Patient Safety Component Pneumonia (PNEU) Surveillance

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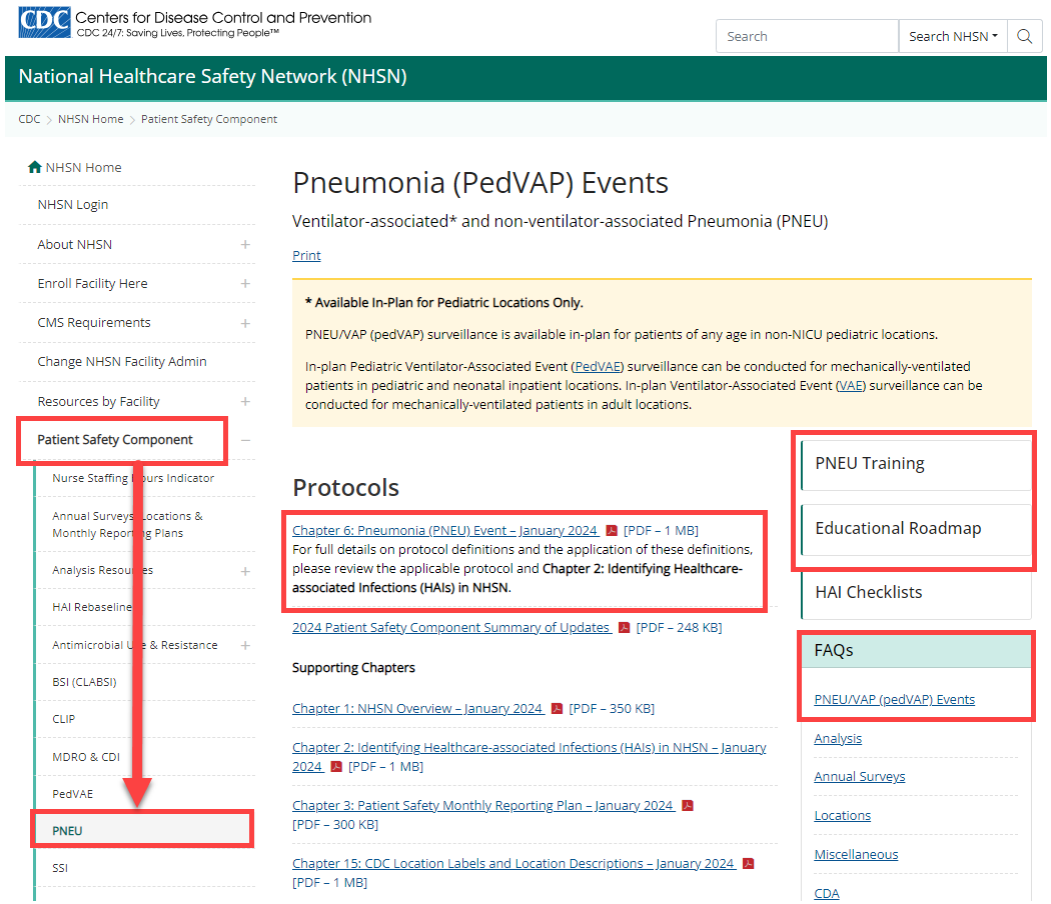
Learning objectives

At the conclusion of this presentation, participants will be able to

- Describe the three Pneumonia (PNEU) algorithms (PNU1, PNU2, and PNU3) and the requirements for each
- Determine what imaging findings are eligible for meeting a PNEU definition
- Identify eligible signs, symptoms, and laboratory findings for meeting a PNEU definition
- Apply PNEU definitions correctly to case scenarios

