



Protocols and Definitions
Device-associated Module

Ventilator-associated Pneumonia
(VAP)

Division of Healthcare Quality Promotion

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This portion of today's training will describe the protocols and definitions for the Ventilator-associated Pneumonia option of the Device-associated Module of the Patient Safety Component of the NHSN.



Target Audience



- This training session is designed for those who will collect and analyze Ventilator-associated Pneumonias in the Patient Safety Component of NHSN. This may include:
 - NHSN Facility Administrator
 - Patient Safety Primary Contact
 - Infection Control Professional (ICP)
 - Epidemiologist
 - Microbiologist
 - Respiratory Therapy Staff
 - Data entry staff

This training session is designed for those of you who will collect and analyze ventilator-associated pneumonias and/or their associated denominators. This may include any of the individuals listed on the slide.



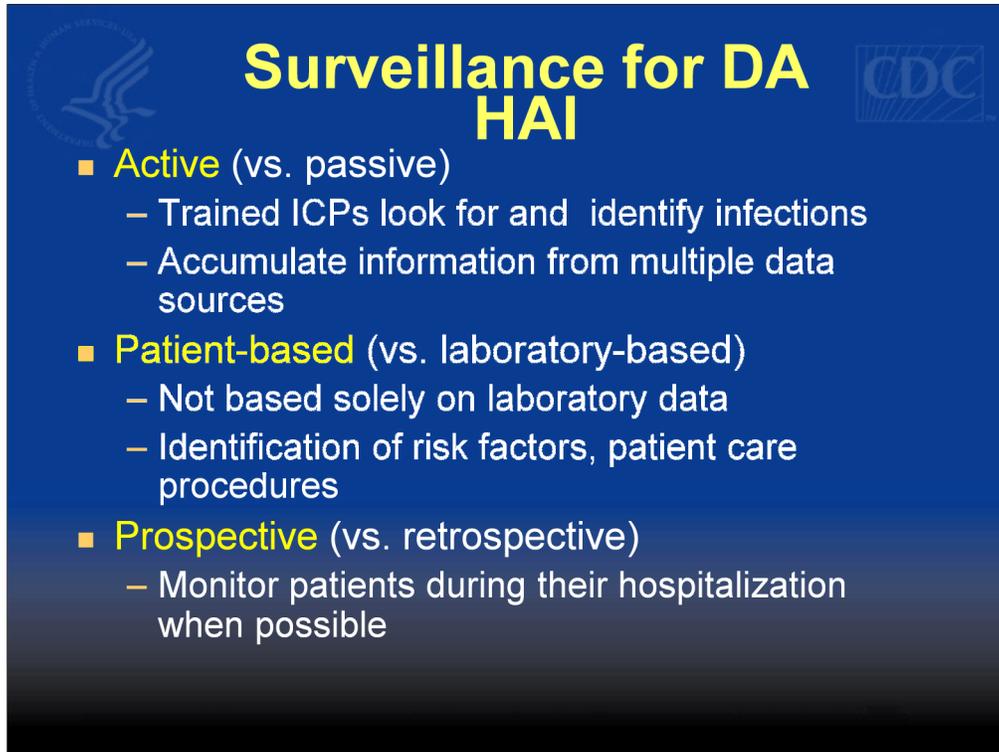
Objectives

- Outline the structure, methodology and purpose of the Device-associated Module of NHSN
- Describe the protocols and definitions used in the VAP option within the Device-associated Module

At the end of this training, you should be able to outline the structure, methodology and purpose of the device-associated module of NHSN and describe the protocols and definitions used in the ventilator-associated pneumonia option of the device-associated module.

The screenshot shows the NHSN website interface. At the top, the NHSN logo is on the left and the CDC logo is on the right. The main heading is "NHSN Website" in white text on a blue background, with the URL "http://www.cdc.gov/nhsn/" in yellow text below it. The page content is on a white background with a blue header. The header includes the CDC Home logo, the text "Centers for Disease Control and Prevention" and "Your Online Source for Credible Health Information", a search bar, and an "A-Z Index" with letters A through Z and a hash symbol. The main content area is titled "National Healthcare Safety Network (NHSN)". To the left of the main content is a text block describing NHSN as a voluntary, secure, internet-based surveillance system. To the right is a video player for the "Biovigilance Component" with a "Replay" button and a "GO" button. Below the video player are three buttons: "MDRO", "HAI: Recovery Act", and "Biovigilance". To the right of the video player are links for "Email page", "Print page", and "Bookmark and share". Below these links is a "FLU.GOV" widget with the text "Know what to do about the flu." and a "VISIT FLU.GOV" button. At the bottom of the page are two buttons: "Topics" and "Data & Statistics".

The NHSN Website is the primary resource for data collection forms, protocol, definitions, and trainings.

A blue slide with a white border. In the top left corner is a circular logo with a stylized bird or wing. In the top right corner is the CDC logo. The title "Surveillance for DA HAI" is in large yellow font. Below the title are three bullet points in yellow, each followed by a list of sub-points in white.

