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

# PNEUMONIA 3 (PNEU3)

***(Last updated January 1, 2014)***

**IMPORTANT UPDATE:** ***(Last updated January 1, 2014)***

1. **In 2014, in-plan surveillance for ventilator-associated pneumonia (PNEU) will be restricted to patients of any age in non-NICU pediatric locations. In 2014, in-plan surveillance conducted for mechanically-ventilated patients in adult locations (regardless of age) will use the Ventilator-associated Event (VAE) protocol (See VAE checklist). The PNEU definitions are still available for those units seeking to conduct off-plan PNEU surveillance for mechanically-ventilated adult and neonatal patients and non-ventilated adults or children.**

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 (e.g., VAP) can be reported to NHSN.
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.
Present on Admission (POA) reporting exception for PNEU/VAP: If all other elements are present per the POA criteria, one chest radiograph alone is acceptable to meet POA criteria for PNEU/VAP, regardless of whether the patient has underlying pulmonary or cardiac disease
How to Apply HAI Definition to the PNEU/VAP Protocol: A serial chest radiograph (CXR) on or after day 3 of admission (HAI) and a second later CXR may be used to meet the radiology finding requirement in a patient with underlying disease. The second CXR must occur within 7 days of the first. These findings can be used to fulfill the current HAI pneumonia/VAP criteria for the required 2 CXR findings are considered 1 element of the VAP/PNEU criteria. All other elements of the PNEU/VAP should be met per the HAI definition. The VAP/PNEU HAI criteria are met even if all other elements required for PNEU/VAP are not present at the time the second CXR is obtained.
Pneumonia (PNEU) is identified by using a combination of radiologic, 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 specific site criteria, reporting instructions, and threshold values for cultured specimens used in the surveillance diagnosis of pneumonia.
Date of event: For VAP the date of event is the date when the last element used to meet the Pneumonia (PNEU) criteria occurred. Synonyms: infection date.
Ventilator: A device to assist or control respiration continuously, inclusive of the weaning period, through a tracheostomy or by endotracheal intubation.

**NOTE:** Lung expansion devices such as intermittent positive-pressure breathing (IPPB); nasal positive end-expiratory pressure (PEEP); and continuous nasal positive airway pressure (CPAP, hypoCPAP) are not considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g., ET-CPAP).

Ventilator-associated PNEU (VAP): A pneumonia where

- The patient is on mechanical ventilation for >2 calendar days on the day the last element used to meet the PNEU infection criterion occurred (date 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 patient is admitted or transferred into a facility on a ventilator, the day of admission is considered Day1.

Location of attribution: The inpatient location where the patient was assigned on the date of the VAP event, which is further defined as the date when the last element used to meet the PNEU criterion occurred (see exception below).

**EXCEPTION TO LOCATION OF ATTRIBUTION:**

*Transfer Rule*: If all elements of a VAP are present within 2 days of transfer from one inpatient location to another in the same facility or a new facility (i.e., on the day of transfer or the next day), the infection is attributed to the transferring location or facility. If the patient was in multiple locations within the transfer rule time frame, attribute the infection to the original location initiating the transfer. Receiving facilities should share information about such HAIs with the transferring facility to enable reporting. This is called the Transfer Rule and examples are shown below:

- Child has been on a ventilator for 7 days in the PICU and is transferred on the ventilator to the pediatric surgical ward. On the next day, the patient meets the criteria for PNEU. This is reported to NHSN as a VAP for the PICU.
- Child has been on a ventilator for 5 days and is transferred in the morning to the pediatric medical ward from the pediatric medical critical care unit after having ventilator discontinued. Later that night, the child meets criteria for a PNEU. This is reported to NHSN as a VAP for the pediatric medical critical care unit.
- Pediatric patient on a ventilator is transferred from the neonatal intensive care unit (NICU) to the pediatric intensive care unit (PICU). After 4 days in the PICU, the patient meets the criteria for a PNEU. This is reported to NHSN as a VAP for the PICU.
- Pediatric patient on the Respiratory ICU (RICU) of Hospital A had the endotracheal tube and ventilator removed after being on the ventilator for 5 days and is discharged home a few hours later. The IP from Hospital B calls the next day to report that this patient has been admitted to Hospital B with a PNEU. This VAP should be reported to NHSN for, and by, Hospital A and attributed to the RICU. No additional ventilator days for the RICU are reported.

**EXCEPTION TO TRANSFER RULE:**

Locations that do not house patients overnight (e.g., Emergency Department or Operating Room) will have no denominator data, i.e., patient days or catheter days. Therefore VAPs cannot be attributed to these locations. Instead, the VAP must be attributed to the next inpatient location in which the patient stays.

