillance.

```
<table>
<thead>
<tr>
<th>MV Day</th>
<th>Daily minimum PEEP (cmH₂O)</th>
<th>Daily minimum FiO₂ (oxygen concentration, %)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1.00 (100%)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>0.50 (50%)</td>
<td>VAC</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
</tbody>
</table>
```
EXAMPLE: 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 FiO₂ is ≥ 0.20 (20 points) over the daily minimum FiO₂ during the baseline period.

<table>
<thead>
<tr>
<th>MV Day</th>
<th>Daily minimum PEEP (cmH₂O)</th>
<th>Daily minimum FiO₂ (oxygen concentration, %)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>1.00 (100%)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>0.40 (40%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>0.40 (40%)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>0.70 (70%)</td>
<td>VAC</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>0.70 (70%)</td>
<td></td>
</tr>
</tbody>
</table>

EXAMPLE: In the example below, there is no VAC, because the FiO₂ on MV day 4 is higher than the FiO₂ on MV day 3 (and therefore not stable or decreasing) – even though the FiO₂ on MV days 3 and 4 meets the 20-point threshold when compared with the daily minimum FiO₂ on MV days 5 and 6.

<table>
<thead>
<tr>
<th>MV Day</th>
<th>Daily minimum PEEP (cmH₂O)</th>
<th>Daily minimum FiO₂ (oxygen concentration, %)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>1.0 (100%)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>0.50 (50%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>0.35 (35%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>0.40 (40%)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>0.70 (70%)</td>
<td>No event</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>0.70 (70%)</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: 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 in VAE surveillance.

NOTE: 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 FiO₂ 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).
NOTE: 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 FiO2 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 FiO2 of 0.35 (35%) on days 4 and 5. On day 6, the patient experiences respiratory deterioration, and requires a minimum FiO2 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 (for PEEP or FiO2) 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).

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” [18]. 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 cmH2O. A sustained increase (defined later in this protocol) in the daily minimum PEEP of ≥ 3 cmH2O following a period of stability or improvement on the ventilator is one of two criteria that can be used in meeting the VAC definition. For the purposes of this surveillance, PEEP values from 0 to 5 cmH2O are considered equivalent.
Fraction of inspired oxygen (FiO₂): The fraction of oxygen in inspired gas. For example, the FiO₂ of ambient air is 0.21; the oxygen concentration of ambient air is 21%. In patients on mechanical ventilation, the FiO₂ 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 FiO₂ of ≥ 0.20 (20%) following a period of stability or improvement on the ventilator is the second of the two criteria that can be used in meeting the VAC definition.

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:

<table>
<thead>
<tr>
<th>Time (pm)</th>
<th>6 pm</th>
<th>7 pm</th>
<th>8 pm</th>
<th>9 pm</th>
<th>10 pm</th>
<th>11 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP (cmH₂O)</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Time</th>
<th>6 pm</th>
<th>7 pm</th>
<th>8 pm</th>
<th>9 pm</th>
<th>10 pm</th>
<th>11 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP (cmH₂O)</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Time</th>
<th>12 am</th>
<th>4 am</th>
<th>8 am</th>
<th>12 pm</th>
<th>4 pm</th>
<th>8 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP (cmH₂O)</td>
<td>5</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>PEEP (cmH2O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>23:30</td>
<td>5</td>
</tr>
<tr>
<td>Tuesday</td>
<td>00:00</td>
<td>5</td>
</tr>
<tr>
<td>Tuesday</td>
<td>00:30</td>
<td>5</td>
</tr>
<tr>
<td>Tuesday</td>
<td>01:00</td>
<td>10</td>
</tr>
<tr>
<td>Tuesday</td>
<td>01:30</td>
<td>10</td>
</tr>
<tr>
<td>Tuesday</td>
<td>02:00 through 23:30</td>
<td>10</td>
</tr>
</tbody>
</table>

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. FiO$_2$ is set at the following values through the remainder of the calendar day:

<table>
<thead>
<tr>
<th>Time</th>
<th>6 pm</th>
<th>7 pm</th>
<th>8 pm</th>
<th>9 pm</th>
<th>10 pm</th>
<th>11 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>FiO$_2$</td>
<td>1.0</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

