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Kuwait National Healthcare-associated  
Infections Surveillance System

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

***Settings:***

Surveillance will occur in all inpatient locations in Kuwait Ministry of Health hospitals.

***NOTE:***

Surveillance for Pneumonia after the patient is discharged from the facility is not required. However, if discovered, any Pneumonia with a date of event on the day of discharge or the next day should be reported to KNHSS (see Transfer Rule). No additional ventilator days are reported.

***Definitions:***

**Present on Admission (POA):** Infections that are POA, are not considered Healthcare-associated infections (HAIs) and therefore are never reported to KNHSS.

**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 before a site specific infection (e.g., PNEU/VAP) can be reported to KNHSS.

**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),

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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 (DOE):** 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.

**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:

### **Examples of the Transfer Rule:**

- 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.

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- 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.

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

Imaging Test Evidence	Signs/Symptoms/Laboratory
<p>Two or more serial chest imaging test results with at least <b><u>one</u></b> of the following<sup>1,2</sup>:</p> <p>New &amp; persistent OR Progressive &amp; persistent :</p> <ul style="list-style-type: none"> <li>- Infiltrate</li> <li>-Consolidation</li> <li>-Cavitation</li> <li>-Pneumatoceles, in infants ≤1 year old</li> </ul> <p><b>Note:</b> In patients <u>without</u> underlying pulmonary or cardiac disease (e.g., respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), <u>one</u> <u>definitive</u> imaging test</p>	<p>For <b>ANY PATIENT</b>, at least <b><u>one</u></b> of the following:</p> <ul style="list-style-type: none"> <li>• Fever (&gt;38.0°C or &gt;100.4°F)</li> <li>• Leukopenia (≤4000 WBC/mm<sup>3</sup>) or leukocytosis (≥12,000 WBC/mm<sup>3</sup>)</li> <li>• For adults ≥70 years old, altered mental status with no other recognized cause</li> </ul> <p><b>And</b></p> <p>At least <b><u>two</u></b> of the following:</p> <ul style="list-style-type: none"> <li>• New onset of purulent sputum<sup>3</sup> or change in character of sputum<sup>4</sup>, or increased respiratory secretions, or increased suctioning requirements</li> <li>• New onset or worsening cough, or dyspnea, or tachypnea<sup>5</sup></li> <li>• Rales<sup>6</sup> or bronchial breath sounds</li> <li>• Worsening gas exchange (e.g., O<sub>2</sub> desaturations [e.g., PaO<sub>2</sub>/FiO<sub>2</sub> ≤240]<sup>7</sup>, increased oxygen requirements, or increased ventilator demand)</li> </ul> <hr/> <p><b>ALTERNATE CRITERIA, for infants ≤1 year old:</b></p> <ul style="list-style-type: none"> <li>• Worsening gas exchange (e.g., O<sub>2</sub> desaturations [e.g. pulse oximetry &lt;94%], increased oxygen requirements, or increased ventilator demand)</li> </ul> <p><b>And</b></p> <p>At least <b><u>three</u></b> of the following:</p>

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result is acceptable <sup>1</sup>	<ul style="list-style-type: none"><li>• Temperature instability</li><li>• Leukopenia (<math>\leq 4000</math> WBC/mm<sup>3</sup>) or leukocytosis (<math>\geq 15,000</math> WBC/mm<sup>3</sup>) and left shift (<math>\geq 10\%</math> band forms)</li><li>• New onset of purulent sputum<sup>3</sup> or change in character of sputum<sup>4</sup>, or increased respiratory secretions or increased suctioning requirements</li><li>• Apnea, tachypnea<sup>5</sup>, nasal flaring with retraction of chest wall or nasal flaring with grunting</li><li>• Wheezing, rales<sup>6</sup>, or rhonchi</li><li>• Cough</li><li>• Bradycardia (<math>&lt; 100</math> beats/min) or tachycardia (<math>&gt; 170</math> beats/min)</li></ul>
	<p>ALTERNATE CRITERIA, <b>for child <math>&gt; 1</math> year old or <math>\leq 12</math> years old</b>, at least <b><u>three</u></b> of the following:</p> <ul style="list-style-type: none"><li>• Fever (<math>&gt; 38.0^{\circ}\text{C}</math> or <math>&gt; 100.4^{\circ}\text{F}</math>) or hypothermia (<math>&lt; 36.0^{\circ}\text{C}</math> or <math>&lt; 96.8^{\circ}\text{F}</math>)</li><li>• Leukopenia (<math>\leq 4000</math> WBC/mm<sup>3</sup>) or leukocytosis (<math>\geq 15,000</math> WBC/mm<sup>3</sup>)</li><li>• New onset of purulent sputum<sup>3</sup> or change in character of sputum<sup>4</sup>, or increased respiratory secretions, or increased suctioning requirements</li><li>• New onset or worsening cough, or dyspnea, apnea, or tachypnea<sup>5</sup>.</li><li>• Rales<sup>6</sup> or bronchial breath sounds</li><li>• Worsening gas exchange (e.g., O<sub>2</sub> desaturations, increased oxygen requirements, or increased ventilator demand)</li></ul>

