**TENNESSEE DEPARTMENT OF HEALTH**
**HEATHCARE-ASSOCIATED INFECTIONS**
**AND ANTIMICROBIAL RESISTANCE PROGRAM**
**HAI Surveillance Definitions**

# PNEUMONIA 3 (PNU3)

***(Revised January 1, 2018)***

Healthcare-associated infections (HAI): All NHSN site-specific infections must first meet the HAI definition as defined in the "Additional Information" checklist before a site-specific infection (for example, PNEU/VAP) can be reported to NHSN.

**NOTE:** For patients with underlying pulmonary or cardiac disease who are required to have serial imaging test results, to satisfy the PNEU/VAP definitions, the second imaging test must occur within 7 days of the first but is not required to occur within the Infection Window Period. The date of the first CXR will be utilized when determining if the PNEU/VAP criteria are met within the infection window period. All other elements of PNEU/VAP definition must be present within the infection window period.

Present on Admission (POA): Infections that are POA, as defined in the "Additional Information" checklist, are not considered HAIs and therefore are never reported to NHSN.

**NOTE:** POA reporting exception for PNEU/VAP: One eligible chest imaging test is acceptable to satisfy the imaging parameter for PNEU/VAP-POA determinations, regardless of whether the patient has underlying pulmonary or cardiac disease.

Pneumonia (PNEU): is identified by using a combination of imaging, clinical and laboratory criteria. The following checklist details the various criteria that may be used for meeting the surveillance definition of healthcare-associated pneumonia, general comments applicable to all site-specific criteria, and reporting instructions shows threshold values for cultured specimens used in the surveillance diagnosis of pneumonia.

Date of event: For PNEU/VAP the date of event is the date when the first element used to meet the PNEU infection criterion occurred for the first time within the 7-day Infection Window Period.

Ventilator: Any device used to support, assist or control respiration (inclusive of the weaning period) through the application of positive pressure to the airway when delivered via an artificial airway, (specifically an oral/nasal endotracheal or tracheostomy tube).

**NOTE:** Ventilation and lung expansion devices that deliver positive pressure to the airway (for example: CPAP, Bipap, bi-level, IPPB and PEEP) via non-invasive means (for example: nasal prongs, nasal mask, full-face mask, total mask, etc.) are not considered ventilators unless positive pressure is delivered via an artificial airway (oral/nasal endotracheal or tracheostomy tube.)

# PNEUMONIA 3 (PNU3)

Ventilator-associated PNEU (VAP): Pneumonia where:

- The patient is on mechanical ventilation for >2 calendar days on the day of event, with day of ventilator placement being Day 1

***AND***

- The ventilator was in place on the date of event or the day before.

*If the ventilator was in place prior to inpatient admission, the ventilator day count begins with the admission date to the first inpatient location.

**General Comments Applicable to All Pneumonia Specific Site Criteria: *(Revised January 1, 2018)***

- Physician's diagnosis of pneumonia alone is NOT an acceptable criterion for POA (present on admission) or HAI (healthcare-associated) pneumonia.
- Although specific criteria are included for infants and children and immunocompromised patients, ALL patients may meet any of the other pneumonia site-specific criteria.
- Pneumonia due to gross aspiration (for example, in the setting of intubation in the field, emergency department, or operating room) that meets the PNEU/VAP definition with a date of event during the HAI timeframe is considered healthcare-associated (HAI).
- Multiple episodes of healthcare-associated pneumonia may occur in critically ill patients with lengthy hospital stays. When determining whether to report multiple episodes of healthcare-associated pneumonia in a single patient, follow the Repeat Infection Timeframe (RIT) guidance found in the Additional Information checklist.
- Excluded organisms that cannot be used to meet the PNEU/VAP definition are as follows:

    1. "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.
    2. The following organisms unless identified from lung tissue or pleural fluid specimens:

        i. *Candida* species* or yeast not otherwise specified

        ii. coagulase negative *Staphylococcus* species

        iii. *Enterococcus* species

*Note: Candida* species* or yeast not otherwise specified, coagulase-negative *Staphylococcus* species, and *Enterococcus* species identified from blood cannot be deemed secondary to a PNU2 or PNU3, unless the organism was also identified from a pleural fluid or lung tissue specimen

* *Candida* species identified from sputum or tracheal aspirate, endotracheal aspirate, broncho-alveolar lavage (BAL) specimens or protected specimen brushing cultures combined with a matching organism identified from a blood specimen can be used to satisfy the PNU3 definition.

