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

David J. Weber, MD, MPH, FIDSA, FSHEA, FRSM (London) Sanders Distinguished Professor of Medicine, Pediatrics and Epidemiology Associate Chief Medical Officer, and Quality Officer, UNC-MC Medical Director, Hospital Epidemiology, UNC-MC University of North Carolina, Chapel Hill, NC President Elect, Society for Healthcare Epidemiology of America

Disclosures: Consultancy; Pfizer, GSK, Merck, PDI, BD, Germitec, GAMA All devices/methods discussed consistent with FDA and EPA regulations

Overview	
Ventilator associated events     Surveillance     Epidemiology     Prevention	
Hospital Acquired Pneumonia • Epidemiology • Pathophysiology and Microbiology • Diagnosis • Prevention	
Thanks to Sarah Lewis for slides	UNC

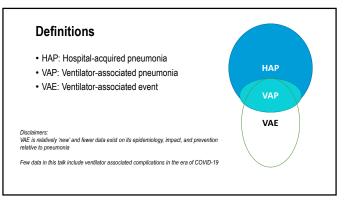
1

UNC

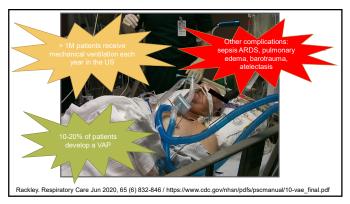
ESTIMATES OF HAIS OCCURRING IN ACUTE CARE
HOSPITALS, US, 2011

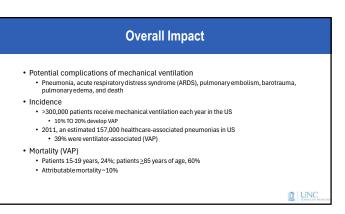
Pneumonia	157,500 (21.8%)	
Gastrointestinal illness	123,000 (17.0%)	
Urinary tract infections	93,000 (12.9%)	
Primary bloodstream infections	71,900 (10.0%)	
Surgical site infections from any inpatient surgery	157,000 (21.7%)	
Other types of infection	118,500 (16.3%)	
Estimated total number of infections in hospitals	721,800	

Magill SS, et al. New Engl J Med 2014;370:1198





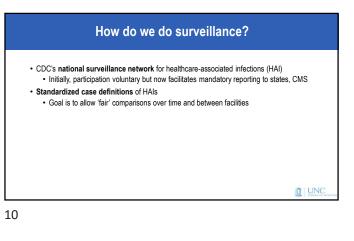


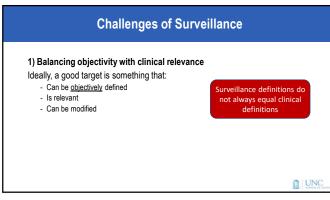


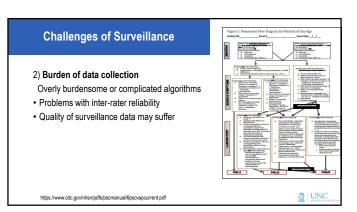
Type of infection	Infections Identified in Survey	Surveyed Patients with Type of Infection	Estimated Infections in the United States*
	80.	% (85% C)	no. (93% CI)
All health care-associated infections			
Preumonia	110	24.3 (20.6-28.5)	137,500 (50,800-281,400)
Surgical-site infection	\$307	24.3 (20.6-28.5)	137,500 (50,800-281,400)
Gastrointestinal infection	86	18.0 (15.6-32.8)	123,100 (38,400-223,100)
Uninary tract infection	85	14.4 (11.4-17.9)	93,300 (28,105-176,700)
Primary bloodstream infection	30	13.1 (8.4-14.2)	71,900 (20,700-140,200)
Eye, ear, nose, throat, or mouth infection	282	6.2 (4.2-8.7)	40,200 (10,400-85,900)
Lower respiratory tract infection	20	4.4 (2.8-4.4)	28,100 (6900-65,200)
Skin and soft-tasser infection	36	3.5 (2.1-3.4)	22,700 (\$200-35,300)
Cardiovascular system infection	6	1.3 (0.5-2.7)	8,400 (1200-26,700)
Bone and joint infection	5	1.1 (0.4-2.4)	7,100 (1000-23,700)
Central nervous system inflection	4	0.9 (0.3-2.1)	5,800 (790-20,790)
Reproductive tract infection	3	0.7 (0.2-1.8)	4,500 (500-17,800)
Systemic inflection	1	0.2 (0.01-1.1)	1,300 (0-10,900)
Tetal			721.800 (214,700-1.411.000
infactions in non-neosatal intensive care units			
Calibreten-associated uninary tract infection	25	5.5 (3.7-2.9)	31,600 (9100-78,000)
Central-catheter-associated primary bloodstream infection	11	2.4 (1.3-4.2)	13,600 (2200-41,500)
Ventilator-associated pneumonia	35	7.7 (5.5-10.5)	49,900 (11,600-101.700)
Surgical Life infections attributed to Surgical Care Improvement Project procedures§	45	10.3 (7.4-13.2)	66,100 (18,700-130,300)
Hospital-onset infections caused by specific pathogens			
Ontridum diffude infection¶	56	32.4 (9.6-15.7)	80,400 (23,700-155,000)
MESA bacteremia)	7	1.5 (0.7-3.0)	9,700 (1700-29,600)