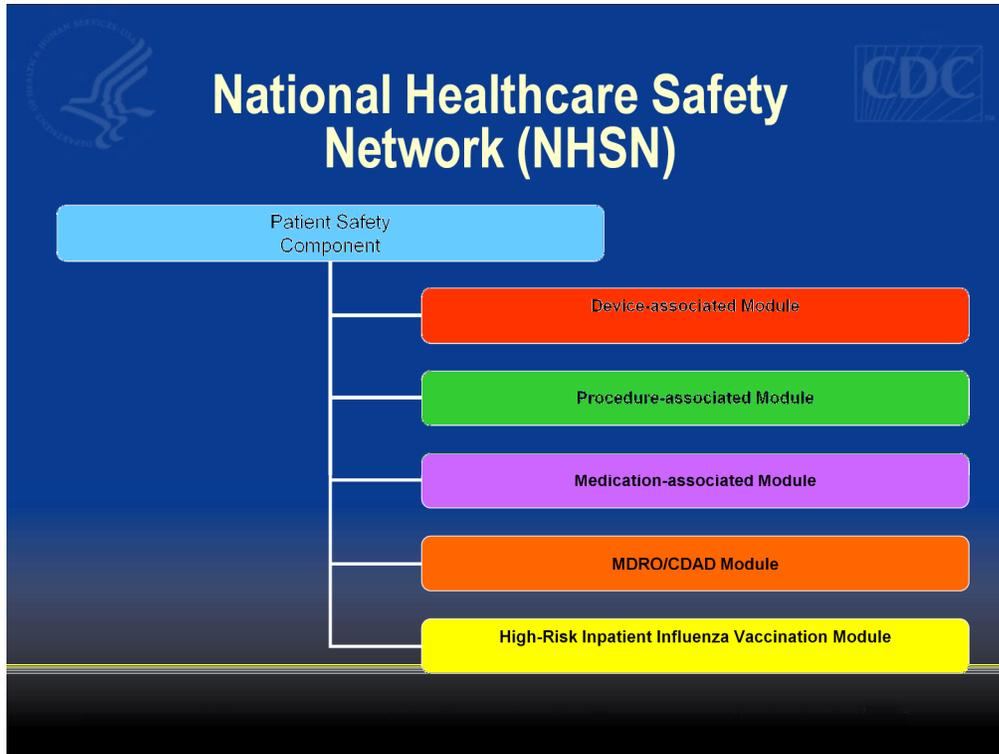
Surveillance for DA HAI

- **Active** (vs. passive)
 - Trained ICPs look for and identify infections
 - Accumulate information from multiple data sources
- **Patient-based** (vs. laboratory-based)
 - Not based solely on laboratory data
 - Identification of risk factors, patient care procedures
- **Prospective** (vs. retrospective)
 - Monitor patients during their hospitalization when possible

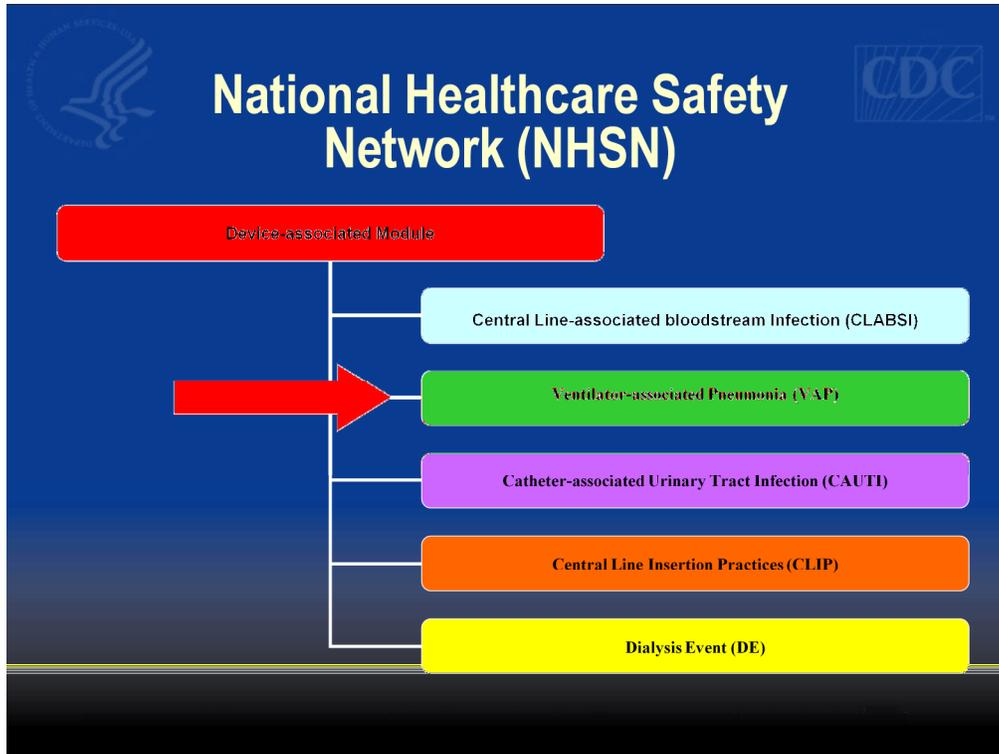
Using this module means that you must use active, patient-based, prospective surveillance of VAPs and their corresponding data by a trained infection control professional (ICP). This means that the ICP shall seek out infections during a patient's stay by screening a variety of data sources, such as laboratory, pharmacy, admission/discharge/transfer and radiology/imaging, and pathology databases, patient charts, including history and physical exam notes, nurses/physician notes, temperature charts, etc.

Others may be trained to screen data sources for these infections, but the ICP must make the final determination. Laboratory-based surveillance should not be used alone, unless all possible criteria for identifying an infection are solely determined by laboratory evidence.