In this example, the daily minimum FiO$_2$ for the purposes of VAE surveillance is 0.5. FiO$_2$ settings are being monitored and recorded every hour. There are two consecutive hours where the FiO$_2$ 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. FiO$_2$ is set at the following values through the remainder of the calendar day:

<table>
<thead>
<tr>
<th>Time</th>
<th>6 pm</th>
<th>7 pm</th>
<th>8 pm</th>
<th>9 pm</th>
<th>10 pm</th>
<th>11 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>FiO$_2$</td>
<td>1.0</td>
<td>0.8</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
<td>0.5</td>
</tr>
</tbody>
</table>

In this example, the daily minimum FiO$_2$ for the purposes of VAE surveillance is 0.8. FiO$_2$ settings are being monitored and recorded every hour. Although the lowest FiO$_2$ 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 FiO$_2$ 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: FiO$_2$ is set at the following values through the course of a calendar day:

<table>
<thead>
<tr>
<th>Time</th>
<th>2 pm</th>
<th>4 pm</th>
<th>6 pm</th>
<th>8 pm</th>
<th>10 pm</th>
<th>12 am</th>
</tr>
</thead>
<tbody>
<tr>
<td>FiO$_2$</td>
<td>1.0</td>
<td>0.60</td>
<td>0.40</td>
<td>0.50</td>
<td>0.55</td>
<td>0.60</td>
</tr>
</tbody>
</table>

In this example, the patient was intubated at 2 pm. The daily minimum FiO$_2$ is 0.40. FiO$_2$ settings are being monitored and recorded every 2 hours; therefore, the lowest recorded FiO$_2$ 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 FiO$_2$ value for Thursday. The ICU monitors and records FiO$_2$ 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 FiO$_2$ for Thursday? In this example, the lowest FiO$_2$ 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.

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>FiO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday</td>
<td>00:00 to 09:00</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>09:15</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>09:30</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>09:45</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>10:00</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>10:15</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>10:30</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>10:45</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>11:00</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>11:15</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>11:30</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>11:45</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>12:00 to 23:45</td>
<td>0.60</td>
</tr>
</tbody>
</table>

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 the Appendix that is initiated on or after the third calendar day of mechanical ventilation AND in the VAE Window Period (i.e., the period typically defined by the 2 calendar days before, the day of, and the 2 calendar days after the onset date of the VAE). The agent is considered new for the purposes of this definition if it was NOT given to the patient on either of the 2 days preceding the current start date.

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 cmH2O 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 Table 1, 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 chapter.

Table 1. Definitions of routes of administration

<table>
<thead>
<tr>
<th>Route of Administration</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous</td>
<td>An intravascular route that begins with a vein.</td>
</tr>
<tr>
<td>Intramuscular</td>
<td>A route that begins within a muscle.</td>
</tr>
<tr>
<td>Digestive Tract</td>
<td>A route that begins anywhere in the digestive tract extending from the mouth through rectum.</td>
</tr>
<tr>
<td>Respiratory Tract</td>
<td>A route that begins within the respiratory tract, including the oropharynx and nasopharynx.</td>
</tr>
</tbody>
</table>

^aOther routes of administration are excluded (e.g., antibiotic locks, intraperitoneal, intraventricular, irrigation, topical). ^bDefinitions 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 \( \geq 25 \) neutrophils and \( \leq 10 \) 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 Table 2, below.
Table 2. Instructions for using the purulent respiratory secretions criterion, based on laboratory reporting of respiratory secretion direct examination results.

<table>
<thead>
<tr>
<th>How do I use the purulent respiratory secretions criterion if …</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>My laboratory reports counts of “white blood cells” or “polymorphonuclear leukocytes” or “leukocytes” rather than counts of “neutrophils”?</td>
<td>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.</td>
</tr>
<tr>
<td>My laboratory reports semi-quantitative results (not quantitative results) for numbers of neutrophils and squamous epithelial cells?</td>
<td>Check with the laboratory to get information about what quantitative ranges the semi-quantitative reports correspond to.</td>
</tr>
<tr>
<td>My laboratory cannot provide additional information on how its semi-quantitative reporting corresponds to quantitative reporting ranges for neutrophils and squamous epithelial cells?</td>
<td>Use the following direct examination results to meet the purulent respiratory secretions criterion: heavy, 4+, or ≥25 neutrophils per low power field (lpf) [x100], AND rare, occasional, few, 1+ or 2+, or ≤10 squamous epithelial cells per lpf [x100] [19].</td>
</tr>
<tr>
<td>My laboratory reports only the numbers of neutrophils present, without reporting the number of squamous epithelial cells?</td>
<td>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]).</td>
</tr>
<tr>
<td>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])?</td>
<td>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.</td>
</tr>
<tr>
<td>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?</td>
<td>In this situation, a report indicating the presence of white blood cells, without quantitation, is sufficient to meet the purulent secretions criterion.</td>
</tr>
</tbody>
</table>
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\textsubscript{2} of \(\geq 0.20\) (20%). On day 4 (also the 4\textsuperscript{th} 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:

