Pneumonia and Ventilator-Associated Events (VAE):
Pathophysiology, Epidemiology, and Prevention

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SPICE
April 27, 2026

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Disclosures

- No relevant conflicts of interest

Acknowledgements: Many slides adapted from prior versions of this session by Drs. David Weber and Erin Gettler.

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Outline

- Hospital-acquired pneumonia
  - Epidemiology
  - Pathophysiology and microbiology
  - Diagnosis
  - Prevention
- Surveillance overview
  - Ventilator-associated events
  - Non-ventilator associated pneumonia

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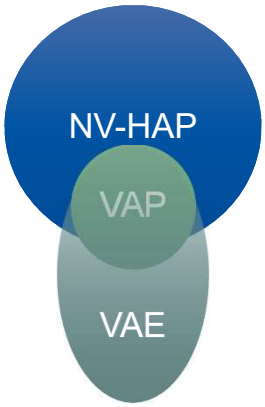
Definitions

- **HAP:** Hospital-acquired pneumonia
- **VAP:** Ventilator-associated pneumonia
- **VAE:** Ventilator-associated event
  - *VAE is a relatively newer term, and fewer data exist on epidemiology, impact, and prevention relative to pneumonia.*
- **NVHAP:** Non-ventilator hospital acquired pneumonia



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Incidence of HAIs:
Acute-care hospitals, 2015

Major Site of Infection	Estimated Number (%)
Pneumonia	176,700 (25.7%)
Gastrointestinal illness	146,300 (21.3%)
Urinary tract infections	62,700 (9.1%)
Primary bloodstream infections	83,600 (12.2%)
Surgical site infections	110,800 (16.1%)
Other types of infection	107,100 (15.6%)
Estimated total number of infections in hospitals	687,200

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Magill SS, et al; Changes in Prevalence of Health Care-Associated Infections in U.S. Hospitals. N Engl J Med. 2018 Nov 1;379(18):1732-1744.

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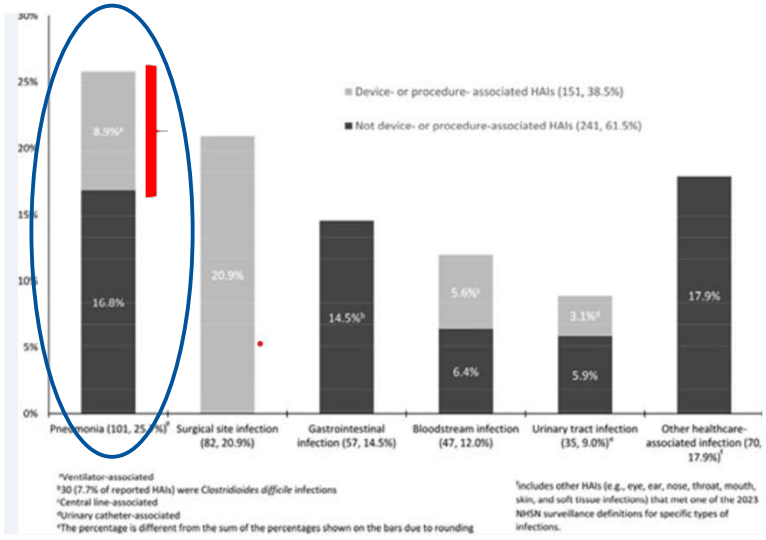
Relative contribution of HAIs:
Acute-care hospitals, 2023

Preliminary Data presented at IDWeek 2024



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Nora Chea, et al. P-427. Prevalence of Healthcare-Associated Infections: 2023 Point Prevalence Survey in 218 U.S. Acute Care Hospitals. *Open Forum Infectious Diseases*, Volume 12, Issue Supplement_1, February 2025, ofae631.628

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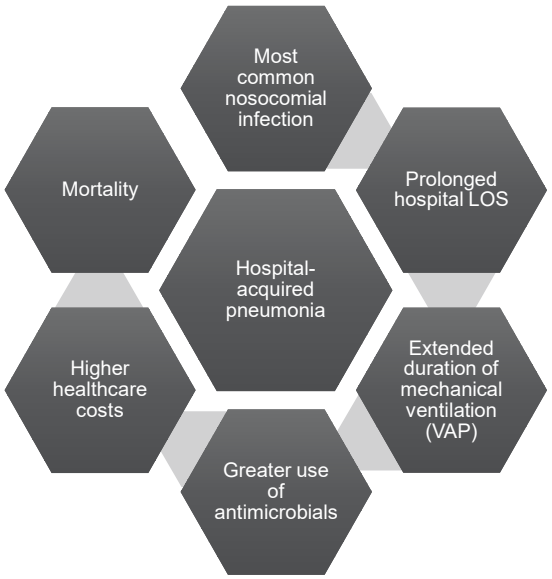
Hospital-acquired pneumonia



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Magill SS, et al; Changes in Prevalence of Health Care-Associated Infections in U.S. Hospitals. N Engl J Med. 2018 Nov 1;379(18):1732-1744.
Giuliano KK, et al. The epidemiology of nonventilator hospital-acquired pneumonia in the United States. Am J Infect Control. 2018 Mar;46(3):322-327.

Hospital-Acquired Pneumonia

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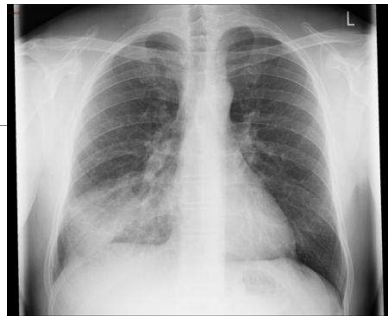
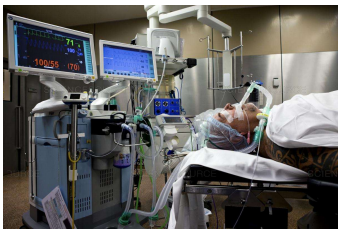
Pneumonia:
Clinical definition

Combination of
- Fever
- Leukocytosis
- Purulent sputum
- Radiographic infiltrates
- Change in oxygenation
- + / - Positive microbiologic culture from respiratory tract

- **Clinical judgment**





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Munro SC, et al. Nonventilator hospital-acquired pneumonia: A call to action. Infect Control Hosp Epidemiol. 2021 Aug;42(8):991-996. doi: 10.1017/ice.2021.239. Epub 2021 Jun 9.

