Pneumonia Event (PNEU)
NHSN Annual Training

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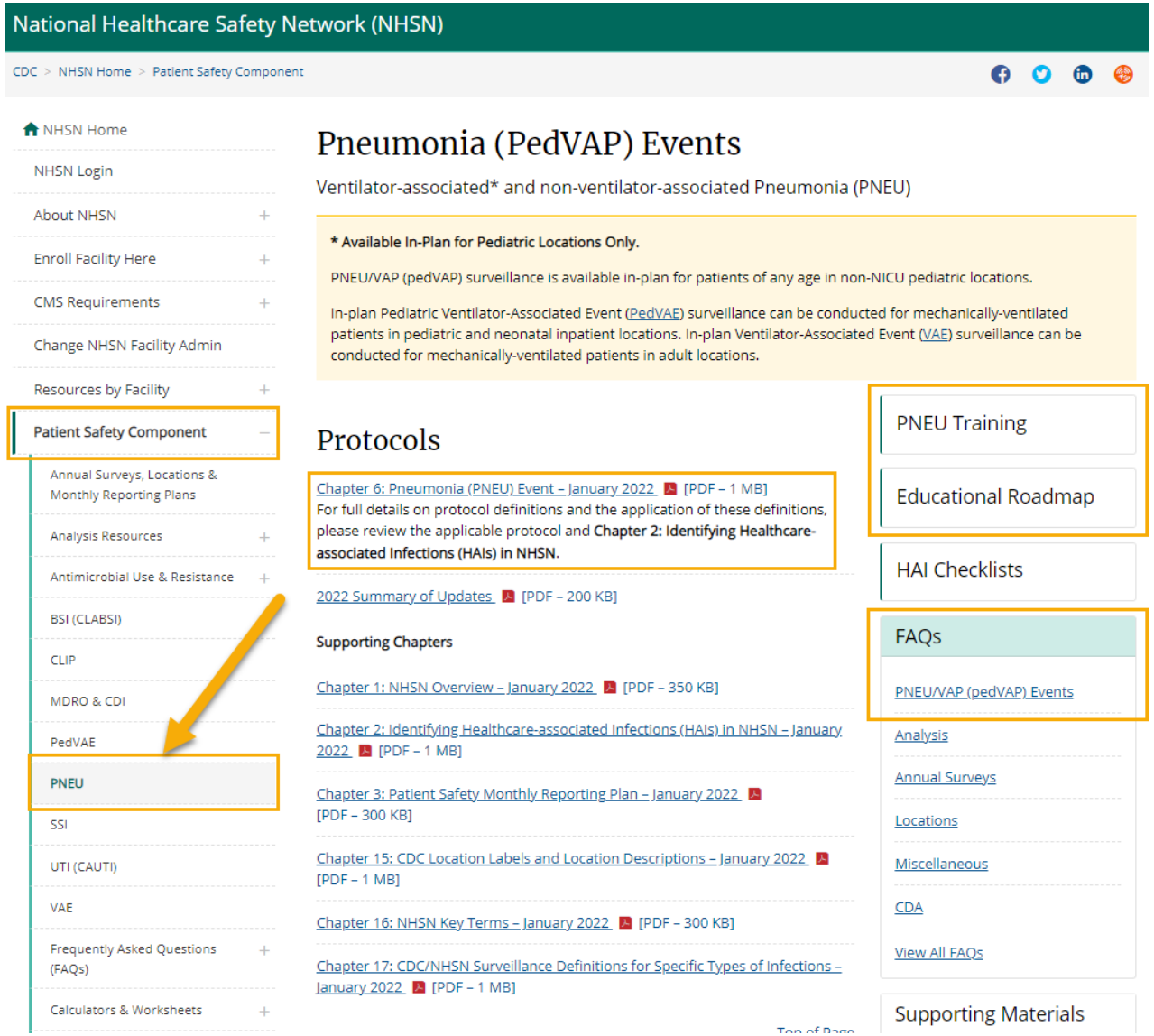
Today's Training Goals

- Understand and apply the PNEU surveillance definition
- Identify imaging test evidence for PNEU
- Review laboratory test evidence for PNEU
- Determine Secondary BSI assignment to Pneumonia Event (PNEU)

NHSN PNEU Surveillance

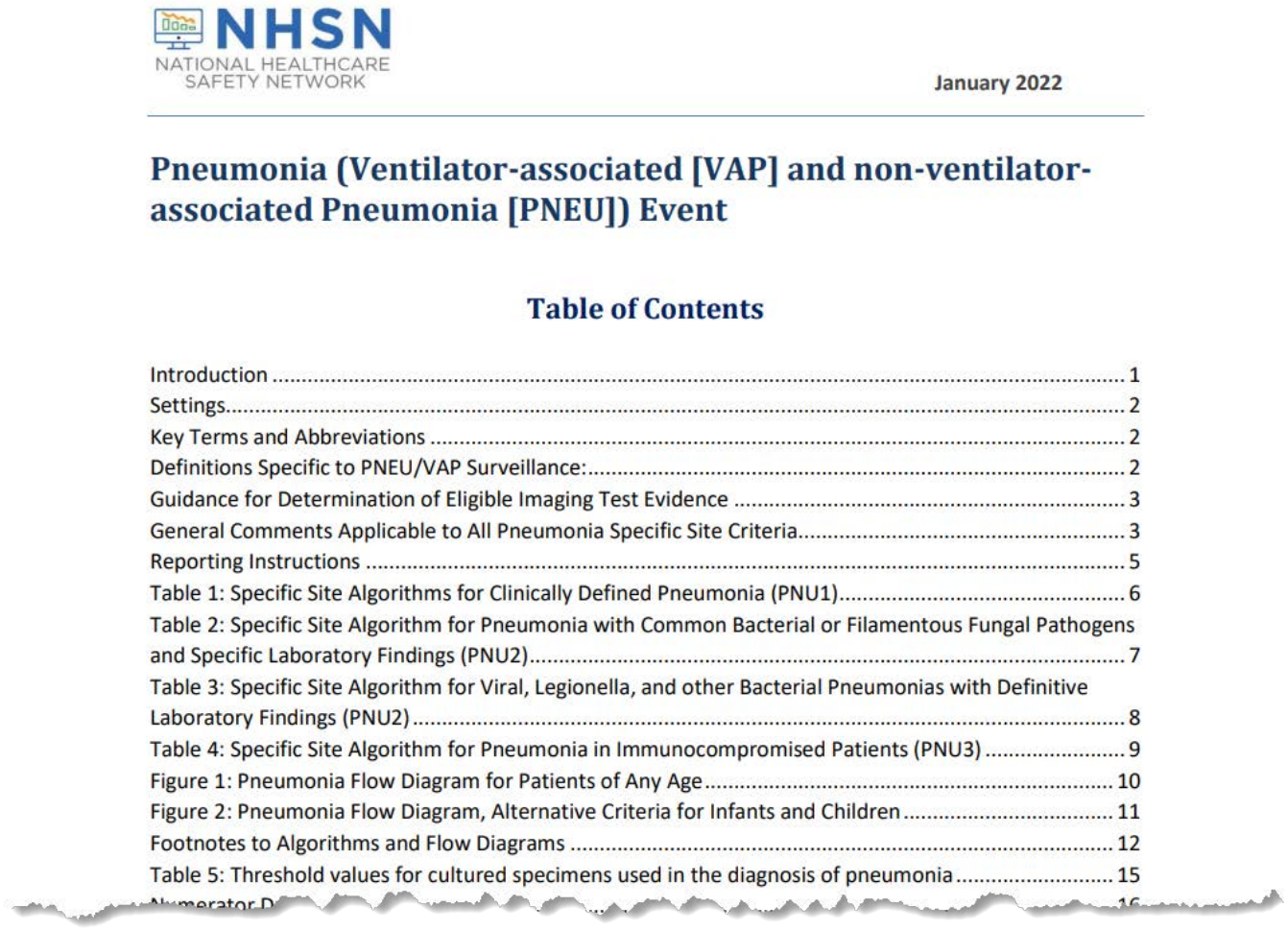
NHSN PNEU Events Webpage



- PNEU Events - https://www.cdc.gov/nhsn/psc/pneu/index.html
- PNEU Training - https://www.cdc.gov/nhsn/training/patient-safety-component/pneu.html
- PNEU FAQs - https://www.cdc.gov/nhsn/faqs/faq-pneu.html