EXAMPLE: 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\textsubscript{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.

EXAMPLE: 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.

EXAMPLE: 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\textsubscript{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.

REPORTING INSTRUCTIONS (additional guidance may be found in the FAQs at the end of this chapter):

- 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 (refer to VAE Additional FAQ document for guidance).

- 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 commensals 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 3 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 Table 3.
Table 3. Threshold values for cultured specimens used in the Probable VAP definition

<table>
<thead>
<tr>
<th>Specimen collection/technique</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung tissue</td>
<td>$\geq 10^4 \text{ cfu/g tissue}$*</td>
</tr>
<tr>
<td>Bronchoscopically (B) obtained specimens</td>
<td></td>
</tr>
<tr>
<td>Bronchoalveolar lavage (B-BAL)</td>
<td>$\geq 10^4 \text{ cfu/ml}$*</td>
</tr>
<tr>
<td>Protected BAL (B-PBAL)</td>
<td>$\geq 10^4 \text{ cfu/ml}$*</td>
</tr>
<tr>
<td>Protected specimen brushing (B-PSB)</td>
<td>$\geq 10^3 \text{ cfu/ml}$*</td>
</tr>
<tr>
<td>Nonbronchoscopically (NB) obtained (blind) specimens</td>
<td></td>
</tr>
<tr>
<td>NB-BAL</td>
<td>$&gt; 10^4 \text{ cfu/ml}$*</td>
</tr>
<tr>
<td>NB-PSB</td>
<td>$\geq 10^3 \text{ cfu/ml}$*</td>
</tr>
<tr>
<td>Endotracheal aspirate (ETA)</td>
<td>$\geq 10^5 \text{ cfu/ml}$*</td>
</tr>
</tbody>
</table>

*Or equivalent semi-quantitative result.

cfu = colony forming units, g = gram, ml = milliliter

- 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 (refer to VAE Additional FAQ document for guidance).

  - 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.
Figure 1: Ventilator-Associated Events (VAE) Surveillance Algorithm

Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 2 calendar days of stable or decreasing daily minimum* FiO₂ or PEEP values. The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or FiO₂.

*Daily minimum defined by lowest value of FiO₂ or PEEP during a calendar day that is maintained for at least 1 hour.

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

1) Increase in daily minimum fiO₂ of ≥ 0.20 (20 points) over the daily minimum FiO₂ in the baseline period, sustained for ≥ 2 calendar days.
2) Increase in daily minimum PEEP values of ≥ 3 cmH₂O over the daily minimum PEEP in the baseline period, sustained for ≥ 2 calendar days.

*Daily minimum defined by lowest value of FiO₂ or PEEP during a calendar day that is maintained for at least 1 hour.
†Daily minimum PEEP values of 0-5 cmH₂O are considered equivalent for the purposes of VAE surveillance.

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

1) Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³.

AND

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

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

1) Purulent respiratory secretions (from one or more specimen collections)
   - Defined as secretions from the lungs, bronchi, or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells per low power field [lpf, x100].
   - If the laboratory reports semi-quantitative results, those results must correspond to the above quantitative thresholds.
   - See additional instructions for using the purulent respiratory secretions criterion in the VAE Protocol.