Pneumonia:
Clinical definition

Combination of
- Fever
- Leukocytosis
- Purulent sputum
- Radiographic infiltrates
- Change in oxygenation
- + / - Positive microbiologic culture from respiratory tract

- **Clinical judgment**

Things that may look like pneumonia:
- ARDS
- Pulmonary edema
- Pulmonary hemorrhage
- Aspiration pneumonitis
- Pulmonary embolism
- Drug reaction
- Underlying lung disease exacerbation

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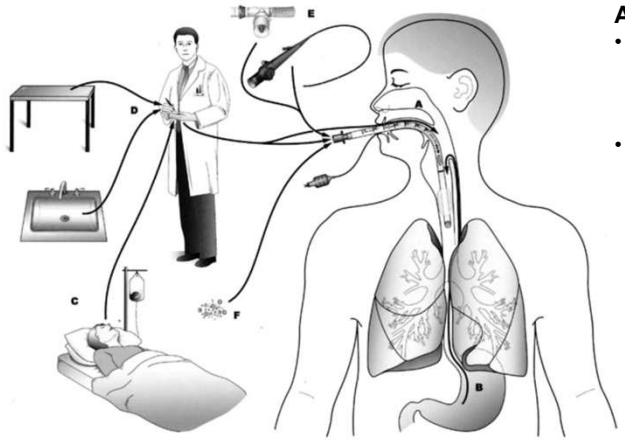
Munro SC, et al. Nonventilator hospital-acquired pneumonia: A call to action. Infect Control Hosp Epidemiol. 2021 Aug;42(8):991-996. doi: 10.1017/ice.2021.239. Epub 2021 Jun 9.

Healthcare-associated pneumonia pathogenesis



Aerodigestive tract colonization

- Colonization of the aerodigestive tract may occur **endogenously** (A and B) or **exogenously** (C through F)
- **Exogenous** colonization may result in primary colonization of the oropharynx or may be the result of direct inoculation into the lower respiratory tract during manipulations of respiratory equipment (D), during using of respiratory devices (E), or from contaminated aerosols (F).

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Safdar N, et al. The pathogenesis of ventilator-associated pneumonia: its relevance to developing effective strategies for prevention. Respir Care. 2005 Jun;50(6):725-39.

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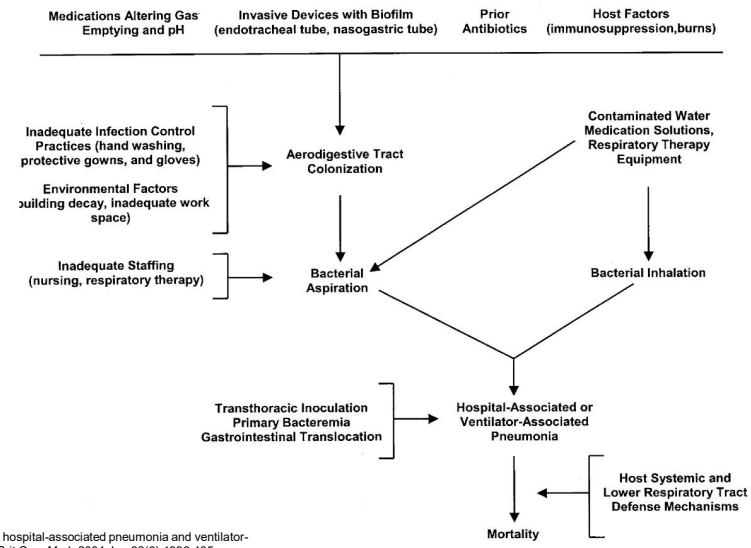
Pathogenesis of pneumonia in hospitalized patients

- **Aspiration** of secretions from upper airway
- **Inhalation** of pathogens (e.g., Legionella, Aspergillus)
- **Instillation** of pathogens (e.g., atypical mycobacteria, environmental Gram-negative rods)



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Kollef MH. Prevention of hospital-associated pneumonia and ventilator-associated pneumonia. Crit Care Med. 2004 Jun;32(6):1396-405.

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HAP/VAP pathogens

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Determinants of pathogens:

- Setting
- Prior antibiotic use
- Duration of hospitalization
  - Early (<5 days): *S. pneumoniae*, *H. influenzae*, MSSA
  - Late (≥5 days): *P. aeruginosa*, MRSA, Gram (-) bacilli
- ICU stay
- Colonization

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HAP/VAP pathogens

Community-acquired	Hospital-acquired	Inhalational	Hematogenous
• *Haemophilus influenzae* • *Streptococcus pneumoniae* • Oropharyngeal streptococci and anaerobes	• Oropharyngeal streptococci and anaerobes • Enterobacteriaceae • Pseudomonas	• Fungi • Legionella • Viruses • Mycobacteria	• *Staph aureus* (common) • Enterobacteriaceae (uncommon)

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HAP/VAP microbiologic diagnosis

- Non-bronchoscopic
  - Sputum or Endotracheal aspiration (common)
- Bronchoscopic techniques
  - Protected specimen brush (PSB)
  - Bronchoalveolar lavage (BAL)
- Tissue diagnosis (rare)
- Pleural fluid analysis & cultures (if parapneumonic effusion present)
- Blood cultures

*****Note: microbiologic diagnosis is not required clinically**

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Prevention of VAE and Pneumonia Guidelines