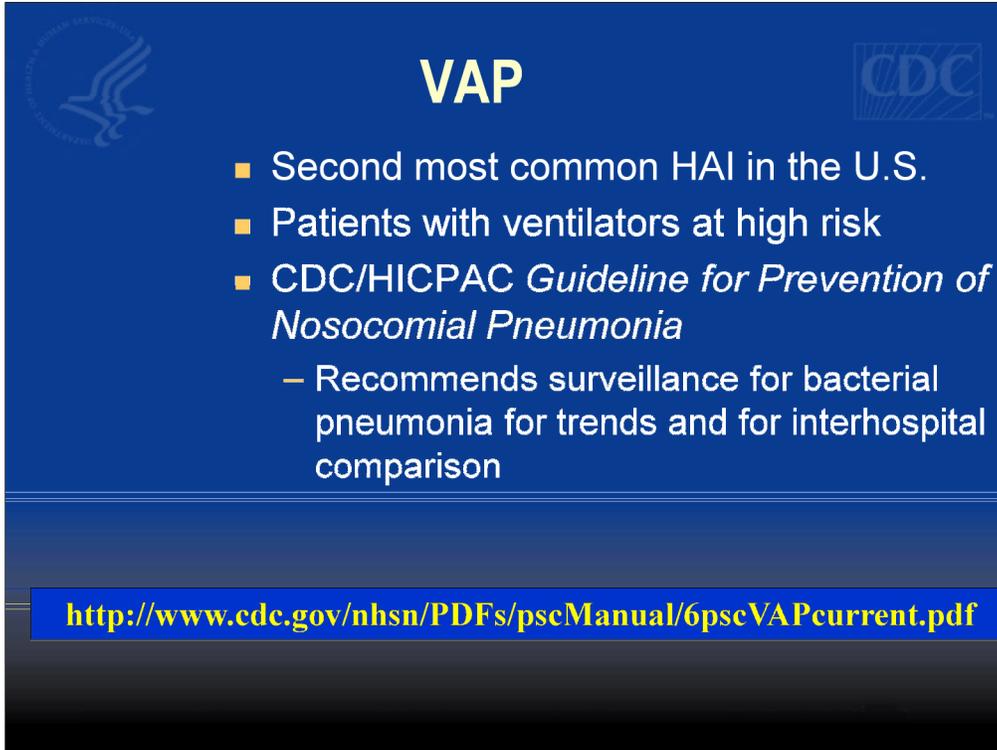
Retrospective chart reviews should be used only when patients are discharged before all information can be gathered



This slide illustrates the basic structure of the Patient Safety Component of NHSN. The Device-associated Module is shown at the top of the diagram in red. This is the module in which the catheter-associated urinary tract infection protocol can be located.



This slide illustrates the further breakdown of the Device-associated module. There are five separate options in this module: Central Line-associated Bloodstream Infections (CLABSI), Ventilator-associated Pneumonia (VAP) Catheter-associated Urinary Tract Infection (CAUTI), Central Line Insertion Practices (CLIP) and Dialysis Event (DE). We will discuss only ventilator-associated Pneumonia during this training session.



The slide features a dark blue background. In the top left corner is the logo for the National Healthcare Safety Network (NHSN), and in the top right corner is the CDC logo. The title 'VAP' is centered at the top in a large, bold, white font. Below the title is a bulleted list of three items, each preceded by a yellow square bullet. The third item includes a sub-bullet. At the bottom of the slide, a yellow horizontal bar contains a URL in black text.

VAP

- Second most common HAI in the U.S.
- Patients with ventilators at high risk
- CDC/HICPAC *Guideline for Prevention of Nosocomial Pneumonia*
 - Recommends surveillance for bacterial pneumonia for trends and for interhospital comparison

<http://www.cdc.gov/nhsn/PDFs/pscManual/6pscVAPcurrent.pdf>

Pneumonia is the second most common healthcare associated infection in the United States and is associated with substantial morbidity and mortality. Patients with mechanically assisted ventilation have a high risk of developing pneumonia. Prevention and control of healthcare-associated pneumonia is discussed in the CDC/HICPAC document, *Guideline for the Prevention of Nosocomial Pneumonia*. 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 interhospital comparisons

**Use CDC Definitions
for the following:**

- VAP
- Ventilator
- PNU1
- PNU2
- PNU3

The following slides outline the various definitions and assessment criteria that you'll need to understand the surveillance criteria used for ventilator associated pneumonia. We'll define VAP, Ventilator, and the three criteria that can be used to define pneumonia.



Definition: VAP

- 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 pneumonia.
- If the PNEU develops in a patient within 48 hours of discharge from a location, indicate the discharging location on the infection report, not the current location of the patient

So...when is a pneumonia considered ventilator-associated? A ventilator associated pneumonia is a pneumonia that occurs in a patient who was intubated and ventilated at the time of or within 48 hours before the onset of the pneumonia. Please notice that there is no requirement that the patient be on a vent for 48 hours before the pneumonia is vent-associated. What this means is that when the patient meets the criteria for pneumonia, you take a look-back at the previous 48 hours. If the patient was on the ventilator continuously at any time during that 48 hours, then the developing pneumonia is ventilator-associated.

Just to better clarify the location to which the VAP is attributed, if the patient develops the pneumonia within 48 hours of discharge from a location, indicate the discharging location on the infection report, not the current location of the patient



Definition: 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)

What, then, is a ventilator? You may think it's obvious, but we don't leave this definition open to interpretation. A ventilator is a device to assist or control respiration continuously, inclusive of the weaning period, through a tracheostomy or by endotracheal intubation. The rest of the slide describes what is not included in the definition – basically, any device that does not deliver mechanical ventilation through any route that is not endotracheal or through a tracheostomy.



