Patient Safety Component
The 1, 2, 3s of Pneumonia (PNEU) Surveillance

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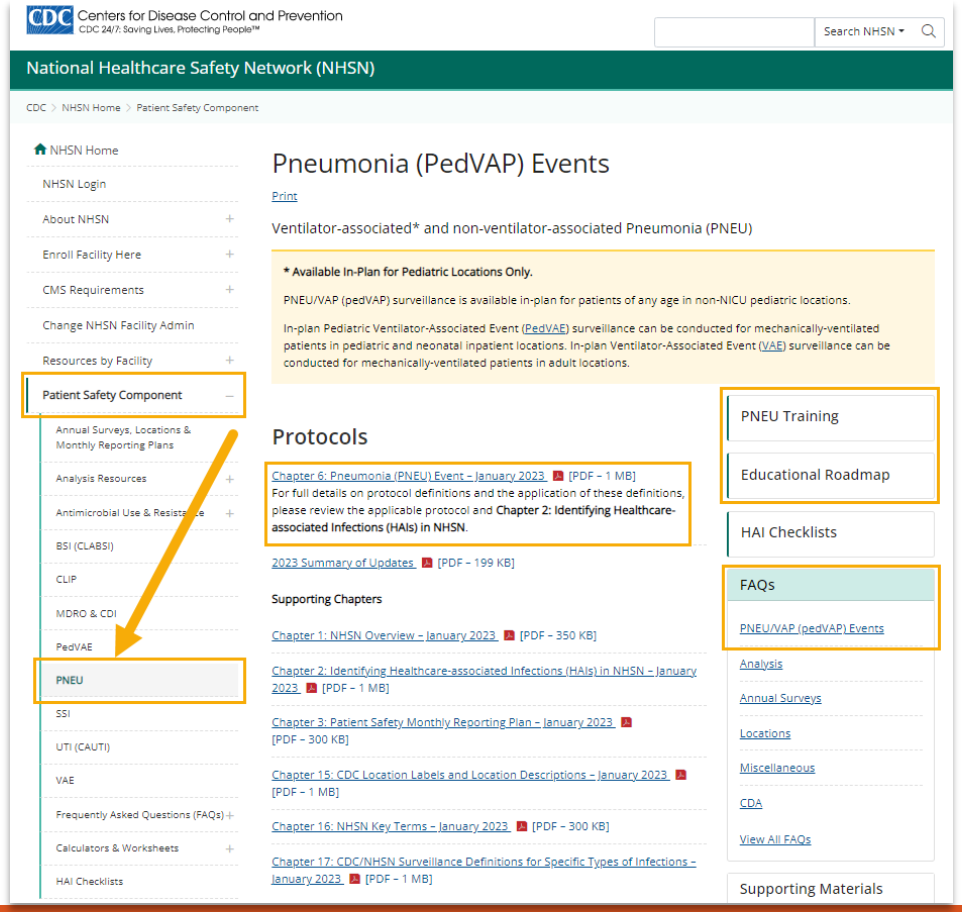
Objectives

By the end of this presentation, you will be able to

- Summarize the three PNEU algorithms – PNU1, PNU2, PNU3
- Identify imaging test evidence for PNEU
- Describe signs and symptoms for PNEU
- Identify laboratory test evidence for PNEU
- Explain Secondary BSI assignment to PNEU

PNEU Surveillance

NHSN Pneumonia 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 2023

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

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PNEU Surveillance Options

- **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

PNEU Events – PNU1, PNU2, PNU3

Meeting PNEU (PNU1, PNU2, PNU3)

- PNEU is comprised of PNU1, PNU2, and PNU3
- PNU1, PNU2, PNU3 each have their own algorithms
- Must meet all elements specific to the criterion
  - PNU1 – imaging, signs/symptoms
  - PNU2 – imaging, signs/symptoms, laboratory
  - PNU3 – immunocompromised, imaging, signs/symptoms, laboratory
- Must meet the **footnote requirements**