SHEA/IDSA/APIC 2022

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Category	Rationale	Intervention	Quality of Evidence
Essential practices	Good evidence that the intervention decreases the average duration of mechanical ventilation, length of stay, mortality, and /or costs. Benefits likely outweigh risks.	Avoid intubation and prevent reintubation • Use high-flow nasal oxygen or noninvasive positive pressure ventilation (NIPPV) as appropriate whenever safe and feasible[92–93,96,99]	HIGH
		Minimize sedation[105,106] • Avoid benzodiazepines in favor of other agents[106] • Use a protocol to minimize sedation[108] • Implement a ventilator liberation protocol[113]	MODERATE
		Maintain and improve physical conditioning[113,120–123]	MODERATE
		Elevate the head of the bed to 30–45°[125,388–390]	LOW[a]
		Provide oral care with toothbrushing but *without* chlorhexidine[98,127]	MODERATE
		Provide early enteral vs. parenteral nutrition[131]	HIGH
		Change the ventilator circuit only if visibly soiled or malfunctioning (or per manufacturers' instructions)[391–394]	HIGH
Additional approaches	Good evidence that the intervention improves outcomes in some populations, but may confer some risk in others.	Use selective oral or digestive decontamination in countries and ICUs with low prevalence of antibiotic-resistant organisms[128,134,135]	HIGH[a]
	May lower VAP rates but insufficient data to determine impact on duration of mechanical ventilation, length of stay, or mortality.	Utilize endotracheal tubes with subglottic secretion drainage ports for patients expected to require >48–72 hours of mechanical ventilation[395]	MODERATE
		Consider early tracheostomy[144]	MODERATE
		Consider postpyloric rather than gastric feeding for patients with gastric intolerance or at high risk for aspiration[151,167]	MODERATE
Generally not recommended	Inconsistently associated with lower VAP rates and no impact or negative impact on duration of mechanical ventilation, length of stay, or mortality.	Oral care with chlorhexidine[75,128–130,150]	MODERATE
		Probiotics[153–156]	MODERATE
		Ultrathin polyurethane endotracheal tube cuffs[165–167]	MODERATE
		Tapered endotracheal tube cuffs[169]	MODERATE
		Automated control of endotracheal tube cuff pressure[170,171,174,175]	MODERATE
		Frequent cuff-pressure monitoring[176]	MODERATE
		Silver-coated endotracheal tubes[178]	MODERATE
		Kinetic beds[180]	MODERATE
		Prone positioning[181,183,a]	MODERATE
		Chlorhexidine bathing[184–186,a]	MODERATE
	No impact on VAP rates, average duration of mechanical ventilation, length of stay, or mortality.[a]	Stress-ulcer prophylaxis[190,191,193]	MODERATE
		Monitoring residual gastric volumes[194]	MODERATE
		Early parenteral nutrition[195]	MODERATE
No recommendation	No impact on VAP rates or other patient outcomes, unclear impact on costs.	Closed endotracheal suctioning systems[187–189]	MODERATE

Klompas M, et al. Strategies to prevent ventilator-associated pneumonia, ventilator-associated events, and nonventilator hospital-acquired pneumonia in acute-care hospitals: 2022 Update. Infect Control Hosp Epidemiol. 2022 Jun;43(6):687-713.

Prevention of VAE and Pneumonia Guidelines

Essential practices

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- **Avoid intubation**; use high-flow nasal oxygen or noninvasive positive pressure ventilation
- **Minimize sedation**
- Maintain and improve **physical conditioning**
- **Elevate the head of bed** to 30-45°
- **Oral care** (without chlorhexidine)
- Provide early **nutrition**
- **Change vent circuit per MIFU, or if visibly soiled or malfunctioning**

Klompas M, et al. Strategies to prevent ventilator-associated pneumonia, ventilator-associated events, and nonventilator hospital-acquired pneumonia in acute-care hospitals: 2022 Update. Infect Control Hosp Epidemiol. 2022 Jun;43(6):687-713.

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Preventing HAP/VAP:
An Important Target for Antimicrobial Stewardship

Pathogen	Incidence and resistance trends
MRSA	Rate in VAP: 12–42%[a] Rate of methicillin resistance is decreasing: 1.4–82%[b]
Pseudomonas aeruginosa	Rate in VAP: 21–61% especially for the second episode of VAP[a] MDR/XDR rates as high as 38–46% with 8–20% susceptible only to colistin [12–14] Meropenem with >10% increase in resistance in North America with susceptibility across all classes of antimicrobials at 60–71% [10]
Enterobacteriaceae	Rate in VAP: 5–19.1% with rising rates of resistance to all classes of antimicrobials[a] [9,10,13] Rates of ESBL of 40% in Asia [9]
Acinetobacter spp.	Rate in VAP: 4.8–36.5% (highest in Latin America and Asia) [9,10,13] MDR rate as high as 80% and XDR 50% with 30% susceptible only to colistin [9,10,13] Meropenem and doripenem with >10% increase in resistance [10], colistin-resistant cases reported [15]

Abbreviations: ESBL, extended spectrum β-lactamases; MDR/XDR, multidrug resistant/extremely drug resistant; MRSA, methicillin-resistant *Staphylococcus aureus*; SA, *Staphylococcus aureus*; VAP, ventilator-associated pneumonia.

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Guillamet CV, Kollef MH. Update on ventilator-associated pneumonia. Curr Opin Crit Care. 2015 Oct;21(5):430-8.

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Surveillance: Brief Overview

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Why do we do surveillance?

- Identify **deviations from the norm**
- Devise, implement, and test strategies for **quality improvement**
- Objective data for internal and external **comparisons**

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Haley RW, et al. The SENIC Project. Study on the efficacy of nosocomial infection control (SENIC Project). Summary of study design. Am J Epidemiol. 1980 May;111(5):472-85.

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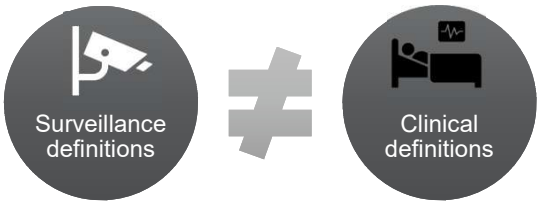
How do we do surveillance?

