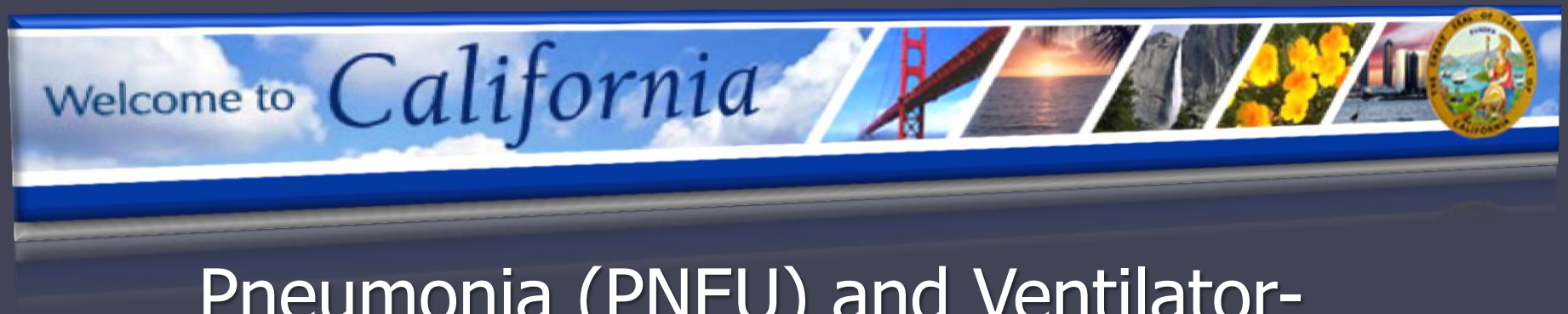


Pneumonia (PNEU) and Ventilator-Associated Pneumonia (VAP) Prevention

CDPH
California Department of
PublicHealth

Basics of Infection Prevention
2-Day Mini-Course
2016

Objectives

- Differentiate long term care categories of respiratory infections from NHSN acute are definitions
- Review the epidemiology and pathogenesis of pneumonia and VAP, focusing on modifiable risk factors
- Discuss evidence-based PNEU/VAE/VAP prevention strategies
- Describe surveillance for PNEU/VAE/VAP

Respiratory Tract Infection – Long Term Care Facilities (LTCF)

Four categories with varying criteria

1. Common cold symptoms/pharyngitis
2. Influenza-like illness
3. Pneumonia
4. Lower respiratory tract (bronchitis or tracheobronchitis)

- Categories used for LTCF surveillance definitions

  Refer to Stone ND, Ashraf MS, Calder J et. Al. CDC/SHEA Surveillance Definitions for Infection in Long-term Care Facilities: Revisiting the McGeer Criteria, 2012.

CDPH California Department of PublicHealth

Ventilator-Associated Pneumonia (VAP)

- Up to 50% patients with VAP die
  - Varies with patient population and organism type
  - Highest mortality occurs in patients with severe illness **and** infection with non-fermentative Gram negative bacilli e.g. Acinetobacter or Burkholderia species
- Increases length of stay >6 ICU days
  - Cost $10,000 - $40,000

CDPH California Department of PublicHealth

Etiology of VAP

Early onset

- Occurs in first 4 days of hospitalization
- More likely to be caused by *Moraxella catarrhalis*, *H. influenzae,* or *S. pneumoniae*