PNEU Surveillance

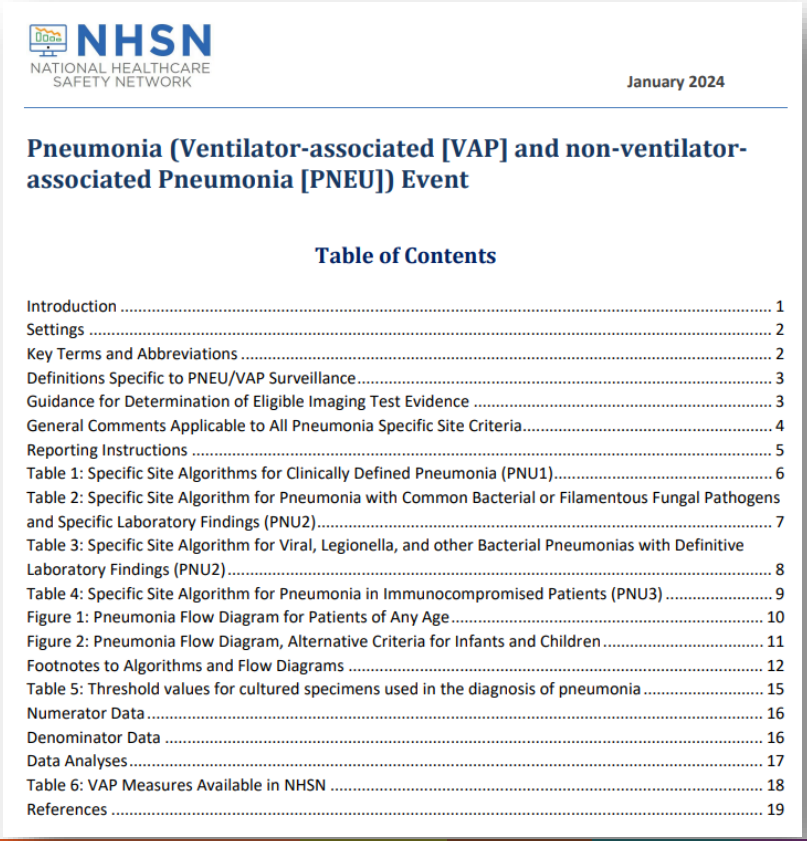
NHSN Pneumonia Events webpage



- 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 (PSC) Manual

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



NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

January 2024

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, state reporting requirement, facility surveillance plan)
  - **Available for secondary bloodstream infection (BSI) assignment in any patient** regardless of location, age, or ventilation status

PNEU Events – PNU1, PNU2, PNU3

Meeting PNEU: PNU1, PNU2, PNU3

- PNEU is comprised of PNU1, PNU2, and PNU3 criteria
- 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**

PNEU: 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.

- Several of the elements in the PNEU algorithms are footnoted
- The footnotes provide additional guidance and instructions that **must be incorporated** into the decision-making process to determine if a PNEU definition can be met
- The footnotes are located on pages 6-12 through 6-15 in the 2024 PNEU chapter

PNU1 algorithm: Table 1

- PNU1 is ‘clinically defined’ – no laboratory test evidence required
- Required elements:
  - Imaging Test Evidence
  - Signs/Symptoms

PNU1 algorithm: Age-specific criteria

- 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

- 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 in both tables
  - Laboratory evidence is different, but all meet PNU2
- No age-specific criteria for signs/symptoms

PNU3 algorithm: Table 4

- 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

PNEU events: General guidance

- Although specific criteria are included for infants and children under the PNU1 algorithm and the 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

PNEU hierarchy

- There is a hierarchy for reporting if a patient meets more than one algorithm during the infection window period (IWP) or the repeat infection timeframe (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?

PNU1

Rationale:

PNU1 does not have a laboratory element.

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

Imaging Test Evidence

Imaging test evidence

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)

And

Evidence of **persistence**

- no indication of rapid resolution
- no indication the finding is due to another condition

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

Persistent

- **Persistence** is assessed by reviewing temporally-related imaging tests to ensure the findings do not resolve quickly
- **Persistence** of eligible definitive findings of pneumonia is required
  - for patients with underlying cardiac or pulmonary disease (serial imaging)
  - for all patients when multiple temporally related imaging test results are available

Exception

- 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

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 (typically, within a 7-day timeframe) 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 (typically, within a 7-day timeframe) 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

Equivocal imaging: Clinical correlation

- What if the imaging findings continue to be equivocal?
- In the absence of clarification of equivocal findings by subsequent imaging, **THEN and only then** can clinical correlation be used
  - Clinical correlation is specifically, 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 eligible findings of pneumonia, clinical correlation cannot be used

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 reports

- Documentation of the radiologist's review of the imaging test
- Imaging reports typically contain 'findings' and 'impressions'
  - Findings = what the radiologist saw
  - Impressions = the radiologist's assessment of what the findings represent
- Both the findings and impressions must be considered when determining if the imaging test results are eligible for use in meeting PNEU

Assessing imaging test reports

Radiographic definition of ‘opacity’ – an area on a radiograph that appears more opaque than surrounding areas

Many conditions can present as opacities on imaging tests

Finding	Impression	Pneumonia?
Opacity	Consistent with infiltrates	yes
Opacity	Represents pulmonary edema	no
Opacity	May represent atelectasis or pneumonia	maybe (equivocal finding)
Opacity	Opacity	??

Imaging test evidence of pneumonia: Summary

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

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

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 pulmonary edema

No additional imaging

A. True

B. False

Knowledge Check #3 - Rationale

The imaging requirement for PNEU is NOT met with the following imaging test findings:

3/2 – Increasing opacities Progressive finding

3/3 – Opacities, may represent infiltrates or 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

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.