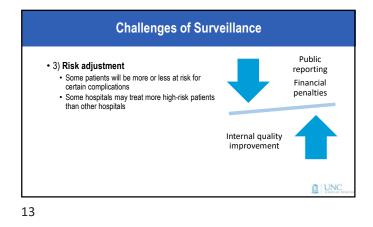


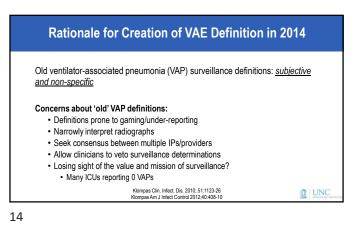


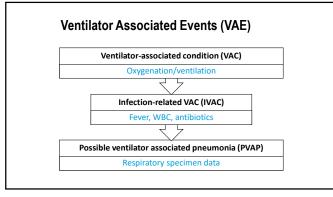




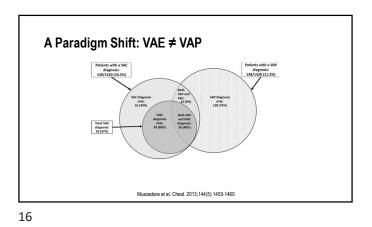


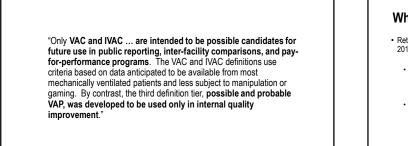




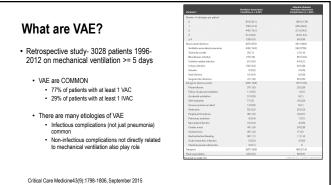


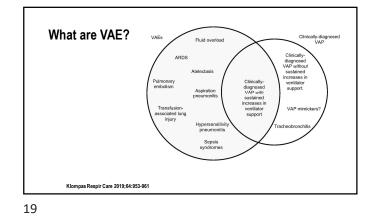


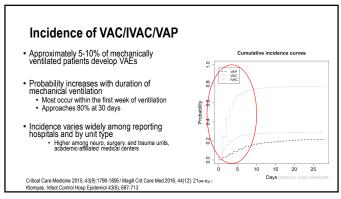


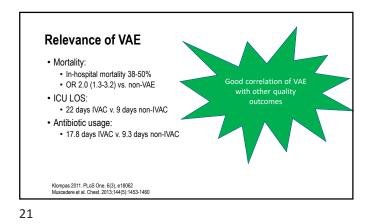


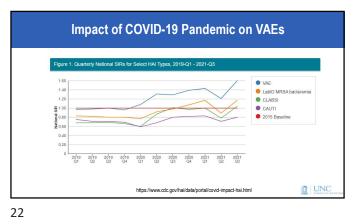
Magill et al. Clin Infect Dis 2013; 57(12):1742-46.

