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

PNEUMONIA 3 (PNU3)

(Revised January 1, 2019)

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.

Guidance for Determination of Eligible Imaging Test Evidence

- If only one imaging test is available it is acceptable for this to satisfy the imaging requirement for PNEU/VAP-POA determinations regardless of whether the patient has underlying pulmonary or cardiac disease

- When multiple imaging test results are available, persistence of imaging test evidence of pneumonia is a requirement for all patients not just those with underlying cardiac or pulmonary disease.

- When identifying persistence of imaging test evidence of pneumonia, the second imaging test must occur within seven days of the first but is not required to occur within the Infection Window Period. The date of the first eligible imaging test 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.

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 and 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.)

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Ventilator-associated pneumonia(VAP): A 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, 2019)*

- 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 (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube):

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

   ii. Any coagulase negative *Staphylococcus* species

   iii. Any *Enterococcus* species

- If the excluded pathogens, Candida species* or; yeast not otherwise specified, coagulase-negative Staphylococcus species, and Enterococcus species are identified from blood they can only be attributed as a secondary BSI to a PNEU if PNU 2 or PNU 3 is met with a, matching organisms identified from a pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and not from an indwelling chest tube) or lung tissue and the blood specimen collection date is within the Secondary BSI Attribution period (SBAP).

  The exception to this is **Candida* species or yeast not otherwise specified identified from blood can be attributed as a secondary BSI to PNEU if PNU 3 is met using the blood and sputum, endotracheal aspirate, broncho-alveolar lavage (BAL or protected specimen brushing with matching Candida species and both specimens have a collection date in the Infection Window Period.

- 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, 2019)*

- 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, 2019)

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 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).***

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Footnotes to Algorithms and Flow Diagram: *(Revised January 1, 2019)*

[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.

- In non-ventilated patients, the diagnosis of healthcare-associated pneumonia may be quite clear on the basis of signs, symptoms and a single definitive chest imaging test result. Therefore, in a patient without underlying pulmonary or cardiac disease and when there is only one imaging test available, if it is an eligible finding, the imaging test evidence requirement can be met.

- In patients without underlying disease if more than one imaging test is available serial imaging test results must also be evaluated and demonstrate persistence.

- In patients with underlying disease, serial chest imaging test results must be examined to help separate infectious from non- infectious pulmonary processes. In patients with pulmonary or cardiac disease (for example: interstitial lung disease or congestive heart failure), the diagnosis of pneumonia may be particularly difficult. For example: Pulmonary edema from decompensated congestive heart failure may simulate the presentation of pneumonia.

[2] Note that there are many ways of describing the imaging appearance of pneumonia. Examples include, but are not limited to, “air-space disease,” “focal opacification,” “patchy areas of increased density”. Although perhaps not specifically delineated as pneumonia by the radiologist, in the appropriate clinical setting these alternative descriptive wordings should be seriously considered as potentially positive findings. If provided and the finding 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.

[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].
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).

- **Note:** A specimen that is not obtained through an artificial airway (specifically endotracheal tube or tracheostomy) from a ventilated patient is not considered minimally-contaminated and is not eligible for use in meeting the laboratory criteria for PNU2. Sputum or tracheal secretions collected from a non-ventilated patient are not a minimally-contaminated specimens.
- 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:
  - Coagulase-negative *Staphylococcus* species
  - *Enterococcus* species
  - *Candida* species or yeast not otherwise specified. **Exception: 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 on the date of event.

[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 is equivocal for pneumonia, check to see if subsequent imaging tests are definite. 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 the equivocal imaging test is eligible for use.

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

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