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

Introduction: In 2011, an estimated 157,000 healthcare-associated pneumonias occurred in acute care hospitals in U.S.[1] Patients with mechanically-assisted ventilation have a high risk of developing healthcare-associated pneumonia. In 2012, the overall ventilator use in various hospital unit types ranged from 0.01 to 0.47 per 100 patient days and the pooled incidence of VAP in in these units ranged from 0.0 to 4.4 per 1,000 ventilator days.[2]
Prevention and control of healthcare-associated pneumonia is discussed in the CDC/HICPAC document, *Guidelines for Prevention of Healthcare-Associated Pneumonia, 2003*[3]. The Guideline strongly recommends that surveillance be conducted for bacterial pneumonia in ICU patients who are mechanically ventilated to facilitate identification of trends and for inter-hospital comparisons.

Settings: Surveillance may occur in any inpatient pediatric location where denominator data can be collected, such as critical/intensive care units (pedICUs), specialty care areas (SCA), step-down units, wards, and long term care units. In 2015, in-plan surveillance for ventilator-associated pneumonia (pedVAP) using the criteria found in this chapter will be restricted to patients of any age in pediatric locations (excludes neonatal locations). In 2015 in-plan surveillance conducted for mechanically-ventilated patients in adult locations (regardless of age) will use the Ventilator-Associated Event (VAE) protocol (see VAE chapter). The PNEU definitions are still available for those units seeking to conduct off-plan PNEU surveillance for mechanically-ventilated adult, pediatric and neonatal patients and non-ventilated adults, pediatric or neonatal patients. A complete listing of inpatient locations and instructions for mapping can be found in the CDC Locations and Descriptions chapter.

Note: If you are following pedVAP in your monthly reporting plan it is not required to monitor for VAPs after the patient is discharged from the facility. However, if discovered, any VAPs with event date on the day of discharge or day after discharge should be reported to NHSN (see Transfer Rule below). No additional ventilator days are reported.

Definitions:

Present on Admission (POA): Infections that are POA, as defined in Chapter 2, are not considered HAIs and therefore are never reported to NHSN. **Note:** POA reporting exception for PNEU/VAP: One chest radiograph is acceptable to meet POA criteria for PNEU/VAP protocol, regardless of whether the patient has underlying pulmonary or cardiac disease.

Healthcare-associated infections (HAI): All NHSN site specific infections must first meet the HAI definition as defined in Chapter 2 before a site specific infection (e.g., 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 seven 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.

Pneumonia (PNEU) is identified by using a combination of imaging, clinical and laboratory criteria. The following pages detail the various criteria that may be used for meeting the surveillance definition of healthcare-associated pneumonia (Tables 1-4 and Figures 1 and 2), general comments applicable to all site - specific criteria, and reporting instructions. Table 5 shows threshold values for cultured specimens used in the surveillance diagnosis of pneumonia.

Date of event: For a 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: A device to assist or control respiration 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 pneumonia (VAP): A pneumonia where the patient is on mechanical ventilation for >2 calendar days on the 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 PNEU/VAP event (see Date of Event). See Exception of Location Attribution below.

Exception to Location of Attribution:

Transfer Rule: If the date of event for a PNEU/VAP is on the date of transfer or the next day, the infection is attributed to the transferring/discharging location. If the patient was in multiple locations within the transfer rule time frame, attribute the infection to the original location initiating the transfer. 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. The criteria for PNEU are met and the date of event is the day following the transfer. 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. The criteria for a PNEU are met and the date of event is the day of transfer. 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). The patient meets the criteria for a PNEU and the date of event is 4 days post transfer. This is reported to NHSN as a VAP for the PICU.

General Comments Applicable to All Pneumonia Specific Site Criteria:

- 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 specific site 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 Chapter 2.
- Excluded organisms and culture results 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 isolated from cultures of lung tissue or pleural fluid
        i. *Candida* species* or yeast not otherwise specified
        ii. coagulase-negative *Staphylococcus* species
        iii. *Enterococcus* species

    **Candida* species isolated from sputum or endotracheal aspirate specimen combined with a matching blood culture can be used to satisfy the PNU3 definition.