Late onset

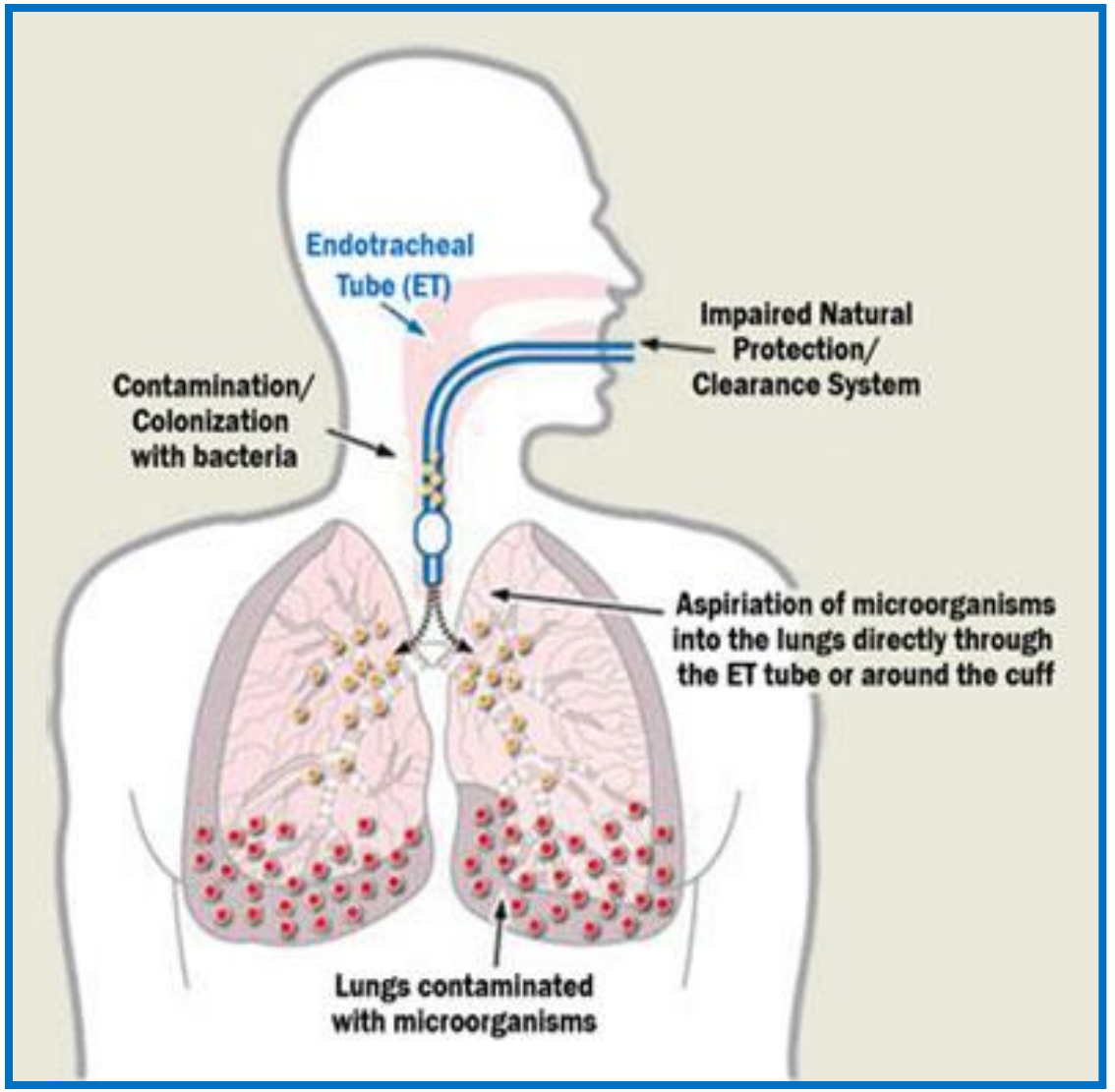
- Occurs 5 or more days into hospitalization
- Often caused by Gram-negative bacilli, or *S. aureus* (including MRSA), yeasts, fungi, *legionellae* and *Pneumocystis carnii*

CDPH California Department of PublicHealth

Pathogenesis of VAP

Results from

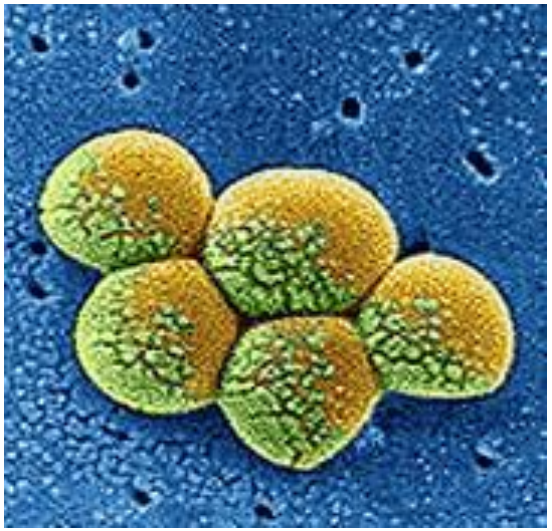
- Aspiration of secretions
- Colonization of aero-digestive tract
- Contaminated respiratory or other medical equipment