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowcharts 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)

- PNU1 is ‘clinically defined’ – no laboratory test evidence required
- Required elements:
  - Imaging Test Evidence
  - Signs/Symptoms
- 3 sets of criteria for Signs/Symptoms
  - Any Patient – patients of any age, including infants and children
  - Alternative Criteria – infants ≤ 1 year old
  - Alternative Criteria – child > 1 year old or ≤ 12 years old
- Age-specific criteria apply to PNU1 only (cannot be used for PNU2 or PNU3)

PNU2 Algorithm (Table 2 and Table 3, PNEU Protocol)

- PNU2 is comprised of
  - Imaging Test Evidence
  - Signs/Symptoms
  - Laboratory evidence
- Split into 2 tables – Table 2 and Table 3
  - Imaging test evidence and signs/symptoms are the same
  - Laboratory evidence is different, but all meet PNU2
- No age-specific criteria for signs/symptoms

PNU3 Algorithm (Table 4, PNEU Protocol)

- PNU3 is for Immunocompromised Patients
  - Immunocompromised definition in footnote #10 must be met in order to apply PNU3
- PNU3 is comprised of
  - Imaging Test Evidence
  - Signs/Symptoms
  - Laboratory evidence
- No age-specific criteria for signs/symptoms

Meeting PNEU Events

- 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 doesn’t require laboratory evidence?

A. PNU1

B. PNU2

C. PNU3

Knowledge Check #1 - Rationale

Which PNEU algorithm doesn't require laboratory evidence?

A. PNU1

B. PNU2

C. PNU3

Rationale:

PNU1 does not have a laboratory element.

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

1. Imaging Test Evidence

Imaging Test Evidence – PNEU Algorithms

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	**Note:** In patients ***without*** underlying pulmonary or cardiac disease (such as respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive imaging test result is acceptable.[1]

- Imaging requirement is the same for PNU1, PNU2, and PNU3
- New and persistent OR Progressive and persistent
- Definitive findings
- **Footnotes #1, #2, #14**

Imaging Test Evidence of Pneumonia

Evidence of **pneumonia**

- **new or progressive 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)

New or Progressive

- **New or Progressive** is determined in comparison to prior imaging test findings
- **New** findings – eligible findings were not present in prior imaging
  - 3/10 imaging finding: lungs are clear
  - 3/12 imaging finding: infiltrates
- **Progressive** findings – eligible findings are worse in comparison to prior imaging
  - 3/10 imaging finding: infiltrates present
  - 3/12 imaging finding: increasing (worsening) infiltrates

Persistence

- **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 definitive 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

Footnote #1 - Persistence

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 the imaging finding 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 the serial imaging test results must also be evaluated and must demonstrate persistence of eligible and definitive findings.
    - In patients with underlying pulmonary or cardiac disease (such as interstitial lung disease, congestive heart failure, etc.), the diagnosis of pneumonia may be particularly difficult. For example, imaging findings of pulmonary edema from decompensated congestive heart failure may simulate the presentation of pneumonia. Therefore, in patients with underlying disease, serial chest imaging test results must be examined and must demonstrate persistence of eligible and definitive findings to help separate infectious from non-infectious pulmonary processes.

Eligible Imaging Findings

- **Definitive findings** listed in the PNEU algorithms:
  - Infiltrate
  - Consolidation
  - Cavitation
  - Pneumatoceles, in infants ≤ 1 year old
- **Alternative findings** – footnote #2
  - Opacities, airspace disease, densities
  - Cannot be attributed to something other than pneumonia

Footnote #2 – Alternative Findings

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.