Pneumonia Criteria

- Indicate the specific type of VAP*
 - PNU1 – Clinically Defined Pneumonia
 - PNU2 – Pneumonia with Common Bacterial Pathogens
 - PNU3 - Pneumonia in Immunocompromised Patients

*** See NHSN Manual: Patient Safety Component Protocol**

So now that we've defined a VAP, and we've defined a Ventilator, it's time to move to the definition of Pneumonia. The CDC has defined pneumonia using three specific sets of criteria. Pneumonia 1 is clinically defined pneumonia, Pneumonia 2 is pneumonia with common bacterial pathogens, and Pneumonia 3 is used for Immunocompromised patients. These criteria use a combination of radiologic, clinical, and laboratory criteria. We'll cover each criterion briefly, and I suggest that you review this after the training using the Pneumonia Flow Diagram in the NHSN Users Manual/Patient Safety Protocol. Until you become more familiar with the pneumonia criteria, the flow diagram is definitely the easiest way to work your way through the surveillance definition. It's also helpful to read through all the comments and footnotes that accompany the pneumonia in order to make certain that you're using them correctly.



PNU1 – Clinically Defined

■ X-Ray findings

<p>Patient <u>with underlying diseases</u> has <u>2 or more serial X-rays</u> with <u>one of the following</u>:</p> <ul style="list-style-type: none"> New or progressive <u>and</u> persistent infiltrate Consolidation Cavitation Pneumatoceles, in <1 y.o. 	or	<p>Patient <u>without underlying diseases</u> has <u>1 or more serial X-rays</u> with <u>one of the following</u>:</p> <ul style="list-style-type: none"> New or progressive <u>and</u> persistent infiltrate Consolidation Cavitation Pneumatoceles, in <1 y.o.
<p>And →</p>		

Beginning at the top of the flow diagram, the first criteria for ALL pneumonias is the chest x-ray. On the right side, we see the patient without underlying pulmonary disease – for this patient, the criteria requires one chest x-ray that identifies one of the following: New or progressive and persistent infiltrate, Consolidation, Cavitation, Pneumatoceles, in a patient <1 y.o. On the left, we see that if the patient has underlying pulmonary disease, such as COPD, congestive heart failure, etc. then 2 or more serial chest x-rays are required. If you read through the footnotes and comments in the definition, you'll find other words that may be acceptable to describe a pneumonia process on chest x-ray.

The positive chest x-ray is the first, and most important criteria for all the pneumonia definitions. If you do not meet this criteria, throw it out – it is not a pneumonia according to the surveillance definition. If the patient has underlying pulmonary disease and has one positive chest ray followed by a chest x-ray that shows improvement, throw it out, it does not meet the surveillance definition of pneumonia.



PNU1 – Clinically defined

■ Signs and Symptoms

<p>At least one of the following:</p> <ul style="list-style-type: none"> •Fever ($> 38^{\circ}\text{C}/100.4^{\circ}\text{F}$) with no other cause •Leukopenia ($< 4,000\text{ WBC}/\text{mm}^3$) or leukocytosis ($\geq 12,000\text{ WBC}/\text{mm}^3$) •Altered mental status with no other cause, in ≥ 70 y.o. 	<p>and</p> <p>→</p>	<p>At least two of the following:</p> <ul style="list-style-type: none"> •New onset of purulent sputum, or change in character of sputum, or \uparrow respiratory secretions, or \uparrow suctioning requirements •New onset or worsening cough, or dyspnea, or tachypnea •Rales or bronchial breath sounds •Worsening gas exchange (e.g., O_2 desats [e.g., $\text{PaO}_2/\text{FiO}_2 \leq 240$], \uparrow O_2 req, or \uparrow ventilation demand)
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After the chest x-ray criterion is met, for Pneumonia 1, move next to the clinical criteria, or signs and symptoms. The patient must have at least one of the symptoms in the left box and at least two of the symptoms in the right box. On the flow diagram, follow the arrows that go down the left side of the page. If these criteria are met, then the patient meets the definition for Pneumonia 1. No other laboratory or other evidence is required.