CDPH California Department of PublicHealth

VAP Pathogens

- *Staphylococcus aureus* - 24.4%
- *Pseudomonas aeruginosa* - 16.3%
- *Enterobacter spp* - 8.4%
- *Acinetobacter baumannii* - 8.4%
- *Klebsiella pneumoniae* - 7.5%
- *Escherichia coli* - 4.6%
- *Candida spp* - 2.7%
- *Klebsiella oxytoca* - 2.2%
- *Coagulase-negative staphylococci* - 1.3%



CDPH California Department of PublicHealth

Challenges in VAP Prevention

Pre-existing conditions (Non-modifiable risk factors)

- Head trauma
- Coma
- Nutritional deficiencies
- Immunocompromised
- Multi organ system failure
- Acidosis
- Co-morbidities
- History of smoking or pulmonary disease

CDPH California Department of PublicHealth

VAP Prevention Strategies (Modifiable Risk Factors)

1. Prevent aspiration of secretions
   - Maintain elevation of head of bed (HOB) (30-45 degrees)
   - Avoid gastric over-distention
   - Avoid unplanned extubation and re-intubation
   - Use cuffed endotracheal tube with in-line or subglottic suctioning
   - Encourage early mobilization of patients with physical/occupational therapy
2. Reduce duration of ventilation
   - Conduct "sedation vacations"
   - Assess readiness to wean from vent daily
   - Conduct spontaneous breathing trials

CDPH California Department of PublicHealth

VAP Prevention Strategies - continued

3. Reduce colonization of aero-digestive tract
   - Use non-invasive ventilation methods when possible
     - i.e. CPAP, BiPap
   - Use oro-tracheal over naso-tracheal intubation
     - Naso-racheal may cause sinusitis, which increases VAP risk
   - Use cuffed Endotracheal Tube (ETT) with inline or subglottic suctioning
     - Minimizes secretions above cuff; prevents contamination of lower airway
   - Avoid acid suppressive therapy for patients not at high risk for stress ulcer or stress gastritis
     - Increases colonization of the digestive tract

CDPH California Department of PublicHealth

VAP Prevention Strategies - continued

3. Reduce colonization of aero-digestive tract (continued)
   - Perform regular oral care with an antiseptic agent
   - Reduce the opportunities to introduce pathogens into the airway
     - Good hand hygiene
     - Glove use for contact with respiratory secretions or contaminated objects; follow with hand hygiene
     - Educate staff to avoid contaminating the ETT from patient's mouth, HCW hands, introducing pathogens from patient's other body sites or the environment

CDPH California Department of PublicHealth

VAP Prevention Strategies - continued

4. Prevent exposure to contaminated equipment
   - Use sterile H20 to rinse reusable respiratory equipment
   - Remove condensate from ventilatory circuits
   - Change ventilatory circuit only when malfunctioning or visibly soiled
   - Store and disinfect respiratory equipment effectively

CDPH California Department of PublicHealth

Measure Adherence to VAP Prevention Practices

Consider monitoring

- Compliance with hand hygiene
- Compliance with daily sedation vacation/interruption and assessment of readiness to wean
- Compliance with regular antiseptic oral care
- Compliance with semi-recumbent position of all eligible patients

NOTE: Even though California has no VAP/VAE reporting mandate, hospitals are required to have CDC VAP prevention strategies in place (HSC 1288.9)

CDPH California Department of PublicHealth

Identifying VAE and VAP

- Follow NHSN surveillance protocols
- Work with ICU and respiratory therapy staff to develop alerting process
- Monitor ventilated patient for
  - Positive cultures
  - Changes in WBC's
  - Temperature chart/log
  - Pharmacy reports of antimicrobial use
  - Change in respiratory secretions

CDPH California Department of PublicHealth

Defining Ventilator-associated Events including Pneumonia

- Pneumonia definitions subjective and complex
  - No gold standard, valid, reliable surveillance definition could be identified despite years of effort
- New approach is a surveillance definition algorithm that detects a broad range of conditions/complications that occur in mechanically ventilated patients
- Ventilator-associated event **(VAE)** defines
  - Ventilator-associated conditions (**VAC**)
  - Infection-related ventilator-associated complications (**IVAC**)
  - **Possible** ventilator-associated pneumonia (**PVAP**)*