Equivocal Imaging Findings

- **Equivocal imaging** – findings do not conclusively identify an infection or an infectious process
  - Infiltrate vs. atelectasis
  - Opacity may represent pneumonia or congestive heart failure
- Equivocal imaging findings can be considered for use in meeting the PNEU imaging requirement, if the requirements in footnote #14 are met

Clarifying Equivocal Imaging Findings

- First, look for further imaging test evidence that clarifies the equivocal imaging finding:
    - Subsequent imaging findings are definitive for pneumonia - verifies the equivocal finding is representative of pneumonia and that there is persistence, making the equivocal finding eligible for use

      OR
    - Subsequent imaging findings no longer show pneumonia - verifies the finding is **not** representative of pneumonia, making the equivocal finding **not** eligible for use

Clarifying Equivocal Imaging Findings, Continued

- What if the imaging findings continue to be equivocal?
- 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

Footnote #14 – Equivocal Findings

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 (see Chapter 16) then the equivocal imaging test is eligible for use.

Imaging Test Evidence of Pneumonia - Review

- Findings must be new **and** persistent OR progressive **and** persistent
- Simply finding words such as infiltrate, consolidation, opacity, or airspace 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
- Additional guidance can be found in the PNEU protocol under “Guidance for Determination of Eligible Imaging Test Evidence” (p. 6-3)

Knowledge Check #2

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

3/14 – Lungs are clear bilaterally

3/15 – Developing bibasilar and perihilar infiltrates

3/18 – Perihilar infiltrates persist

3/20 – Increasing bilateral infiltrates

A. True

B. False

Knowledge Check #2 - Rationale

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

3/14 – Lungs are clear bilaterally

3/15 – Developing bibasilar and perihilar infiltrates — New definitive finding

3/18 – Perihilar infiltrates persist — Persistent finding

3/20 – Increasing bilateral infiltrates — Progressive & Persistent

A. True

B. False

Rationale:

The imaging demonstrates definitive findings that are new on 3/15 and persistent on 3/18 and 3/20.
Additionally, the imaging findings on 3/20 are progressive.

Knowledge Check #3

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

3/2 – Increasing opacities

3/3 – Opacities, may represent infiltrates vs. pulmonary edema

3/5 – Worsening bibasilar opacities reflect worsening pulmonary edema

3/6 – Bibasilar opacities due to pulmonary edema

No additional imaging

A. True

B. False

Knowledge Check #3 - Rationale

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

3/2 – Increasing opacities Progressive finding

3/3 – Opacities, may represent infiltrates vs. pulmonary edema Equivocal finding

3/5 – Worsening bibasilar opacities reflect worsening pulmonary edema Equivocal finding clarified to represent something other than pneumonia

3/6 – Bibasilar opacities due to pulmonary edema Ineligible finding

No additional imaging

A. True

B. False

Rationale:

The 3/3 imaging findings are equivocal for pneumonia, and subsequent imaging on 3/5 and 3/6 clarify that the equivocal findings represent a non-infectious process.

2. Signs/Symptoms

PNU1 – ANY PATIENT

For ANY PATIENT, 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 ***two*** 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 example, PaO_2/FiO_2 ≤ 240][7], increased oxygen requirements, or increased ventilator demand)

One (1) of these

PLUS

At least two (2) of these

(the 2 qualifying signs/ symptoms must be from different bullets)

PNU1 – Infants ≤ 1 year old

ALTERNATE CRITERIA, for infants ≤ 1 year old:

Worsening gas exchange (for example, O_2 desaturations [for example, pulse oximetry < 94%], increased oxygen requirements, or increased ventilator demand)

And at least ***three*** of the following:

- Temperature instability
- Leukopenia (≤ 4000 WBC/mm^3) or leukocytosis (≥ 15,000 WBC/mm^3) and left shift (≥ 10% band forms)
- New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions, or increased suctioning requirements
- Apnea, tachypnea[5], nasal flaring with retraction of chest wall, or nasal flaring with grunting
- Wheezing, rales[6], or rhonchi
- Cough
- Bradycardia (< 100 beats/min) or tachycardia (> 170 beats/min)

This **PLUS** at least three (3) of these (the 3 qualifying signs/ symptoms must be from different bullets)

