

Intensive Care Unit (ICU): Ventilator Associated Pneumonia (VAP)

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1. Introduction

The VICNISS VAP surveillance module is based on the National Health Safety Network (NHSN) Patient Safety Component Manual, Centers for Disease Control and Prevention (CDC) in the United States¹.

Pneumonia (PNEU) is a common healthcare-associated infection and is associated with substantial morbidity and mortality. Patients with mechanically assisted ventilation have a high risk of developing healthcare-associated pneumonia.

Prevention and control of healthcare-associated pneumonia is discussed in the CDC/HICPAC document, [Guidelines for Preventing Healthcare-Associated Pneumonia, 2003](#)². 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.

2. Methodology

This module requires active, patient-based, prospective surveillance of ventilator associated pneumonia and corresponding denominator data. This means that the person undertaking surveillance shall seek out infections during a patient's stay by screening a variety of data sources, such as laboratory, pharmacy, admission/discharge/transfer, radiology/imaging, and pathology databases, and patient charts, including history and physical exam notes, nurses/physicians notes, temperature charts, etc.

Due to the potential for poor documentation and the delay in obtaining patient histories from Medical Record (Health Information) offices retrospective chart review should be used only when patients are discharged before all information can be gathered.

Use VICNISS forms to record all required data, using the definitions of each data field. To minimise the ICP's data collection burden, others may be trained to collect the denominator data and to screen data sources for these infections, however the ICP must make the final determination.

Settings

Surveillance can be performed in any adult/paediatric intensive care unit in Victoria.

Note: It is not required to monitor for VAPs after the patient is discharged from the intensive care unit.

Requirements

Refer to the [VICNISS Type 1 VICNISS Performance Indicators](#) on the VICNISS website for required VAP surveillance activities. For further information also refer to the [VICNISS Type 1 Surveillance Manual \(section 4.1\)](#) on the VICNISS website.

Definitions

As for all infections reported to VICNISS, infections associated with complications or extensions of infections already present on admission, unless a change of pathogen or symptoms strongly suggests the acquisition of a new infection, are not considered healthcare associated. Therefore, infections that become apparent within the first few days of admission must be carefully reviewed to determine whether they should be considered healthcare associated

VICNISS ICU Patient: is an inpatient admission **and** must be admitted to a nursing care area that provides intensive observation, diagnosis, and therapeutic procedures for adults, or children who are critically ill.

Pneumonia (PNEU): is identified by using a combination of radiologic, clinical and laboratory criteria, [Section 4 \(below\)](#), outlines the various assessment criteria may be used for meeting the surveillance definition of healthcare-associated pneumonia.

Ventilator associated Pneumonia (VAP): is a healthcare-associated pneumonia (PNEU) that occurs in a patient who was intubated and ventilated at the time of, or within 48 hours before the onset of the PNEU.

Note: There is no minimum period of time that the ventilator must be in place in order for the PNEU to be considered ventilator-associated.

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).

Denominator Data

Ventilator days and patient days are used for denominators:

- When denominator data are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/-5%) from manually collected data.
- *Ventilator days:* a daily count of the number of patients managed with a ventilatory device. To calculate ventilator days, for each day of the month, at the same time each day, record the number of patients who have ventilatory support. At the end of the month sum the daily counts and record on [ICU Monthly Denominator](#) form. The [ICU Daily Denominator](#) form may be used to assist recording the daily count. Only the monthly denominator form is required by the VCC.

- *Patient days*: is a daily count of the number of patients in the ICU during a time period. To calculate patient days, for each day of the month, at the same time each day, record the number of patients. At the end of the month sum the daily counts and record on [ICU Monthly Denominator](#) form. The [ICU Daily Denominator](#) form may be used to assist recording the daily count. Only the monthly denominator form is required by the VCC.
- All attempts should be made to cover weekends, public holidays etc. However, if a day is missed, use the previous day's data for that day. If two days are missed, use data from the day counting is resumed for the second day. For example, if both Saturday and Sunday are missed, use Friday's data for Saturday and Monday's data for Sunday.
- The denominator data **must also be collected on the first day of the month after ceasing the ICU surveillance components**. For example, if the surveillance period is January, February and March, denominator data must also be collected on 1st April.
- For further explanation of required data fields see [Instructions for Completion of ICU VAP Data Forms](#) on the VICNISS website.