CDPH California Department of PublicHealth

*2015 NHSN Updated Definition

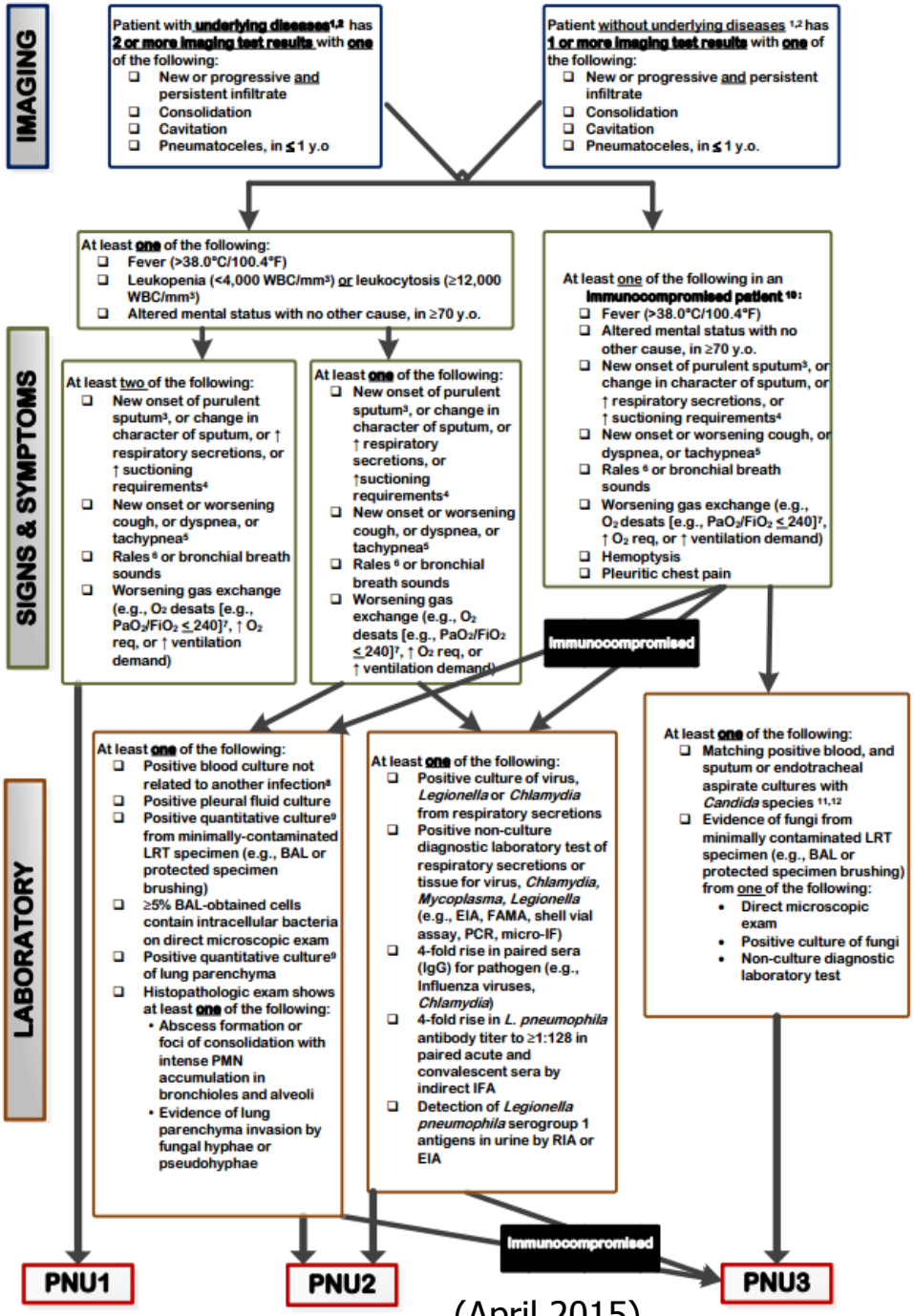
Applying VAE and Pneumonia Surveillance Definitions