2) Positive culture (qualitative, semi-quantitative or quantitative) of sputum, endotracheal aspirate, bronchoalveolar lavage, lung tissue, or 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

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, one of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections)—and defined as for possible VAP
   AND one of the following:
   - Positive culture of endotracheal aspirate, ≥ 10⁵ CFU/ml or equivalent semi-quantitative result
   - Positive culture of bronchoalveolar lavage, ≥ 10⁴ CFU/ml or equivalent semi-quantitative result
   - Positive culture of lung tissue, ≥ 10⁴ CFU/g or equivalent semi-quantitative result
   - Positive culture of protected specimen brush, ≥ 10³ CFU/ml or equivalent semi-quantitative result

   *Same organism exclusions as noted for Possible VAP.

2) 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 influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

Possible Ventilator-Associated Pneumonia

Probable Ventilator-Associated Pneumonia
Figure 2: Ventilator-Associated Condition (VAC)

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

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

AND

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

1) Increase in daily minimum* \( \text{FiO}_2 \) of \( \geq 0.20 \) (20 points) over the daily minimum \( \text{FiO}_2 \) in the baseline period, sustained for \( \geq 2 \) calendar days.

2) Increase in daily minimum* PEEP values of \( \geq 3\, \text{cmH}_2\text{O} \) over the daily minimum PEEP in the baseline period†, sustained for \( \geq 2 \) calendar days.

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

†Daily minimum PEEP values of 0-5 cmH\(_2\)O are considered equivalent for the purposes of VAE surveillance.
Figure 3: Infection-related Ventilator-Associated Complication (IVAC)

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

1) Temperature > 38 °C or < 36°C, **OR** white blood cell count ≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³.

**AND**

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

*See Appendix for eligible agents.
Figure 4: Possible Ventilator-Associated Pneumonia (VAP)

Patient meets criteria for VAC and IVAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections)
   - Defined as secretions from the lungs, bronchi, or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells per low power field [lpf, x100].
   - If the laboratory reports semi-quantitative results, those results must be equivalent to the above quantitative thresholds.
   - See additional instructions for using the purulent respiratory secretions criterion in the VAE Protocol.

OR

2) Positive culture (qualitative, semi-quantitative or quantitative) of sputum*, endotracheal aspirate*, bronchoalveolar lavage*, lung tissue, or 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
**Figure 5: Probable Ventilator-Associated Pneumonia (VAP)**

Patient meets criteria for VAC and IVAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections—and defined as for possible VAP)

   **AND** one of the following (see Table 2):
   - 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.

OR

2) 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 influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus
Numerator Data: The Ventilator-Associated Event form (CDC 57.112) is used to collect and report each VAE that is identified during the month selected for surveillance. The Instructions for Completion of Ventilator-Associated Event Form includes brief instructions for collection and entry of each data element on the form. The VAE form includes patient demographic information and information on the start date and location of initiation of mechanical ventilation. Additional data include the specific criteria met for identifying VAE, whether the patient developed a secondary bloodstream infection, whether the patient died, and, where applicable, the organisms detected and their antimicrobial susceptibilities.

REPORTING INSTRUCTION:  
• If no VAEs are identified during the month of surveillance, the Report No Events box must be checked on the appropriate denominator summary screen, e.g., Denominators for Intensive Care Unit (ICU)/Other locations (Not NICU or SCA), etc.

Denominator Data: Device days and patient days are used for denominators (see Chapter 16 Key Terms). Ventilator days, which are the numbers of patients managed with ventilatory devices, are collected daily, at the same time each day, according to the chosen location using the appropriate form (CDC 57.117 and 57.118). These daily counts are summed and only the total for the month is entered into NHSN. Ventilator and patient days are collected for each of the locations monitored. When denominator data are available from electronic sources (e.g., ventilator days from respiratory therapy), these sources may be used as long as the counts are not substantially different (+/- 5%) from manually-collected counts, pre-validated for a minimum of 3 months.

NOTE: All ventilator days are counted, including ventilator days for patients on mechanical ventilation for < 3 days, and patients on high frequency ventilation and other therapies excluded from VAE surveillance. Patients with tracheostomies who are undergoing weaning from mechanical ventilation using tracheostomy collar trials are included in ventilator day counts as long as they spend some portion of the day on mechanical ventilation at a time that overlaps with the daily time during which ventilator day counts are performed.