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**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
<p>Two or more serial chest imaging test results with at least <b>one</b> of the following<sup>1,2</sup>:</p> <p>New &amp; persistent OR Progressive &amp; persistent:</p> <ul style="list-style-type: none"> <li>-Infiltrate</li> <li>-Consolidation</li> <li>-Cavitation</li> <li>-Pneumatoceles, in infants ≤1 year old</li> </ul> <p><b>Note:</b> In patients <u>without</u> underlying pulmonary or cardiac disease (e.g., respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), <u>one definitive</u> imaging test result is acceptable<sup>1</sup></p>	<p>At least <b>one</b> of the following:</p> <ul style="list-style-type: none"> <li>• Fever (&gt;38.0°C or &gt;100.4°F)</li> <li>• Leukopenia (≤4000 WBC/mm<sup>3</sup>) or leukocytosis (≥ 12,000 WBC/mm<sup>3</sup>)</li> <li>• For adults ≥70 years old, altered mental status with no other recognized cause</li> </ul> <p style="text-align: center;"><b>And</b></p> <p>At least <b>one</b> of the following:</p> <ul style="list-style-type: none"> <li>• New onset of purulent sputum<sup>3</sup> or change in character of sputum<sup>4</sup>, or increased respiratory secretions, or increased suctioning requirements</li> <li>• New onset or worsening cough, or dyspnea or tachypnea<sup>5</sup></li> <li>• Rales<sup>6</sup> or bronchial breath sounds</li> <li>• Worsening gas exchange (e.g., O<sub>2</sub> desaturations [e.g., PaO<sub>2</sub>/FiO<sub>2</sub> ≤240]<sup>7</sup>, increased oxygen requirements, or increased ventilator demand)</li> </ul>	<p>At least <b>one</b> of the following:</p> <ul style="list-style-type: none"> <li>• Organism identified from blood<sup>8,13</sup></li> <li>• Organism identified from pleural fluid<sup>9,13</sup></li> <li>• Positive quantitative culture or corresponding semi-quantitative result<sup>9</sup> from minimally-contaminated LRT specimen (e.g. BAL, protected specimen brushing, or endotracheal aspirate)</li> <li>• ≥5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (e.g., Gram’s stain)</li> <li>• Positive quantitative culture or corresponding semi-quantitative result of lung tissue<sup>9</sup></li> <li>• Histopathologic exam shows at least <b>one</b> of the following evidences of pneumonia: <ul style="list-style-type: none"> <li>• Abscess formation or foci of consolidation with intense PMN accumulation in bronchioles and alveoli</li> <li>• Evidence of lung parenchyma invasion by fungal hyphae or pseudohyphae</li> </ul> </li> </ul>