3. Additionally, because organisms belonging to the following genera are typically causes of community-associated respiratory 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 the PNEU/VAP definition when isolated from any eligible specimen type (to include lung and pleural fluid): *Blastomyces, Histoplasma, Coccidioides, Paracoccidioides, Cryptococcus and Pneumocystis.*

- Abbreviations used in the PNEU laboratory criteria:

  BAL–bronchoalveolar lavage
  EIA–enzyme immunoassay
  FAMA–fluorescent-antibody staining of membrane antigen
  IFA–immunofluorescent antibody
  LRT–lower respiratory tract
  PCR–polymerase chain reaction
  PMN–polymorphonuclear leukocyte
  RIA–radioimmunoassay

Reporting Instructions:

- 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.
- Secondary bloodstream infections can only be reported for PNU2 and PNU3 specific events.
- Report concurrent LUNG (e.g., abscess or empyema) and PNEU with at least one matching organism(s) as PNEU.
- Lung abscess or empyema without pneumonia is classified as LUNG

Table 1: Specific Site Algorithms for Clinically Defined Pneumonia (PNU1)

Imaging Test Evidence	**Signs/Symptoms/Laboratory**
Two or more serial chest imaging test results with at least ***one*** of the following[1,2]: • New or progressive and persistent infiltrate • Consolidation • Cavitation • 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 imaging test result is acceptable.[1]	For ANY PATIENT, at least ***one*** of the following: • Fever (>38.0°C or >100.4°F) • Leukopenia (<4000 WBC/mm^3) or leukocytosis (≥12,000 WBC/mm^3) • For adults ≥70 years old, altered mental status with no other recognized cause And at least ***two*** of the following: • New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, or tachypnea[5] • Rales[6] or bronchial breath sounds • Worsening gas exchange (e.g., O_2 desaturations (e.g., PaO_2/FiO_2 ≤240)[7], increased oxygen requirements, or increased ventilator demand)
	ALTERNATE CRITERIA, for infants ≤1 year old: Worsening gas exchange (e.g., O_2 desaturations [e.g. pulse oximetry <94%], increased oxygen requirements, or increased ventilator demand) And at least ***three*** of the following: • Temperature instability • Leukopenia (<4000 WBC/mm^3) or leukocytosis (≥15,000 WBC/mm^3) and left shift (≥10% band forms) • New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions or increased suctioning requirements • Apnea, tachypnea[5], nasal flaring with retraction of chest wall or nasal flaring with grunting • Wheezing, rales[6], or rhonchi • Cough • Bradycardia (<100 beats/min) or tachycardia (>170 beats/min)
	ALTERNATE CRITERIA, for child >1 year old or ≤12 years old, at least ***three*** of the following: • Fever (>38. 0°C or >100. 4°F) or hypothermia (<36. 0°C or <96. 8°F) • Leukopenia (<4000 WBC/mm^3) or leukocytosis (≥15,000 WBC/mm^3) • New onset of purulent sputum[3] or change in character of sputum[4], or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, apnea, or tachypnea[5]. • Rales[6] or bronchial breath sounds • Worsening gas exchange (e.g., O_2 desaturations [e.g., pulse oximetry <94%], increased oxygen requirements, or increased ventilator demand)

Table 2: Specific Site Algorithms for Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

Imaging Test Evidence	**Signs/Symptoms**	**Laboratory**

Two or more serial chest imaging test results with at least ***one*** of the following[1,2]:
• New or progressive and persistent infiltrate
• Consolidation
• Cavitation
• 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 imaging test result is acceptable.[1]
	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
	• New onset or worsening cough, or dyspnea or tachypnea[5]
	• Rales[6] or bronchial breath sounds
	• Worsening gas exchange (e.g., O_2 desaturations [e.g., PaO_2/FiO_2 ≤240][7], increased oxygen requirements, or increased ventilator demand)
		At least ***one*** of the following:
		• Positive growth in blood culture[8] not related to another source of infection
		• Positive growth in culture of pleural fluid[9]
		• Positive quantitative culture[9] from minimally-contaminated LRT specimen (e.g., BAL or protected specimen brushing)
		• ≥5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (e.g., Gram's stain)
		• Positive quantitative culture[9] of lung tissue
		• Histopathologic exam shows at least ***one*** of the following evidences of pneumonia:
		  ○ Abscess formation or foci of consolidation with intense PMN accumulation in bronchioles and alveoli
		  ○ Evidence of lung parenchyma invasion by fungal hyphae or pseudohyphae