NOTE: In addition to the total number of patients on ventilators on each day of surveillance, the number of patients on ventilators who are on the APRV mode of mechanical ventilation or related modes (which is a subset of all patients on ventilators) should also be indicated on the appropriate form (CDC 57.117 and 57.118). See FAQ nos. 22 and 23.

Data Analyses: The VAE rate per 1000 ventilator days is calculated by dividing the number of VAEs by the number of ventilator days and multiplying the result by 1000. Rates that may be appropriate for use in public reporting, inter-facility comparisons, and pay-for-reporting/pay-for-performance programs are the overall VAE rate (where the numerator consists of all events meeting at least the VAC definition) and the “IVAC-plus” rate (where the numerator consists of all events meeting at least the IVAC definition). Rates that may be appropriate for internal use within an individual unit or facility include rates of specific event types (e.g., events meeting
only the VAC definition, events meeting only the IVAC definition, events meeting only the Possible or Probable VAP definition), and rates of combined Possible and Probable VAP. Ventilator Utilization Ratio is calculated by dividing the number of ventilator days by the number of patient days. These calculations will be performed separately for the different types of ICUs, SCAs, and other locations in the institution.

***The information that follows regarding the Standardized Infection Ratio (SIR) is for informational purposes only, until a baseline period of VAE reporting has been established.***

The SIR is calculated by dividing the number of observed events by the number of expected events. The number of expected events, in the context of statistical prediction, is calculated using VAE rates from a standard population during a baseline time period as reported in the NHSN Report.

**NOTE: The SIR should be calculated only if the number of expected VAEs (numExp) is ≥ 1.**

\[
\text{SIR} = \frac{\text{Observed (O) VAEs}}{\text{Expected (E) VAEs}}
\]

While the VAE SIR can be calculated for single locations, the measure also allows you to summarize your data by multiple locations, adjusting for differences in the incidence of VAEs among the location types. For example, you can obtain one VAE SIR adjusting for all locations reported. Similarly, you can obtain one VAE SIR for all specialty care areas in your facility.

Descriptive analysis options of numerator and denominator data are available in the NHSN application, such as line listings, frequency tables, and bar and pie charts. VAE rates and run charts are also available. Guides on using NHSN analysis features are available from: [http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html](http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html).
References

7) Klompas M. Does this patient have ventilator-associated pneumonia? JAMA 2007;297:1583-93.
Appended. List of Antimicrobials Agents Eligible for IVAC, Possible and Probable VAP

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VAE FREQUENTLY-ASKED QUESTIONS

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 18 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.

NOTE: 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 FiO2 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 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 FiO₂ 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 FiO₂. 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 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.

NOTE: 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 FiO₂ and must be characterized by ≥ 2 calendar days of stable or decreasing daily minimum FiO₂ 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 FiO₂ on the first day of the baseline period of stability or improvement). Keep in mind, too, that PEEP values of 0 to 5 cmH₂O are considered equivalent for the purposes of VAE surveillance. This means that any daily minimum value of 0 to 5 cmH₂O will be evaluated as if it were 5 cmH₂O when determining whether a VAC has occurred or not. Also, the daily minimum PEEP or FiO₂ is defined as the lowest setting during a 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 cmH₂O on each day. On MV days 5 and 6, the daily minimum PEEP is 8 cmH₂O, 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/mm³ or ≥ 12,000 cells/mm³) – 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.
**Device-associated Module**

**VAE**

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**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<sub>2</sub> are increased 3 cmH<sub>2</sub>O or 20 points over baseline. On MV days 2 and 3, the PEEP values are 7 cmH<sub>2</sub>O and 6 cmH<sub>2</sub>O respectively, and then increase to 9 cmH<sub>2</sub>O on MV days 4 and 5 – but the difference between day 4 or day 5 and day 2 is only 2 cmH<sub>2</sub>O, rather than the required 3 cmH<sub>2</sub>O. Also, the gradual increase in FiO<sub>2</sub> from the time of initiation of mechanical ventilation means that there are not two days on which the FiO<sub>2</sub> 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.
3) Is there a hierarchy of reporting for VAE? How do I know whether to report a VAC, an IVAC or a Possible or Probable VAP?

- 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 participating in 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.

4) 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 FiO2 is increased more than 0.20 (20 points) over baseline, therefore meeting the VAC FiO2 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.

5) 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.

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 hospital 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.