- CDC's **national surveillance network** for healthcare-associated infections (HAI)
  - Mandatory reporting to states and CMS
- **Standardized case definitions** of HAIs
  - Goal is to allow 'fair' comparisons over time and between facilities

https://www.cdc.gov/nhsn

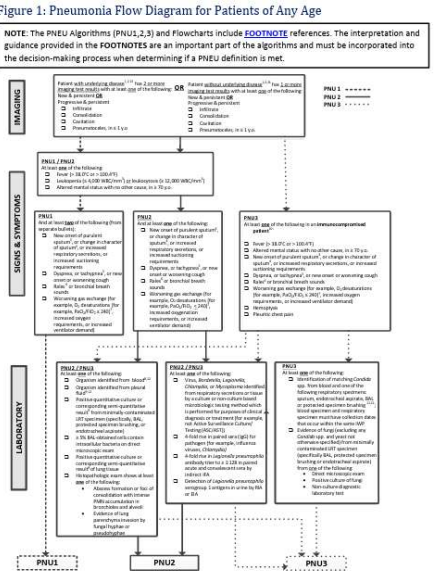
Challenges of surveillance

- **Balancing objectivity with clinical relevance**
- Ideally, a good target…
  - Can be objectively defined
  - Is relevant
  - Can be modified



Challenges of surveillance

- **Burden of data collection**
  - Overly burdensome or complicated algorithms
  - Problems with inter-rater reliability
  - Quality of surveillance data may suffer



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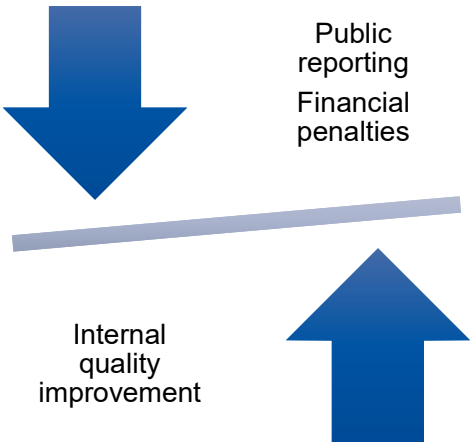
https://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf

Challenges of surveillance

- **Risk adjustment**
- Some patients will be more or less at risk for certain complications.
- Some hospitals may treat more high-risk patients than other hospitals



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Ventilator-Associated Events

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VAE

Definition created in 2014

- Prior ventilator-associated pneumonia (VAP) surveillance definitions: *subjective and non-specific*
- Concerns about 'old' PNUE definitions:
  - Definitions prone to gaming or under-reporting
  - Narrowly interpret radiographs
  - Allow clinicians to veto surveillance determinations
  - Losing sight of the value and mission of surveillance
  - Difficult to determine effectiveness of interventions

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Magill SS, et al. Developing a new, national approach to surveillance for ventilator-associated events*. Crit Care Med. 2013 Nov;41(11):2467-75.
Klompas M. Eight initiatives that misleadingly lower ventilator-associated pneumonia rates. Am J Infect Control. 2012 Jun;40(5):408-10.

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VAE

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Ventilator-associated condition (VAC)

Worsening oxygenation

↓

Infection-related VAC (IVAC)

Fever/hypothermia | WBC | Antibiotic

↓

Possible ventilator-associated pneumonia (PVAP)

Respiratory specimen data

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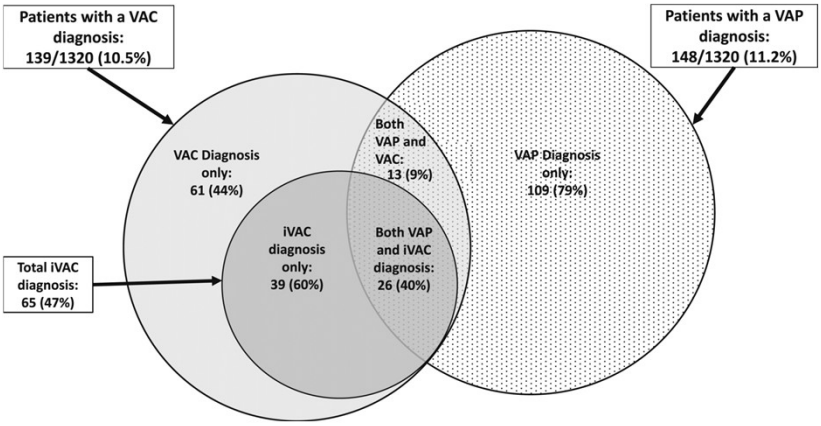
VAE ≠ VAP

A paradigm shift



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Muscedere J, et al. The clinical impact and preventability of ventilator-associated conditions in critically ill patients who are mechanically ventilated. Chest. 2013 Nov;144(5):1453-1460.

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"Only **VAC and IVAC … are intended to be possible candidates for future use in public reporting, inter-facility comparisons, and pay-for-performance programs**. The VAC and IVAC definitions use criteria based on data anticipated to be available from most mechanically ventilated patients and less subject to manipulation or gaming. By contrast, the third definition tier, **possible and probable VAP, was developed to be used only in internal quality improvement**."

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Magill SS, et al. Developing a new, national approach to surveillance for ventilator-associated events: executive summary. Clin Infect Dis. 2013 Dec;57(12):1742-6.

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What are VAEs?