Table 3: Specific Site Algorithms for Viral, Legionella, and other Bacterial Pneumonias with Definitive Laboratory Findings (PNU2)

Imaging Test Evidence	**Signs/Symptoms**	**Laboratory**
Two or more serial chest imaging test results with at least ***one*** of the following[1,2]: • New or progressive and persistent infiltrate • Consolidation • Cavitation • 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 imaging test result is acceptable.[1]	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 • New onset or worsening cough or dyspnea, or tachypnea[5] • Rales[6] or bronchial breath sounds • Worsening gas exchange (e.g., O_2 desaturations [e.g., PaO_2/FiO_2 ≤240][7], increased oxygen requirements, or increased ventilator demand)	At least ***one*** of the following: • Positive culture of virus, *Legionella* or *Chlamydia* from respiratory secretions • Positive non culture diagnostic laboratory test of respiratory secretions or tissue for virus, *Bordetella*, *Chlamydia*, *Mycoplasma*, *Legionella* (e.g., EIA, FAMA, shell vial assay, PCR, micro-IF) • Fourfold rise in paired sera (IgG) for pathogen (e.g., influenza viruses, *Chlamydia*) • Fourfold rise in *Legionella pneumophila* serogroup 1 antibody titer to ≥1:128 in paired acute and convalescent sera by indirect IFA. • Detection of *L. pneumophila* serogroup 1 antigens in urine by RIA or EIA

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

Imaging Test Evidence	**Signs/Symptoms**	**Laboratory**
Two or more serial chest imaging test results with at least ***one*** of the following[1,2]: • New or progressive and persistent infiltrate • Consolidation • Cavitation • 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 imaging test result is acceptable.[1]	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 ofsputum[4], or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, or tachypnea[5] • Rales[6] or bronchial breath sounds • Worsening gas exchange (e.g., O_2 desaturations [e.g., PaO_2/FiO_2 ≤240][7], increased oxygen requirements, or increased ventilator demand) • Hemoptysis • Pleuritic chest pain	At least ***one*** of the following: • Matching positive blood and sputum or endotracheal aspirate cultures with *Candida* spp.[11,12] • Evidence of 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 – Non-culture diagnostic laboratory test Any of the following from: **LABORATORY CRITERIA DEFINED UNDER PNU2**