- VAE definition: used for all ventilated patients in adult locations (regardless of age)
  - IVAC is an infection-related VAE
  - IVAC/PVAP* is pneumonia that occurs in patients intubated and on mechanical ventilation
- VAP/PNEU definition: used for pediatric locations
  - Includes infant locations (NICU)
- PNEU definition: used for surveillance of patients not ventilated, such as for determining whether a BSI is primary or secondary to pneumonia

CDPH California Department of PublicHealth

*2015 NHSN Updated Definition

Pneumonia Surveillance Definition



(April 2015)

Use for determining secondary BSI infections or Pediatric VAP

Surveillance definition can be met by 3 different criteria

- Clinically defined pneumonia (PNU1)
- Pneumonia with specific laboratory findings (PNU2)
- Pneumonia in immuno-compromised patients (PNU3)

NHSN Patient Safety Module: Chapter 6
Device-Associated Module: PNEU

VAE/VAP Surveillance Definition

- Patient must be ventilated more than 2 calendar days
- Patient must have ≥3 calendar days of stability or improvement of oxygenation followed by ≥2 calendar days of worsening oxygenation.
- Earliest date of event for VAE is mechanical ventilation day 3 (first day of worsening oxygenation).
- First possible day that VAC criteria can be fulfilled is mechanical ventilation day 4
- For VAE surveillance, PEEP values between 0 - 5 cmH2O will be considered equivalent*

CDPH California Department of PublicHealth

*2015 NHSN Updated Definition

NHSN Patient Safety Module: Chapter 10 Device-Associated Module: VAE

Ventilator Associated Event (VAE) and Pneumonia – (New 2015)

- Daily minimum PEEP and FiO_2 values are defined as the lowest value set on the ventilator during a calendar day (and maintained for at least 1 hour)
  - 2015 change: If there is no value documented to have been maintained for at least 1 hour, the daily minimum value is the lowest value set on the ventilator during the calendar day
- VAE New Optional Denominator – Episodes of Mechanical Ventilation (EMV)
  - An episode of mechanical ventilation is a period of days during which the patient was mechanically ventilated for some portion of each consecutive day

VAC Criteria

A baseline period of stability or improvement on the ventilator, defined by ≥2 calendar days of stable or decreasing daily minimum FiO_2 or PEEP.

The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or FiO_2.

AND

After the period of stability – At least 1 of the following 2 criteria sustained for ≥ 2 calendar days:

- ❑ 1. Increase in daily minimum FiO_2 of> 20 points over the daily minimum FiO_2 in the baseline period.
- ❑ 2. Increase in daily minimum PEEP of ≥3 cmH_2O

IVAC Criteria

- Meets VAE criteria for VAC (ventilator associated condition)

AND

- On or after calendar day 3 on ventilator & within 2 calendar days before or after onset worsening oxygenation:

Both of the following **2** criteria are met:

- ❑ 1.Temp >38° C or <36° C,

OR

WBC≥12,000 cells/mm^3 or ≤4,000 cells/mm^3

AND

- ❑ 2. A new antimicrobial agent(s) is started, and is continued for >4 calendar days

Possible/Probable (PVAP) Criteria

- Meets VAE criteria for IVAC (Infection related ventilator associated complication)

AND

- On or after calendar day 3 on ventilator & within 2 calendar days before or after onset of worsening oxygenation:

1 of the following three criteria is met:

- ❑ 1. Positive culture (see list) without requirement for purulent respiratory secretions*
- ❑ 2. Purulent respiratory secretions plus specified positive respiratory culture*
- ❑ 3. Positive pleural culture, lung histopathology, or diagnostic test for Legionella, or specified virus*