- **VAEs are common**
  - 77% of patients with at least 1 VAC
  - 29% of patients with at least 1 IVAC
  - There are many etiologies of VAE
    - Infectious complications (not just pneumonia) common
    - Non-infectious complications not directly related to mechanical ventilation also play role

Variables[a]	Ventilator-Associated Condition ($n = 2,331$)	Infection-Related Ventilator-Associated Complication ($n = 869$)
Number of etiologies per patient		
0	818 (35.1)	189 (21.78)
1	726 (31.2)	260 (29.9)
2	445 (19.1)	213 (24.5)
3	214 (9.2)	124 (14.3)
≥ 4	128 (5.5)	83 (9.6)
Nosocomial infections	637 (27.3)	381 (43.8)
Ventilator-associated pneumonia	339 (14.5)	240 (27.6)
Tracheobronchitis	23 (1)	12 (1.4)
Bloodstream infection	173 (7.4)	95 (10.9)
Catheter-related infection	81 (3.5)	44 (5.1)
Urinary infection	102 (4.4)	42 (4.8)
Sinusitis	5 (0.2)	4 (0.5)
Viral infection	10 (0.4)	8 (0.9)
Surgical site infections	41 (1.8)	30 (3.5)
Iatrogenic adverse events	322 (13.8)	137 (15.8)
Pneumothorax	37 (1.6)	23 (2.6)
Failure of planned extubation	11 (0.5)	1 (0.1)
Accidental extubation	21 (0.9)	9 (1)
Self-extubation	71 (3)	19 (2.2)
Venous puncture accident	14 (0.6)	9 (1)
Atelectasis	52 (2.2)	20 (2.3)
Peripheral thrombosis	36 (1.5)	18 (2.1)
Pulmonary embolism	9 (0.4)	1 (0.1)
Myocardial infarction	10 (0.4)	4 (0.5)
Cardiac arrest	43 (1.8)	24 (2.8)
Cardioversion	29 (1.2)	17 (2)
Gastrointestinal bleeding	26 (1.1)	11 (1.3)
Acute mesenteric infarction	5 (0.2)	4 (0.5)
Intestinal pseudo-obstruction	2 (0.1)	0
Transport	387 (16.6)	186 (21.4)
Fluid resuscitation	123 (5.3)	58 (6.7)

[a]Expressed as number (%).

CRITICAL CARE MEDICINE

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Bouadma L, et al. Ventilator-Associated Events: Prevalence, Outcome, and Relationship With Ventilator-Associated Pneumonia. Crit Care Med. 2015 Sep;43(9):1798-806.

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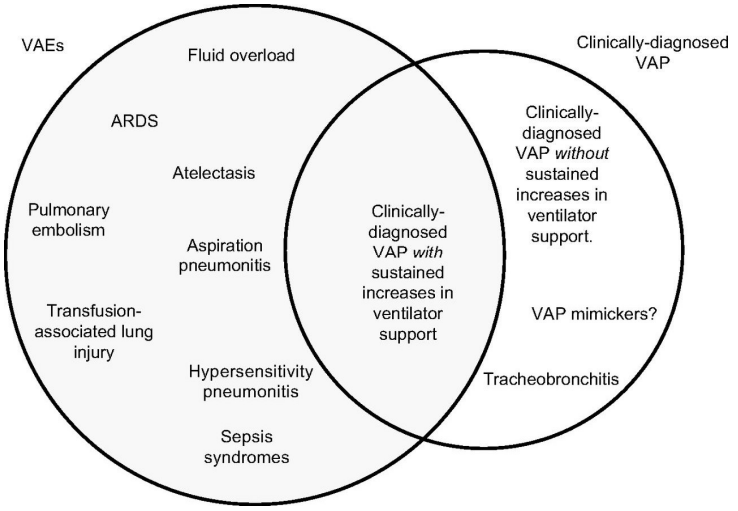
What are VAEs?



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Klompas M. Ventilator-Associated Events: What They Are and What They Are Not. Respir Care. 2019 Aug;64(8):953-961.

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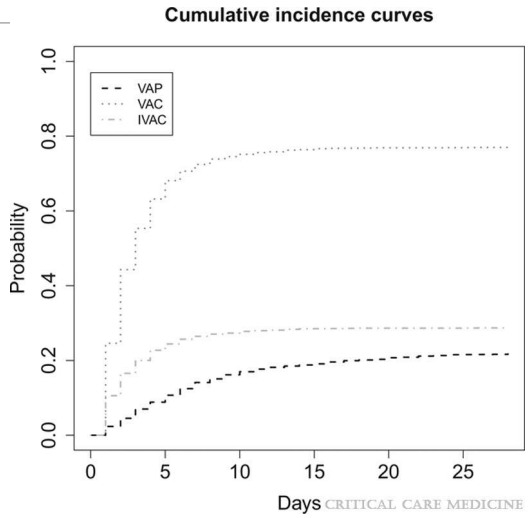
Incidence of VAEs:
VAC/IVAC/VAP

- Approximately 5-10% of mechanically ventilated patients develop VAEs
- Probability increases with duration of mechanical ventilation
  - Most occur within the first week of ventilation
  - Approaches 80% at 30 days
- Incidence varies widely among reporting hospitals and by unit type
  - Higher among neuro, surgery, and trauma units, academic-affiliated medical centers



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Bouadma L, et al. Crit Care Med. 2015 Sep;43(9):1798-806.
Magill SS, et al. Crit Care Med. 2016 Dec;44(12):2154-2162.
Klompas M, et al. Infect Control Hosp Epidemiol. 2022 Jun;43(6):687-713.

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Relevance of VAEs

- Duration of ventilation
  - 14.7 days VAC vs 9 days non-VAC
- ICU LOS:
  - 22 days IVAC vs 9.3 days non-IVAC
- Antibiotic usage:
  - 17.8 days IVAC vs 9.3 days non-IVAC
- Mortality:
  - In-hospital mortality 38-50%
  - OR 2.0 (1.3-3.2) vs. non-VAE

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Klompas M, et al. PLoS One. 2011 Mar 22;6(3):e18062.
Muscedere J, et al. The clinical impact and preventability of ventilator-associated conditions in critically ill patients who are mechanically ventilated. Chest. 2013 Nov;144(5):1453-1460.

Relevance of VAE

- Relative to surveillance definition of VAP, VAC was:
  - Faster
  - A better predictor of outcomes and mortality
  - Attributable to similar frequencies of pneumonia, pulmonary edema, ARDS, and atelectasis.

"Screening ventilator settings for VAC captures a similar set of complications to traditional VAP surveillance but is faster, more objective, and a superior predictor of outcomes."