Chapter 6 - NHSN Patient Safety Component Manual

- PNEU protocol - https://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf



NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

January 2022

Pneumonia (Ventilator-associated [VAP] and non-ventilator-associated Pneumonia [PNEU]) Event

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NHSN PNEU Surveillance

- **PNEU Surveillance**
  - Available for **in-plan reporting** for mechanically ventilated patients in **pediatric locations only (pedVAP)**
  - **Available for off-plan** reporting **any patient** regardless of location, age, or ventilation status (for example a state reporting requirement, facility surveillance plan)
  - **Available for secondary BSI assignment in any patient** regardless of location, age, or ventilation status. Also, regardless of surveillance of VAE or PedVAE in the same location

NHSN PNEU Events

Meeting PNEU (PNU1, PNU2, PNU3)

- PNEU is comprised of
  - PNU1
  - PNU2
  - PNU3
- PNU1, PNU2, PNU3 each have their own algorithms
- Must meet all elements specific to the criterion
- Must meet the footnote requirements

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

PNU1 algorithm (Table 1, PNEU protocol)

Table 1: Specific Site Algorithms for Clinically Defined Pneumonia (PNU1)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or** Progressive and persistent • Infiltrate • Consc	For ANY PATIENT, at least ***one*** of the following: • Fever (> 38.0°C o • Leukopenia (≤ 40 • For adults ≥ 70 ye And at least ***two*** of t • New onset of pur respiratory secret • New onset or wo • Rales[6] or bronchi • Worsening gas ex ≤ 240)[7], increased ALTERNATE CRITERIA, for infants ≤ 1 year old: Worsening gas exchange (for example: O_2 desaturations [for example pulse oximetry < 94%], increased oxygen require And at least ***three*** of the followir • Temperature instability • Leukopenia (≤ 4000 WBC/mm (≥ 10% band forms) • New onset of purulent sputun respiratory secretions, or incr • Apnea, tachypnea[5], nasal flar grunting • Wheezing, rales[6], or rhonchi • Cough • Bradycardia (< 100 beats/min) or tachycardia (> 170 beats/min) ALTERNATE CRITERIA, for child > 1 year old or ≤ 12 years old, at least ***three*** of the following: • Fever (> 38. 0°C or > 100. 4°F) or hypothermia (< 36. 0°C or < 96.8°F) • Leukopenia (≤ 4000 WBC/mm^3) or leukocytosis (≥ 15,000 WBC/mm^3) • New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, or apnea, or tachypnea[5]. • Rales[6] or bronchial breath sounds • Worsening gas exchange (for example: O_2 desaturations [for example pulse oximetry < 94%], increased oxygen requirements, or increased ventilator demand)

PNU2 algorithm (Table 2 and Table 3, PNEU protocol)

Table 2: Specific Site Algorithm for Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or**	At least ***one*** of the f • Fever (> 38.0°C • Leukopenia (≤ 4 or leukocytosis WBC/mm³)	

Table 3: Specific Site Algorithm for Viral, Legionella, and other Bacterial Pneumonias with Definitive Laboratory Findings (PNU2)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or**	At least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F) • Leukopenia (≤ 4000 WBC/mm³) or leukocytosis (≥ 12,000 WBC/mm³) • For adults > 70 years o	At least ***one*** of the following: • Virus, *Bordetella, Legionella, Chlamydia, or Mycoplasma* identified from respiratory secretions or tissue by a culture or non-culture based

PNU3 algorithm (Table 4, PNEU protocol)

Table 4: Specific Site Algorithm for Pneumonia in Immunocompromised Patients (PNU3)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent	Patient who is immunocompromised (see definition in footnote[10]) has at least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F)	At least ***one*** of the following: • Identification of matching *Candida* spp. from blood and one of the following: sputum, endotracheal aspirate, BAL or protected specimen brushing[11, 12, 13]

PNEU Key Concepts

- Although specific criteria are included for infants and children under the PNU1 algorithm and PNU3 algorithm is specific to immunocompromised patients, all patients may meet any of the other pneumonia criteria
  - For example, an infant can meet PNU1 any patient, PNU2, or PNU3
  - An immunocompromised patient can meet PNU1 or PNU2
- There is a hierarchy for reporting if a patient meets more than one algorithm during the infection window period or the RIT:
  - If a patient meets criteria for both PNU1 and PNU2, report PNU2
  - If a patient meets criteria for both PNU2 and PNU3, report PNU3
  - If a patient meets criteria for both PNU1 and PNU3, report PNU3

Knowledge Check #1

Which PNEU algorithm requires laboratory evidence?

A. PNU1

B. PNU2

C. PNU3

D. Both PNU2 and PNU3

Knowledge Check #1 - Rationale

Which PNEU algorithm requires laboratory evidence?