Numerator Data

- All ventilated patients in ICU at the beginning of the month and all patients admitted to the ICU (new arrivals) during the surveillance month are monitored for VAP.
- The VAP must occur in a VICNISS ICU patient and there was no evidence that the infection was present or incubating at the time of ICU admission or was related to a previously reported infection and it meets the VICNISS criteria (see section 4 below, [Criteria for Ventilator Associated Pneumonia \(VAP\)](#)).
- Report each VAP identified in ICU that meets the VICNISS criteria during the month selected for surveillance on the [ICU Infection \(Numerator\)](#) form.
- For further explanation of required data fields see [Instructions for Completion of ICU VAP Data Forms](#) on the VICNISS website.

3. 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 i.e. adult medical/surgical and paediatric.

4. Criteria for Ventilator Associated Pneumonia (VAP)

Criteria for Defining Healthcare-associated Pneumonia: General Comments Applicable to All Pneumonia Specific Site Criteria

- A. Physician's diagnosis of pneumonia alone is not an acceptable criterion for healthcare-associated pneumonia.
- B. Although specific criteria are included for infants and children, paediatric patients may meet any of the other pneumonia specific site criteria.

- C. VAP (i.e., pneumonia in persons who had a device to assist or control respiration continuously through a tracheostomy or by endotracheal intubation within the 48-hour period before the onset of infection, inclusive of the weaning period) should be so designated when reporting data.
- D. 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 colonisation, upper respiratory tract infections (e.g., tracheobronchitis), and early onset pneumonia. Finally, it should be recognised 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.
- E. Healthcare-associated pneumonia can be characterised by its onset: early or late. Early onset pneumonia occurs during the first four days of hospitalisation 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.
- F. Pneumonia due to gross aspiration (for example, in the setting of intubation in the emergency room or operating room) is considered healthcare-associated if it meets any specific criteria and was not clearly present or incubating at the time of admission to the hospital.
- G. 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. The addition of or change in pathogen alone is not indicative of a new episode of pneumonia. The combination of new signs and symptoms and radiographic evidence or other diagnostic testing is required.
- H. Positive Gram 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 colonisers and therefore must be interpreted cautiously. In particular, *Candida* is commonly seen on stain, but infrequently causes healthcare-associated pneumonia.
- I. 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

Abbreviations used in PNEU laboratory criteria

BAL – bronchoalveolar lavage

LRT – lower respiratory tract

EIA – enzyme immunoassay

PCR – polymerase chain reaction

FAMA – fluorescent-antibody staining of PMN (see below)

PMN – polymorphonuclear leukocyte membrane antigen

IFA – immunofluorescent antibody RIA – radioimmunoassay

RIA – radioimmunoassay

Specific Site Algorithms for Ventilator Associated Pneumonia

A. Clinically Defined Pneumonia (PNU1)

Radiology	Signs/Symptoms/Laboratory
<p>Two or more serial chest radiographs with at least one of the following ^{1,2}:</p> <p>New or progressive and persistent infiltrate</p> <p>Consolidation</p> <p>Cavitation</p> <p>Pneumatocoles, in infants ≤ 1 year old</p> <p>NOTE: In patients without underlying pulmonary or cardiac disease (e.g. respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), <u>one definitive</u> chest radiograph is acceptable.¹</p>	<p>FOR ANY PATIENT, at least one of the following:</p> <ul style="list-style-type: none"> -Fever ($>38^{\circ}\text{C}$) with no other recognized cause -Leukopenia ($<4000 \text{ WBC}/\text{mm}^3$) or leukocytosis ($\geq 12,000 \text{ WBC}/\text{mm}^3$) -For adults ≥ 70 years old, altered mental status with no other recognized cause <p>and</p> <p>at least two of the following:</p> <ul style="list-style-type: none"> • New onset of purulent sputum³, or change in character of sputum⁴, or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, or tachypnea⁵ • Rales⁶ or bronchial breath sounds • Worsening gas exchange (e.g. O_2 desaturations, e.g., $\text{PaO}_2/\text{FiO}_2 < 240$)⁷, increased oxygen requirements, or increased ventilator demand) <hr/> <p>ALTERNATE CRITERIA, for infants ≤ 1 year old:</p> <p>Worsening gas exchange (e.g., O_2 desaturations, increased oxygen requirements, or increased ventilator demand)</p> <p>and</p> <p>at least three of the following:</p> <ul style="list-style-type: none"> • Temperature instability with no other recognized cause • Leukopenia ($<4000 \text{ WBC}/\text{mm}^3$) or leukocytosis ($\geq 15,000 \text{ WBC}/\text{mm}^3$) and left shift ($\geq 10\%$ band forms) • New onset of purulent sputum³ or change in character of sputum⁴, or increased respiratory secretions or increased suctioning requirements • Apnea, tachypnea⁵, nasal flaring with retraction of chest wall or grunting • Wheezing, rales⁶, or rhonchi • Cough • Bradycardia (<100 beats/min) or tachycardia (>170 beats/min) <hr/> <p>ALTERNATE CRITERIA, for child >1 year old or ≤ 12 years old, at least three of the following:</p> <ul style="list-style-type: none"> • Fever ($>38.4^{\circ}\text{C}$) or hypothermia ($<36.5^{\circ}\text{C}$) with no other recognized cause • Leukopenia ($<4000 \text{ WBC}/\text{mm}^3$) or leukocytosis ($\geq 15,000 \text{ WBC}/\text{mm}^3$) • New onset of purulent sputum³, or change in character of sputum⁴, or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, apnea, or tachypnea⁵. • Rales⁶ or bronchial breath sounds. • Worsening gas exchange (e.g. O_2 desaturations, increased oxygen requirements, or increased ventilator demand)

B. Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

Radiology	Signs/Symptoms	Laboratory
<p>Two or more serial chest radiographs with at least one of the following^{1,2}:</p> <p>New or progressive and persistent infiltrate</p> <p>Consolidation</p> <p>Cavitation</p> <p>Pneumatoceles, in infants ≤ 1 year old</p> <p>NOTE: In patients without underlying pulmonary or cardiac disease (e.g. respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary oedema, or chronic obstructive pulmonary disease), <u>one definitive chest radiograph</u> is acceptable.¹</p>	<p>At least one of the following:</p> <p>Fever (>38°C) with no other recognized cause</p> <p>Leukopenia (<4000 WBC/mm³) or leukocytosis (>12,000 WBC/mm³)</p> <p>For adults ≥70 years old, altered mental status with no other recognized cause</p> <p>and</p> <p>at least one of the following:</p> <p>New onset of purulent sputum³, or change in character of sputum⁴, or increased respiratory secretions, or increased suctioning requirements</p> <p>New onset or worsening cough, or dyspnea or tachypnea⁵</p> <p>Rales⁶ or bronchial breath sounds</p> <p>Worsening gas exchange (eg. O₂ desaturations [eg. PaO₂/FiO₂ <240]⁷, increased oxygen requirements, or increased ventilator demand)</p>	<p>At least one of the following:</p> <p>Positive growth in blood culture⁸ not related to another source of infection</p> <p>Positive growth in culture of pleural fluid</p> <p>Positive quantitative culture⁹ from minimally contaminated LRT specimen (e.g., BAL or protected specimen brushing)</p> <p>≥5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (e.g., Gram stain)</p> <p>Histopathologic exam shows at least one of the following evidences of pneumonia:</p> <p>Abscess formation or foci of consolidation with intense PMN accumulation in bronchioles and alveoli</p> <p>Positive quantitative culture⁹ of lung parenchyma Evidence of lung parenchyma invasion by fungal hyphae or pseudohyphae</p>