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 (from separate bullets):

- New onset of purulent sputum (3) or change in character of sputum (4), or increased respiratory secretions, or increased suctioning requirements
- Dyspnea, or tachypnea (5), or new onset or worsening cough
- 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 (from separate bullets):

- 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 (from separate bullets):

- 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
- Dyspnea, or apnea, or tachypnea (5), or new onset or worsening cough
- 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:

- 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
- Dyspnea, or tachypnea (5), or new onset or worsening cough
- 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 to meet PNU2)

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
- Dyspnea, or tachypnea (5), or new onset or worsening cough
- 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**!!!

Footnote #3

- New onset of purulent sputum (3): **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

- Tachypnea (5): **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 CANNOT be used with the PNU2 and PNU3 algorithms.

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.

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* species are identified from a *respiratory specimen and blood specimen*, and both specimens have a collection date in the same infection window period (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 • 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 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[a] 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: Lower respiratory tract (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* spp.

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**

PNEU – Secondary BSI Assignment

PNEU and Secondary BSI Assignment*

A 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 (SBAP) [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 IWP.

*BSI Protocol https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf Appendix: 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 with a site-specific specimen
- Blood specimen collection date is within the PNEU SBAP
- Cultures have 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 with a site-specific specimen
- Blood specimen collection date is within the PNEU SBAP
- Cultures have 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 with a site-specific specimen**
- **Blood specimen collection date is 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: Excluded pathogens

Candida species or yeast not otherwise specified

Coagulase-negative _Staphylococcus_ species

Enterococcus species

- If any of the excluded pathogens are identified from blood, they can only be attributed as a secondary BSI to PNEU if PNU2 or PNU3 is met with a matching organism identified from lung tissue or pleural fluid and the blood specimen collection date is in the PNEU SBAP.

PNEU and Secondary BSI Assignment: Excluded pathogens continued

Pathogens excluded from site-specific infection definitions are also excluded as pathogens for BSIs secondary to that type of infection, and the excluded pathogens cannot be attached to one of these infections as a pathogen, even if identified in the same blood specimen as an eligible organism (see Pathogen Assignment Guidance, Chapter 2, p. 2-22).

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 with a site-specific specimen
- Blood specimen collection date is within the PNEU SBAP
- Cultures have at least one matching organism
- BUT - *VRE* is an excluded pathogen
- Determine if the *VRE* BSI is secondary to another site-specific infection or is a 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 with a site-specific specimen**
- **Blood specimen collection date is within the PNEU SBAP**
- ***VRE* is not excluded when identified in lung tissue or pleural fluid**
- ***VRE* BSI can be secondary to PNU2 in this case**

  PNU2 & Secondary BSI

  Date of Event = Day 7

  Pathogen*: VRE*

BSI Secondary to PNEU: Scenario 2

Blood specimen 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 specimen 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**
- **Eligible organism identified from a blood specimen with a collection date within the IWP**
- **Organism from 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 specimen 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 specimen as an element of the PNU3 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, 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
- Patient meets immunocompromised definition
- Matching *Candida* spp. in blood and respiratory specimen
- Both specimens with collection dates in the PNEU IWP
- Organism from blood is used as an element to meet the criterion

  PNU3 & Secondary BSI

  Date of Event: Day 7

  Pathogen: *Candida albicans*

BSI secondary to PNEU: Additional scenario #1

- What if a blood specimen and a site-specific specimen both have collection dates in the IWP, but the pathogens do not match?
  - Any BSI that is captured in the IWP and is eligible for use in meeting the site-specific infection criterion can be attributed to the site-specific infection as a secondary BSI (as per Secondary BSI Guide Scenario 2), whether or not the BSI pathogen matches the pathogens from other specimens (blood specimen or site-specific specimen) in the IWP that are also used to meet the site-specific definition.

BSI secondary to PNEU: Add. scenario #1

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	Blood Culture: *S. aureus*
11		5	BAL: 4+ *E. coli*
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 with eligible organism is identified from a blood specimen with a collection date within the IWP
- PNU2 is also met with an eligible organism from a site-specific specimen

PNU2 & Secondary BSI
Date of Event = Day 7
Pathogens: *E. coli*, *S. aureus*

BSI secondary to PNEU: Additional scenario #2

- What if PNU2 is met with an organism from a blood specimen, and there is a blood specimen with a matching organism with a collection date in the SBAP (outside the IWP)?
  - If a BSI with a collection date within the PNEU SBAP (outside the IWP) has at least one matching organism to the organism identified from the specimen – either site-specific specimen OR blood specimen – that was originally used to meet PNEU, the BSI can be attributed as a secondary BSI (as per Secondary BSI Scenario 1).