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

Imaging Test Evidence	Signs/Symptoms	Laboratory
<p>Two or more serial chest imaging test results with at least <b><u>one</u></b> of the following<sup>1,2</sup>:</p> <p>New &amp; persistent OR Progressive &amp; persistent:</p> <ul style="list-style-type: none"> <li>- Infiltrate</li> <li>-Consolidation</li> <li>-Cavitation</li> <li>-Pneumatoceles, in infants ≤1 year old</li> </ul> <p><b>Note:</b> In patients <u>without</u> underlying pulmonary or cardiac disease (e.g., respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), <u>one definitive</u> imaging test result is acceptable<sup>1</sup></p>	<p>At least <b><u>one</u></b> of the following:</p> <ul style="list-style-type: none"> <li>• Fever (&gt;38.0°C or &gt;100.4°F)</li> <li>• Leukopenia (≤4000 WBC/mm<sup>3</sup>) or leukocytosis (≥12,000 WBC/mm<sup>3</sup>)</li> <li>• For adults ≥70 years old, altered mental status with no other recognized cause</li> </ul> <p style="text-align: center;"><b>And</b></p> <p>At least <b><u>one</u></b> of the following:</p> <ul style="list-style-type: none"> <li>• New onset of purulent sputum<sup>3</sup> or change in character of sputum<sup>4</sup>, or increased respiratory secretions, or increased suctioning requirements</li> <li>• New onset or worsening cough, or dyspnea or tachypnea<sup>5</sup></li> <li>• Rales<sup>6</sup> or bronchial breath sounds</li> <li>• Worsening gas exchange (e.g., O<sub>2</sub> desaturations [e.g., PaO<sub>2</sub>/FiO<sub>2</sub> ≤240]<sup>7</sup>, increased oxygen requirements, or increased ventilator demand)</li> </ul>	<p>At least <b><u>one</u></b> of the following:</p> <ul style="list-style-type: none"> <li>• Virus, <i>Bordetella</i>, <i>Legionella</i>, <i>Chlamydia</i> or <i>Mycoplasma</i> identified from respiratory secretions or tissue by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST).</li> <li>• Fourfold rise in paired sera (IgG) for pathogen (e.g., influenza viruses, <i>Chlamydia</i>)</li> <li>• Fourfold rise in <i>Legionella pneumophila</i> serogroup 1 antibody titer to ≥1:128 in paired acute and convalescent sera by indirect IFA.</li> <li>• Detection of <i>L. pneumophila</i> serogroup 1 antigens in urine by RIA or EIA</li> </ul>

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

Imaging Test Evidence	Signs/Symptoms	Laboratory
<p>Two or more serial chest imaging test results with at least <b><u>one</u></b> of the following<sup>1,2</sup>:</p> <p>New &amp; persistent OR Progressive &amp; persistent:</p> <ul style="list-style-type: none"> <li>- Infiltrate</li> <li>-Consolidation</li> <li>-Cavitation</li> <li>-Pneumatoceles, in infants ≤1 year old</li> </ul> <p><b>Note:</b> In patients <u>without</u> underlying pulmonary or cardiac disease (e.g., respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), <u>one definitive</u> imaging test result is acceptable<sup>1</sup></p>	<p>Patient who is immunocompromised (see definition in footnote <sup>10</sup>) has at least <b><u>one</u></b> of the following:</p> <ul style="list-style-type: none"> <li>• Fever (&gt;38.0°C or &gt;100.4°F)</li> <li>• For adults ≥70 years old, altered mental status with no other recognized cause</li> <li>• New onset of purulent sputum<sup>3</sup>, or change in character of sputum<sup>4</sup>, or increased respiratory secretions, or increased suctioning requirements</li> <li>• New onset or worsening cough, or dyspnea, or tachypnea<sup>5</sup></li> <li>• Rales<sup>6</sup> or bronchial breath sounds</li> <li>• Worsening gas exchange (e.g., O<sub>2</sub> desaturations [e.g., PaO<sub>2</sub>/FiO<sub>2</sub> ≤240]<sup>7</sup>, increased oxygen requirements, or increased ventilator demand)</li> <li>• Hemoptysis</li> <li>• Pleuritic chest pain</li> </ul>	<p>At least <b><u>one</u></b> of the following:</p> <ul style="list-style-type: none"> <li>• Identification of matching <i>Candida</i> spp. from blood and one of the following: sputum, endotracheal aspirate, BAL or protected specimen brushing<sup>11,12,13</sup>.</li> <li>• Evidence of fungi from minimally-contaminated LRT specimen (i.e, BAL or protected specimen brushing or endotracheal aspirate) from one of the following: <ul style="list-style-type: none"> <li>– Direct microscopic exam</li> <li>– Positive culture of fungi</li> <li>– Non-culture diagnostic laboratory test</li> </ul> </li> </ul> <p style="text-align: center;"><b>OR</b></p> <p>Any of the following from: <b>LABORATORY CRITERIA DEFINED UNDER PNU2</b></p>