A. PNU1

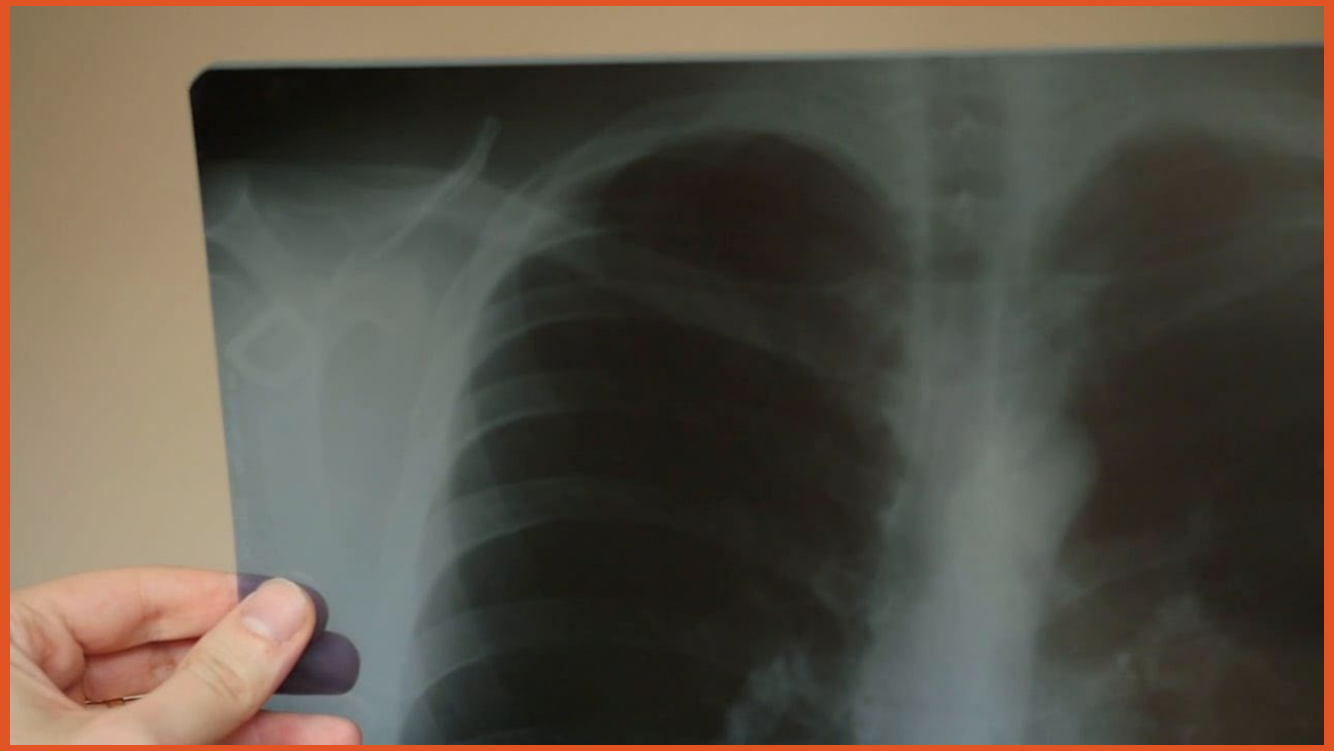
B. PNU2

C. PNU3

D. Both PNU2 and PNU3

Rationale

Both PNU2 and PNU3 require laboratory evidence as defined in the Laboratory column of the algorithms.



Imaging Test Evidence

Imaging Test Evidence of Pneumonia

- It can be challenging to determine if an imaging test results meet the requirement
- Findings must be new **and** persistent OR progressive **and** persistent
- Simply finding the words infiltrate, consolidation, opacity, or air space disease on an imaging test report is not enough
- Unlike imaging for other NHSN events, due to the persistence requirement, all available imaging findings that are temporally related must be considered
- Only definitive and equivocal findings are eligible for consideration
- For purposes of PNEU surveillance, atelectasis is not evidence of pneumonia

Imaging Test Evidence of Pneumonia

Evidence suggestive of pneumonia

- new or worsening finding of infiltrate, consolidation, cavitation, pneumatoceles (infants ≤ 1 y/o) or other descriptive wording that could be considered (for example, opacity, air space disease, density) that is **not attributed** to something other than pneumonia

And

Evidence of persistence

- no indication of rapid resolution
- no subsequent indication the finding is attributable to another condition (for example, 2 days later the opacity is now attributed to pulmonary edema)

Imaging Test Evidence of Pneumonia

- Persistence of findings of pneumonia in subsequent imaging test results is required
  - for patients with underlying cardiac or pulmonary disease (serial imaging)
  - for all patients when multiple temporally related imaging test results are available
- If only one imaging test is available, it can satisfy the imaging requirement in the following situations only:
  - for POA determinations for all patients
  - for patients without underlying cardiac or pulmonary disease, when no other imaging is available

What if imaging findings are equivocal?

- ??? Infiltrate vs. atelectasis
- ??? Opacity may represent pneumonia or congestive heart failure
- First, look for further imaging test evidence that clarifies the equivocal finding
    - Verifies the finding is suggestive of pneumonia and that there is persistence making the equivocal finding eligible for use

    or

    - Verifies the finding is **not** suggestive of pneumonia making the equivocal finding **NOT** eligible for use

What if equivocal findings continue to be equivocal - there is no verification on imaging either way?

- In the absence of verification one way or the other **THEN and only then** can clinical correlation be used
  - Physician documentation of antimicrobial treatment for site-specific infection related to the equivocal imaging finding — in this case treatment for pneumonia
- If the imaging does not demonstrate findings of pneumonia, clinical correlation cannot be used
- Otherwise, physician diagnosis of pneumonia or treatment for pneumonia is not used to meet PNEU

Imaging Test Evidence – Footnotes #1, 2, and 14

Imaging Test Evidence

Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]:

New and persistent
or
Progressive and persistent

- Infiltrate
- Consolidation
- Cavitation
- Pneumatoceles, in infants ≤1 year old

1. To help confirm difficult cases, multiple imaging test results spanning over several calendar days must be considered when determining if there is imaging test evidence of pneumonia. Pneumonia may have rapid onset and progression but does not resolve quickly. Imaging test evidence of pneumonia will persist. Rapid imaging resolution suggests that the patient does not have pneumonia, but rather a non-infectious process such as atelectasis or congestive heart failure.
   - The diagnosis of healthcare-associated pneumonia may be quite clear on the basis of signs, symptoms, and a single definitive chest imaging test result. Therefore, in a patient without underlying pulmonary or cardiac disease and when there is only one imaging test available, if it is an eligible and definitive finding, the imaging test evidence requirement can be met.
   - In patients without underlying disease if more than one imaging test is available serial imaging test results must also be evaluated and demonstrate persistence.
   - In patients with underlying disease, serial chest imaging test results must be examined to help separate infectious from non-infectious pulmonary processes. In patients with pulmonary or cardiac disease (for example, interstitial lung disease or congestive heart failure), the diagnosis of pneumonia may be particularly difficult. For example, pulmonary edema from decompensated congestive heart failure may simulate the presentation of pneumonia.

2. Note that there are many ways of describing the imaging appearance of pneumonia. Examples include, but are not limited to, "air-space disease", "focal opacification", "patchy areas of increased density". Although perhaps not specifically delineated as pneumonia by the radiologist, in the appropriate clinical setting these alternative descriptive wordings should be seriously considered as potentially positive findings. If provided and the findings are not documented as attributed to another issue (for example, pulmonary edema, chronic lung disease) they are eligible for meeting imaging test evidence of pneumonia.

14. If the imaging test result is equivocal for pneumonia, check to see if subsequent imaging tests are definitive. For example, if a chest imaging test result states infiltrate vs. atelectasis and a subsequent imaging test result is definitive for infiltrate—the initial imaging test would be eligible for use. In the absence of finding a subsequent imaging result that clarifies the equivocal finding, if there is clinical correlation then the equivocal imaging test is eligible for use.

Additional information can be found under the "Guidance for Determination of Eligible Imaging Test Evidence" section on page 6-3 in the PNEU protocol.

Knowledge Check #2

The imaging requirement for PNEU is met with the following imaging test findings:

- 2/14: Lungs are clear
- 2/17: Infiltrates developing bilaterally
- 2/18: Infiltrates significantly improved
- 2/19: No evidence of acute cardiopulmonary process

A. True

B. False

Knowledge Check #2 - Rationale

The imaging requirement for PNEU is met with the following imaging test findings:

- 2/14: Lungs are clear
- 2/17: Infiltrates developing bilaterally
- 2/18: Infiltrates significantly improved
- 2/19: No evidence of acute cardiopulmonary process

A. True

B. False

Rationale

Rapid resolution of findings suggests that the patient does not have pneumonia, but rather a non-infectious process.

Knowledge Check #3

The imaging requirement for PNEU is met with the following imaging test findings:

- 12/1: Basilar airspace opacities bilaterally, differential includes atelectasis and/or pneumonia
- 12/2: Persistent dense left lower lobe atelectasis and/or infiltrate with interval development of layering pleural effusion
- 12/4: Improving left lung base opacity with layering left pleural effusion
- 12/5: Left lower lobe opacities improved, likely pleural effusion and atelectasis

  There are no more chest imaging tests after 12/5

A. True
B. False

Knowledge Check #3

The imaging requirement for PNEU is met with the following imaging test findings:

- 12/1: Basilar airspace opacities bilaterally, differential includes atelectasis and/or pneumonia equivocal – atelectasis vs. pneumonia
- 12/2: Persistent dense left lower lobe atelectasis and/or infiltrate with interval development of layering pleural effusion equivocal
- 12/4: Improving left lung base opacity with layering left pleural effusion
- 12/5: Left lower lobe opacities improved, likely pleural effusion and atelectasis

  equivocal finding is now confirmed to be something other than pneumonia

A. True

B. False

Rationale

The equivocal findings are clarified to represent a non-infectious process in subsequent imaging tests.