3. Additionally, because organisms belonging to the following genera are typically causes of community-associated infections, and are rarely or are not known to be causes of healthcare-associated infections, they are also excluded, and cannot be used to meet any NHSN definition: *Blastomyces, Histoplasma, Coccidioides, Paracoccidioides, Cryptococcus* and *Pneumocystis.*

- *Abbreviations used in the PNEU laboratory criteria:*

| | | | |
|---|---|---|---|
| BAL | Bronchi alveolar lavage | LRT | Lower respiratory tract |
| EIA | Enzyme immunoassay | PMN | Polymorphonuclear leukocyte |
| IFA | Immunofluorescent antibody | RIA | Radioimmunoassay |

**Reporting instructions: *(Revised January 1, 2018)***

- There is a hierarchy of specific categories within the major site pneumonia. If the patient meets criteria for more than one specific site during the infection window period or the RIT, report only one:
  - 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.
- Pathogens and secondary bloodstream infections can only be reported for PNU2 and PNU3 specific events.
- Report concurrent LUNG and PNEU with at least one matching organism(s) as PNEU.

## Specific Site Algorithm for Pneumonia in Immunocompromised Patients

***(Revised January 1, 2018)***

***DEFINITION:*** Patient must meet the following criterion:

- **Criterion:**
  - Patient has two or more serial chest imaging test results with at least **ONE** Δ of the following[1,2,14]: New and persistent **OR** progressive and persistent
    - Δ infiltrate
    - Δ consolidation
    - Δ cavitation
    - Δ pneumatoceles, in infants ≤1 year old

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

***AND***

- Patient who is immunocompromised[10] has at least **ONE** Δ of the following:
  - Δ fever (>38.0°C or >100.4°F)
  - Δ for adults ≥70 years old, altered mental status with no other recognized cause
  - Δ **ONE** ◊ of the following:
    - ◊ new onset of purulent sputum[3]
    - ◊ change in character of sputum[4]
    - ◊ increased respiratory secretions
    - ◊ increased suctioning requirements
  - Δ **ONE** ◊ of the following:
    - ◊ new onset cough
    - ◊ worsening cough
    - ◊ dyspnea
    - ◊ tachypnea[5]
  - Δ **ONE** ◊ of the following:
    - ◊ rales[6]
    - ◊ bronchial breath sounds

- Δ worsening gas exchange indicated by ONE ◊ of the following:
  - ◊ $O_2$ desaturations (for example, $PaO_2/FiO_2$ ≤240)[7]
  - ◊ increased oxygen requirements
  - ◊ increased ventilator demand
- Δ hemoptysis
- Δ pleuritic chest pain

***AND***

- Patient has **EITHER** Δ:
  - Δ **ONE** ◊ of the following:
    - ◊ Identification of matching *Candida* spp. from **BOTH** ✚ of the following:
      - ✚ blood
      - ✚ **ONE** ❖ of the following:
        - ❖ sputum[11, 12, 13]
        - ❖ endotracheal aspirate[11, 12, 13]
        - ❖ BAL or protected specimen brushing[11,12,13]
    - ◊ evidence of fungi 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
  - Δ **ONE** ◊ of the following:
    - ◊ organism identified from blood culture [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)
    - ◊ ≥5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (for example, Gram's stain)
    - ◊ positive quantitative culture or corresponding semi-quantitative culture result[9] of lung tissue

- histopathologic exam shows at least **ONE** + of the following evidences of pneumonia:
  - + **ONE** ❖ of the following:
    - ❖ abscess formation with intense PMN accumulation in bronchioles and alveoli
    - ❖ foci of consolidation with intense PMN accumulation in bronchioles and alveoli
  - + **ONE** ❖ of the following:
    - ❖ evidence of lung parenchyma invasion by fungal hyphae
    - ❖ evidence of lung parenchyma invasion by fungal pseudo hyphae
- **ONE** + of the following identified from respiratory secretions[#]:
  - + Virus
  - + *Bordetella*
  - + *Legionella*
  - + *Chlamydia*
  - + Mycoplasma
- **ONE** + of the following identified from tissue[#]:
  - + Virus
  - + *Bordetella*
  - + *Legionella*
  - + *Chlamydia*
  - + *Mycoplasma*
- four-fold rise in paired sera (IgG) for pathogen (for example, influenza viruses, *Chlamydia*)
- four-fold rise in *L. pneumophila* serogroup 1 antibody titer to ≥1:128 in paired acute and convalescent sera by indirect IFA.
- detection of *Legionella pneumophila* serogroup 1 antigens in urine by **ONE** + of the following:
  - + RIA
  - + EIA

[#]***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).***

# PNEUMONIA 3 (PNU3)

## Footnotes to Algorithms and Flow Diagram: *(Revised January 1, 2018)*

[1] Occasionally, in non-ventilated patients, the diagnosis of healthcare-associated pneumonia may be quite clear on the basis of symptoms, signs, and a single definitive chest imaging test result. However, in patients with pulmonary or cardiac disease (for example, interstitial lung disease or congestive heart failure), the diagnosis of pneumonia may be particularly difficult. Other non-infectious conditions (for example, pulmonary edema from decompensated congestive heart failure) may simulate the presentation of pneumonia. In these more difficult cases, serial chest imaging test results must be examined to help separate infectious from non-infectious pulmonary processes. To help confirm difficult cases, it may be useful to review multiple imaging test results spanning over several calendar days.