## Algorithms for Pneumonia in Immunocompromised Patients

***(Last updated January 1, 2013)***

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

☐ **Criterion**:

- ○ Patient has two or more serial chest radiographs with at least **ONE** Δ of the following:
  - Δ infiltrate is **ONE** ☐ of the following[1, 2]:
    - ☐ new
    - ☐ progressive and persistent
  - Δ consolidation
  - Δ cavitation
  - Δ pneumatoceles, in infants ≤ 1 year old

> **NOTE:** In patients **without** underlying pulmonary or cardiac disease (e.g. respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive chest radiograph is acceptable[1].

***AND***

- ○ Patient who is immunocompromised[13] has at least **ONE** Δ of the following:
  - Δ fever (>38°C or >100.4°F)
  - Δ for adults ≥70 years old, altered mental status with no other recognized cause
  - Δ change in sputum production including **ONE** ☐ of the following:
    - ☐ new onset of purulent sputum[3]
    - ☐ change in character of sputum[4]
    - ☐ increased respiratory secretions
    - ☐ increased suctioning requirements
  - Δ symptoms of **ONE** ☐ of the following:
    - ☐ new onset cough
    - ☐ worsening cough
    - ☐ dyspnea
    - ☐ tachypnea[5]
  - Δ exam findings of **ONE** ☐ of the following:
    - ☐ rales [6]
    - ☐ bronchial breath sounds
  - Δ worsening gas exchange indicated by **ONE** ☐ of the following:
    - ☐ $O_2$ desaturations (e.g., $PaO_2/FiO_2 \leq 240$) [7]
    - ☐ increased oxygen requirements
    - ☐ increased ventilator demand

- Δ hemoptysis
- Δ pleuritic chest pain

***AND***

- Patient has at least **ONE** Δ of the following:
  - Δ matching positive blood and sputum cultures with *Candida* spp. [14, 15]
  - Δ evidence of **ONE** ☐ of the following:
    - ☐ fungi from minimally contaminated LRT specimen (e.g., BAL or protected specimen brushing) from **ONE** ○ of the following:
      - ○ direct microscopic exam
      - ○ positive culture of fungi
    - ☐ *Pneumocystis carinii* from minimally contaminated LRT specimen (e.g., BAL or protected specimen brushing) from **ONE** ○ of the following:
      - ○ direct microscopic exam
      - ○ positive culture of fungi
  - Δ positive growth in blood culture [8] not related to another source of infection
  - Δ positive growth in culture of pleural fluid
  - Δ positive quantitative culture [9] from minimally contaminated LRT specimen (e.g., BAL or protected specimen brushing)
  - Δ ≥5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (e.g., Gram stain)
  - Δ histopathologic exam shows at least **ONE** ☐ of the following evidences of pneumonia:
    - ☐ choose **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
    - ☐ positive quantitative culture [9] of lung parenchyma
    - ☐ choose **ONE** ○ of the following:
      - ○ evidence of lung parenchyma invasion by fungal hyphae
      - ○ evidence of lung parenchyma invasion by fungal pseudohyphae
  - Δ choose **ONE** ☐ of the following:
    - ☐ positive culture of virus from respiratory secretions

- ☐ positive culture of *Chlamydia* from respiratory secretions

Δ positive detection of **ONE** ☐ of the following:

- ☐ viral antigen from respiratory secretions (e.g., EIA, FAMA, shell vial assay, PCR)
- ☐ viral antibody from respiratory secretions (e.g., EIA, FAMA, shell vial assay, PCR)

Δ fourfold rise in paired sera (IgG) for pathogen (e.g., influenza viruses, *Chlamydia*)

Δ positive PCR for **ONE** ☐ of the following:

- ☐ *Chlamydia*
- ☐ *Mycoplasma*

Δ positive micro-IF test for *Chlamydia*

Δ patient has **ONE** ☐ of the following:

- ☐ positive *Legionella* culture, from **ONE** ○ of the following:
  - ○ respiratory secretions
  - ○ tissue
- ☐ positive visualization by micro-IF of *Legionella* spp, from **ONE** ○ of the following:
  - ○ respiratory secretions
  - ○ tissue

Δ detection of *Legionella pneumophila* serogroup 1 antigens in urine by **ONE** of the following:

- ☐ RIA
- ☐ EIA

Δ fourfold rise in *L. pneumo*phila serogroup 1 antibody titer to ≥1:128 in paired acute and convalescent sera by indirect IFA.

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***Footnotes to Algorithms*:** ***(Last updated January 1, 2013)***

[1]Occasionally, in non-ventilated patients, the diagnosis of health care – associated pneumonia may be quite clear on the basis of symptoms, signs, and a single definitive chest radiograph. 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 presences of pneumonia. In these more difficult cases, serial chest radiographs must be examined to help separate infectious from noninfectious pulmonary processes. To help confirm difficult cases, it may be useful to review radiographs on the day of diagnosis, 3 days prior to the diagnosis and on days 2 and 7 after the diagnosis. Pneumonia may have rapid onset and progression, but does not resolve quickly. Radiographic changes of pneumonia persist for several weeks. As a result, rapid

radiographic resolution suggests that the patient does not have pneumonia but rather a noninfectious process such as atelectasis or congestive heart failure.