PNU1 – Child > 1 year old or ≤ 12 years old

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)

At least three (3) of these

(the 3 qualifying signs/ symptoms must be from different bullets)

PNU2 (Table 2 and Table 3)

One (1) of these **PLUS** At least one (1) of these

At least ***one*** of the following:	And 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	• 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 example, $PaO_2/FiO_2 \leq 240$][7], increased oxygen requirements, or increased ventilator demand)

- Same criteria applies to patients of all ages (no age-specific criteria)
- Cannot apply age-specific criteria from PNU1

PNU3 – Immunocompromised Patients

Must meet the PNEU immunocompromised definition

Patient who is immunocompromised (see definition in footnote[10]) has at least ***one*** of the following:

PLUS At least one (1) of these

- 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 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 example, $PaO_2/FiO_2 \leq 240$][7], increased oxygen requirements, or increased ventilator demand)
- Hemoptysis
- Pleuritic chest pain

Footnote #10 – Immunocompromised Patients

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 consecutive days on the date of event

Signs/Symptoms – A Few Key Points

- Fever, leukopenia, and leukocytosis must meet the stated parameters
  - Leukocytosis parameters are different for infants and children
- Breath sounds
  - Wheezing and rhonchi are only eligible to meet PNU1, Alternative criteria for infants ≤ 1 year old (not eligible for PNU1 any patient, PNU1 child, PNU2, or PNU3)
- Don't forget about the **FOOTNOTES**!!!

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowcharts 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.

Footnotes #3 and #5

- **Footnote #3** – purulent secretions must meet the definition; documentation of "purulent" does not meet the criteria (see table on p. 6-13 for additional guidance)

> 3. Purulent sputum is defined as secretions from the lungs, bronchi, or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells per low power field (x100). Refer to the table below if your laboratory reports these data semi-quantitatively or uses a different format for reporting Gram stain or direct examination results (for example, "many WBCs" or "few squamous epithelial cells"). This laboratory confirmation is required since written clinical descriptions of purulence are highly variable.

- **Footnote #5** – documented respiratory rate must meet the age-based parameters; documentation of "tachypnea" does not meet the criteria

> 5. In adults, tachypnea is defined as respiration rate > 25 breaths per minute. Tachypnea is defined as > 75 breaths per minute in premature infants born at < 37 weeks gestation and until the 40th week; > 60 breaths per minute in patients < 2 months old; > 50 breaths per minute in patients 2-12 months old; and > 30 breaths per minute in children > 1 year old.

Knowledge Check #4

The PNU1 Alternative Criteria for infants ≤ 1 year old can be used with the PNU2 and PNU3 algorithms.

A. True

B. False

Knowledge Check #4 - Rationale

The PNU1 Alternative Criteria for infants ≤ 1 year old can be used with the PNU2 and PNU3 algorithms.

A. True

B. False

Rationale:

The PNU1 Alternative Criteria for infants and children can only be used with the PNU1 algorithm.

PNU2 and PNU3 do not have age-specific criteria.

3. Laboratory Test Evidence

PNEU Pathogen Exclusions

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

PNEU Pathogen Exclusions, Continued

All *Candida* species or yeast not otherwise specified

All coagulase-negative *Staphylococcus* species

All *Enterococcus* species

- **Exception**: *Candida* species are eligible for use in 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

PNU2 – Laboratory Evidence – Blood Specimen

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 Flowcharts 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	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:	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***)

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 event 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 (for patients meeting the immunocompromised definition) 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 – LRT Specimen

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 Flowcharts 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	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:	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***)

9. Refer to threshold values for cultured specimens (lung tissue, BAL, protected specimen brushing, or endotracheal aspirate) with growth of eligible pathogens (Table 5).

Notes:

- A specimen that is not obtained through an artificial airway (specifically an endotracheal tube or a 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

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.