Figure 1: Pneumonia Flow Diagram for Patients of Any Age

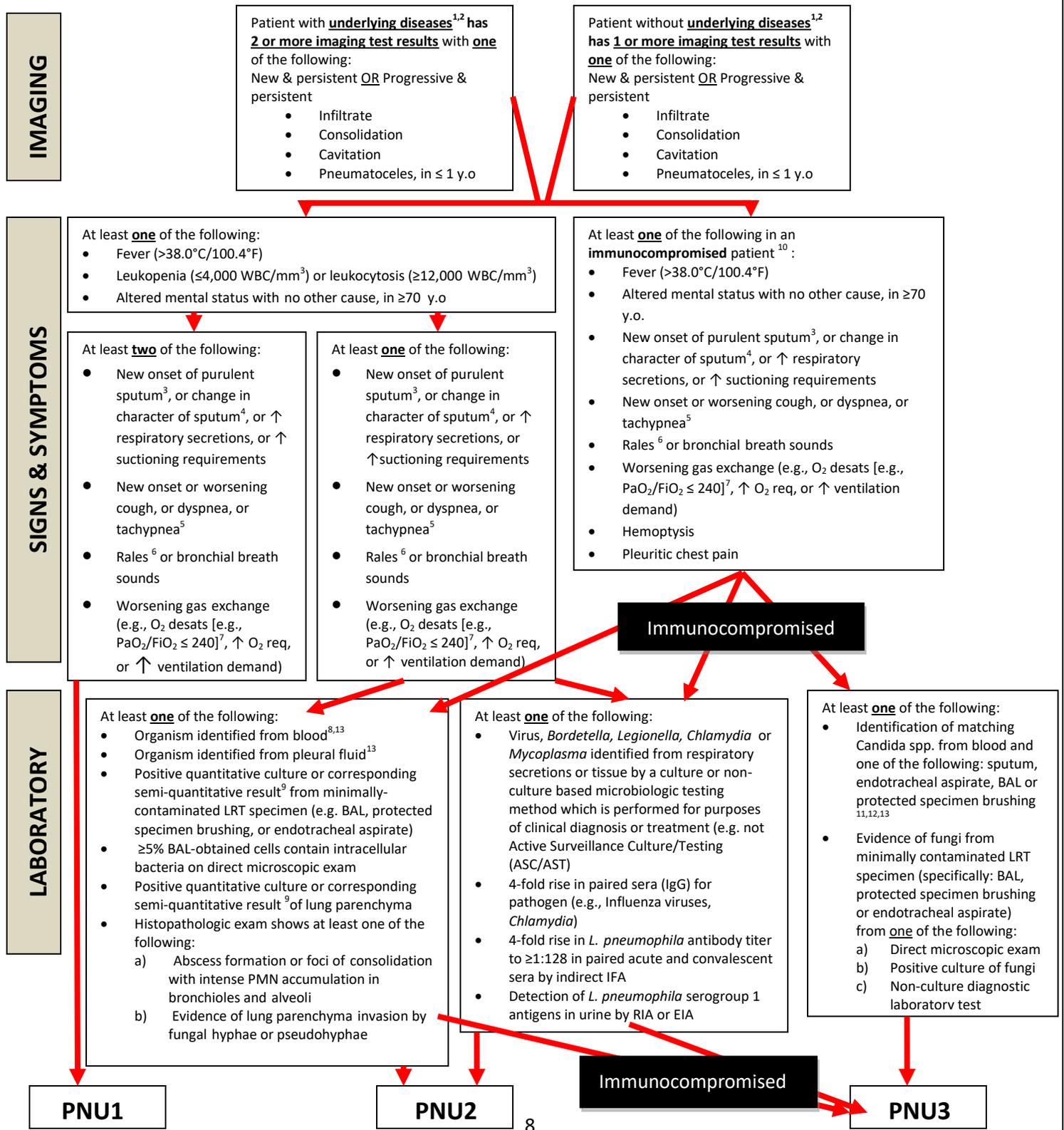
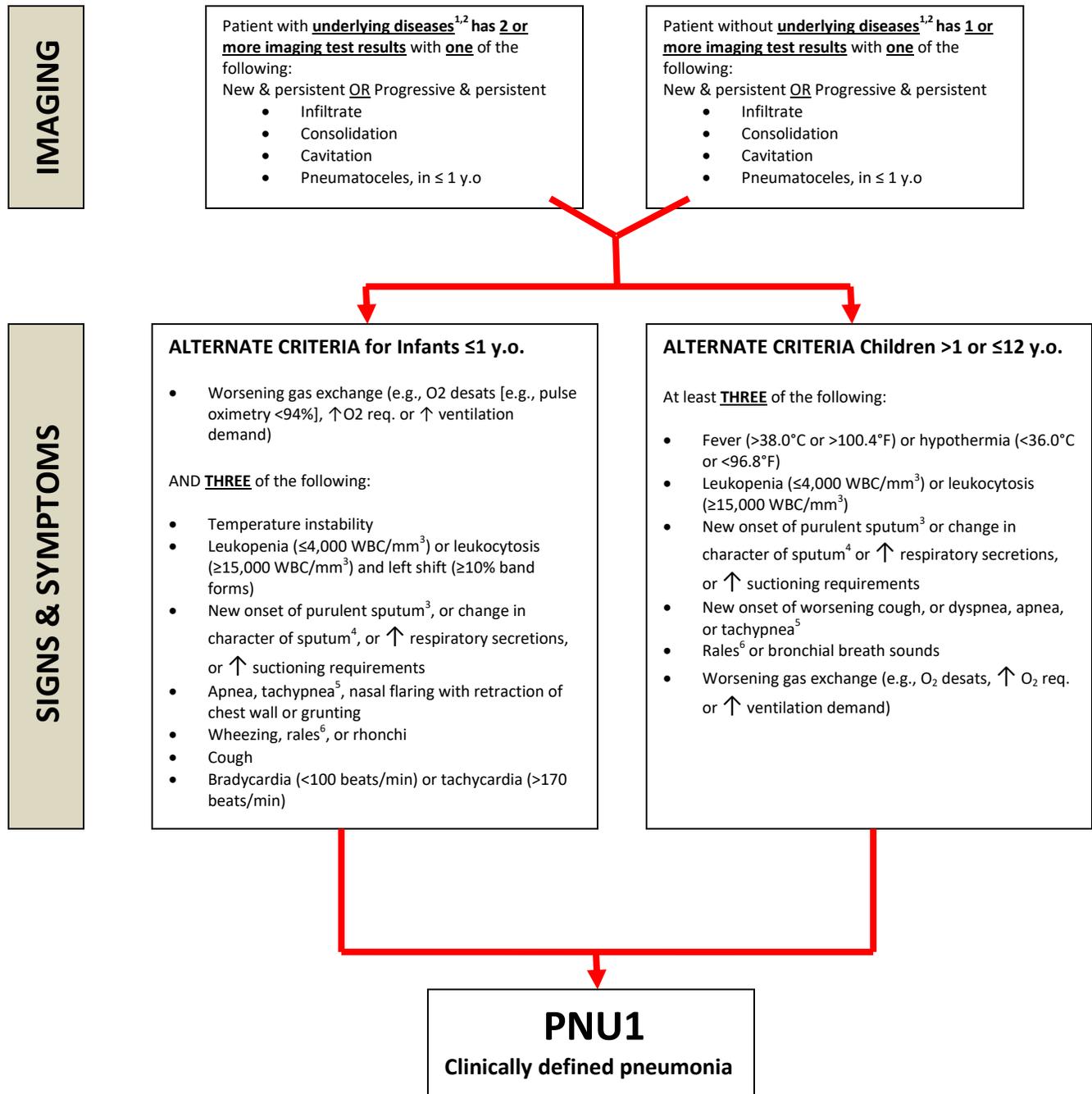