[2]Note that there are many ways of describing the radiographic 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 are alternative descriptive wording 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). If your laboratory reports these data qualitatively (e.g., “many WBCs” or “few squames”), be sure their descriptors match this definition of purulent sputum. This laboratory confirmation is required because written clinical descriptions of purulence are highly variable.

[4]A single notation of either purulent sputum or change in character of the sputum is not meaningful; repeated notations over a 24-hour period would be more indicative of the onset of an infectious process. A 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 40$^{th}$ week; >60 breaths per minute in infants <2 months old; >50 breaths per minute in infants 2 to 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]Care must be taken to determine the etiology of pneumonia in a patient with positive blood cultures and radiographic evidence of pneumonia, especially if the patient has invasive devices in place such as intravascular lines or an indwelling urinary catheter. In general, in an immunocompetent patient, blood cultures positive for coagulase-negative staphylococci, common skin contaminants, and yeasts will not be etiologic agent of the pneumonia.

[9]Refer to threshold values for cultured specimens (see table below). An endotrachial aspirate is not a minimally contaminated specimen. Therefore, an endotrachial aspirate does not meet the laboratory criteria for PNU2 or PNU3.

[10]Once laboratory-confirmed due to pneumonia because of respiratory syncytial virus (RSV), adenovirus, or influenza virus have been identified in hospital, clinician’s presumptive diagnosis of these pathogens in subsequent cases with similar clinical signs and symptoms is an acceptable criterion for presence of health care-associated infection.

[11]Scant or watery sputum is commonly seen in adults with pneumonia due to viruses and Mycoplasma although sometimes the sputum may be mucopurulent. In infants, pneumonia due to RSV or influenza yields copious sputum. Patients, except premature infants, with viral or Mycoplasmal pneumonia may exhibit few signs or symptoms, even when significant infiltrates are present on radiographic exam.

[12]Few bacteria may be seen on stains of respiratory secretions for patients with pneumonia due to Legionella spp, mycoplasma, or viruses.

[13]Immunocompromised patients include those with neutropenia (absolute neutrophil count <500/mm$^3$), leukemia, lymphoma, HIV with CD4 count <200, or splenectomy; those who are early post-transplantation, are on cytotoxic chemotherapy, or are on high-dose steroids (e.g., >40 mg of prednisone or its equivalent [>160mg hydrocortisone, >32mg methylprednisolone, >6mg dexamethasone, >200mg cortisone] daily for >2weeks).

[14]Blood and sputum specimens must be collected within 48 hours of each other.

[15]Semiquantitative or non-quantitative cultures of sputum obtained by deep cough, induction, aspiration, or lavage are acceptable. If quantitative culture results are available, refer to algorithms that include such specific laboratory findings.

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**Threshold values for cultured specimens used in the diagnosis of pneumonia**
***(Last updated June, 2008)***

| **Specimen collection/technique** | **Values** |
|---|---|
| Lung parenchyma* | ≥$10^4$ cfu/g tissue |
| Bronchoscopically (B) obtained specimens: | |
| Bronchoavleolar lavage (B-BAL) | ≥$10^4$ cfu/ml |
| Protected BAL (B-BAL) | ≥$10^4$ cfu/ml |
| Protected specimen brushing (B-PSB) | ≥$10^3$ cfu/ml |
| Nonbronchoscopically obtained (blind) specimens: | |
| Bronchoavleolar lavage (NB-BAL) | ≥$10^4$ cfu/ml |
| Protected BAL (NB-PSB) | ≥$10^3$ cfu/ml |

cfu = culture-forming units
g = gram
ml = milliliter
* Open-lung biopsy specimens and immediate post-mortem specimens obtained by transthoracic or transbronchial biopsy

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***GENERAL COMMENTS:*** ***(Last updated January 1, 2014)***

1. Physician's diagnosis of pneumonia alone is not an acceptable criterion for healthcare-associated pneumonia.
2. Although specific criteria are included for infants and children, pediatric patients may meet any of the other pneumonia specific site criteria.
3. When assessing a patient for presence of pneumonia, it is important to distinguish between changes in clinical status due to other conditions such as myocardial infarction, pulmonary embolism, respiratory distress syndrome, atelectasis, malignancy, chronic obstructive pulmonary disease, hyaline membrane disease, bronchopulmonary dysplasia, etc. Also, care must be taken when assessing intubated patients to distinguish between tracheal colonization, upper respiratory tract infections (e.g., tracheobronchitis), and early onset pneumonia. Finally, it should be recognized that it may be difficult to determine healthcare-associated pneumonia

in the elderly, infants, and immunocompromised patients since such conditions may mask typical signs or symptoms associated with pneumonia. Alternate specific criteria for the elderly, infants and immunocompromised patients have been included in this definition of healthcare-associated pneumonia.