PNU2 – Laboratory Evidence – Lung Tissue & Pleural Fluid

- Organism identified from pleural fluid[9,13]

- Positive quantitative culture or corresponding semi-quantitative culture result[9] of lung tissue

- Eligible specimen sites for *Candida*, *Enterococcus*, and coagulase-negative *Staphylococcus* species
- Pleural fluid – organisms can be identified with any amount of growth
- Lung tissue – organisms must be identified with growth that meets the threshold values in Table 5
- Make note of specimen collection requirements for both specimen types

PNU2 – Laboratory Evidence - Viruses

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 Flowcharts 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	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	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 microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (for example, not Active Surveillance Culture/Testing (ASC/AST)

- Nasopharyngeal (NP) swab specimens are eligible specimens
- Both culture and non-culture based test results are eligible
- COVID-19 (SARS-CoV-2) is an eligible pathogen

PNU3 – Laboratory Evidence – Matching Candida

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

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowcharts 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	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 respiratory secretions, or increased suctioning requirements	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: – Direct microscopic exam – Positive culture of fungi – Non-culture diagnostic laboratory test

11. Blood specimen and respiratory specimen (sputum, endotracheal aspirate, BAL, or protected specimen brushing) must have a collection date that occurs within the IWP.
12. Semi-quantitative or non-quantitative cultures of sputum obtained by deep cough, induction, aspiration, or lavage are acceptable.
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 Flowcharts 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
		OR Any of the following from: **LABORATORY CRITERIA DEFINED UNDER PNU2**

Knowledge Check #5

What is identified in this scenario?

Within the 7-day IWP, there is

- definitive imaging test evidence of pneumonia
- the patient has leukocytosis
- there is documentation of dyspnea and rales
- *E. faecalis* is identified from a BAL specimen

A. PNU1
B. PNU2
C. PNU3
D. No PNEU criteria identified

Knowledge Check #5 - Rationale

What is identified in this scenario?

Within the 7-day IWP, there is

- definitive imaging test evidence of pneumonia
- the patient has leukocytosis
- there is documentation of dyspnea and rales
- *E. faecalis* is identified from a BAL specimen

A. PNU1
B. PNU2
C. PNU3
D. No PNEU criteria identified

Rationale:

PNU1 is identified – definitive imaging, leukocytosis, and at least 2 qualifying signs/symptoms in the IWP

PNU2 and PNU3 are not met – *E. faecalis* is an excluded organism unless identified from pleural fluid or lung tissue

Knowledge Check #6

What if the organism identified from the BAL specimen was an eligible organism – would PNU2 be met?

Within the 7-day IWP, there is

- definitive imaging test evidence of pneumonia
- the patient has leukocytosis
- there is documentation of dyspnea and rales
- *E. coli* is identified from a BAL specimen

A. Yes
B. No
C. Maybe

Knowledge Check #6 - Rationale

What if the organism identified from the BAL specimen was an eligible organism – would PNU2 be met?

Within the 7-day IWP, there is

- definitive imaging test evidence of pneumonia
- the patient has leukocytosis
- there is documentation of dyspnea and rales
- *E. coli* is identified from a BAL specimen

A. Yes
B. No
C. Maybe

Rationale:

While *E. coli* is an eligible organism, it must be identified with sufficient growth to meet the quantitative thresholds or semi-quantitative equivalents in Table 5.

PNEU – 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, Example 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	DOE	1	New onset cough
8		2	Imaging test: New infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL:Many *E. coli*
12		6	Imaging test: Infiltrate
13		7	
14		8	
15		9	
16	BC+	10	Blood Culture: *E. coli*
17		11	
18		12	
19		13	
20		14	
21			

- **PNU2 is met – site-specific specimen**
- **Blood Culture collection date within the PNEU SBAP**
- **Matching organisms**

PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen: *E. coli*

BSI Secondary to PNEU – Scenario 1, Example 2

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	DOE	1	New onset cough
8		2	Imaging test: New infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: 3+ *S. aureus* 4+ *A.baumannii*
12		6	Imaging test: Infiltrate
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 PNEU SBAP**
- **At least one matching organism**