Pathogen Exclusions

Pathogen Exclusions when meeting PNEU

All *Candida* species or yeast not otherwise specified

All coagulase-negative *Staphylococcus* species

All *Enterococcus* species

- Excluded as a *site-specific pathogen* **unless** isolated from *lung tissue or pleural fluid*
- If identified from *blood*, the excluded pathogens can **only** be attributed as secondary to PNEU if PNU2 or PNU3 is met with a *matching organism* isolated from *lung tissue or pleural fluid* and the blood specimen is collected in the secondary BSI attribution period

Pathogen Exclusions when meeting PNEU

All *Candida* species or yeast not otherwise specified

All coagulase-negative *Staphylococcus* species

All *Enterococcus* species

- **Exception**: *Candida* species are eligible for use when meeting PNU3

  IF

  - Patient meets the immunocompromised definition (footnote #10)
  - Matching *Candida* is identified from a *respiratory specimen and blood specimen*, and both specimens have a collection date in the same IWP

Laboratory Test Evidence

PNU2 – Laboratory Evidence

Table 2: Specific Site Algorithm for Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or** Progressive and persistent • Infiltrate • Consolidation • Cavitation • Pneumatoceles, in infants ≤1 year old	At least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F) • Leukopenia (≤ 4000 WBC/mm^3) or leukocytosis (≥ 12,000 WBC/mm^3) • For adults ≥ 70 years old, altered mental status with no other recognized cause And at least ***one*** of the following: • New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions, or increased suctioning requirements	At least ***one*** of the following: • Organism identified from blood[8, 13] • Organism identified from pleural fluid[9, 13] • Positive quantitative culture or corresponding semi-quantitative culture result[9] from minimally-contaminated LRT specimen (specifically, BAL, protected specimen brushing or endotracheal aspirate) • ≥ 5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (for example: Gram's stain)

8. Any coagulase-negative *Staphylococcus* species, any *Enterococcus* species and any *Candida* species or yeast not otherwise specified that are identified from blood cannot be deemed secondary to a PNEU, unless the organism was also identified from lung tissue or pleural fluid (where specimen was obtained during thoracentesis or within 24 hours of chest tube placement; a pleural fluid specimen collected after a chest tube is repositioned or from a chest tube in place > 24 hours is not eligible). This applies when meeting PNU2 or when meeting PNU3 with the laboratory findings found in PNU2. Identification of matching *Candida* spp. from blood and sputum, endotracheal aspirate, BAL or protected specimen brushing with specimen collection dates in the same IWP (see footnote 11) can be used to satisfy PNU3 definition for patients meeting the immunocompromised definition (see footnote 10).

13. Identification of organism by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (for example, not Active Surveillance Culture/Testing (ASC/AST)).

PNU2 – Laboratory Evidence

Table 2: Specific Site Algorithm for Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or** Progressive and persistent • Infiltrate • Consolidation • Cavitation • Pneumatoceles, in infants ≤1 year old	At least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F) • Leukopenia (≤ 4000 WBC/mm^3) or leukocytosis (≥ 12,000 WBC/mm^3) • For adults ≥ 70 years old, altered mental status with no other recognized cause And at least ***one*** of the following: • New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions, or increased suctioning requirements	At least ***one*** of the following: • Organism identified from blood[8, 13] • Organism identified from pleural fluid[9, 13] • Positive quantitative culture or corresponding semi-quantitative culture result[9] from minimally-contaminated LRT specimen (specifically, BAL, protected specimen brushing or endotracheal aspirate) • ≥ 5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (for example: Gram's stain)

9. Refer to threshold values for cultured specimens with growth of eligible pathogens (Table 5).

Notes:

- A specimen that is not obtained through an artificial airway (specifically endotracheal tube or tracheostomy) from a ventilated patient is not considered minimally contaminated and is not eligible for use in meeting the laboratory criteria for PNEU (PNU2 or PNU3 when using the laboratory findings found in PNU2). Sputum or tracheal secretions collected from a non-ventilated patient are not minimally-contaminated specimens.
- The following organisms can only be used to meet PNEU definitions when identified from lung tissue or pleural fluid obtained during thoracentesis or within 24 hours of chest tube placement (not from a chest tube that has been repositioned or from a chest tube that has been in place > 24 hours):
  - Any coagulase-negative *Staphylococcus* species
  - Any *Enterococcus* species
  - Any *Candida* species or yeast not otherwise specified. Exception: identification of matching *Candida* spp. from blood and sputum, endotracheal aspirate, BAL, or protected specimen brushing with specimen collection dates in the same IWP can be used to satisfy PNU3 definition for immunocompromised patients (see footnote 10)

PNU2 – Laboratory Evidence

Table 5: Threshold values for cultured specimens used in the diagnosis of pneumonia

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

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

*Consult with your laboratory to determine if reported semi-quantitative results match the quantitative thresholds. In the absence of additional information available from your laboratory, a semi-quantitative result of "moderate" or "heavy" or "many" or "numerous" growth, or 2+, 3+, or 4+ growth is considered to correspond.

†Lung tissue specimens obtained by either open or closed lung biopsy methods. For post-mortem specimens, only lung tissue specimens obtained by transthoracic or transbronchial biopsy that are collected immediately post-mortem are eligible for use.

PNU3 – Laboratory Evidence

Table 4: Specific Site Algorithm for Pneumonia in Immunocompromised Patients (PNU3)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or** Progressive and persistent • Infiltrate • Consolidation	Patient who is immunocompromised (see definition in footnote[10]) has at least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F) • For adults ≥ 70 years old, altered mental status with no other recognized cause • New onset of purulent sputum[3], or change in character of sputum[4], or increased	At least ***one*** of the following: • Identification of matching *Candida* spp. from blood and one of the following: sputum, endotracheal aspirate, BAL or protected specimen brushing[11, 12, 13] • Evidence of fungi (excluding any Candida and yeast not otherwise specified) from minimally-contaminated LRT specimen (specifically BAL, protected specimen brushing or endotracheal aspirate) from one of the following:

10. Immunocompromised patients include only
    - those with neutropenia defined as absolute neutrophil count or total white blood cell count (WBC) < 500/mm^3
    - those with leukemia, lymphoma, or who are HIV positive with CD4 count < 200
    - those who have undergone splenectomy
    - those who have a history of solid organ or hematopoietic stem cell transplant
    - those on cytotoxic chemotherapy
    - those on enteral or parenteral administered steroids (excludes inhaled and topical steroids) daily for > 14 days on the date of event

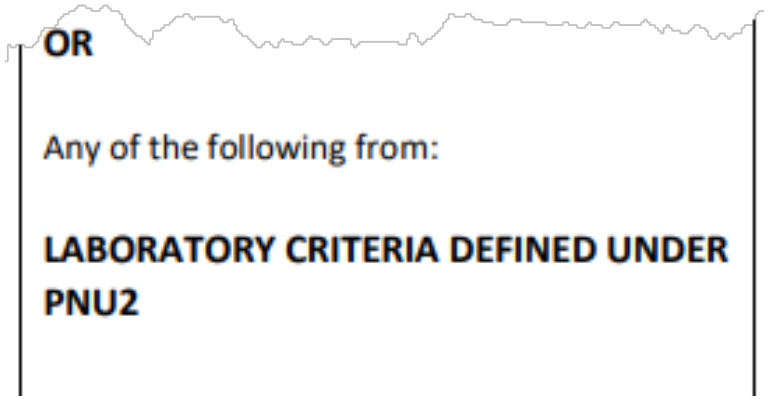
11. Blood specimen and respiratory specimen (sputum, endotracheal aspirate, BAL, or protected specimen brushing) must have a collection date that occurs within the IWP.