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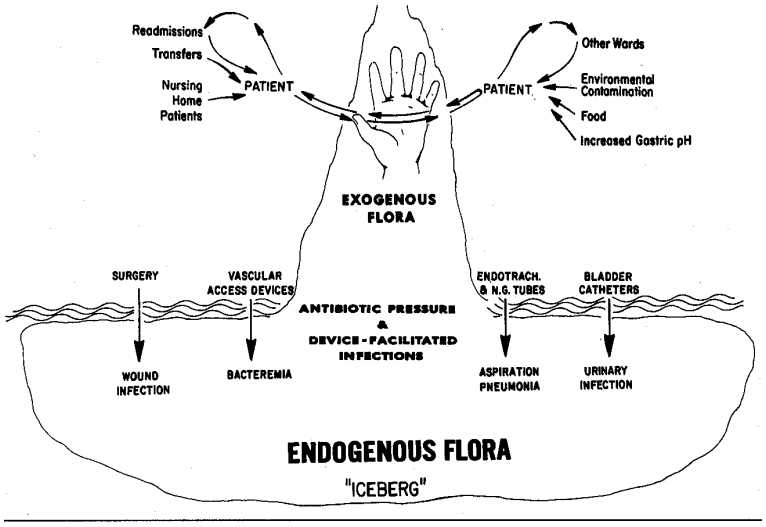
Klompas M, et al. PLoS One. 2011 Mar 22;6(3):e18062.
Muscedere J, et al. The clinical impact and preventability of ventilator-associated conditions in critically ill patients who are mechanically ventilated. Chest. 2013 Nov;144(5):1453-1460.

VAE Prevention



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Weinstein RA. Epidemiology and control of nosocomial infections in adult intensive care units. Am J Med. 1991 Sep 16;91(3B):179S-184S.

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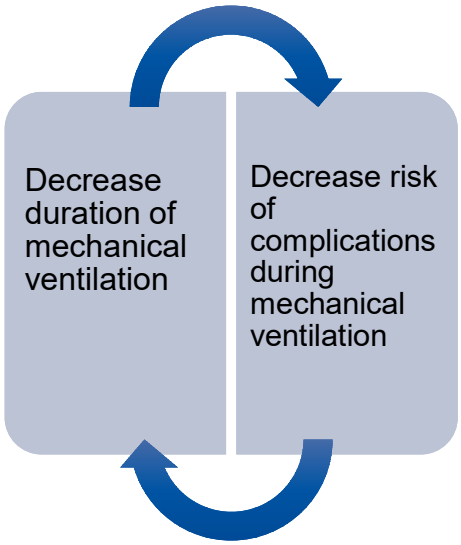
VAE Prevention

These 2 aspects of prevention are intimately related



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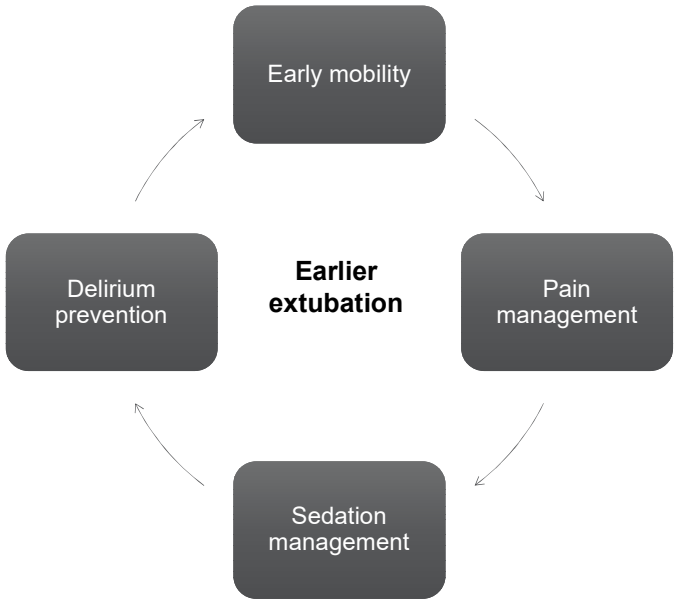
VAE Prevention



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VAE Prevention

⇩ **Possible** (evidence from observational studies alone and/or inconsistent evidence from randomized controlled trials) ⬇ **Probable** (evidence from randomized controlled trials and/or meta-analyses)	Duration of Ventilation	Pneumonia	Atelectasis	ARDS	Fluid Overload
Minimize sedation	⬇	⇩	⇩		
Paired SATs and SBTs	⬇	⇩		⇩	
Early mobility	⬇	⇩	⇩		
Low tidal volume ventilation	⇩	⬇	⬇	⬇	
Conservative fluid management	⬇	⇩		⇩	⬇
Conservative transfusion thresholds	⇩	⬇		⬇	⬇

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Klompas M. Potential Strategies to Prevent Ventilator-associated Events. Am J Respir Crit Care Med. 2015 Dec 15;192(12):1420-30.

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VAE Prevention:
Pain and sedation management

- Sedatives and analgesics are mandatory in most mechanically ventilated patients.
- Overuse of analgesics/sedating medications may impair ventilator weaning, resulting in prolonged intubation, mechanical ventilation, and ICU stay.

Recommendation:

- Nurse-driven assessments and protocols to target sedation to a monitored sedation goal.
- Daily spontaneous awakening trials in appropriate patients

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Degrado JR, et al. Evaluation of a local ICU sedation guideline on goal-directed administration of sedatives and analgesics. J Pain Res. 2011;4:127-34.

VAE Prevention:
Pain and sedation management

Goal-directed analgesia and sedation:

- Measure and document pain and sedation level using validated, objective criteria
  - Pain: Behavioral Pain Scale (BPS)
  - Sedation: Richmond-Agitation Sedation Scale (RASS)
- Implement nurse-driven protocols to target adequate analgesia and light sedation
- Screen for and treat delirium

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Degrado JR, et al. Evaluation of a local ICU sedation guideline on goal-directed administration of sedatives and analgesics. J Pain Res. 2011;4:127-34.
Barr J, et al. Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the Intensive Care Unit: executive summary. Am J Health Syst Pharm. 2013 Jan 1;70(1):53-8.