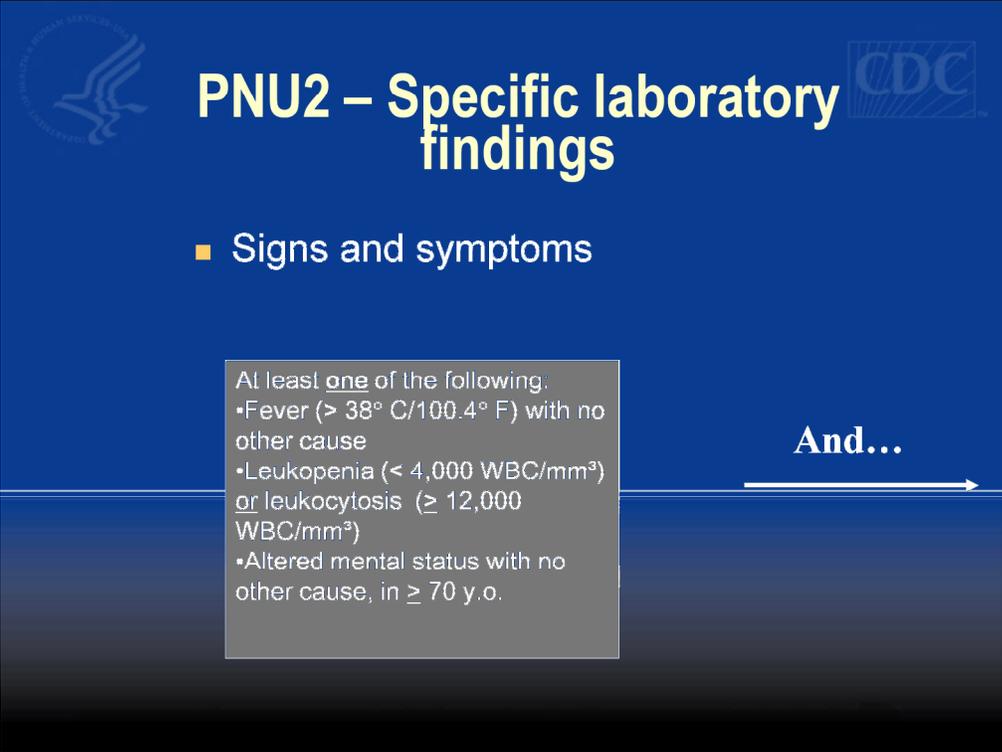
PNU2 – Specific laboratory findings

■ X-Ray findings

Patient with underlying diseases has <u>2 or more serial X-rays</u> with <u>one</u> of the following: New or progressive and persistent infiltrate Consolidation Cavitation Pneumatoceles, in <1 y.o.	or	Patient without underlying diseases has <u>1 or more serial X-rays</u> with <u>one</u> of the following: New or progressive and persistent infiltrate Consolidation Cavitation Pneumatoceles, in <1 y.o.
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And...

Moving now to Pneumonia 2 – back to the top of the flow diagram. The chest x-ray criteria are exactly the same as they were for Pneumonia 1. Moving next to the signs and symptoms area of the flow diagram...



The slide features a dark blue background with a white title and a list of symptoms. A grey box highlights the criteria for 'one' of the symptoms. To the right, the text 'And...' is followed by a white arrow pointing right. Logos for the University of North Carolina and the CDC are visible in the top corners.

PNU2 – Specific laboratory findings

- Signs and symptoms

At least one of the following:

- Fever ($> 38^{\circ}\text{C}/100.4^{\circ}\text{F}$) with no other cause
- Leukopenia ($< 4,000\text{ WBC}/\text{mm}^3$) or leukocytosis ($\geq 12,000\text{ WBC}/\text{mm}^3$)
- Altered mental status with no other cause, in ≥ 70 y.o.

And... →

Pneumonia 2 still requires that at least one of these signs or symptoms are present. If they are present, then you move down and are also required to have --

PNU2 – Specific laboratory findings

At least **two** of the following:

- New onset of purulent sputum, or change in character of sputum, or ↑ respiratory secretions, or ↑ suctioning requirements
- New onset or worsening cough, or dyspnea, or tachypnea
- Rales or bronchial breath sounds
- Worsening gas exchange (e.g., O₂ desats [e.g., PaO₂/FiO₂ ≤ 240], ↑ O₂ req, or ↑ ventilation demand)

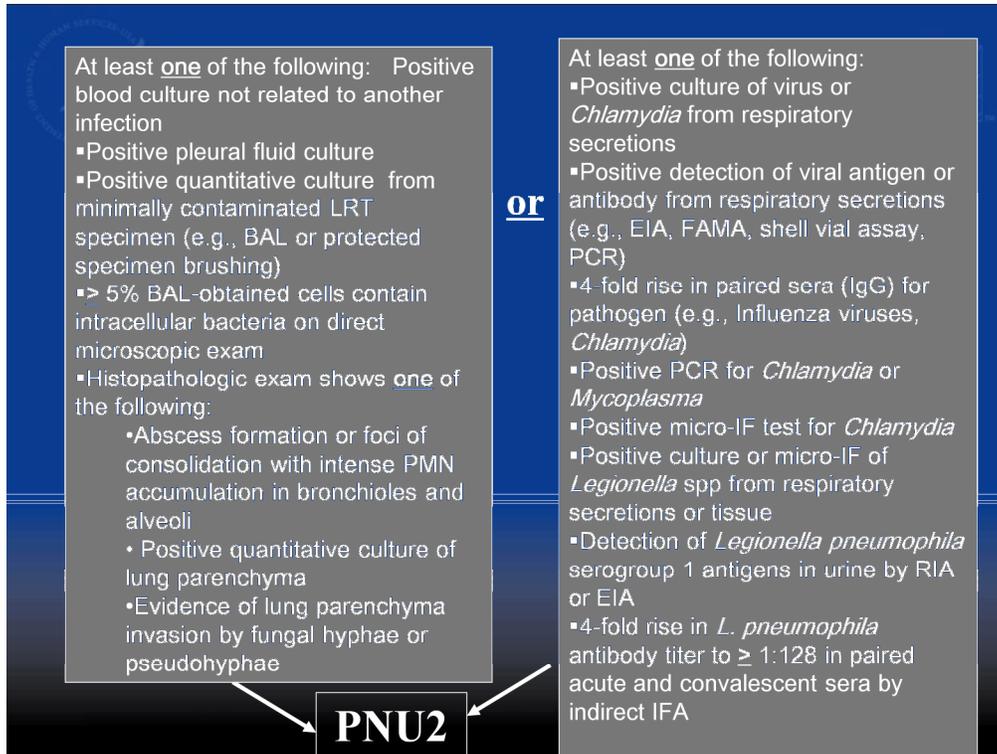
or

At least **one** of the following:

- New onset of purulent sputum, or change in character of sputum, or ↑ respiratory secretions, or ↑ suctioning requirements
- New onset or worsening cough, or dyspnea, or tachypnea
- Rales or bronchial breath sounds
- Worsening gas exchange (e.g., O₂ desats [e.g., PaO₂/FiO₂ ≤ 240], ↑ O₂ req, or ↑ ventilation demand)

and

At least two of the symptoms in the box on the left (just like in Pneumonia 1) or you can identify just one of these symptoms, identified in the box to its right. If the patient demonstrates only one of the symptoms, however, then you must also identify laboratory criteria



Either – one of the laboratory criteria in the left box or one from the right box. The criteria on the left are used to identify a bacterial pneumonia and the one on the right is used for viral, fungal, or more uncommon pathogens. Please take a good look at Comment # 9 on the back of the flow diagram– it clearly states that an endotracheal aspirate does not meet the laboratory criteria – it must be a minimally contaminated specimen,-- a specimen obtained bronchoscopically.