Figure 2: Pneumonia Flow Diagram, Alternative Criteria for Infants and Children



**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.

**Imaging test evidence for PNEU event:** For the imaging test evidence to be definitive for pneumonia the findings must provide:

*Evidence suggestive of pneumonia.* For example, this includes but is not limited to a new or worsening infiltrate, consolidation, opacity, or air space disease that is not attributed to something other than pneumonia

AND

*Evidence of persistence.* There should not be rapid resolution of the finding or contradictory information in a subsequent imaging test which suggests the finding is attributable to another condition (e.g., 2 days later the opacity is now attributed to pulmonary edema). Pneumonia may have rapid onset and progression, but does not resolve quickly. Rapid imaging resolution suggests that the patient does not have pneumonia, but rather a non-infectious process such as atelectasis or congestive heart failure.

Non-definitive imaging results: If the imaging test result is non-definitive for pneumonia, check to see if subsequent imaging tests are definitive. For example, if a chest imaging test result states infiltrate vs. atelectasis and a subsequent imaging test result is definitive for infiltrate—the initial imaging test would be eligible for use.

In the absence of finding an imaging result that clarifies a non-definitive finding, if there is clinical correlation (documentation that imaging is interpreted as evidence of pneumonia and treatment for pneumonia) then the non-definitive imaging test is eligible for use.

Unless you have a subsequent imaging test result that is definitive for pneumonia or clinical correlation, the imaging requirement of the PNEU definitions is not met.

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- 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.
- Purulent sputum is defined as secretions from the lungs, bronchi, or trachea that contain  $\geq 25$  neutrophils and  $\leq 10$  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 $\geq 25$ neutrophils per low power field (lpf) [x100], AND rare, occasional, few, 1+ or 2+, or $\leq 10$ squamous epithelial cells per lpf [x100].
My laboratory reports <u>only</u> 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 $\geq 25$ neutrophils per lpf [x100]).
My laboratory uses different reporting thresholds for neutrophils and squamous epithelial cells (e.g., maximum report of $\geq 20$ neutrophils per low power field [x100], or minimum report of $\leq 15$ 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.

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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.
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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 40<sup>th</sup> 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<sub>2</sub>) to the inspiratory fraction of oxygen (FiO<sub>2</sub>).
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 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. 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 (Table 5).

### Note:

- **Endotracheal specimen is considered a minimally contaminated sample:** A specimen that is obtained through an artificial airway (specifically endotracheal tube or tracheostomy) is considered minimally contaminated and is eligible for use in meeting the laboratory criteria for PNU-2.

Sputum is not a minimally-contaminated specimen. PNEU events which qualify for PNU-1, with qualifying organism cultured from the sputum, will be reported as PNU-1 with unreliable sample.

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- 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. 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
10. Immunocompromised patients include those with neutropenia (absolute neutrophil count or total white blood cell count (WBC)  $<500/\text{mm}^3$ ), 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.,  $>40\text{mg}$  of prednisone or its equivalent ( $>160\text{mg}$  hydrocortisone,  $>32\text{mg}$  methylprednisolone,  $>6\text{mg}$  dexamethasone,  $>200\text{mg}$  cortisone) daily for  $>2$ weeks).
11. Cultures of blood and sputum, endotracheal aspirate, BAL or protected specimen brushing 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 microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST)).

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

<b>Specimen collection/technique</b>	<b>Values*</b>
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 result 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 transbronchial biopsy.

**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).

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- 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.
- Excluded organisms and culture results that cannot be used to meet the PNEU/VAP definition are as follows:
  - “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.
  - 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\* or yeast not otherwise specified, coagulase-negative *Staphylococcus* species, and *Enterococcus* species cultured from blood cannot be deemed secondary to a PNU2 or PNU3, unless the organism was also cultured from pleural fluid or lung tissue.