Figure 1: Pneumonia Flow Diagram for Patients of Any Age

Facility ID#_____Event #_____Event Date __/__/____

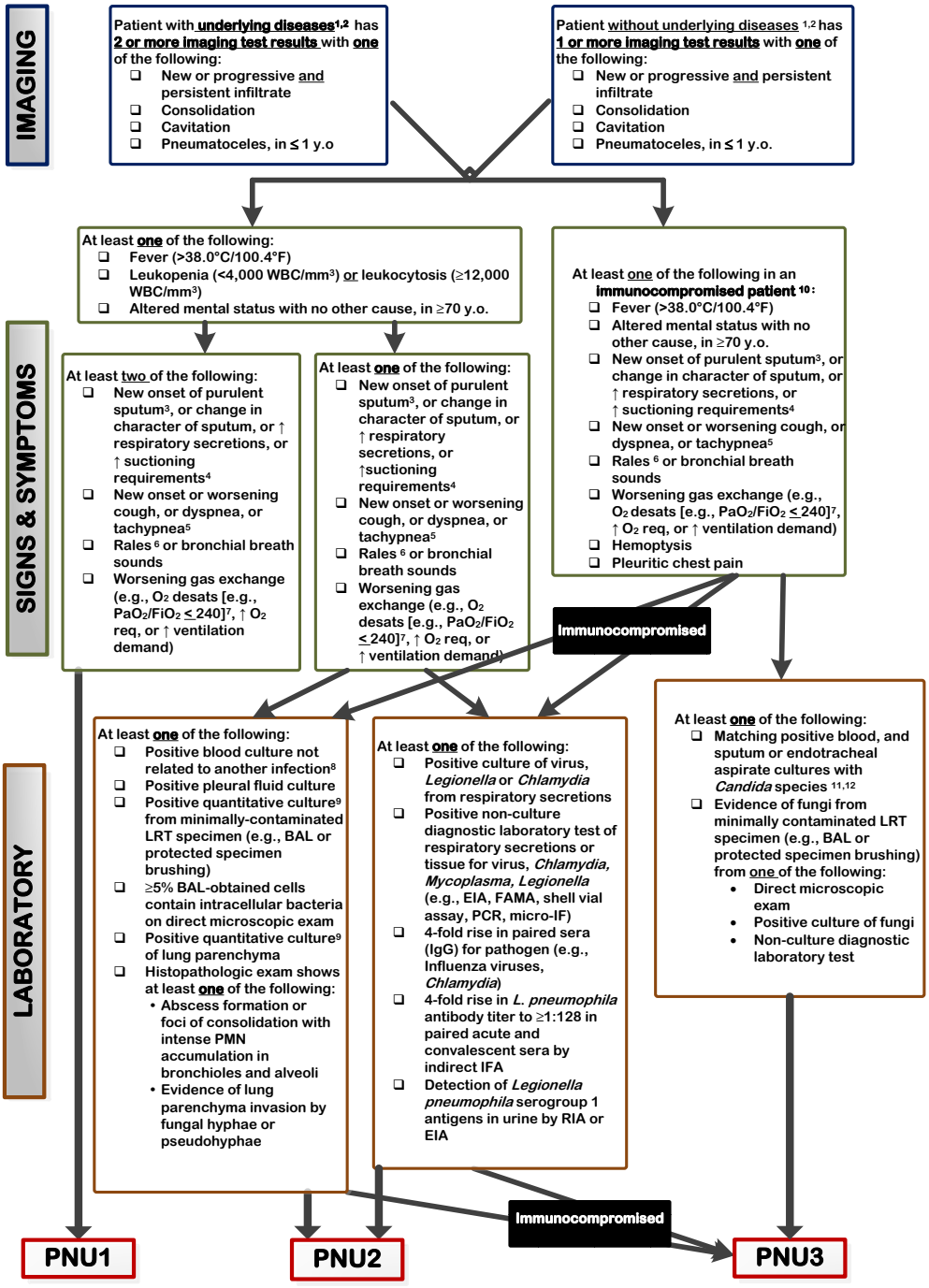
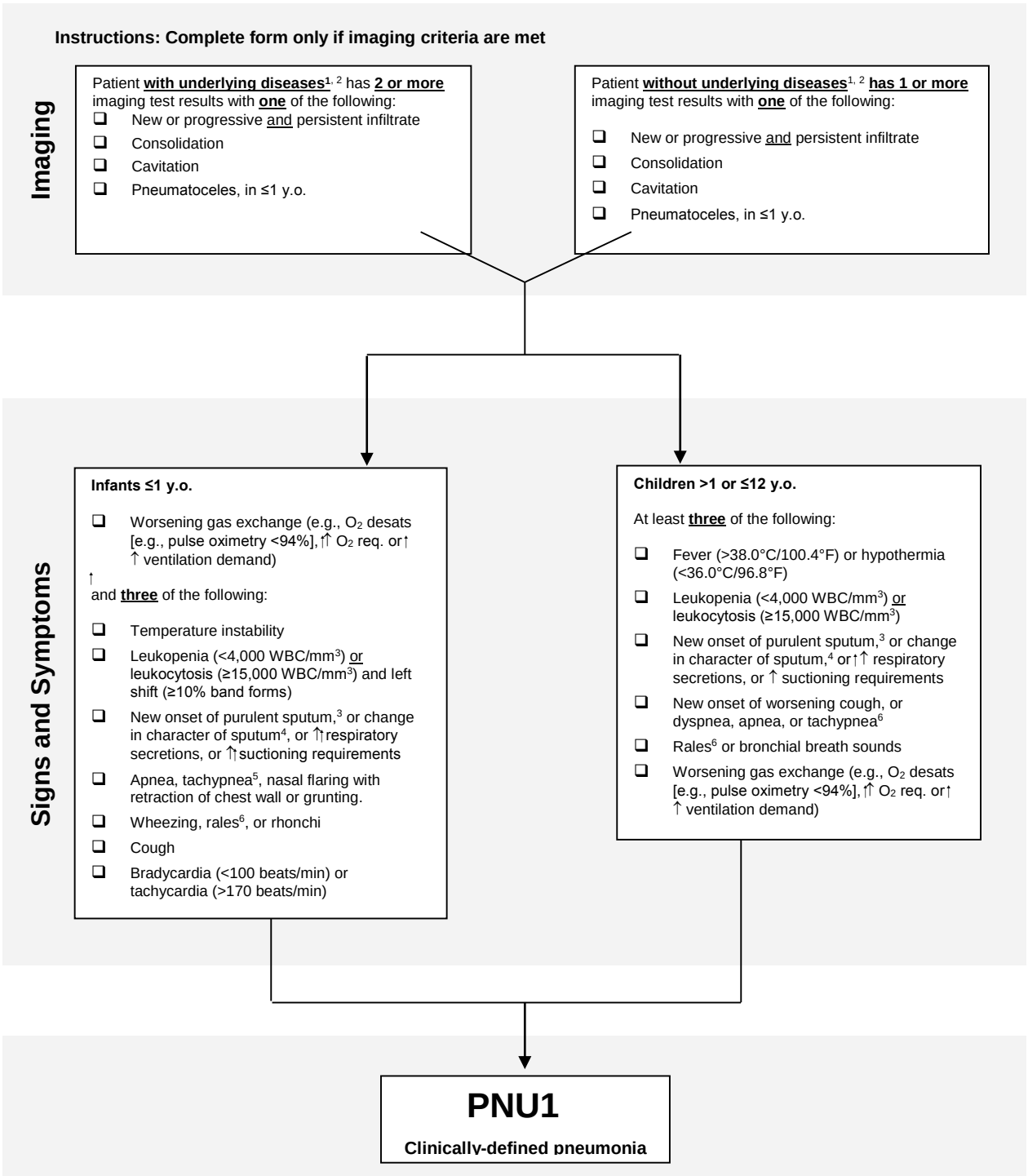