VAE Prevention: Wake Up and Breathe

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ATS Journals

American Journal of Respiratory and Critical Care Medicine

The Preventability of Ventilator-associated Events. The CDC Prevention Epicenters Wake Up and Breathe Collaborative

Michael Klompas [1,2]*, Deverick Anderson [3]*, William Trick [4], Hilary Babcock [5], Meeta Prasad Kerlin [6], Lingling Li [1], Ronda Sinkowitz-Cochran [7], E. Wesley Ely [8,9], John Jernigan [7], Shelley Magill [7], Rosie Lyles [4], Caroline O'Neil [5], Barrett T. Kitch [10], Ellen Arrington [10], Michele C. Balas [11], Ken Kleinman [1], Christina Bruce [1], Julie Lankiewicz [1], Michael V. Murphy [1], Christopher E. Cox [3], Ebbing Lautenbach [6], Daniel Sexton [3], Victoria Fraser [5], Robert A. Weinstein [12], and Richard Platt [1,2], for the CDC Prevention Epicenters

Assess the preventability of VAEs with daily, coordinated spontaneous awakening trials and spontaneous breathing trials.

Klompas M, et al. The preventability of ventilator-associated events. The CDC Prevention Epicenters Wake Up and Breathe Collaborative. Am J Respir Crit Care Med. 2015 Feb 1;191(3):292-301.

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VAE Prevention: Spontaneous Awakening Trial

Safety screen	SAT failure
• No active seizures • No alcohol withdrawal • No agitation • No paralytics • No myocardial ischemia • Normal intracranial pressure	• Anxiety, agitation, pain • Respiratory rate >35/min • Oxygen saturation <88% • Respiratory distress • Acute cardia arrhythmia

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VAE Prevention:
Spontaneous Breathing Trial

Safety screen	SBT failure
• No agitation • Oxygen saturation ≥88% • FiO2 ≤50% • PEEP ≤7.5cm H_2O • No myocardial ischemia • No vasopressor use • Inspiratory efforts	• Respiratory rate >35/min or <8/min • Oxygen saturation <88% • Respiratory distress • Mental status change • Acute cardiac arrhythmia

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VAE Prevention:
Wake Up and Breathe

- Improved performance of daily SAT when indicated (14 to 77%)
- Improved performance of SBTs when indicated (49 to 75%)
- Improved proportion of SBTs performed with sedatives off (6 to 87%)

- Decreased mean duration of mechanical ventilation by 2.4 (95% CI 1.7-3.1) days
- Decreased ICU LOS by 3.0 (95% CI 1.6-4.3) days

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Klompas M, et al. The preventability of ventilator-associated events. The CDC Prevention Epicenters Wake Up and Breathe Collaborative. Am J Respir Crit Care Med. 2015 Feb 1;191(3):292-301.

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VAE Prevention

ABCDEF Bundle

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A: Assess, Prevent, Manage Pain

B: Both Spontaneous Awakening Trials and Spontaneous Breathing Trials

C: Choice of Analgesia and Sedation

D: Delirium: Assess, Prevent, and Manage

E: Early Mobility and Exercise

F: Family Engagement and Empowerment

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VAEs: Review

	What They Are	What They Aren't
Intent	Surveillance concept	Clinical diagnosis
Surveillance	Objective and reproducible	Sensitive/specific for VAP
Etiology	Many potential causes including non-infectious ones	Proxy for pneumonia
Morbidity	Highly morbid	Not benign
Prevention strategy	Re-think prevention bundles: Minimize sedation Early mobility Low tidal volume ventilation Conservative fluid management	Not fully preventable by traditional bundles

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Klompas M. Ventilator-Associated Events: What They Are and What They Are Not. Respir Care. 2019 Aug;64(8):953-961.

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Establishing VAE surveillance and prevention

- Establish multidisciplinary collaboration
- Review surveillance definitions and goals of surveillance
- Frame VAE as an objective measure with many etiologies
- Agree on best practices to prevent harm and track performance

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Non-ventilator Associated Pneumonia

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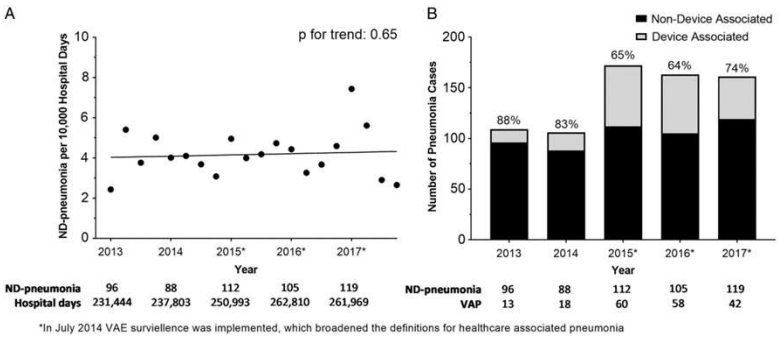
UNC: Leaders in Non-ventilator Pneumonia Surveillance



*In July 2014 VAE surviellence was implemented, which broadened the definitions for healthcare associated pneumonia

"Between 2013 and 2017, the rate of ND pneumonia cases remained constant in UNC Hospitals, and non–device infections continue to account for most hospital-associated pneumonia cases."

Strassle PD, Sickbert-Bennett EE, Klompas M, et al. Incidence and risk factors of non–device-associated pneumonia in an acute-care hospital. *Infection Control & Hospital Epidemiology*. 2020;41(1):73-79.

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Non-ventilator-associated pneumonia

Quick Safety

Issue 61 | September 2021

Preventing non-ventilator hospital-acquired pneumonia

Issue:

It's estimated that one in every 100 hospitalized patients will be affected by non-ventilator hospital-acquired pneumonia (NVHAP). While NVHAP is a significant patient safety and quality of care concern, it is not currently recognized as one of the National Database of Nursing Quality indicators for which hospitals are held accountable; nor is it one of the conditions that the Centers for Medicare & Medicaid Services (CMS) requires hospitals to report to the Centers for Disease Control & Prevention (CDC) National Healthcare Safety Network; and it is not integrated into the CMS current pay-for-reporting or performance programs.[1] As a result, this leaves NVHAP a health care-acquired condition without national tracking or accountability, and, most likely, is unaddressed by health care organizations.