BSI secondary to PNEU: Scenarios 1 & 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 (Scenario 2)
- Second blood specimen with a collection date within the PNEU SBAP with at least one matching organism (Scenario 1)

PNU2 & Secondary BSI

Date of Event = Day 7

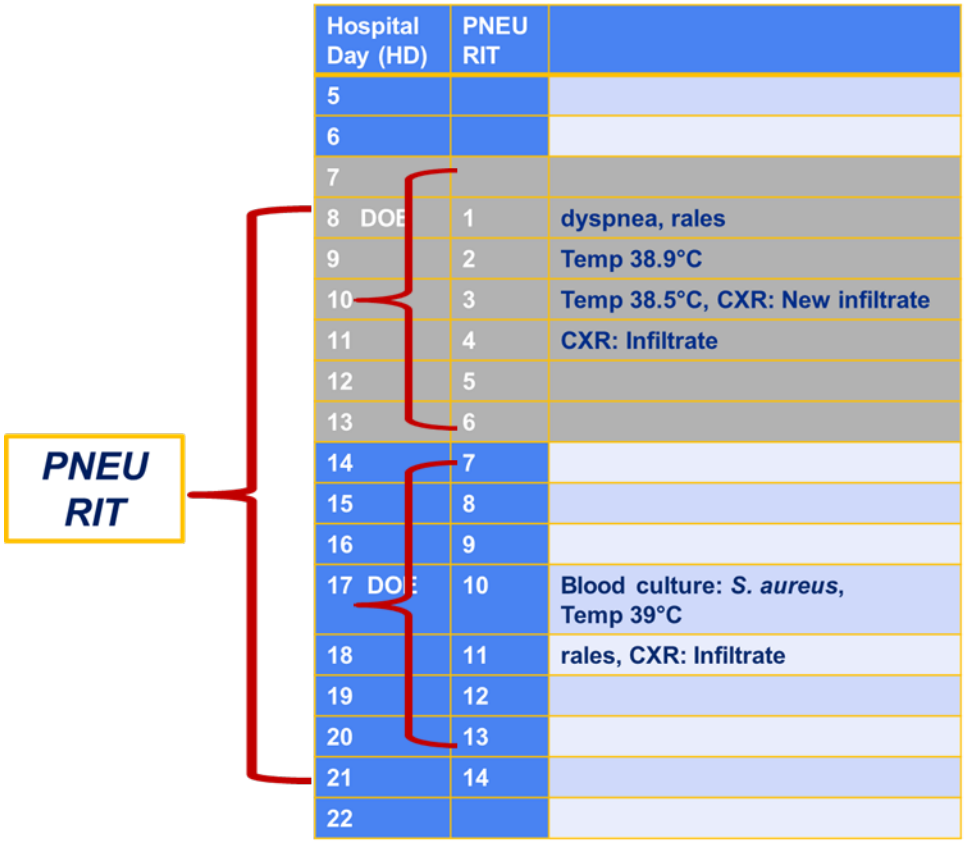
Pathogen: *E. coli*

BSI secondary to PNEU: Re-meeting PNEU in the PNEU RIT

- 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 #1

PNU1 met originally – PNU2 met in the RIT



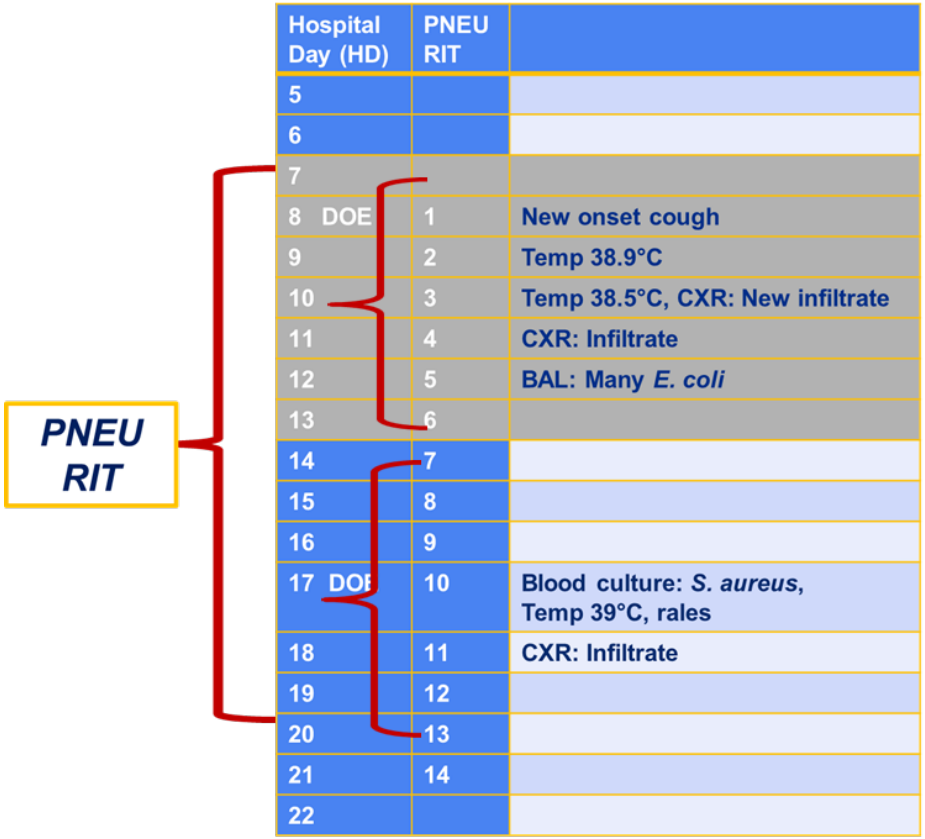
Hospital Day (HD)	PNEU RIT	
5		
6		
7		
8 DOE	1	dyspnea, rales
9	2	Temp 38.9°C
10	3	Temp 38.5°C, CXR: New infiltrate
11	4	CXR: Infiltrate
12	5	
13	6	
14	7	
15	8	
16	9	
17 DOE	10	Blood culture: *S. aureus*, Temp 39°C
18	11	rales, CXR: Infiltrate
19	12	
20	13	
21	14	
22		