\**Candida* species isolated from sputum, endotracheal aspirate, broncho-alveolar lavage (BAL) or protected specimen brushing cultures combined with a matching blood culture can be used to satisfy the PNU3 definition.
- 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—bronchoalveolar lavage
- EIA—enzyme immunoassay
- IFA—immunofluorescent antibody
- LRT—lower respiratory tract
- PMN—polymorphonuclear leukocyte
- RIA—radioimmunoassay

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### **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.
- Pathogens and secondary bloodstream infections can only be reported for PNU2 and PNU3 specific events.
- A secondary BSI cannot be attributed to PNU1. If a BSI is thought to be secondary to a pneumonia and the blood culture collection date did not occur within the infection window period such that it could be used as an element to meet the PNU2 definition, reassess to determine if the PNU2 definition can be met within the PNU1 RIT. See the example and table below
  - All elements necessary to satisfy the PNU1 definition occur within the infection window period. The date of event is 2/14.
  - The PNU1 RIT is 2/14 through and including 2/27. Blood cultures collected on 2/20 are reported as positive for *Pseudomonas aeruginosa*.
  - While this collection date is within the secondary BSI attribution period for PNU1, a secondary BSI cannot be reported for PNU1 as the blood culture is not used to satisfy the PNU1 definition and there is no site specific culture to which the blood culture pathogen can match.
  - However, during the RIT, all elements needed to meet the PNU2 definition are present such that the PNU2 definition can be met using the blood culture as an element.
  - The specific event reported is edited to represent PNU2 (PNU1 changed to PNU2).
  - The date of event remains as 2/14, as does the originally determined RIT (2/14 through 2/27). The BSI can be attributed as secondary to PNEU.
  - If the PNU2 definition had not been met as described above and additionally, another specific site infection for which the BSI could be attributed as a secondary was not found, the BSI would be reported as a primary BSI/CLABSI.

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Date	RIT	Infection Window Period	Secondary BSI Attrib. Period
2/10			
2/11			
2/12			
2/13			
2/14		CXR: new infiltrate, new onset cough	
15		CXR: infiltrate, T = 38.9°C, cough, worsening gas exchange	
16			
17			
18			
19			
20		Blood Cx: Pseudomonas aeruginosa, CXR: infiltrate, WBC = $\geq$ 12,000, increased respiratory secretions	
21		CXR: infiltrate,	
22			
23			
24			
25			
26			
27			
28			
29			

- Report concurrent non pneumonia LRT (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.
- Blood or Site-specific specimen can be used as a diagnostic test for PNU-2 and PNU-3: When meeting PNEU definition using the PNU-2 criterion, identification of an eligible organism from blood or from a site-specific specimen, and an imaging test may be available. Both the organism identification and the imaging test are diagnostic tests. Use the first diagnostic test for which all elements of the PNU-2 criterion occur within the infection window period.

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In this example below, Option 1 uses the imaging test (not the blood culture) to set the infection window period. This is the first diagnostic test that creates an infection window period in which all elements of PNU2 criterion occur.

<b><u>Option 1: Correct diagnostic test selection</u></b>		<b><u>Option 2: Incorrect diagnostic test selection</u></b>	
<b>Hospital Day</b>	<b>Infection Window Period</b>	<b>Hospital Day</b>	<b>Infection Window Period</b>
-2		-2	
-1		-1	
1		1	
<b>2 POA</b>	New onset cough	2	New onset cough
3	<b>Imaging test: Infiltrate</b>	<b>3 HAI</b>	Imaging test: Infiltrate
4	Fever > 38.0 C	4	Fever > 38.0 C
5	Fever > 38.0 C	5	Fever > 38.0 C
6	Blood culture: <i>A. baumannii</i>	6	<b>Blood culture: <i>A. baumannii</i></b>
7	Rales, Fever > 38.0 C	7	Rales, Fever > 38.0 C
8	Cough, Rales	8	Cough, Rales
9		9	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	
16		16	
17		17	

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### **Numerator Data:**

The *Pneumonia (PNEU)* form is used to collect and report each VAP that is identified during the month selected for surveillance.

### **Denominator Data:**

Device days and patient days are used for denominators. 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 denominator form. These daily counts are summed and the total for the month is entered onto the denominator form. Ventilator days and patient days are collected for each of the locations where VAP is monitored.

### **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, wards and other locations in the institution.

**The Standardized Infection Ratio (SIR)** 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.

#### Note:

- The SIR should be calculated only if the number of expected HAIs (numExp) is  $\geq 1$  in order to enforce a minimum precision criterion
- 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.

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### **References**

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