13. Identification of organism by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (for example, not Active Surveillance Culture/Testing (ASC/AST)).

PNU3 – Laboratory Evidence

Table 4: Specific Site Algorithm for Pneumonia in Immunocompromised Patients (PNU3)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.



Knowledge Check #4

What is identified in this scenario?

Within the 7-day IWP, there is

- definitive imaging test evidence suggestive of pneumonia
- the patient has leukocytosis
- there is documentation of new onset cough and rales
- *Staphylococcus aureus* has been identified in an expectorated sputum specimen

A. PNU1
B. PNU2
C. PNU3
D. None

Knowledge Check #4 - Rationale

Within the 7-day IWP, there is definitive imaging test evidence suggestive of pneumonia, the patient has leukocytosis, there is documentation of new onset cough and rales, and *Staphylococcus aureus* has been identified in an expectorated sputum specimen.

What is identified?

A. PNU1
B. PNU2
C. PNU3
D. None

Rationale

PNU1 is met with imaging, leukocytosis, and at least two signs/symptoms.

Expectorated sputum is not a minimally contaminated lower respiratory tract (LRT) specimen, and therefore is not an eligible specimen for meeting PNU2 or PNU3 when using the laboratory criteria defined under PNU2. **(Footnote #9)**

Knowledge Check #5

What if the specimen was minimally contaminated – would PNU2 be met?

Within the 7-day IWP, there is

- definitive imaging test evidence suggestive of pneumonia
- the patient has leukocytosis
- there is documentation of new onset cough and rales
- *Staphylococcus aureus* has been identified in a BAL specimen

A. Yes

B. No

C. Maybe

Knowledge Check #5 - Rationale

What if the specimen was minimally contaminated – would PNU2 be met?

Within the 7-day IWP, there is definitive imaging test evidence suggestive of pneumonia, the patient has leukocytosis, there is documentation of new onset cough and rales, and *Staphylococcus aureus* has been identified in a BAL specimen.

A. Yes
B. No
C. Maybe

Rationale

Simply identifying a pathogen in a minimally contaminated LRT specimen is not sufficient. The quantity of the pathogen identified must meet the quantitative requirements (or semi-quantitative equivalents) found in Table 5. **(Footnote #9)**

Pneumonia and Secondary BSI Assignment

PNEU and Secondary BSI Assignment*

An PNEU site-specific definition must be met

AND

One of the following scenarios must be met:

Scenario 1:

At least one organism from the blood specimen matches an organism identified from the site-specific infection that is used as an element to meet the **PNEU** criterion AND the blood specimen is collected during the secondary BSI attribution period (infection window period + repeat infection timeframe)

OR

Scenario 2:

An organism identified in the blood specimen is an element that is used to meet **PNEU** criterion, and therefore is collected during the site-specific infection window period.

*BSI Protocol https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf Appendix B: Secondary BSI Guide

Key Concepts

- PNU1 does not have a site-specific specimen or a blood specimen as a part of the criterion
  - Therefore, a BSI cannot be secondary to PNU1

- Pathogens can be reported for PNU2 and PNU3 events
  - Therefore, secondary BSIs can be attributed to PNU2 and PNU3

BSI Secondary to PNEU Scenario 1

Table B1: Secondary BSI Guide: List of all NHSN primary site-specific definitions available for making secondary BSI determinations using Scenario 1 or Scenario 2

Scenario 1	Scenario 2
A positive blood specimen must contain at least **one eligible matching organism** to the site-specific specimen	Positive blood specimen must be an **element** of the **site-specific definition**
And the blood specimen is collected in the site-specific **secondary BSI attribution period**	**And** blood specimen is collected in the site-specific **infection window period**
And an eligible organism **identified from the site-specific specimen** is used as an element to meet the site-specific definition	And an eligible organism **identified in a blood specimen** is used as an element to meet the site-specific definition

Site	Criterion
ABUTI	ABUTI
BONE	1
BRST	1
CARD	1
CIRC	2 or 3
CONJ	1a
DECU	1
DISC	1
EAR	1, 3, 5 or 7
EMET	1
ENDO	1
EYE	1
GE	2a
GIT	2a, 2b (only yeast)
IAB	1 or 3a
IC	1
JNT	1
LUNG	1
MED	1
MEN	1
ORAL	1, 3a, 3d (only yeast)
OREP	1
PNEU	2 or 3
SINU	1
SSI	SI, DI or OS
SKIN	2a
ST	1
UMB	1a
UR	1a or 3a
USI	1
SUTI	1a, 1b or 2
VASC *only as SSI*	1
VCUF	3

Site	Criterion
ABUTI	ABUTI
BONE	3a
BURN	1
DISC	3a
ENDO	4a, 4b, 5a or 5b (specific organisms) 6e or 7e plus other criteria as listed
GIT	1b or 2c
IAB	2b or 3b
JNT	3c
MEN	2c or 3c
OREP	3a
PNEU	2 or 3
SA	3a
UMB	1b
USI	3b or 4b

BSI Secondary to PNEU – Scenario 1

Scenario 1:

At least one organism from the blood specimen matches an organism identified from the site-specific infection that is used as an element to meet the PNEU criterion AND the blood specimen is collected during the secondary BSI attribution period

- PNEU Eligible specimens include:
  - Minimally contaminated specimen (Endotracheal aspirate, BAL, protected specimen brushing)
  - Pleural fluid
  - Lung tissue

  Sputum is **NOT a minimally contaminated specimen**
- Eligible site-specific specimen collection date occurs within the 7-day infection window period (IWP)
- Blood culture collection date occurs in the secondary BSI attribution period (SBAP)

BSI Secondary to PNEU – Scenario 1

Blood & site-specific specimen identification must match for at least one organism.

Examples of site-specific specimens

Table 2: Specific Site Algorithm for Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or** Progressive and persistent • Infiltrate • Consolidation • Cavitation • Pneumatoceles, in infants ≤1 year old **Note**: In patients ***without*** underlying pulmonary or cardiac disease (for example: respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary	At least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F) • Leukopenia (≤ 4000 WBC/mm^3) or leukocytosis (≥ 12,000 WBC/mm^3) • For adults ≥ 70 years old, altered mental status with no other recognized cause And at least ***one*** of the following: • New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, or tachypnea[5] • Rales[6] or bronchial breath sounds • Worsening gas exchange (for example: O_2 desaturations [for	At least ***one*** of the following: • Organism identified from blood[8, 13] • Organism identified from pleural fluid[9, 13] • Positive quantitative culture or corresponding semi-quantitative culture result[9] from minimally-contaminated LRT specimen (specifically, BAL, protected specimen brushing or endotracheal aspirate) • ≥ 5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (for example: Gram's stain) • Positive quantitative culture or corresponding semi-quantitative culture result[9] of lung tissue • Histopathologic exam shows at least ***one*** of the following evidences of pneumonia:

BSI Secondary to PNEU – Scenario 1

Blood & site-specific specimen identification must match for at least one organism.

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: Many *A. baumannii*
12		6	
13		7	
14		8	
15		9	
16	BC +	10	Blood Culture : *A. baumannii*
17		11	
18		12	
19		13	
20		14	
21			

- **PNU2 is met – site-specific specimen**
- **Blood Culture collection date within the SBAP**
- **Matches at least one**

PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen*: A. baumannii*

BSI Secondary to PNEU – Scenario 1

Blood & site-specific specimen identification must match for at least one organism.