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 #2

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



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

Pneumonia Case Studies
2024 Annual Training

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NHSN Protocol and Training Team

March 2024

Case Study #1

Case #1 Background

Mr. Brown, a 52-year-old man, is admitted to the hospital on February 20, 2024 with upper gastrointestinal bleeding. He is admitted to the medical ICU due to hemodynamic instability. Two central lines and a urinary catheter are placed on February 20. The patient's most recent previous hospitalization was in March 2023. He has no recent surgeries. His medical history is significant for hypertension and alcoholism. The patient is afebrile on admission. Blood products and intravenous fluids are administered, and an upper endoscopy is performed on February 20. Chest x-ray on admit shows lungs are clear.

Case #1 Additional Background

The patient's blood pressure stabilizes on February 21. He remains afebrile.

On February 23, the patient experience copious hematemesis (vomiting of blood), aspirates gastric contents, and develops respiratory distress. He is placed on a non-rebreather mask, and maintains stable oxygenation overnight.

Chest x-ray on February 23 includes findings of infiltrate in the right lung base.

Case #1: Knowledge Check 1a

Is the chest x-ray performed on February 23 eligible for use to meet a PNEU definition?

A. Yes
B. No
C. Maybe

Case #1: Knowledge Check 1a – Answer and Rationale

Correct answer

C. Maybe

Rationale: Infiltrates are an eligible imaging finding to meet a PNEU definition. However, these findings must also be persistent.

Case #1 Additional Background

On February 24, he has a fever to 38.4°C at 5am and has developed a new cough. A chest x-ray at 6am shows bilateral infiltrates in the right lower lung field. Antibiotics are started (vancomycin and piperacillin/tazobactam).

February 24 at 8am, he develops increasing shortness of breath, and his oxygen saturation drops from 92% to 84% while on the non-rebreather mask. He is intubated and placed on mechanical ventilation at 8:45am. A chest x-ray done immediately after intubation shows worsening right lower lobe infiltrates.

Case #1 Additional Background

On February 24, urine, blood, and endotracheal aspirate cultures are collected. The urine culture is negative.

Blood and endotracheal aspirate cultures are positive for *Enterococcus faecalis.*

On February 25, the patient is febrile to 39^{o}C. Antibiotics are continued.

On February 26, the patient's maximum temperature is 37.9^{o}C. Antibiotics are continued. A chest x-ray is performed and shows improved right lower lung infiltrate with atelectasis.

On February 27, the patient is afebrile and chest imaging shows stable right lower lung infiltrate.

Case #1: Knowledge Check 1b

Do the chest imaging results demonstrate new or worsening AND persistent findings that are eligible to meet a PNEU definition?

A. Yes
B. No
C. Maybe

Case #1: Knowledge Check 1 – Answer and Rationale

Correct answer

A. Yes

Rationale: The imaging demonstrates new and worsening eligible definitive finding for PNEU and these findings are persistent.

Remember persistence is required for all patients. So, it is important to look at all temporally related imaging [the whole imaging picture] to ensure that the eligible findings do remain persistent.

Case #1: Knowledge Check 1c

Are the blood culture and/or endotracheal cultures eligible to use to meet the laboratory component of a PNEU (PNU2 or PNU3) definition?