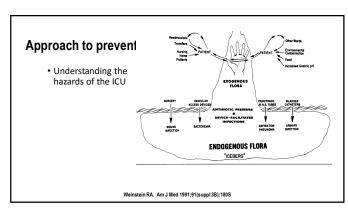


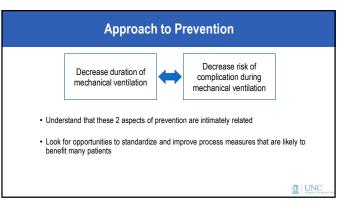


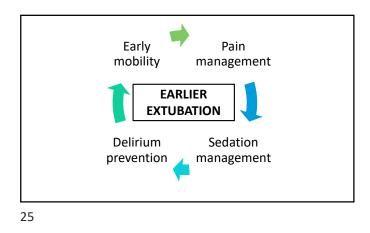


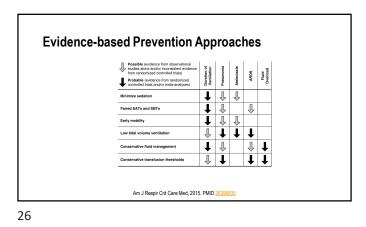






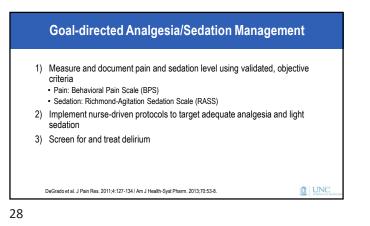


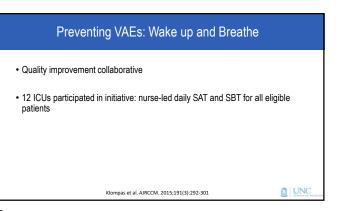


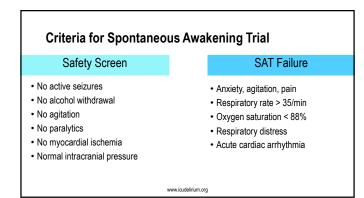


Sedation Management
 Sedatives and analgesics are mandatory in most mechanically ventilated patients
 Overuse of analgesics/sedating medications may impair ventilator weaning, resulting in prolonged intubation, mechanical ventilation, and ICU stay
 Recommendation:

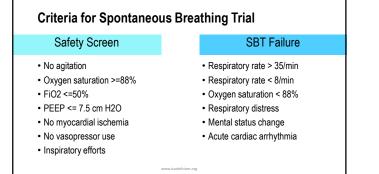
 Nurse-driven assessments and protocols to target sedation to a monitored sedation goal
 Daily spontaneous awakening trials in appropriate patients\*







UNC



31

### Preventing VAEs: Wake up and Breathe

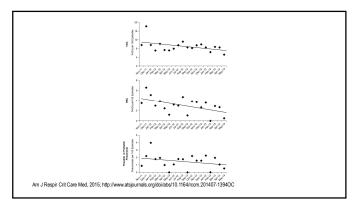
#### Participating units

- 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%)

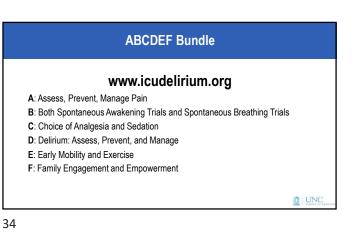
Klompas Am J Respir Crit Care Med 2015; 191(3): 292-301

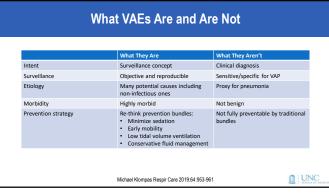
- Decreased mean duration of mechanical ventilation by 2.4 (95% CI 1.7-3.1) days
- Decreased ICU LOS by 3.0 (95% CI 1.6-4.3) days

32



33

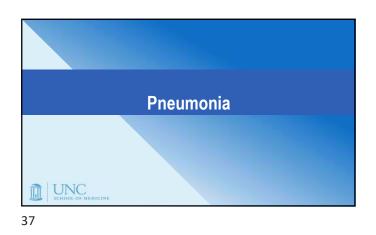


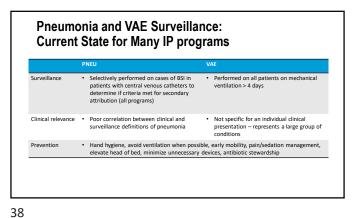


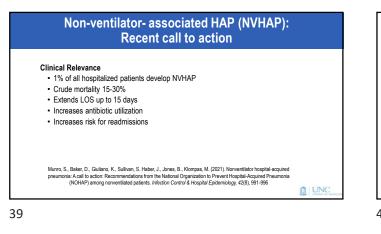
## Tips for Establishing a VAE Surveillance and Prevention Program