Quick Safety Alert: Preventing non-ventilator hospital-acquired pneumonia. The Joint Commission. 2021: 61. https://www.jointcommission.org/resources/news-and-multimedia/news/2021/09/new-quick-safety-on-preventing-nvhap/

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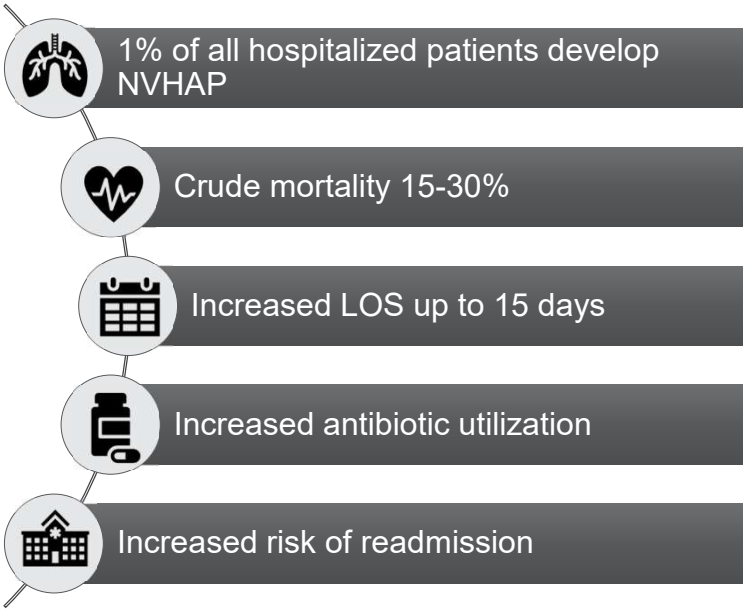
Non-ventilator-associated HAP (NVHAP)



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Munro SC, et al. Nonventilator hospital-acquired pneumonia: A call to action. Infect Control Hosp Epidemiol. 2021 Aug;42(8):991-996. doi: 10.1017/ice.2021.239. Epub 2021 Jun 9.

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Watch This Space: Proposed Electronic Definition for Non-Ventilator Pneumonia

- **Proposed electronic definition:**
  - 2 or more days of sustained decreased oxygenation
  - Fever or elevated WBC
  - Chest imaging
  - 3 or more days of new antibiotics
- **Applied definition within 284 hospitals in the VA and HCA systems**
  - Incidence of NV-HAP: 0.55 events per 100 admissions
  - Occurred in patients with multiple comorbidities, often at the end of life
  - Attributable mortality from NV-HAP estimated at 7% of all inpatient deaths

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Jones BE, Sarvet AL, Ying J, et al. Incidence and Outcomes of Non–Ventilator-Associated Hospital-Acquired Pneumonia in 284 US Hospitals Using Electronic Surveillance Criteria. *JAMA Netw Open*. 2023;6(5):e2314185

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Non-ventilator-associated HAP

Current Gaps
- No standard surveillance definition or methodology

Big questions
- How can we improve the reproducibility, relevance, and efficiency of surveillance for HAP?
- To what extent is NVHAP preventable?
- What are the best-performing interventions to prevent NVHAP?

In absence of data
- Promote early mobility
- Screen for and manage dysphagia to reduce risk of aspiration
- Decrease risk of hospital transmission of respiratory viruses
- Perform regular oral care

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Munro SC, et al. Nonventilator hospital-acquired pneumonia: A call to action. Infect Control Hosp Epidemiol. 2021 Aug;42(8):991-996. doi: 10.1017/ice.2021.239. Epub 2021 Jun 9.

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Pneumonia and VAE surveillance:
Current state for many IP programs

	PNEU	VAE
Surveillance	Selectively performed on cases of BSI in patients with central venous catheters to determine if criteria met for secondary attribution (all programs)	Performed on all patients on mechanical ventilation > 4 days
Clinical relevance	Poor correlation between clinical and surveillance definitions of pneumonia	Not specific for an individual clinical presentation – represents a large group of conditions
Prevention	Hand hygiene, avoid ventilation when possible, early mobility, pain/sedation management, elevate head of bed, minimize unnecessary devices, antibiotic stewardship	

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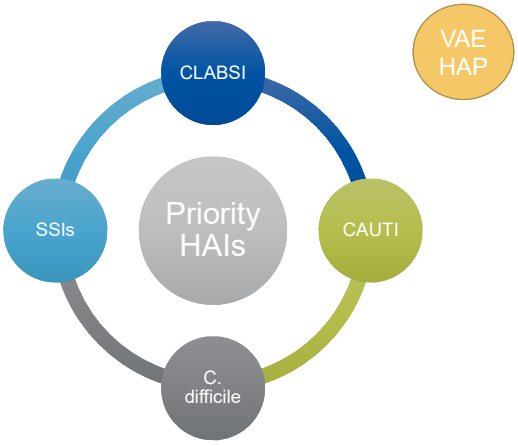
Where does VAE/VAP/HAP prevention fit in?



IMPORTANCE OF VAE PREVENTION

- **Correlates with important quality outcomes including mortality, length of stay**
- **Key prevention strategies provide many layers of benefit for patients**
- **Strong correlation with antimicrobial utilization**
  - Prevent MDROs
  - Decrease *C. difficile* rates

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Take Home Points

- VAE and HAP are common and highly correlated **with healthcare utilization, morbidity, and antimicrobial utilization**.
- Growing interest in **NVHAP** as a target for prevention though more work needed to define best surveillance and prevention measures
- VAE definitions are based on **objective criteria**.
- **Infectious and non-infectious** conditions will be identified as VAEs.
- Many VAEs are believed to be preventable complications.
  - **Optimize pain management, sedation, delirium, early mobilization.**

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Questions

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