If the patient meets the definition of both Pneumonia 1 and Pneumonia 2, it should be reported as Pneumonia 2



PNU3 – Immunocompromised patient

■ X-Ray findings

<p>Patient <u>with underlying diseases</u> has <u>2 or more serial X-rays</u> with <u>one</u> of the following:</p> <ul style="list-style-type: none"> New or progressive and persistent infiltrate Consolidation Cavitation Pneumatoceles, in <1 y.o. 	or	<p>Patient <u>without underlying diseases</u> has <u>1 or more serial X-rays</u> with <u>one</u> of the following:</p> <ul style="list-style-type: none"> New or progressive and persistent infiltrate Consolidation Cavitation Pneumatoceles, in <1 y.o.
and →		

Moving now to Pneumonia 3 – this criteria may be used with a patient that is immunocompromised. Please note, however, that you may also use Pneumonia 1 or Pneumonia 2 for the immunocompromised patient.

As with pneumonias 1 and 2, Pneumonia 3 begins with the same x-ray criteria. If this criterion is not met, the patient does not meet the surveillance definition of Pneumonia.



PNU3 – Immunocompromised patient



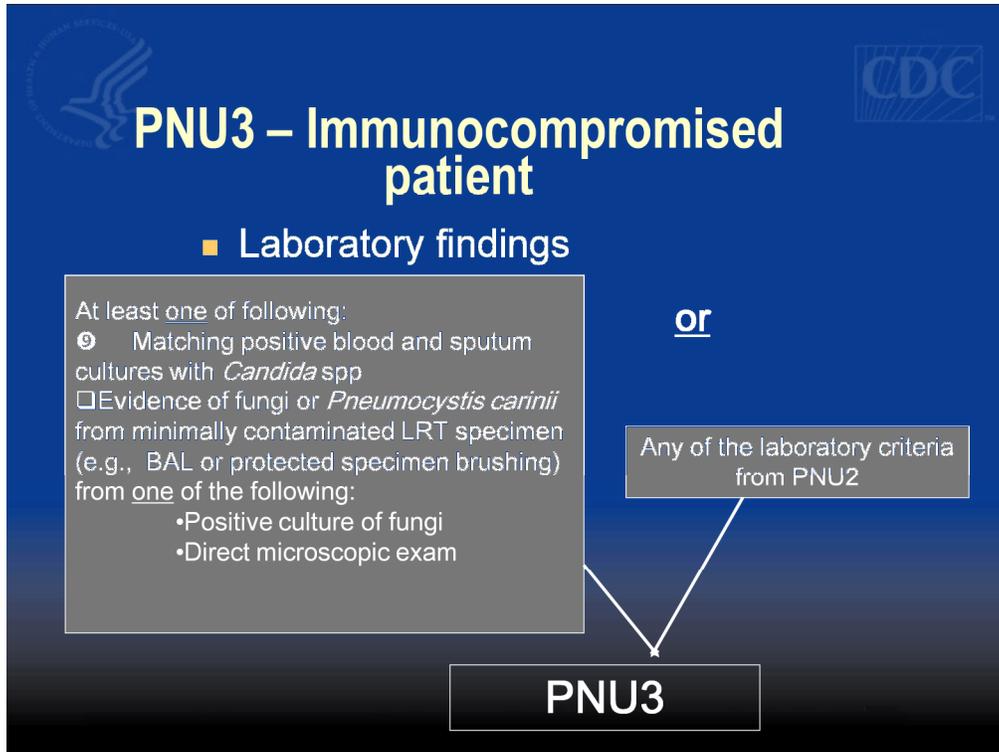
- Signs and symptoms

At least **one** of the following in an immunocompromised patient:

- ⊗ Fever ($> 38^{\circ}\text{C}/100.4^{\circ}\text{F}$) with no other cause
- ⊗ Altered mental status with no other cause, in ≥ 70 y.o.
- ⊗ New onset of purulent sputum, or change in character of sputum, or respiratory secretions, or \uparrow suctioning requirements
- ⊗ New onset or worsening cough, or dyspnea, or tachypnea
- ⊗ Rales or bronchial breath sounds
- ⊗ Worsening gas exchange (e.g., O_2 desats [e.g., $\text{PaO}_2/\text{FiO}_2 \leq 240$], \uparrow O_2 req, or \uparrow ventilation demand)
- ⊗ Hemoptysis
- ⊗ Pleuritic chest pain

and

Next, identify one of the signs or symptoms listed here. You'll note that there are symptoms included here, such as hemoptysis and pleuritic chest pain that are more appropriate for the immunocompromised patient.



And finally, one of these laboratory findings which identify fungi. Notice that any of the laboratory criteria for PNU2 can also be used for PNU3.