C. Viral, Legionella, and other Bacterial Pneumonias with Definitive Laboratory Findings (PNU2)

Radiology	Signs/Symptoms	Laboratory
<p>Two or more serial chest radiographs with at least one of the following ^{1,2}:</p> <p>New or progressive and persistent infiltrate</p> <p>Consolidation</p> <p>Cavitation</p> <p>Pneumatoceles, in infants ≤1 year old</p> <p>NOTE: In patients without underlying pulmonary or cardiac disease (e.g. respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), <u>one definitive</u> chest radiograph is acceptable</p>	<p>At least one of the following:</p> <p>Fever (>38°C) with no other recognized cause</p> <p>Leukopenia (<4000 WBC/mm³) or leukocytosis (>12,000 WBC/mm³)</p> <p>For adults ≥70 years old, altered mental status with no other recognized cause</p> <p>and</p> <p>at least one of the following:</p> <p>New onset of purulent sputum³, or change in character of sputum⁴, or increased respiratory secretions, or increased suctioning requirements</p> <p>New onset or worsening cough or dyspnea, or tachypnea⁵</p> <p>Rales⁶ or bronchial breath sounds</p> <p>Worsening gas exchange (e.g. O₂ desaturations [e.g. PaO₂/FiO₂ < 240]⁷, increased oxygen requirements, or increased ventilator demand)</p>	<p>At least one of the following ¹⁰⁻¹²:</p> <p>Positive culture of virus or <i>Chlamydia</i> from respiratory secretions</p> <p>Positive detection of viral antigen or antibody from respiratory secretions (e.g., EIA, FAMA, shell vial assay, PCR)</p> <p>Fourfold rise in paired sera (IgG) for pathogen (e.g., influenza viruses, <i>Chlamydia</i>)</p> <p>Positive PCR for <i>Chlamydia</i> or <i>Mycoplasma</i></p> <p>Positive micro-IF test for <i>Chlamydia</i></p> <p>Positive culture or visualization by micro-IF of <i>Legionella</i> spp, from respiratory secretions or tissue.</p> <p>Detection of <i>Legionella pneumophila</i> serogroup 1 antigens in urine by RIA or EIA</p> <p>Fourfold rise in <i>L. pneumophila</i> serogroup 1 antibody titer to ≥1:128 in paired acute and convalescent sera by indirect IFA.</p>

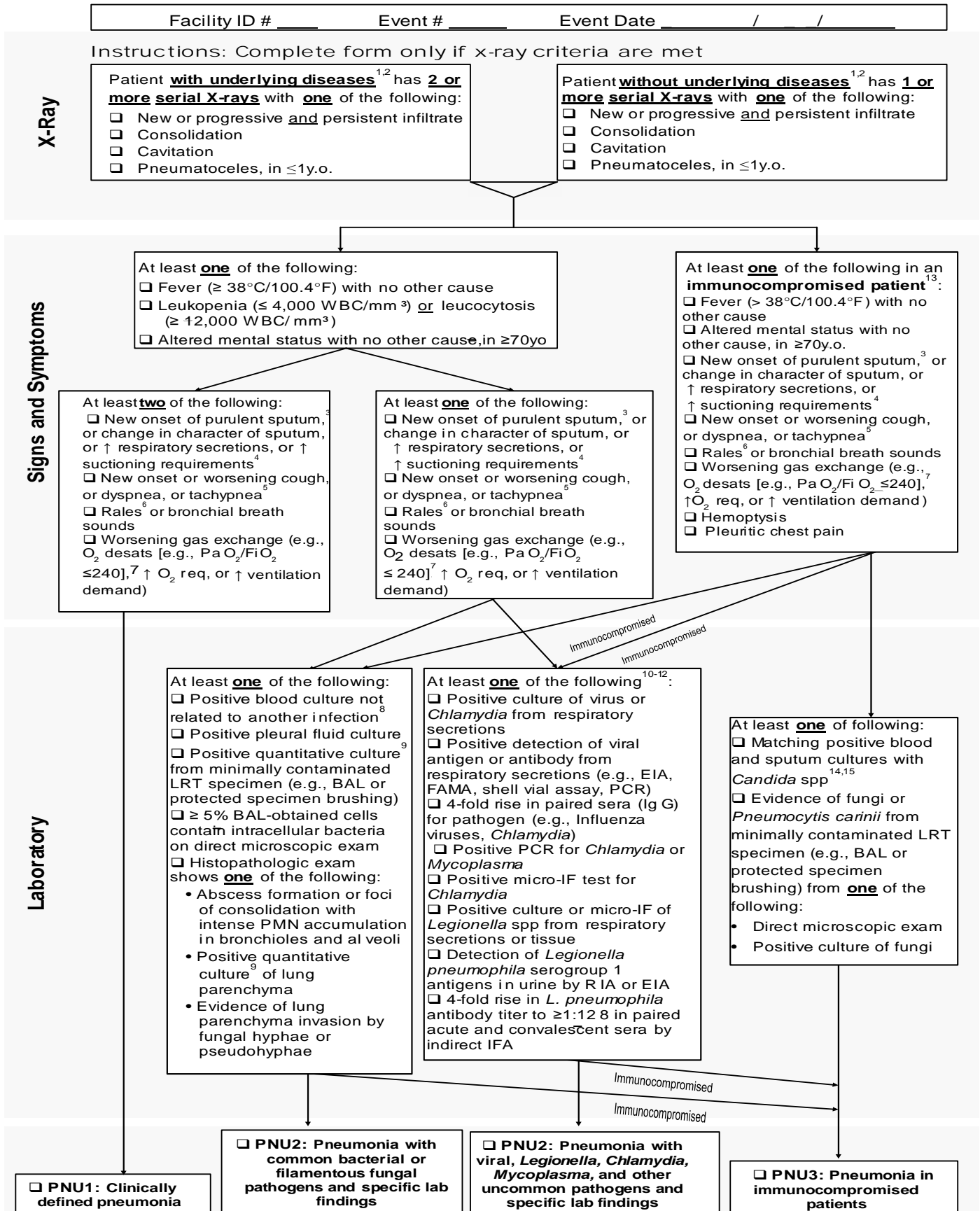
D. Pneumonia in Immunocompromised Patients (PNU3)