4. Healthcare-associated pneumonia can be characterized by its onset: early or late. Early-onset pneumonia occurs during the first four days of hospitalization and is often caused by *Moraxella catarrhalis, H. influenzae*, and *S. pneumoniae*. Causative agents of late-onset pneumonia are frequently Gram-negative bacilli or *S. aureus*, including methicillin-resistant *S. aureus*. Viruses (e.g., Influenza A and B or Respiratory Syncytial Virus) can cause early- and late-onset healthcare-associated pneumonia, whereas yeasts, fungi, legionellae, and *Pneumocystis carinii* are usually pathogens of late-onset pneumonia.
5. Pneumonia due to gross aspiration (for example, in the setting of intubation in the field, emergency room, or operating room) is considered healthcare-associated if it meets any specific criteria and the infection itself was not clearly present at the time of admission to the hospital.
6. 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, look for evidence of resolution of the initial infection. (See note following the HAI definition in the Additional Information checklist.)The addition of or change in pathogen alone is not indicative of a new episode of pneumonia.
7. Positive Gram's stain for bacteria and positive KOH (potassium hydroxide) mount for elastin fibers and/or fungal hyphae from appropriately collected sputum specimens are important clues that point toward the etiology of the infection. However, sputum samples are frequently contaminated with airway colonizers and therefore must be interpreted cautiously. In particular, *Candida* is commonly seen on stain, but infrequently causes healthcare-associated pneumonia, especially in immunocompetent patients.

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***Abbreviations used in PNEU laboratory criteria:*** ***(Last updated June, 2008)***

| | | | |
|---|---|---|---|
| BAL | Bronchioalveolar lavage | LRT | Lower respiratory tract |
| EIA | Enzyme immunoassay | PCR | Polymerase chain reaction |
| FAMA | Fluorescent-antibody staining of membrane antigen | PMN | Polymorphonuclear leukocyte |
| IFA | Immunoflourescent antibody | RIA | radioimmunoassay |

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***REPORTING INSTRUCTIONS:*** ***(Last updated June, 2008)***

- There is a hierarchy of specific categories within the major site pneumonia. Even if a patient meets criteria for more than one specific site, 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.

- Report concurrent lower respiratory tract infection (e.g., abscess or empyema) and pneumonia with the same organism(s) as PNEU.
- Lung abscess or empyema without pneumonia is classified as LUNG.
- Bronchitis, tracheitis, tracheobronchitis, or bronchiolitis without pneumonia are classified as BRON.

***Patient Safety Component Protocol FAQs:*** ***(Last updated October 31, 2012)***

- **New or progressive and persistent infiltrate:**
  *Please offer a specific definition for "new or progressive and persistent infiltrate."*

  This phrase is meant to ensure that there has been a change in the chest x-ray and that it is not a change that is due to some acute reason such as fluid overload. A true pneumonia would not be seen on a single CXR and then resolve the next day.

- **Tracheostomy ventilation:**
  *I just recently ran into two cases of people that were on a vent and vent documentation was done. Sometime later they were put on a T-piece with an ET tube documented, but no vent documentation. Documentation was done this way for multiple days. How should these patients be addressed and should they be included in the vent days?*

  These patients are similar to patients with tracheostomies that are undergoing weaning from the ventilator. They may have periods of "rest" on the ventilator, and also periods where they are not ventilated during the same calendar day. In short, if the patient is off vent at the time the vent day count is being done, they are not included in the vent day count. But they would still remain very much eligible for a VAP since they are experiencing some period of mechanical ventilation every day.

- **Patients on ventilator for a portion of the day:**
  *Some of our patients are on the ventilator only at night. We count or ventilator days at noon. Are these patients eligible for VAP? If so, we are not getting an accurate number ventilator days to account for the risk of VAP on this unit.*

  We recognize certain patient populations will use the ventilator only for a portion of the day. We recommend you count ventilator days in this unit at night, perhaps 12 midnight to include this patient population in your denominator for the unit.

- **Distinguishing serial reporting infections from single, unresolved infection:**
  *Is there a time period following the identification of an infection during which another of the same type of infection cannot be reported?*

  No. At present time NHSN does not have a set time period during which only 1 infection of the same event type may be reported for the same patient (with the exception of VAE and LabID Event reporting for which there is a 14-day window [see individual protocols for VAE and LabID Events]) following an infection which is present on admission (POA) or a healthcare-associated infection (HAI). Discussions are underway regarding creating such a rule, however no final decisions have been made and no changes would be made before 2014. In the meantime, use the clinical information you have available to determine if the original infection has resolved before reporting a second.