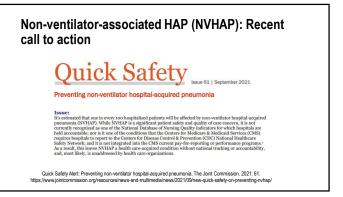
- Establish a multidisciplinary collaboration with intensivists, respiratory therapists, infection prevention
- Review the surveillance definitions and goals of the surveillance
  - Frame VAE as an objective measure of 'harm' in ventilated patients with many etiologies, and not solely an infection-related outcome
  - eurougues, and not solely an infection-related outcome
     Agree on best practices to prevent ventilator harm and track performance of these processes (SBT/SAT, delirium assessment, pain management)

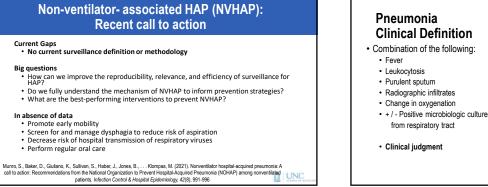
UNC

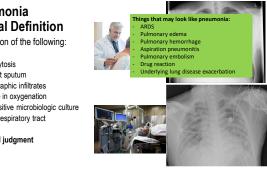




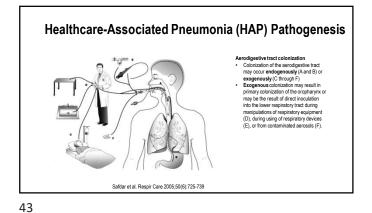


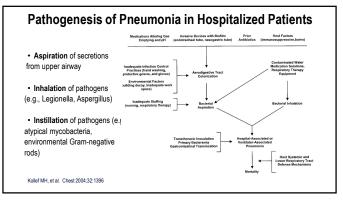




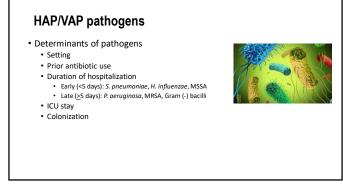


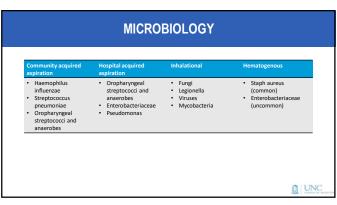
**Big questions** 

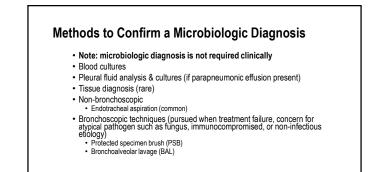




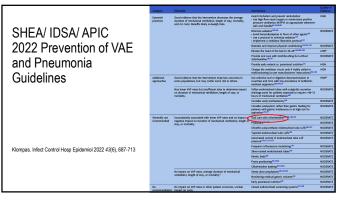
<section-header><section-header>

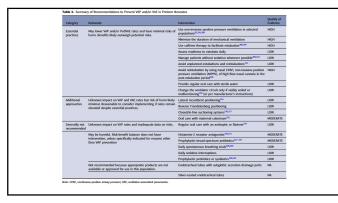






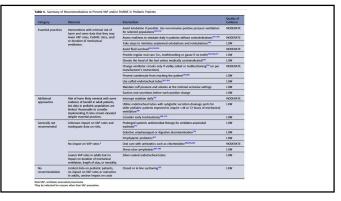
Pothogen	Incidence and resistance trends			
MRSA	Rate in VAP: 12-42%"			
	Rate of methicillin resistance is decreasing: 1.4-82% <sup>b</sup>			
Pseudomonas aeruginosa	Rate in VAP: 21-61% especially for the second episode of VAP*			
	MDR/XDR rates as high as 38-46% with 8-20% susceptible only to colistin [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 <sup>a</sup> [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], collistin-resistant cases reported [1]			



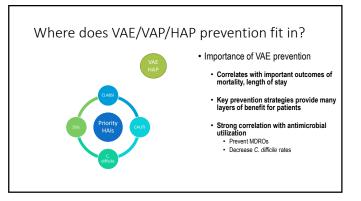


51

49



52



### Summary

- VAE definitions are based on objective criteria
- · Infectious and non-infectious conditions will be identified as VAEs
- Many VAE are believed to be preventable complications
   Optimize pain management, sedation, delirium, early mobilization
- VAE and HAP are common and highly correlated with healthcare utilization, morbidity, and antimicrobial utilization
- Growing interest in NVHAP as a target for prevention stay tuned

UNC