A. Yes
B. No

Case #1: Knowledge Check 1c – Answer and Rationale

Correct answer

A. No

Rationale: *Enterococcus faecalis* is only eligible for use for meeting a PNEU definition when identified in lung tissue or pleural fluid per General Comments #5.

5. Excluded organisms that cannot be used to meet the PNEU/VAP definition are as follows:
   a. "Normal respiratory flora," "normal oral flora," "mixed respiratory flora," "mixed oral flora," "altered oral flora," or other similar results indicating isolation of commensal flora of the oral cavity or upper respiratory tract. NOTE: A report of "flora" does not exclude the use of an eligible organism isolated or identified from the specimen. Only the "flora" is excluded from use.
   b. The following organisms, unless identified from lung tissue or pleural fluid (where specimen was obtained during thoracentesis or within 24 hours of chest tube placement; pleural fluid specimens collected after a chest tube is repositioned or from a chest tube in place > 24 hours are not eligible):
      i. Any *Candida* species as well as a report of "yeast" that is not otherwise specified
      ii. Any coagulase-negative *Staphylococcus* species
      iii. Any *Enterococcus* species

Case #1: Knowledge Check 1d

What is the date of diagnostic test used to set an Infection Window Period [IWP] for this PNEU event?

A. February 20 chest x-ray
B. February 23 chest x-ray
C. February 24 chest x-ray
D. February 24 blood and endotracheal culture

Case #1: Knowledge Check 1d – Answer and Rationale

Correct answer

B. February 23 chest x-ray

Rationale: The IWP is set using the collection date of the first positive diagnostic test that is used as an element to meet the site-specific infection criterion for which all elements of the PNEU criterion occur within the IWP and sets the earliest Date of Event [DOE].

Case #1: Knowledge Check 1e

What is the PNEU IWP?

A. February 21-27
B. February 20-26
C. February 22-28
D. February 19-25

Case #1: Knowledge Check 1e – Answer and Rationale

Correct Answer

B. February 20-26

Rationale: The IWP will be set for the 3 calendar days before and the 3 calendar days after using the first diagnostic test for which all elements of the criterion occur within the IWP.

Case #1: Knowledge Check 1f

Is a PNEU event met in this case, and if so what type of PNEU event is this?

A. PNU1
B. PNU2
C. PNU3
D. There is no PNEU Event

Case #1: Knowledge Check 1f – Answer and Rationale

Correct Answer

A. PNU1

Rationale: There are no eligible laboratory specimens to meet a PNEU (PNU2 or PNU3) definition. However, all elements of a PNEU (PNU1) definition are met using the following criteria for ANY patients:

- New and persistent imaging test evidence of pneumonia
- Fever
- Worsening gas exchange and new onset cough/dyspnea [please note, new onset cough and dyspnea are from the same bullet and therefore this qualifies as one sign/symptom]

Case #1: Knowledge Check 1g

What is the Date of Event [DOE]?

A. February 22
B. February 23
C. February 24
D. February 25

Case #1: Knowledge Check 1g – Answer and Rationale

Correct Answer

B. February 23

Rationale: The DOE is the date the first element used to meet an NHSN site-specific infection criterion occurs for the first time within the seven-day infection window period. In this case, the worsening gas exchange and new eligible imaging finding documented on 2/23 set the DOE for this PNEU (PNU1) event.

Case #1: Knowledge Check 1h

What is the Repeat Infection Timeframe [RIT]? [As a reminder the event occurs in 2024, so February has 29 days].

A. RIT 2/20 – 3/4
B. RIT 2/21 – 3/5
C. RIT 2/22 – 3/6
D. RIT 2/23 – 3/7

Case #2: Knowledge Check 1h – Answer and Rationale

Correct Answer

D. RIT 2/23 – 3/7

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

Case Study #2

Case #2 Background

Ms. Fall was admitted following a head injury from a fall at home on 9/17.

- 9/20 chest x-ray: Stable infiltrates
- 9/21 chest x-ray: Stable infiltrates
- 9/22 chest x-ray: There are moderate coarse bilateral pulmonary infiltrates that are similar or slightly improved from prior study
- 9/24 Fever 38.7°C
- 9/26 chest x-ray: Diffuse bilateral pulmonary increased infiltrate is noted, slightly progressed from prior study
- 9/26 WBC: 16.4
- 9/26 Intubated due to declining respiratory status and desaturations

Case #2 Additional Background

- 9/27 chest x-ray: There are diffuse pulmonary infiltrates without significant interval change
- 9/27 Endotracheal aspirate culture result: Moderate growth of *Enterobacter cloacae*
- 9/28 chest x-ray: Stable bilateral infiltrates
- 9/28 WBC: 19.7
- 9/29 chest x-ray: When compared to prior study on 9/28, there has been interval worsening of bilateral diffuse patchy infiltrates

Case #2: Knowledge Check 2a

Do the chest imaging results demonstrate new or worsening AND persistent findings that are eligible to meet a PNEU definition?