Figure 2: Pneumonia Flow Diagram, Alternative Criteria for Infants and Children

Facility ID#_____Event #_____Event Date __/__/____



Footnotes to Algorithms and Flow Diagrams:

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 (e.g., interstitial lung disease or congestive heart failure), the diagnosis of pneumonia may be particularly difficult. Other non-infectious conditions (e.g., 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 (e.g., "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 (e.g., "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 (i.e., heavy, 4+, or ≥25 neutrophils per lpf [x100]).
My laboratory uses different reporting thresholds for neutrophils and squamous epithelial cells (e.g., 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 (e.g., "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 the 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 cultured from blood cannot be deemed secondary to a PNEU, unless the organism was also cultured 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. *Candida* species isolated from sputum or endotracheal aspirate specimen combined with a matching blood culture can be used to satisfy the PNU3 definition for immunocompromised patients.

9. Refer to threshold values for cultured specimens with growth of eligible pathogens. (Table 5).

Note: a sputum and endotracheal aspirate are not minimally- contaminated specimens and therefore, organisms isolated from these specimens do not meet the laboratory criteria for PNU2.

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 isolated 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. *Candida* species combined with a matching blood culture can be used to meet the PNU3 definition.

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

11. Cultures of blood and sputum or endotracheal aspirate 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. If quantitative culture results from minimally-contaminated LRT specimen are available, refer to criteria that include such specific laboratory findings.