*Consult VAE protocol for organism exclusions

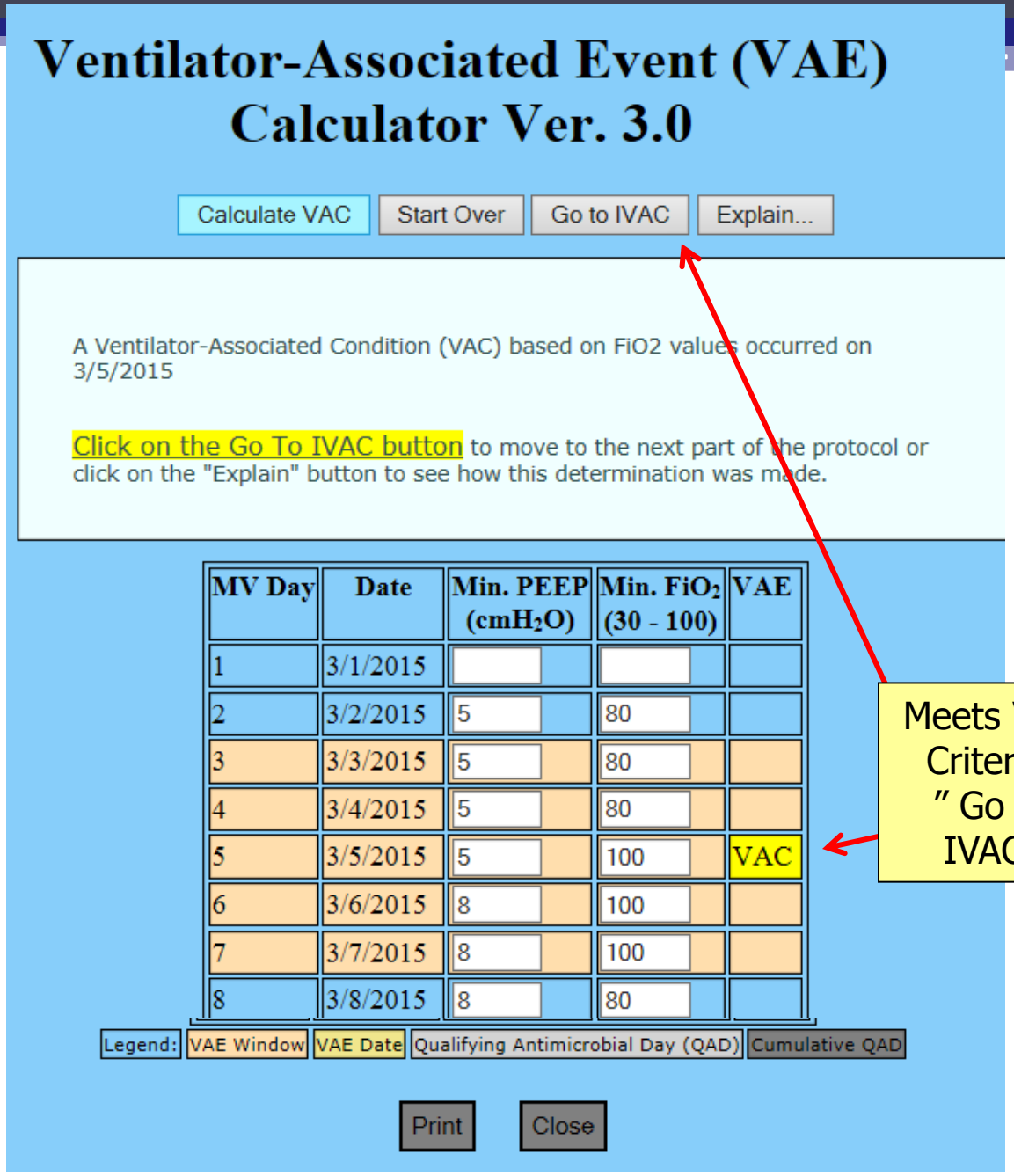
2015 NHSN Updated Definition

NHSN Patient Safety Module: Chapter 10 Device-Associated Module: VAE

CDPH California Department of PublicHealth

NHSN VAE Calculator Version 3.0

1. Enter ventilator data, follow instructions



www.cdc.gov/nhsn/VAE-calculator/