A. Yes
B. No
C. Maybe

Case #2: Knowledge Check 2a – Answer and Rationale

Correct answer

A. Yes

Rationale: There are worsening findings on the 9/26 chest x-ray [increased infiltrate is noted, slightly progressed from prior study]. Eligible findings remain persistent on 9/27, 9/28, and 9/29.

Case #2: Knowledge Check 2b

Which diagnostic test would be used to set an IWP?

A. 9/23 chest x-ray
B. 9/26 chest x-ray
C. 9/27 endotracheal aspirate
D. 9/29 chest x-ray

Case #2: Knowledge Check 2b – Answer and Rationale

Correct Answer

B. 9/26 chest x-ray

The IWP is set using the collection date of the first positive diagnostic test that is used as an element to meet the site-specific infection criterion for which all elements of the PNEU criterion occur within the IWP and sets the earliest DOE. The imaging findings up until 9/26, while eligible and persistent, are not new/worsening and wouldn't be used to set the IWP. Since the 9/26 imaging has worsening, this is the first imaging to set the IWP.

Case #2: Knowledge check 2c

What is the PNEU IWP set by this imaging test?

A. 9/22-9/28
B. 9/23-9/29
C. 9/24-9/30

Case #2: Knowledge Check 2c – Answer and Rationale

Correct Answer

B. 9/23-9/29

Rationale: The IWP will be set for the 3 calendar days before and the 3 calendar days after using the first diagnostic test for which all elements of the criterion occur within the IWP.

Case #2: Knowledge Check 2d

Is the endotracheal aspirate eligible for use to meet the laboratory component of a PNEU definition?

9/27 Endotracheal aspirate culture result: Moderate growth of *Enterobacter cloacae*

A. Yes
B. No

Case #2: Knowledge Check 2d – Answer and Rationale

Correct Answer

A. Yes

Rationale: The patient is intubated. Therefore, the endotracheal aspirate is an eligible laboratory specimen. In addition, the description of 'moderate growth' meets the semi-quantitative requirement noted in the footnote of 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.

Case #2: Knowledge Check 2e

Is there an eligible PNEU event in this case? If so, what PNEU definition is met?

A. PNU1
B. PNU2
C. PNU3
D. There is no PNEU event

Case #2: Knowledge Check 2e – Answer and Rationale

Correct Answer

B. PNU2

Rationale: The following elements can be used to meet a PNEU (PNU2) definition:

- Worsening and persistent eligible imaging findings [infiltrate]
- Signs/Symptoms: fever/leukocytosis* and worsening gas exchange
- Laboratory: eligible laboratory findings [endotracheal aspirate with qualifying semi-quantitative values]

All elements are captured in the PNEU (PNU2) IWP.

*Please note, this patient had both fever and leukocytosis in IWP. Either fever or leukocytosis can be used to meet the definition, but both are not required

Case #2: Knowledge Check 2f

What is the DOE for this event?

A. 9/23
B. 9/24
C. 9/25
D. 9/26

Case #2: Knowledge Check 2f – Answer and Rationale

Correct Answer

B. 9/24

The DOE is the date the first element used to meet an NHSN site-specific infection criterion occurs for the first time within the seven-day infection window period. In this case, the fever documented on 9/24 sets the DOE.

Case Study #3

Case #3 Background

Mr. Opa City is a 38-year-old male with a history of HIV [last CD4 count 180] admitted from the Emergency Department [ED] following a motor vehicle accident on April 6. He has no other chronic health conditions. In the ED a urinary catheter and right subclavian catheter are inserted. He is taken directly from the ED to the operating room where several operative procedures are performed including a NHSN qualifying open reduction of a fracture and a craniotomy. Chest x-ray on admission shows clear lungs.

Case #3 Additional Background

- Temperature on 4/9 is 37.4°C.
- On 4/10 his WBC increases to 17.2, temperature is 37.0°C and chest x-ray shows multiple opacities consistent with pneumonia bilaterally. Blood and urine cultures are collected in addition to endotracheal aspirate. In addition, he has severe respiratory decline and is intubated.
- On 4/11 his temperature is 37.2°C. Preliminary blood culture findings show yeast and antimicrobials are initiated. Chest x-ray: stable bilateral opacities consistent with pneumonia.
- On 4/12 the final blood culture results show growth of *Candida albicans* and endotracheal aspirate culture shows *Candida* species. Rhonchi are auscultated on physical exam. Chest x-ray: slightly improved opacities consistent with pneumonia bilaterally.
- On 4/13-4/15 the patient remains stable.
- On 4/16 the patient is afebrile and vent is discontinued.