Acceptable Specimens for PNU2 and PNU3

- Quantitative culture from minimally contaminated LRT specimen
 - Obtained with or without bronchoscope
 - Bronchoalveolar lavage (BAL)
 - Protected specimen brushing
- Lung parenchyma
 - Open lung biopsy specimens
 - Immediate post-mortem specimens obtained by transthoracic or transbronchial biopsy

These are specimens that are acceptable for Pneumonia 2 and 3

Quantitative culture from minimally contaminated LRT specimen

Obtained with or without bronchoscope

Bronchoalveolar lavage (BAL)

Protected specimen brushing

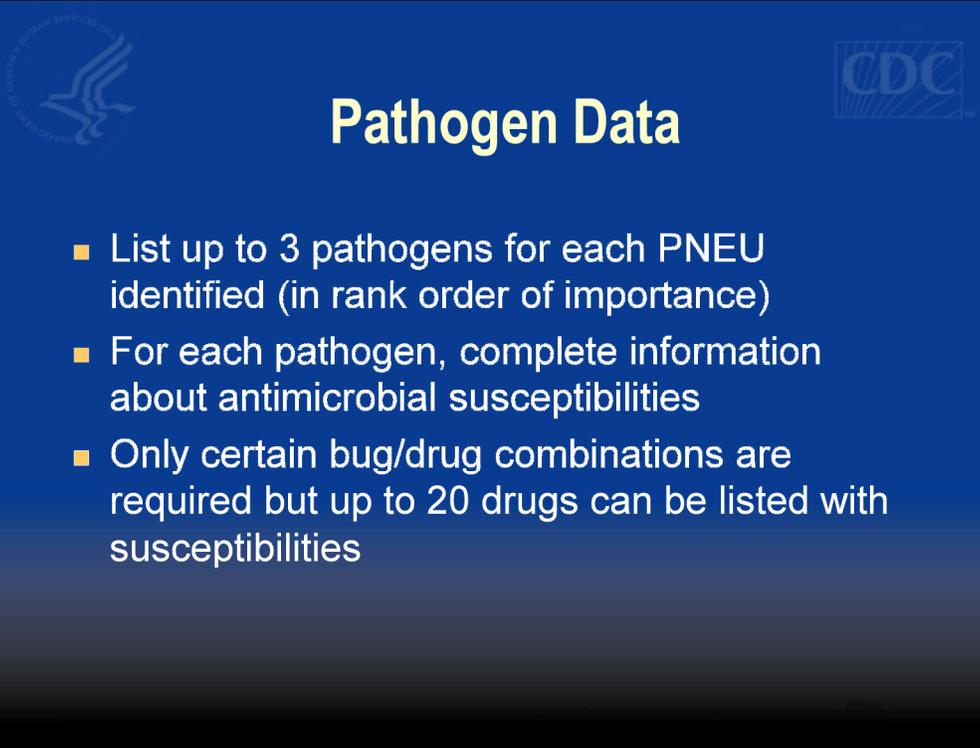
Lung par en kai'ma

Open lung biopsy specimens

Immediate post-mortem specimens obtained by transthoracic or transbronchial biopsy

* required for saving **required for completion	
Facility ID: 3001	Event #: 162
*Patient ID: 24689	Social Security #:
Secondary ID:	
Patient Name, Last: Miller	First: James Middle: R
*Gender: F M	*Date of Birth: 3/11/1964
Ethnicity (Specify):	Race (Specify):
*Event Type: PNEU	*Date of Event: 9/8/2009
*Post-procedure PNEU: Yes No	Date of Procedure: 9/1/2009
NHSN Procedure Code:	ICD-9-CM Procedure Code:
*MDRO Infection Surveillance: <input type="checkbox"/> Yes, this event's pathogen & location are in-plan for the MDRO/CDAD Mod <input checked="" type="checkbox"/> No, this event's pathogen & location are not in-plan for the MDRO/CDAD	
*Date Admitted to Facility: 08/31/2009	*Location: ICU
Risk Factors	
*Ventilator: Yes No Location of Device Insertion: SURG Date of Device Insertion: __09/_01/_2009	
*For NICU only: Birth weight: _____grams	
Event Details	
*Specific Event: <input type="checkbox"/> PNU1 <input checked="" type="checkbox"/> PNU2 <input type="checkbox"/> PNU3	*Immunocompromised: Yes No
*Specify Criteria Used: (check all that apply)	
X-Ray	
<input checked="" type="checkbox"/> New or progressive and persistent infiltrate <input type="checkbox"/> Consolidation <input type="checkbox"/> Cavitation <input type="checkbox"/> Pneumatoceles (p.o.)	

This is an example of a completed PNEU form for a PNU2 VAP event. This information can be entered into the NHSN Reporting application.



Pathogen Data

- List up to 3 pathogens for each PNEU identified (in rank order of importance)
- For each pathogen, complete information about antimicrobial susceptibilities
- Only certain bug/drug combinations are required but up to 20 drugs can be listed with susceptibilities

For each identified VAP, you can list up to 3 pathogens (in rank order of importance.) For each pathogen, complete the information about the antimicrobial susceptibility. Although only certain bug-drug combinations are required, you can list up to 20 drugs with their associated susceptibilities

VAP Denominator Data



- At the same time each day, count
 - # patients (i.e., patient days)
 - # patients on ventilators

Using the denominator form that is appropriate for the location, at the same time each day, someone on the monitored unit records the number of patients and the number of patients on ventilators on that unit.

NHSN National Healthcare Safety Network		Denominators for Intensive Care Unit (ICU)/ Other locations (not NICU or SCA)			OMB No. 0920-0666 Exp. Date: 02-29-2008
Facility ID #: _____		Location Code: _____			Month: _____ Year: _____
Date	Number of patients	Number of patients with 1 or more central lines	Number of patients with a urinary catheter	Number of patients on a ventilator	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

Record the number of patients and the number of patients on a ventilator each day

This is the denominator form that is used for collecting denominators for an ICU or other non-NICU/SCA location, showing the appropriate columns for recording patient days and patients using ventilators. The numbers are totaled at the end of the month and entered into the NHSN internet application.