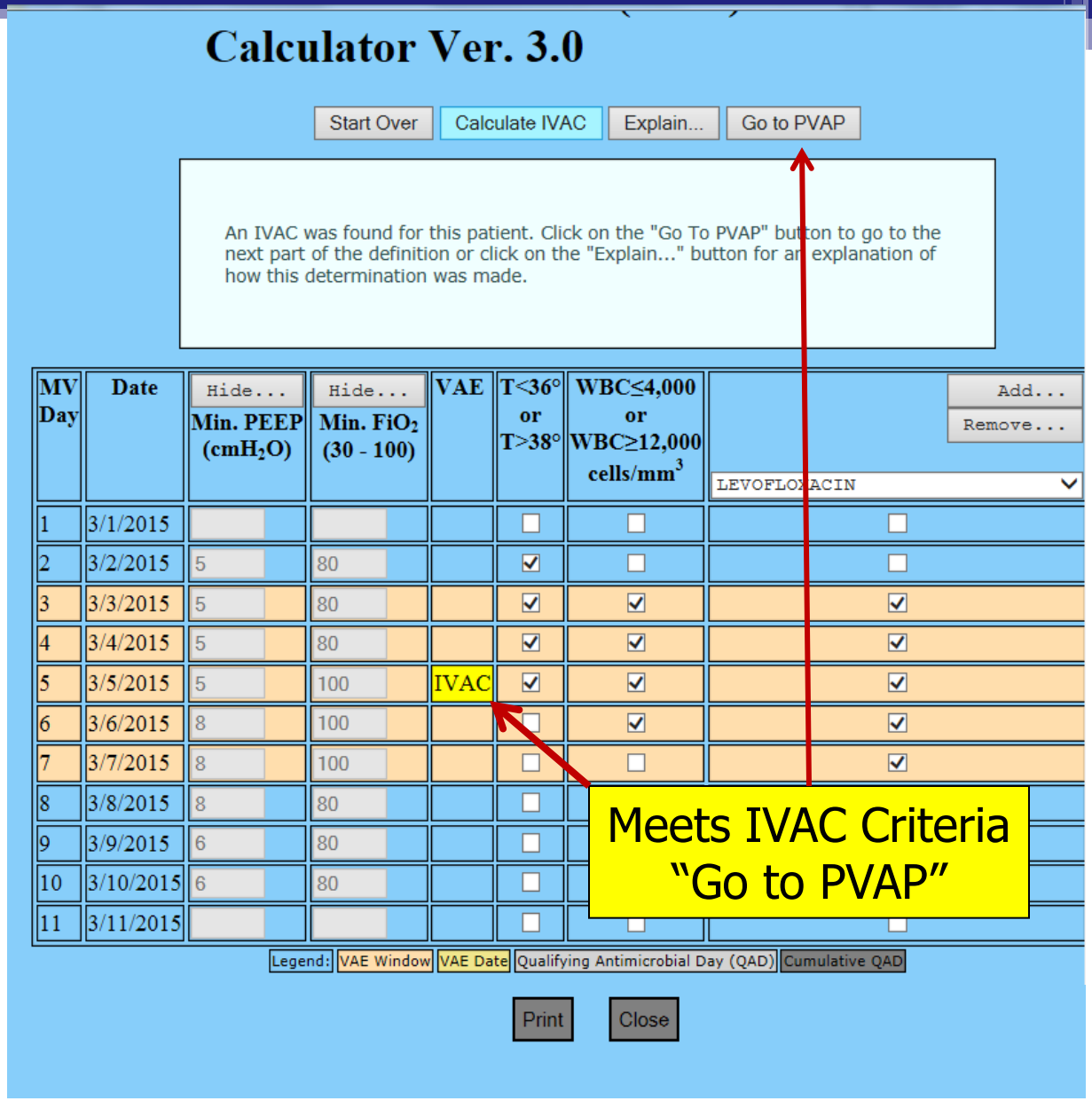
CDPH California Department of PublicHealth

NHSN VAE Calculator

2. Enter temperature, WBC count, antibiotics

3. Click "Calculate IVAC"

www.cdc.gov/nhsn/VAE-calculator/



Ventilator-Associated Event (VAE) Calculator

1.Check off criteria in table, then "Calculate PVAP"