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: 4+ *A. baumannii*, 3+ *S. aureus*
12		6	
13		7	
14		8	
15		9	
16	BC +	10	Blood Culture : *S. aureus*
17		11	
18		12	
19		13	
20		14	
21			

- **PNU2 is met – site-specific specimen**
- **Blood Culture collection date within the SBAP**
- **Matches at least one**

PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen*: A. baumannii, S. aureus*

BSI Secondary to PNEU – Scenario 1

Blood & site-specific specimen identification must match for at least one organism

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: Many *A. baumannii*
12		6	
13		7	
14		8	
15		9	
16	BC +	10	Blood Cu S. aureus
17		11	
18		12	
19		13	
20		14	
21			

- **PNU2 is met - site-specific specimen**
- **Blood Culture collection date within the SBAP**
- **BUT---No match**
- **No secondary BSI**

PNU2

Date of Event = Day 7

Pathogen*: A. baumannii*

PNEU and Secondary BSI Assignment – Scenario 1 Excluded Pathogens

Candida species or yeast not otherwise specified

Coagulase-negative _Staphylococcus_ species

Enterococcus species

- Excluded as a secondary BSI pathogen unless isolated from lung tissue or pleural fluid which is used to meet PNU2 or PNU3 and the blood specimen has a collection date in the PNEU secondary BSI attribution period. (Scenario 1)

BSI Secondary to PNEU – Scenario 1

Blood & site-specific specimen identification must match for at least one organism

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: Many *A. baumannii*
12		6	
13		7	
14		8	
15		9	
16	BC +	10	Blood Culture : *A baumannii* &
17		11	
18		12	
19		13	
20		14	
21			

- **PNU2 – site-specific specimen**
- **Blood Culture collection date within the SBAP**
- **Matches at least one**
- **BUT - *VRE* is excluded pathogen**
- **Determine if *VRE* BSI is secondary to another site-specific infection or primary BSI/CLABSI**

PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen: *A. baumannii*

BSI Secondary to PNEU – Scenario 1

Blood & site-specific specimen identification must match for at least one organism

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Lung : Many *VRE*
12		6	
13		7	
14		8	
15		9	
16	BC +	10	Blood Culture : *VRE*
17		11	
18		12	
19		13	
20		14	
21			

- **PNU2 is met - site-specific specimen**
- **Blood Culture collection date within the SBAP**
- ***VRE* is not excluded when identified in lung tissue (or pleural fluid)**
- ***VRE* BSI can be secondary to PNU2**

PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen*: VRE*

BSI Secondary to PNEU Scenario 2

Table B1: Secondary BSI Guide: List of all NHSN primary site-specific definitions available for making secondary BSI determinations using Scenario 1 or Scenario 2

Scenario 1	Scenario 2
A positive blood specimen must contain at least **one eligible matching organism** to the site-specific specimen	Positive blood specimen must be an **element** of the **site-specific definition**
And the blood specimen is collected in the site-specific **secondary BSI attribution period**	**And** blood specimen is collected in the site-specific **infection window period**
And an eligible organism **identified from the site-specific specimen** is used as an element to meet the site-specific definition	And an eligible organism **identified in a blood specimen** is used as an element to meet the site-specific definition

Site	Criterion
ABUTI	ABUTI
BONE	1
BRST	1
CARD	1
CIRC	2 or 3
CONJ	1a
DECU	1
DISC	1
EAR	1, 3, 5 or 7
EMET	1
ENDO	1
EYE	1
GE	2a
GIT	2a, 2b (only yeast)
IAB	1 or 3a
IC	1
JNT	1
LUNG	1
MED	1
MEN	1
ORAL	1, 3a, 3d (only yeast)
OREP	1
PJI	1 or 3e
PNEU	2 or 3
SA	1
SINU	1
SSI	SI, DI or OS
SKIN	2a
ST	1
UMB	1a
UR	1a or 3a
USI	1
SUTI	1a, 1b or 2
VASC *only as SSI*	1
VCUF	3

Site	Criterion
ABUTI	ABUTI
BONE	3a
BURN	1
DISC	3a
ENDO	4a, 4b, 5a or 5b (specific organisms) 6e or 7e plus other criteria as listed
GIT	1b or 2c
IAB	2b or 3b
JNT	3c
MEN	2c or 3c
OREP	3a
PNEU	2 or 3
SA	3b
UMB	1b
USI	3b or 4b

BSI Secondary to PNEU – Scenario 2

Scenario 2:

An organism identified in the blood specimen is an element that is used to meet PNEU criterion, and therefore is collected during the site-specific infection window period.

- Blood culture collection date occurs within a 7-day infection window period
- Pathogen exclusions apply

BSI Secondary to PNEU – Scenario 2

Examples of Blood as an Element

Table 2: Specific Site Algorithm for Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or** Progressive and persistent • Infiltrate • Consolidation • Cavitation • Pneumatoceles, in infants ≤1 year old	At least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F) • Leukopenia (≤ 4000 WBC/mm^3) or leukocytosis (≥ 12,000 WBC/mm^3)	At least ***one*** of the following: • Organism identified from blood[8, 13] • Organism identified from pleural fluid[9, 13]

Table 4: Specific Site Algorithm for Pneumonia in Immunocompromised Patients (PNU3)

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowchart include **FOOTNOTE** references. The interpretation and guidance provided in the **FOOTNOTES** are an important part of the algorithms and must be incorporated into the decision-making process when determining if a PNEU definition is met.

Imaging Test Evidence	Signs/Symptoms	Laboratory
Two or more serial chest imaging test results with at least ***one*** of the following[1, 2, 14]: New and persistent **or** Progressive and persistent • Infiltrate • Consolidation	Patient who is immunocompromised (see definition in footnote[10]) has at least ***one*** of the following: • Fever (> 38.0°C or > 100.4°F) • For adults ≥ 70 years old, altered mental status with no other recognized cause • New onset of purulent sputum[3], or change in character of sputum[4], or increased	At least ***one*** of the following: • Identification of matching *Candida* spp. from blood and one of the following: sputum, endotracheal aspirate, BAL or protected specimen brushing[11, 12, 13] • Evidence of fungi (excluding any Candida and yeast not otherwise specified) from minimally-contaminated LRT specimen (specifically BAL, protected specimen brushing or endotracheal aspirate) from one of the following:

BSI Secondary to PNEU – Scenario 2

Blood culture as an element of the PNU2 criterion

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Blood culture: *A. baumannii*
12		6	
13		7	
14		8	
15		9	
16		10	
17		11	
18		12	
19		13	
20		14	
21			

- PNU2 is met – blood specimen
- Blood specimen collection date within the IWP
- Blood is used as an element

PNU2 & Secondary BSI
Date of Event = Day 7
Pathogen: *A. baumannii*

BSI Secondary to PNEU – Scenario 2

Blood culture as an element of the PNU2 criterion

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Blood cu[illegible] *Enterococcus faecalis*
12		6	
13		7	
14		8	
15		9	
16		10	
17		11	
18		12	
19		13	
20		14	
21			

- **Blood specimen collection date within the IWP**
- **Blood cannot be used as an element due to excluded pathogen**
- **PNU2 is not met**

BSI Secondary to PNEU – Scenario 2

Blood culture as an element of PNU3 criterion- **Immunocompromised definition must be met**