- 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.
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 FiO₂ criteria are met. PEEP and FiO₂ 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 FiO₂ 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.

<table>
<thead>
<tr>
<th>Hosp Day No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV Episode 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>MV Day No. 1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6—extubated at noon</td>
<td>--</td>
<td>1—reintubated</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Day 1 of stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
</tr>
</tbody>
</table>

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.
Device-associated Module
VAE

<table>
<thead>
<tr>
<th>Hosp Day No.</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV Day No.</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>Extubated at 11 am</td>
<td>--</td>
</tr>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>Day 1 of stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
<td>Temp 38.4°C</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
</tr>
</tbody>
</table>

6) **What antimicrobial agents are included in the IVAC definition?**
   - See the Appendix for a list of the antimicrobial agents eligible for consideration in the IVAC definition (as well as the Possible and Probable VAP definitions).
   - See Table 1 for eligible routes of administration.

7) **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 Appendix 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 1. See the example in the figure below:

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Criterion</td>
<td></td>
<td></td>
<td></td>
<td>Onset (day 1) of worsening oxygenation meeting VAE PEEP or FiO₂ thresholds</td>
<td></td>
<td>Day 2 of worsening oxygenation meeting VAE PEEP or FiO₂ thresholds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Patient has fulfilled all IVAC criteria, and IVAC should be reported. Date of the IVAC event is hospital day/MV day 7.
EXAMPLE: A single dose of intravenous 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).

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>Day 1 of stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Single dose of vancomycin ordered and administered</td>
<td>None</td>
<td>None</td>
<td>Single dose of vancomycin ordered and administered</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>Day 1 of stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
</tr>
</tbody>
</table>

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.
8) 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.

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>Day 1 of Stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
</tr>
<tr>
<td>QAD</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>Day 1 of Stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Meropenem</td>
<td>Imipenem</td>
<td>Piperacillin/tazobactam</td>
<td>Piperacillin/tazobactam</td>
</tr>
<tr>
<td>QAD</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>Day 1 of stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td></td>
<td>Levofloxacin</td>
<td>Levofloxacin</td>
<td></td>
<td>Levofloxacin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QAD</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

9) 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.

10) What if the patient is being given one-time doses of intravenous 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.

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Criterion</td>
<td>--</td>
<td>--</td>
<td>Day 1 of stability or improvement</td>
<td>Day 2 of stability or improvement</td>
<td>Day 1 of worsening oxygenation</td>
<td>Day 2 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Vancomycin 1 gram IV x 1 dose</td>
<td>None</td>
<td>None</td>
<td>Vancomycin 1 gram IV x 1 dose</td>
<td>None</td>
</tr>
<tr>
<td>QAD</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

11) 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/mm³ on day 14. Meropenem and intravenous 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.

12) 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 3 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 Table 3.

13) 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/mm³ 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.
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. 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.

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. 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.

14) 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.
15) 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.

16) 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.

17) 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.

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.

- 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.

18) 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.
19) 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 \( \geq 25 \) neutrophils and \( \leq 10 \) 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 \( \geq 25 \) neutrophils per low power field [lpf, x100] AND rare, occasional, few, 1+ or 2+, or \( \leq 10 \) squamous epithelial cells per low power field [lpf, x100].


- 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 VAE Protocol, Table 2.

20) 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.

21) 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 FiO₂ 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.

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

<table>
<thead>
<tr>
<th>MV Day No.</th>
<th>Worsening oxygenation</th>
<th>Temperature abnormality or white blood cell count abnormality</th>
<th>Antimicrobial agent</th>
<th>Purulent respiratory secretions, positive culture, positive histopathology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Day 1 of stability or improvement</td>
<td>New agent must be started on any day within this shaded period, and then continued for at least 4 days</td>
<td>Specimen must be collected on any day within this shaded period</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Day 2 of stability or improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Day 1 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Day 2 of worsening oxygenation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

22) 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?

- VAE surveillance is restricted to adult inpatient locations. Patients on mechanical ventilation who are in adult inpatient locations in acute care and long-term acute care hospitals and inpatient rehabilitation facilities are eligible for inclusion in VAE surveillance.
- Patients are excluded from VAE 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, helium-oxygen mixtures (heliox) 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 FiO₂ 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.

23) 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).

24) 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).