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.

[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.

[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.

| How do I use the purulent respiratory secretions criterion if… | Instruction |
|---|---|
| My laboratory reports counts of “white blood cells” or “polymorphonuclear leukocytes” or “leukocytes” rather than counts of “neutrophils”? | Assume that counts of cells identified by these other descriptors (for example, “white blood cells”) are equivalent to counts of neutrophils, unless the laboratory tells you this is not the case. |
| My laboratory reports semi-quantitative results (not quantitative results) for numbers of neutrophils and squamous epithelial cells? | Check with the laboratory to get information about what quantitative ranges the semi- quantitative reports correspond to. |
| My laboratory cannot provide additional information on how its semi-quantitative reporting corresponds to quantitative reporting ranges for neutrophils and squamous epithelial cells? | Use the following direct examination results to meet the purulent respiratory secretions criterion: heavy, 4+, or ≥25 neutrophils per low power field (lpf) [x100], AND rare, occasional, few, 1+ or 2+, or ≤10 squamous epithelial cells per lpf [x100] [19]. |

| How do I use the purulent respiratory secretions criterion if… | Instruction |
|---|---|
| My laboratory reports only the numbers of neutrophils present, without reporting the number of squamous epithelial cells? | In this situation, the purulent secretions criterion may be met using the specified quantitative and semi-quantitative thresholds for neutrophils alone (specifically, heavy, 4+, or ≥25 neutrophils per lpf [x100]). |
| My laboratory uses different reporting thresholds for neutrophils and squamous epithelial cells (for example, maximum report of ≥ 20 neutrophils per low power field [x100], or minimum report of ≤ 15 squamous epithelial cells per low power field [x100])? | In this situation, the purulent secretions criterion may be met using the laboratory's specified maximum quantitative threshold for neutrophils, and/or minimum quantitative threshold for squamous epithelial cells. |
| My laboratory processes respiratory specimens such as bronchoalveolar lavage fluid using a centrifugation procedure (for example, "cytospin"), and there is no quantitation or semi-quantitation of neutrophils or white blood cells in the direct examination report? | In this situation, a report indicating the presence of white blood cells, without quantitation, is sufficient to meet the purulent secretions criterion. |

[4] Change in character of sputum refers to color, consistency, odor, and quantity.

[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.

[6] Rales may be described as "crackles."

[7] This measure of arterial oxygenation is defined as the ratio of the arterial tension ($PaO_2$) to the inspiratory fraction of oxygen ($FiO_2$).

[8] Coagulase-negative *Staphylococcus* species, *Enterococcus* species and *Candida* species or yeast not otherwise specified that are identified from blood cannot be deemed secondary to a PNEU, unless the organism was also identified from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube) or lung tissue. Identification of matching *Candida* spp. from blood and sputum, endotracheal aspirate, BAL or protected specimen brushing can be used to satisfy PNU3 definition for immunocompromised patients.

[9] Refer to threshold values for cultured specimens with growth of eligible pathogens (see table titled "Threshold values for cultured specimens used in the diagnosis of pneumonia found on the next page).

# PNEUMONIA 3 (PNU3)

**Note:**

- A specimen that is not obtained through an artificial airway (specifically endotracheal tube or tracheostomy) is not considered minimally-contaminated and is not eligible for use in meeting the laboratory criteria for PNU2. Sputum is not a minimally-contaminated specimen.
- Because they are an indication of commensal flora of the oral cavity or upper respiratory tract, the following organisms can only be used to meet PNEU definitions when identified from pleural fluid obtained during thoracentesis or initial placement of chest tube (not from an indwelling chest tube) or lung tissue:
  - o Coagulase-negative *Staphylococcus* species
  - o *Enterococcus* species
  - o *Candida* species or yeast not otherwise specified. Identification of matching *Candida* species from blood and sputum, endotracheal aspirate, BAL or protected specimen brushing can be used to satisfy PNU3 definition for 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 a splenectomy;
- those who have a history of solid organ or hematopoietic stem cell transplant,
- those on cytotoxic chemotherapy
- those on steroids (excluding inhaled steroids) daily for >2 weeks).

[11] Blood specimen and sputum, endotracheal aspirate, BAL or protected specimen brushing specimens must have a collection date that occurs within the Infection Window Period.

[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 microbiological testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST)

[14] If the imaging test result, is non-definite for infiltrate-the initial imaging test would be eligible for use. In the absence of finding an imaging result that clarifies a non-definite finding, if there is clinical correlation (documentation that imaging is interpreted as evidence of pneumonia and treatment for pneumonia) then the non-definite imaging test is eligible for use. Unless you have a subsequent imaging test result that is definite for pneumonia or clinical correlation, the imaging requirement of the PNEU definitions is not met.

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 results of “moderate” or “heavy” growth, or 2+, 3+ or 4+ growth is considered to correspond.

†Open-lung biopsy specimens and immediate post-mortem specimens obtained by transthoracic or trans-bronchial biopsy.