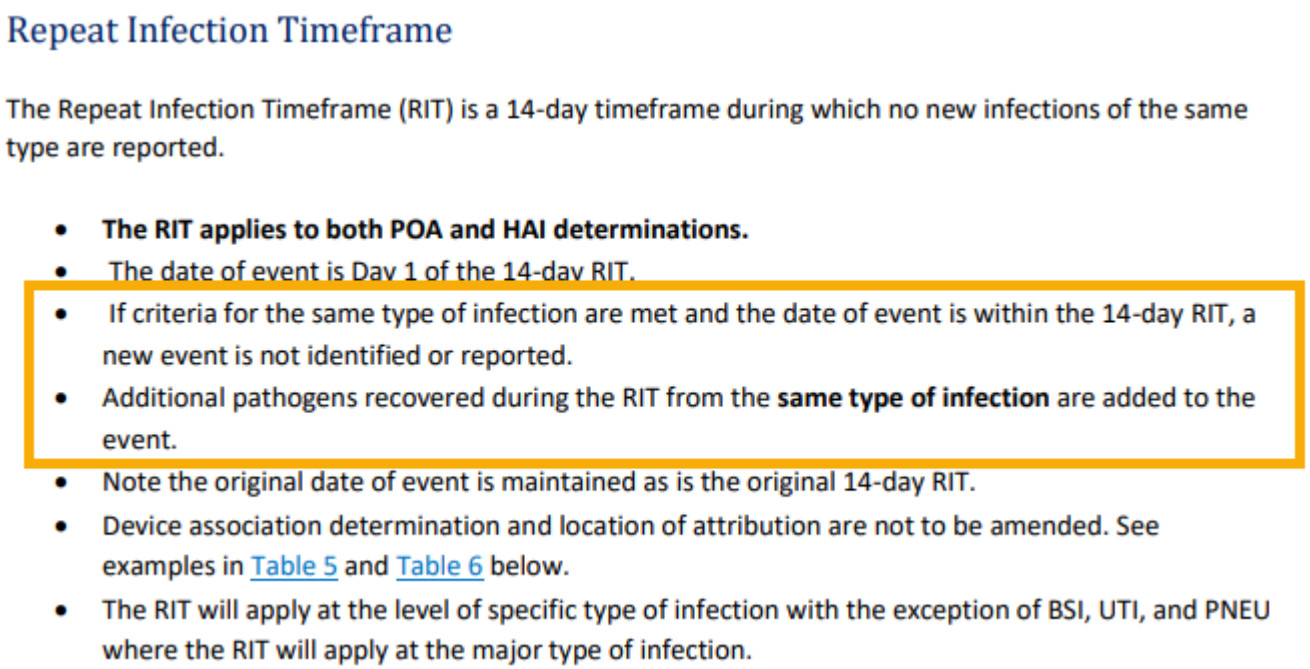
Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate, Sputum : Few *Candida* species
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Blood culture: *Candida albicans*
12		6	
13		7	
14		8	
15		9	
16		10	
17		11	
18		12	
19		13	
20		14	
21			

- PNU3 is met – blood specimen
- Matching *Candida* in blood and respiratory specimen
- Both specimens with collection date in the IWP
- Blood is used as an element

PNU3 & Secondary BSI
Date of Event: Day 7
Pathogen: *Candida albicans*

PNEU Definition

- CHAPTER 2:

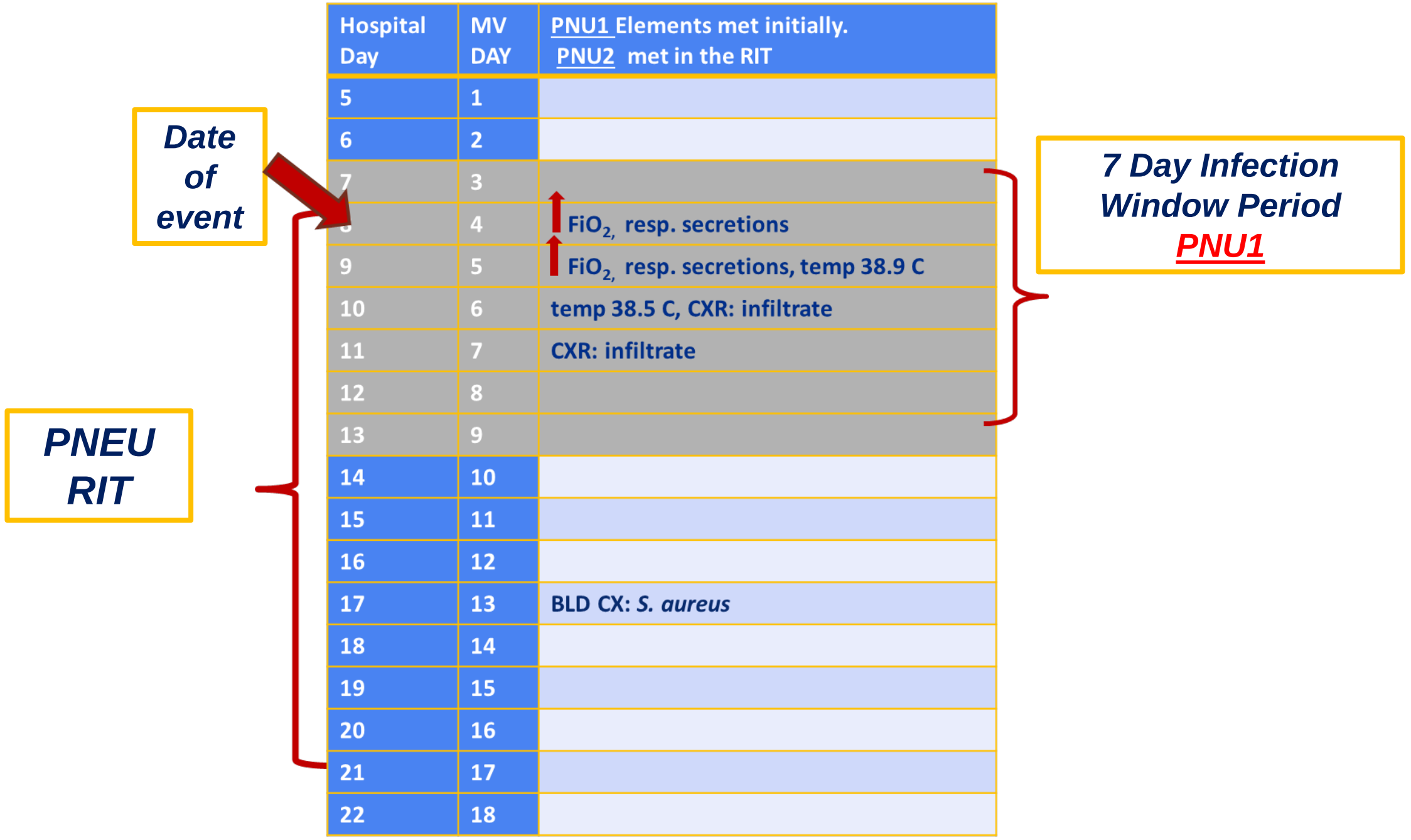


Repeat Infection Timeframe

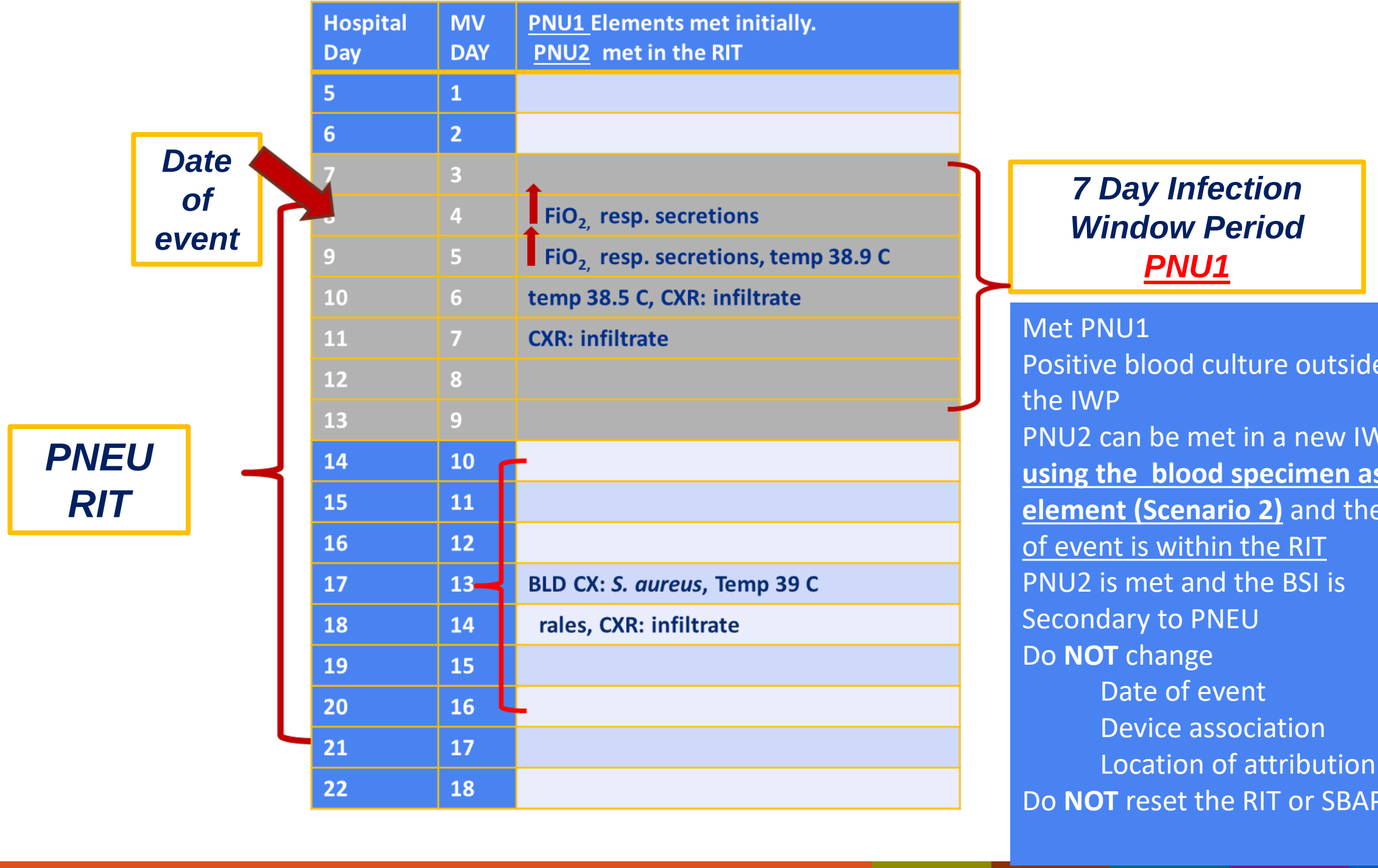
The Repeat Infection Timeframe (RIT) is a 14-day timeframe during which no new infections of the same type are reported.

- **The RIT applies to both POA and HAI determinations.**
- The date of event is Day 1 of the 14-day RIT.
- If criteria for the same type of infection are met and the date of event is within the 14-day RIT, a new event is not identified or reported.
- Additional pathogens recovered during the RIT from the **same type of infection** are added to the event.
- Note the original date of event is maintained as is the original 14-day RIT.
- Device association determination and location of attribution are not to be amended. See examples in Table 5 and Table 6 below.
- The RIT will apply at the level of specific type of infection with the exception of BSI, UTI, and PNEU where the RIT will apply at the major type of infection.

- Additional means of possibly attributing a secondary BSI
  - A modification of the specific event from PNU1 to PNU2 or PNU3
  - **Meeting Scenario 2 with a different criterion in the RIT**



Hospital Day	MV DAY	PNU1 Elements met initially. PNU2 met in the RIT
5	1	
6	2	
7	3	
8	4	FiO_2, resp. secretions
9	5	FiO_2, resp. secretions, temp 38.9 C
10	6	temp 38.5 C, CXR: infiltrate
11	7	CXR: infiltrate
12	8	
13	9	
14	10	
15	11	
16	12	
17	13	BLD CX: *S. aureus*
18	14	
19	15	
20	16	
21	17	
22	18	


Hospital Day
MV DAY
PNU1 Elements met initially.
PNU2 met in the RIT
5 1
6 2
7 3
4 FiO2, resp. secretions
9 5 FiO2, resp. secretions, temp 38.9 C
10 6 temp 38.5 C, CXR: infiltrate
11 7 CXR: infiltrate
12 8
13 9
14 10
15 11
16 12
17 13 BLD CX: S. aureus, Temp 39 C
18 14 rales, CXR: infiltrate
19 15
20 16
21 17
22 18
Date of event
PNEU RIT
7 Day Infection Window Period
PNU1
Met PNU1
Positive blood culture outside of the IWP
PNU2 can be met in a new IWP using the blood specimen as an element (Scenario 2) and the date of event is within the RIT
PNU2 is met and the BSI is Secondary to PNEU
Do NOT change
Date of event
Device association
Location of attribution
Do NOT reset the RIT or SBAP

RETURN to BSI Secondary to PNEU – Scenario 1

Blood & site-specific specimen identification must match for at least one organism.

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infi
9		3	Fever > 3
10		4	F
11			
12			
13			
		10	Blood C : *S. aureus*
		11	
		12	
19		13	
20		14	
21			

BUT WAIT - THERE'S MORE

- *t used as an element*

o secondary BSI

PNU2

Date of Event = Day 7

Pathogen*: A. baumannii*

PNEU Definition

- CHAPTER 2:

Repeat Infection Timeframe

The Repeat Infection Timeframe (RIT) is a 14-day timeframe during which no new infections of the same type are reported.

- **The RIT applies to both POA and HAI determinations.**
- The date of event is Day 1 of the 14-day RIT.
- If criteria for the same type of infection are met and the date of event is within the 14-day RIT, a new event is not identified or reported.
- Additional pathogens recovered during the RIT from the **same type of infection** are added to the event.
- Note the original date of event is maintained as is the original 14-day RIT.
- Device association determination and location of attribution are not to be amended. See examples in Table 5 and Table 6 below.
- The RIT will apply at the level of specific type of infection with the exception of BSI, UTI, and PNEU where the RIT will apply at the major type of infection.

- Additional means of possibly attributing a secondary BSI
  - **Meeting PNU2 “again” in the RIT**

BSI Secondary to PNEU

Blood & site-specific specimen identification must match for at least one organism OR Blood is used as an element .

PNEU RIT

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: Infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: *A. baumannii*
12		6	
13		7	
14		8	Fever > 38.0 C, rales
15		9	Imaging test: Infiltrate
16	BC+	10	Blood Culture : *S. aureus*
17		11	
18		12	
19		13	
20		14	
21			

- ***No match***
- ***Blood is used as an element and PNU2 met again in the RIT***

PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen*: A. baumannii, S. aureus*

Knowledge Check #6

The PNEU definition can be used as a site-specific infection for secondary BSI attribution when conducting CLABSI surveillance

A. True
B. False

Knowledge Check #6 - Rational

The PNEU definition can be used as a site-specific infection for secondary BSI attribution when conducting CLABSI surveillance

A. True

B. False

Rationale

When conducting CLABSI surveillance, the PNEU definition is available for use as a site-specific infection to which a bloodstream infection can be attributed as a secondary BSI for all patients, in all locations, regardless of use of mechanical ventilation.

Questions?
Please contact the NHSN Helpdesk
nhsn@cdc.gov

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E-mail: cdcinfo@cdc.gov Web: www.cdc.gov