Radiology	Signs/Symptoms	Laboratory
<p>Two or more serial chest radiographs with at least one of the following^{1,2}:</p> <p>New or progressive <u>and</u> persistent infiltrate</p> <p>Consolidation</p> <p>Cavitation</p> <p>Pneumatoceles, in infants ≤ 1 year old</p> <p>NOTE: In patients without underlying pulmonary or cardiac disease (e.g. respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), <u>one definitive</u> chest radiograph is acceptable.¹</p>	<p>Patient who is immunocompromised¹³ has at least one of the following:</p> <p>Fever ($>38^{\circ}\text{C}$) with no other recognized cause</p> <p>For adults ≥ 70 years old, altered mental status with no other recognized cause</p> <p>New onset of purulent sputum³, or change in character of sputum⁴, or increased respiratory secretions, or increased suctioning requirements</p> <p>New onset or worsening cough, or dyspnea, or tachypnea⁵</p> <p>Rales⁶ or bronchial breath sounds</p> <p>Worsening gas exchange (e.g. O₂ desaturations [e.g., PaO₂/FiO₂ ≤ 240]⁷, increased oxygen requirements, or increased ventilator demand)</p> <p>Haemoptysis</p> <p>Pleuritic chest pain</p>	<p>At least one of the following:</p> <p>Matching positive blood and sputum cultures with <i>Candida</i> spp.^{14,15}</p> <p>Evidence of fungi or <i>Pneumocystis carinii</i> from minimally contaminated LRT specimen (e.g., BAL or protected specimen brushing) from one of the following:</p> <ul style="list-style-type: none"> - Direct microscopic exam - Positive culture of fungi <p>Any of the following from</p> <p>LABORATORY CRITERIA DEFINED UNDER PNU2</p>