PNU2 & Secondary BSI

Date of Event = Day 7

Pathogen: *S. aureus, A. baumannii*

BSI Secondary to PNEU – Scenario 1, Example 3

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: New infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: Many *A. baumannii*
12		6	Imaging Test: Infiltrate
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 PNEU SBAP**
- **BUT---No matching organism**
- **No secondary BSI**

PNU2, no secondary BSI

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, Example 4

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: New infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	BAL: Many *E. coli*
12		6	Imaging test: Infiltrate
13		7	
14		8	
15		9	
16	BC +	10	Blood Culture: *E. coli*, *VRE*
17		11	
18		12	
19		13	
20		14	
21			

- PNU2 is met – site-specific specimen
- Blood Culture collection date within the PNEU SBAP
- Matches at least one organism
- BUT---*VRE* is an 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: *E. coli*

BSI Secondary to PNEU – Scenario 1, Example 5

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: New infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Pleural fluid: *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 PNEU SBAP**
- ***VRE* is <u>not</u> 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

Blood culture as an element of the PNEU criteria

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 Flowcharts 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	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 other recognized cause And at least ***one*** of the followi	At least ***one*** of the following: • Organism identified from blood[8,13]

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

NOTE: The PNEU Algorithms (PNU1,2,3) and Flowcharts 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]

BSI Secondary to PNEU – Scenario 2, Example 1

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: New infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11			Blood culture: *S. aureus*
12		6	Imaging test: Infiltrate
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 to meet the criterion**

PNU2 & Secondary BSI
Date of Event = Day 7
Pathogen: *S. aureus*

BSI Secondary to PNEU – Scenario 2, Example 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: New infiltrate
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Blood culture: *Enterococcus faecalis*
12		6	Imaging test: Infiltrate
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, Example 3

Blood culture as an element of the PNU3 criterion - Immunocompromised

Hospital Day	SBAP	RIT	Infection Window Period
1			
2			
3			
4			
5			
6			
7		1	New onset cough
8		2	Imaging test: New infiltrate, Sputum: *Candida* species
9		3	Fever > 38.0 C
10		4	Fever > 38.0 C
11		5	Blood culture: *Candida albicans*
12		6	Imaging test: Infiltrate
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 PNEU IWP
- Blood is used as an element

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

BSI Secondary to PNEU – Scenario 1 and Scenario 2

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

- PNU2 is met with a blood specimen collected in the IWP
- Second blood specimen with a collection date within the PNEU SBAP
- At least one matching organism