VAP Denominator Data for NICU



- At the same time each day, for each birthweight category, count
 - # patients on ventilators
 - # patients (i.e., patient days)
- Enter the totals within 30 days of the end of the month

Denominators in the NICU are collected by birthweight category – again, at the same time each day

patients on ventilators and # patients (i.e., patient days)



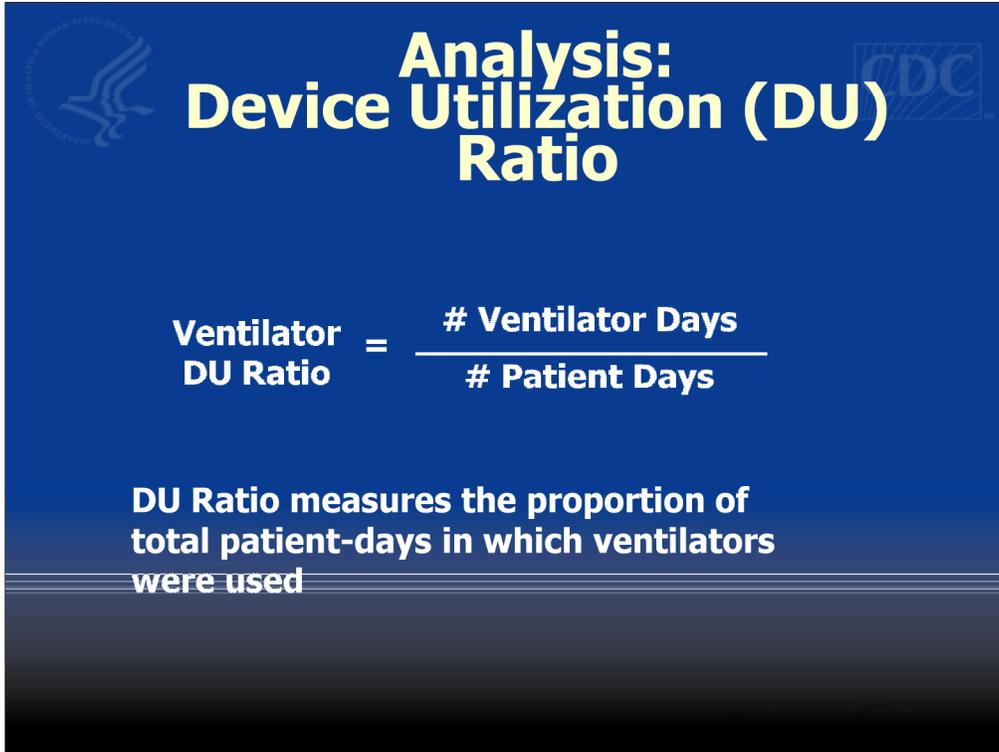
Analysis: VAP Rate

$$\text{VAP Rate} = \frac{\text{\#VAPs identified*}}{\text{\# ventilator days*}} \times 1000$$

* Stratify by:

- Type Location
- NICU
 - Birthweight category

This is the formula that is used to calculate the VAP rate for a given unit. In the NICU, this is calculated separately for each birthweight category.



**Analysis:
Device Utilization (DU)
Ratio**

**Ventilator
DU Ratio = $\frac{\# \text{ Ventilator Days}}{\# \text{ Patient Days}}$**

**DU Ratio measures the proportion of
total patient-days in which ventilators
were used**

The slide features a dark blue background with white text. In the top left corner, there is a circular logo for the National Health and Medical Research Council (NH&MRC). In the top right corner, there is a logo for the Centers for Disease Control and Prevention (CDC). The title 'Analysis: Device Utilization (DU) Ratio' is centered at the top. Below the title, the formula for the Ventilator DU Ratio is presented. At the bottom, a definition of the DU Ratio is provided.

The Device Utilization Ratio gives us a measure of how much ventilators are used on a given unit and there are DU ratios available in the NNIS/NHSN Report that you can use for comparison. The DU ratio is calculated by dividing the number of ventilator days by the number of patient days. There is no multiplier used for this.



Example of VAP Analysis

*National Healthcare Safety Network
Rate Table for Ventilator-Associated FNEU Data for ICU-Other/SCA
As of: August 16, 2006 at 11:06 AM
Data Range: VAP_RATES_ICU_SCA summary TQ 2005Q1 to 2006Q1*

Org ID=10000

Location	VA Pneu		NHSN VA VAP		Incidence Density p-value	Incidence Density Percentile	Patient Days	NHSN Vent DU		Proportion p-value	Proportion Percentile
	Count	Ventilator Days	Rate	Pooled Mean				Util Ratio	Mean		
2SOUTH	0						503				
3 MS	4	509	7.9	5.1	0.2579	83	1,819	0.28	0.37	0.0000	32
BICU	1	203	4.9	12.0	0.2996		507	0.40	0.31	0.0000	
BURN	2	199	10.1	12.0	0.5715		386	0.52	0.31	0.0000	
RICU	0	203	0.0	4.9	0.3671		284	0.71	0.71	0.4423	
SICU	3	295	10.2	9.3	0.5175	62	1,309	0.23	0.44	0.0000	11
STROKE	0						563				

This an example of VAP Analysis that was performed in NHSN. This is a VAP Rate Analysis for a specific time period of your choice. The analysis documents the units being monitored (click), the number of VAPs on the unit, the number of ventilator or device days, the calculated VAP rate for each unit, the NNIS/NHSN VAP pooled mean for comparison the Central Line Device Utilization Ratio for that unit and the NNIS/NHSN DU rate for comparison



Questions ?

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<http://www.cdc.gov/nhsn>

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