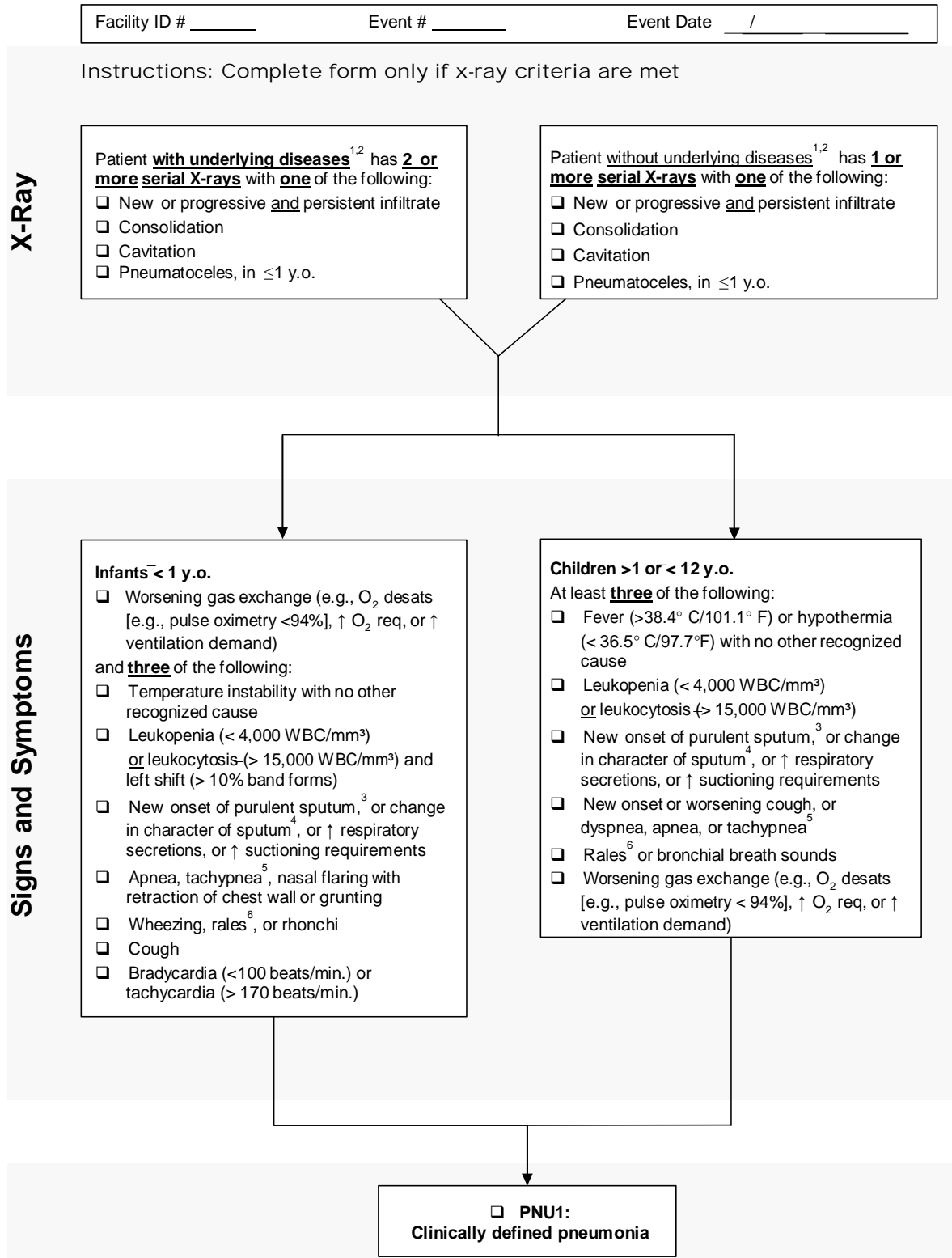
Footnotes to Algorithms:

1. Occasionally the diagnosis of healthcare-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 oedema from decompensated congestive heart failure) may simulate the presentation of pneumonia. In these more difficult cases, serial chest radiographs must be examined to help separate infectious from non-infectious 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 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). 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 since 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. 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 >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. 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 the etiologic agent of the pneumonia.
9. Refer to Threshold values for cultured specimens in table 6.1(below) An endotracheal aspirate is not a minimally contaminated specimen. Therefore, an endotracheal aspirate does not meet the laboratory criteria.
10. Once laboratory-confirmed cases of pneumonia due to respiratory syncytial virus (RSV), adenovirus, or influenza virus have been identified in a hospital, clinician’s presumptive diagnosis of these pathogens in subsequent cases with similar clinical signs and symptoms is an acceptable criterion for presence of healthcare-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 from patients with pneumonia due to *Legionella* spp, mycoplasma, or viruses.
13. Immunocompromised patients include those with neutropenia (absolute neutrophil count $<500/\text{mm}^3$), 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).
14. Blood and sputum specimens must be collected within 48 hours of each other.
15. Semiquantitative or nonquantitative 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.

Figure 1. PNEUMONIA FLOW DIAGRAM



**Figure 2: PNEUMONIA FLOW DIAGRAM
ALTERNATE CRITERIA FOR INFANTS AND CHILDREN**



Threshold Values for Cultured Specimens used in Diagnosis of Pneumonia

Specimen Collection/Technique	Values
Lung parenchyma ** Bronchoscopically (B) obtained specimens: Bronchoalveolar lavage (B-BAL) Protected BAL (B-PBAL) Protected specimen brushing (B-PSB) Nonbronchoscopically (NB) obtained (blind) specimens NB-BAL NB-PSB	$\geq 10^4$ cfu/g tissue $\geq 10^4$ cfu/ml $\geq 10^4$ cfu/ml $\geq 10^3$ cfu/ml $\geq 10^4$ cfu/ml $\geq 10^3$ cfu/ml
cfu = colony forming units g = gram ml = millilitre	** <i>open-lung biopsy specimens and immediate post-mortem specimens obtained by transthoracic or transbronchial biopsy</i>

5. References

- Centers for Disease Control and Prevention. The National Healthcare Safety Network (NHSN) Manual. Patient Safety Component Protocol. 2010 www.cdc.gov/nhsn/TOC_PSCManual.html.
- 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).