Case #3: Knowledge Check 3a

Do the chest imaging results demonstrate new or worsening AND persistent findings that are eligible to meet a PNEU definition?

A. Yes
B. No
C. Maybe

Case #3: Knowledge Check 3a – Answer and Rationale

Correct answer

A. Yes

Rationale: The opacities noted on the 4/10 chest x-ray are not attributed to something other than pneumonia and therefore this finding is eligible for use to meet a PNEU definition. In addition, this finding remains persistent.

Case #3: Knowledge Check 3b

Are the blood culture and/or endotracheal cultures eligible to use to meet the laboratory component of a PNEU (PNU2 or PNU3) definition?

A. Yes
B. No
C. Maybe

Case #3: Knowledge Check 3b – Answer and Rationale

Correct answer

C. Maybe

Rationale: Per General Comments #6 and footnote #9, matching *Candida* species identified from blood and respiratory specimens with collection dates in the same IWP can be considered for use in meeting PNEU (PNU3) if the patient meets the PNEU immunocompromised definition.

- 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).

Case #3: Knowledge Check 3c

Does the patient meet an immunocompromised definition?

A. Yes
B. No

Case #3: Knowledge Check 3c – Answer and Rationale

Correct Answer

A. Yes

Rationale: For NHSN surveillance purposes, this patient is immunocompromised per footnote #10 with a CD4 count <200.

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

Case #3: Knowledge Check 3d

Are the organisms identified in the blood and endotracheal aspirate considered matching?

A. Yes
B. No

Case #3: Knowledge Check 3d – Answer and Rationale

Correct Answer

A. Yes

Rationale: *Candia* albicans in the blood and *Candida* species in the endotracheal aspirate are considered matching as per matching organism guidance in Chapter 2.

Case #3: Knowledge Check 3e

Which diagnostic test would be used to set a PNEU IWP?

A. 4/6 chest x-ray
B. 4/10 chest x-ray
C. 4/11 chest x-ray
D. 4/10 chest x-ray and blood culture
E. 4/10 chest x-ray, blood culture, and endotracheal aspirate

Case #3: Knowledge Check 3e – Answer and Rationale

Correct Answer

E. 4/10 chest x-ray, blood culture, and endotracheal aspirate

Rationale: Both the imaging test and the cultures [blood and endotracheal] that were collected on 4/10 are eligible for use to set a PNEU IWP. In this case, the PNEU IWP would be 4/7 – 4/13.

Case #3: Knowledge Check 3f

What are the eligible signs/symptoms for this case that can be used to meet the PNU3 definition?

A. Leukocytosis
B. Fever
C. Worsening gas exchange
D. Rhonchi

Case #3: Knowledge Check 3f – Answer and Rationale

Correct Answer

C. Worsening gas exchange

- Fever is not eligible as it is not >38.0°C
- Leukocytosis is not an eligible sign/symptom for meeting the PNU3 definition
- Rhonchi is not an eligible sign/symptom for meeting PNU2 or PNU3 definitions

Case #3: Knowledge Check 3g

Is there an eligible PNEU event in this case? If so, what PNEU definition is met?

A. PNU1
B. PNU2
C. PNU3
D. There is no PNEU event

Case #3: Knowledge Check 3g – Answer and Rationale

Correct Answer

C. PNU3

Rationale: This is a PNEU (PNU3) event. There are matching blood and respiratory laboratory specimens with matching *Candida* species collected in same IWP, and the patient meets the immunocompromised definition. In addition, the patient has new eligible imaging findings that remain persistent and an eligible sign/symptom [worsening gas exchange].

Case #3: Knowledge Check 3h

What is the DOE for this event?

A. 4/6
B. 4/7
C. 4/9
D. 4/10

Case #3: Knowledge Check 3h – Answer and Rationale

Correct Answer

D. 4/10

Rationale: The DOE is the date the first element used to meet an NHSN site-specific infection criterion occurs for the first time within the seven-day infection window period. In this case, the blood and endotracheal aspirate cultures collected on 4/10 as well as worsening gas exchange [intubation] on 4/10 set the DOE.

For any questions or concerns, contact the NHSN Helpdesk using

NHSN-ServiceNow to submit questions to the NHSN Help Desk. The new portal can be accessed at **https://servicedesk.cdc.gov/nhsncsp**. Users will be authenticated using CDC's Secure Access Management Services (SAMS) the same way you access NHSN. If you do not have a SAMS login, or are unable to access ServiceNow, you can still email the NHSN Help Desk at nhsn@cdc.gov.

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