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

CFU = colony forming units
g = gram
ml = milliliter

* Open-lung biopsy specimens and immediate post-mortem specimens obtained by transthoracic or transbronchial biopsy
† 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" growth, or 2+, 3+ or 4+ growth is considered to correspond.

Numerator Data: The *Pneumonia (PNEU)* form (CDC 57.111) is used to collect and report each VAP that is identified during the month selected for surveillance. The Instructions for Completion of Pneumonia (PNEU) form contains brief instructions for collection and entry of each data element on the form. The pneumonia form includes patient demographic information and information on whether or not mechanically-assisted ventilation was present. Additional data include the specific criteria met for identifying pneumonia, whether the patient developed a secondary bloodstream infection, whether the patient died, the organisms isolated from cultures, and the organisms' antimicrobial susceptibilities.

Reporting Instruction:
If no VAPs are identified during the month of surveillance, the "*Report No Events"* box must be checked on the appropriate denominator summary screen, e.g., Denominators for Intensive Care Unit (ICU)/Other Locations (Not NICU or SCA/ONC), etc.

Denominator Data: Device days and patient days are used for denominators (see Key Terms chapter). Ventilator days, which are the number of patients managed with a ventilatory device, are collected daily, at the same time each day, according to the chosen

location using the appropriate form (CDC 57.116, 57.117, and 57.118). These daily counts are summed and only the total for the month is entered into NHSN. Ventilator days and patient days are collected for each of the locations where VAP is monitored. When denominator data are available from electronic sources (e.g., ventilator days from respiratory therapy), these sources may be used as long as the counts are not substantially different (+/- 5%) from manually-collected counts, validated for a minimum of three months.

Data Analyses: The VAP rate per 1000 ventilator days is calculated by dividing the number of VAPs by the number of ventilator days and multiplying the result by 1000. The Ventilator Utilization Ratio is calculated by dividing the number of ventilator days by the number of patient days. These calculations will be performed separately for the different types of ICUs, SCAs, and other locations in the institution.

The Standardized Infection Ratio (SIR[4]) is another measure of VAP incidence that can be calculated by dividing the number of observed infections by the number of predicted infections. The number of predicted infections can be calculated using VAP rates from a standard population during a baseline time period, which represents a standard population's VAP experience.[5]

Note: The SIR should be calculated only if the number of expected HAIs (numExp) is ≥1 in order to enforce a minimum precision criterion

Note: The VAP SIR is not available from within the NHSN application, but can be calculated using the methods described above.

While the VAP SIR can be calculated for single locations, the measure also allows you to summarize your data by multiple locations, adjusting for differences in the incidence of infection among the location types. For example, you can calculate one VAP SIR adjusting for all locations reported. Similarly, you can calculate one VAP SIR for all oncology locations in your facility.

Descriptive analysis options of numerator and denominator data are available in the NHSN application, such as line listings, frequency tables, and bar and pie charts. VAP rates and run charts are also available. Guides on using NHSN analysis features are available from: http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html.

References:

[1]Magill SS., Edwards, JR., Bamberg, W., et al. "Multistate Point-Prevalence Survey of Health Care-Associated Infections, 2011". New England Journal of Medicine. 370: (2014): 1198-208.

[2]Dudeck, MA., Weiner, LM., Allen-Bridson, K., et. al. National Healthcare Safety Network (NHSN) Report, Data Summary for 2012, "Device-associated Module". *American Journal of Infection Control* 41: (2013):1148-66.

[3]Centers for Disease Control and Prevention. Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. MMWR 2004; 53(No. RR-3).

[4]Your guide to the Standardized Infection Ratio (SIR). October 2010. http://www.cdc.gov/nhsn/PDFs/Newsletters/NHSN_NL_OCT_2010SE_final.pdf

[5] Edwards, JR., Peterson, KD., Mu, Y., et al. National Healthcare Safety Network (NHSN) Report: Data Summary for 2006 through 2008, issued December 2009. American Journal of Infection Control 37: (2009):783-805. Available at: http://www.cdc.gov/nhsn/PDFs/dataStat/2009NHSNReport.PDF.