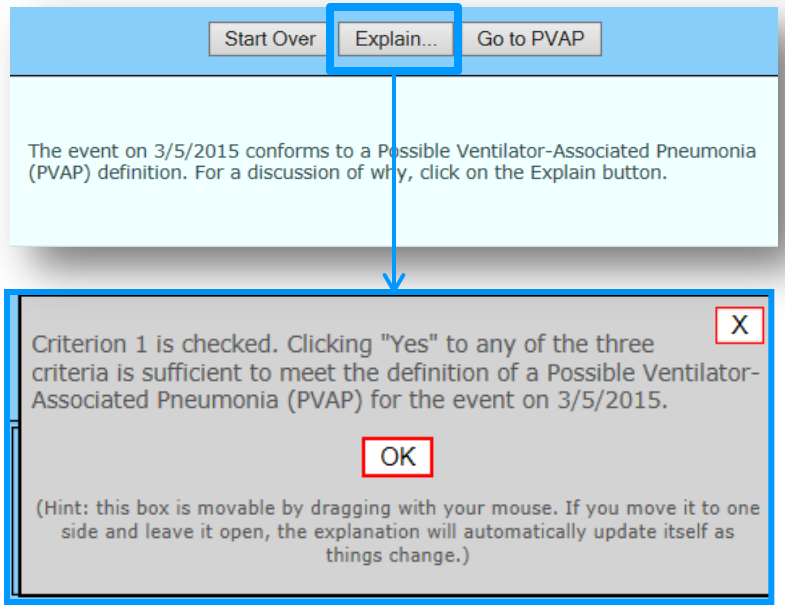
PVAP Determination

For the IVAC on 3/5/2015, did the patient have documentation of any of the following findings during the VAE Window: 3/3/2015 to 3/7/2015.

Question	Yes
Criterion 1. Positive culture of one of the following (without requirement for purulent respiratory secretions): • Endotracheal aspirate ≥ 10^5 cfu/ml* • Bronchoalveolar lavage ≥ 10^4 cfu/ml* • Lung tissue ≥ 10^4 cfu/ml* • Protected specimen brush ≥ 10^3 cfu/ml* *or corresponding semi-quantitative result	☐
Criterion 2. Positive culture of one of the following (qualitative or quantitative/semi-quantitative culture without sufficient growth to meet Criterion 1). • Sputum • Endotracheal aspirate • Bronchoalveolar lavage • Lung tissue • Protected specimen brush **AND** Evidence of purulent respiratory secretions (defined as secretions from lungs, bronchi or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells).	☐
Criterion 3. One of the following positive tests (as outlined in the protocol): • Pleural fluid culture • Lung histopathology • Diagnostic test for *Legionella* species • Diagnostic test for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus or coronavirus.	☐

Calculate PVAP

2. Result:
- After calculating PVAP, a pop-up will appear verifying the type of event.
- Select "Explain" for information on the criteria used.



CDPH California Department of PublicHealth

Summary

- Morbid complications of ventilated patients are common but many can be prevented
- Diagnosis of VAP is very challenging with high inter-observer variability
- Newer VAE definitions reduce variability
  - Currently used only in adult locations
- Focus on prevention
  - Elevate head of the bed
  - Regular oral care with antiseptic
  - Daily sedation interruption and assessment of readiness to extubate
- Regularly audit pneumonia prevention practices

CDPH California Department of PublicHealth

References for VAP Prevention and Bundles

- Institute for Healthcare Improvement (IHI):
  - http://www.ihi.org/knowledge/Pages/Changes/ImplementtheVentilatorBundle.aspx
- SHEA Compendium: Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals: 2014 Update:
  - http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=9497953&fileId=S0195941700094807
- VAP Getting Started Kit: Safer Healthcare Now (Canada)
  - http://www.saferhealthcarenow.ca/EN/Interventions/VAP/Documents/VAP%20One%20Pager.pdf

CDPH California Department of PublicHealth

References and Resources

Coffin, S, et al. Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals. *Infect Control Hosp Epidemiol* 2008; 29:S31-S40.

Greene LR, Sposato K, Farber MR, Fulton TM, Garcia RA. (2009). Guide to the Elimination of Ventilator – Associated Pneumonia. Washington, D.C.: APIC.

Greene LR, Sposato K, Farber MR, Fulton TM, Garcia RA. Guide to the Elimination of Ventilator – Associated Pneumonia, 2009. APIC. 2009.

Hidron AI, et.al., *Infect Control Hosp Epidemiol* 2008;29:996-1011

Magill, SS. (2010). Surveillance for ventilator-associated pneumonia at CDC: Current Approach, Challenges, and Future Directions. Retrieved from lecture notes online website: http://www.hhs.gov/ash/initiatives/hai/Events/progresstoward-day2-magill.pdf

NHSN Patient Safety Module: Chapter 6 (PNEU/VAP) http://www.cdc.gov/nhsn/PDFs/pscManual/6pscVAPcurrent.pdf

Chapter 10(VAE): http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf

CDPH California Department of PublicHealth

Questions?

For more information, please contact any HAI Liaison Team member.

Thank you

CDPH California Department of PublicHealth