PNU2 & Secondary BSI

Date of Event = Day 7

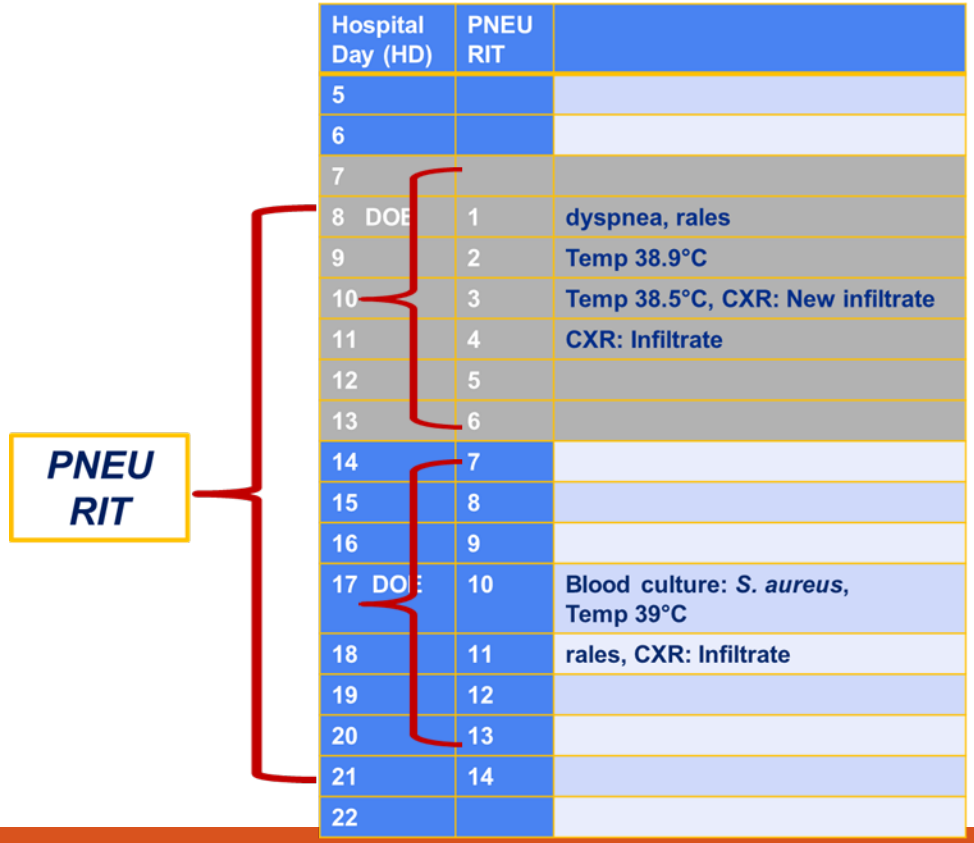
Pathogen: *E. coli*

BSI Secondary to PNEU – Additional Scenarios

- What if PNU1 is met originally, and there is a blood specimen collected in the PNEU SBAP?
  - A BSI cannot be secondary to PNU1
- What if PNU2 or PNU3 is met originally, and there is a blood specimen collected in the PNEU SBAP but pathogen doesn't match the site-specific pathogen?
- PNU1, PNU2, and PNU3 events create a PNEU RIT
  - If PNU2 or PNU3 can be met in the PNEU RIT using the blood specimen as an element in the PNEU IWP, the BSI can be determined secondary to PNEU

BSI Secondary to PNEU – Re-meeting PNEU in the RIT

PNU1 met originally – PNU2 met in the RIT



Hospital Day (HD)	PNEU RIT	
5		
6		
7		
8 DOE	1	dyspnea, rales
9	2	Temp 38.9°C
10	3	Temp 38.5°C, CXR: New infiltrate
11	4	CXR: Infiltrate
12	5	
13	6	
14	7	
15	8	
16	9	
17 DOE	10	Blood culture: *S. aureus*, Temp 39°C
18	11	rales, CXR: Infiltrate
19	12	
20	13	
21	14	
22		

Met PNU1 (IWP HD 7-13)
Positive blood culture outside of the IWP
PNU2 can be met in a new IWP (HD 14-20) **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

BSI Secondary to PNEU – Re-meeting PNEU in the RIT

PNU2 met originally – organisms don't match – PNU2 re-met in the RIT

PNEU RIT

Hospital Day (HD)	PNEU RIT	
5		
6		
7		
8 DOE	1	New onset cough
9	2	Temp 38.9°C
10	3	Temp 38.5°C, CXR: New infiltrate
11	4	CXR: Infiltrate
12	5	BAL: Many *E. coli*
13	6	
14	7	
15	8	
16	9	
17 DOE	10	Blood culture: *S. aureus*, Temp 39°C, rales
18	11	CXR: Infiltrate
19	12	
20	13	
21	14	
22		

Met PNU2 (IWP HD 7-13)
Positive blood culture outside of the IWP, but organism doesn't match site-specific organism
PNU2 can be met in a new IWP (HD 14-20) **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

Knowledge Check #7

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 #7 - Rationale

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.

For any questions or concerns,

contact the NHSN Helpdesk at nhsn@cdc.gov

For more information please contact Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov