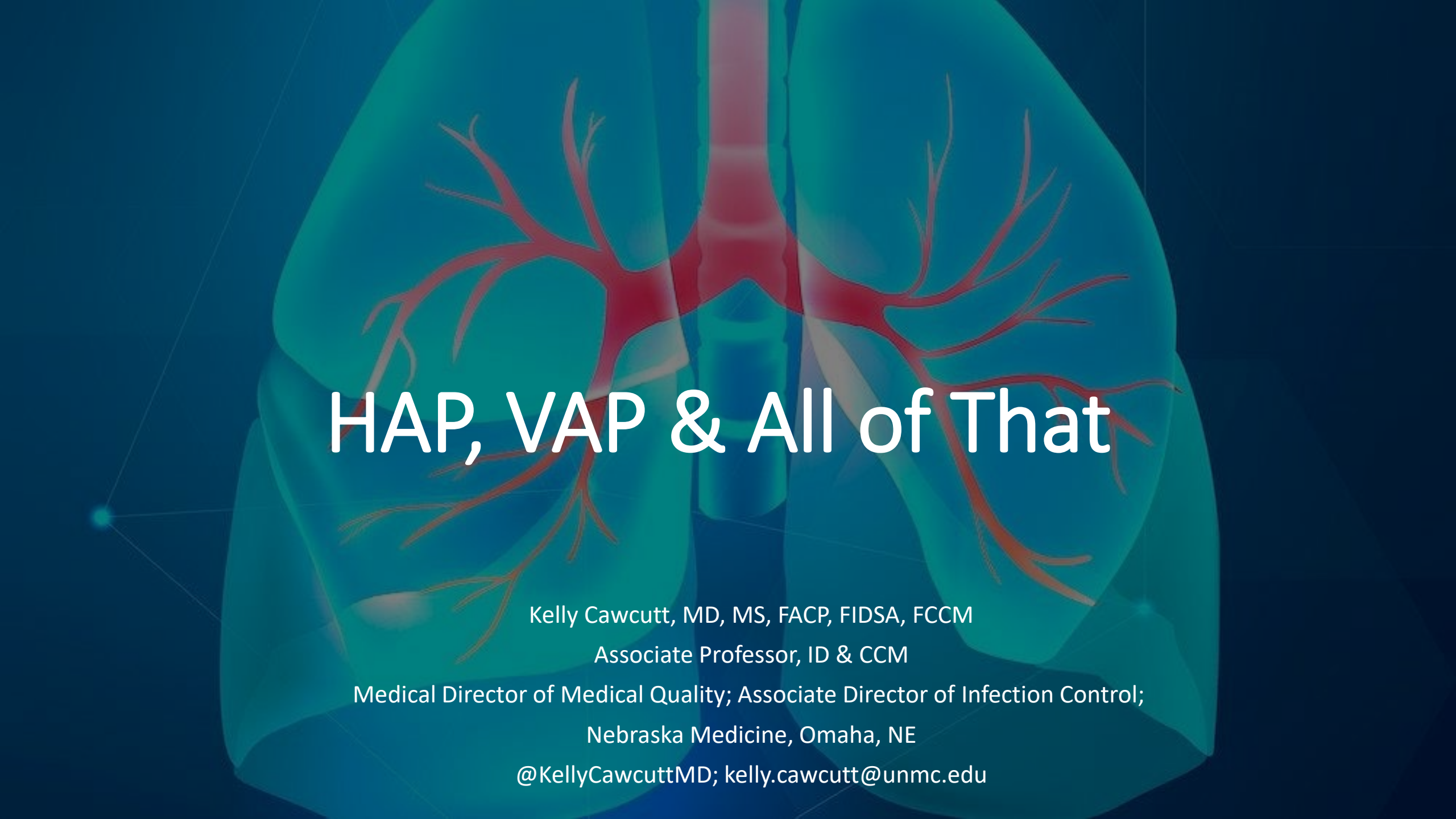

HAP, VAP & All of That

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Objectives

1

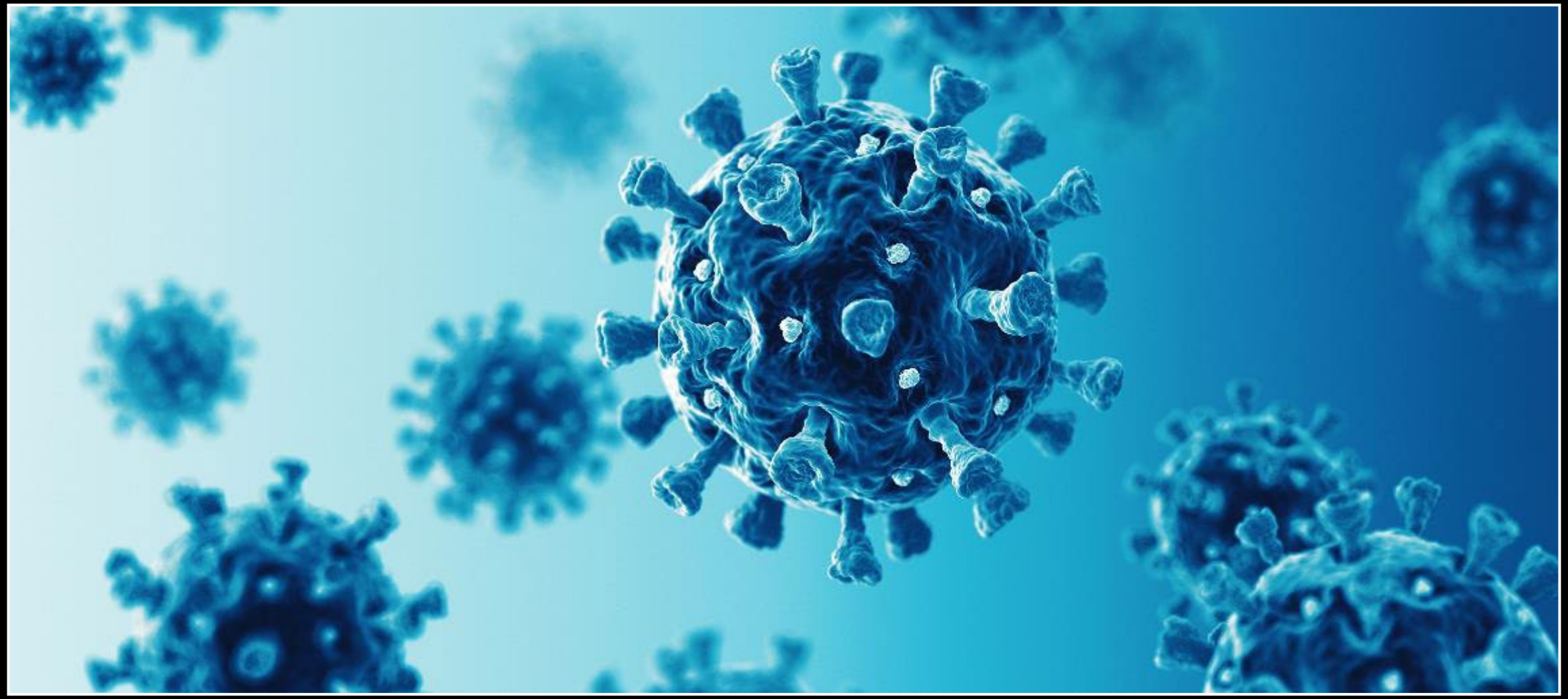
Recognize the definitions of NV-HAP, VAE, and VAP

2

Discuss the epidemiology and pathophysiology of all types of HAP

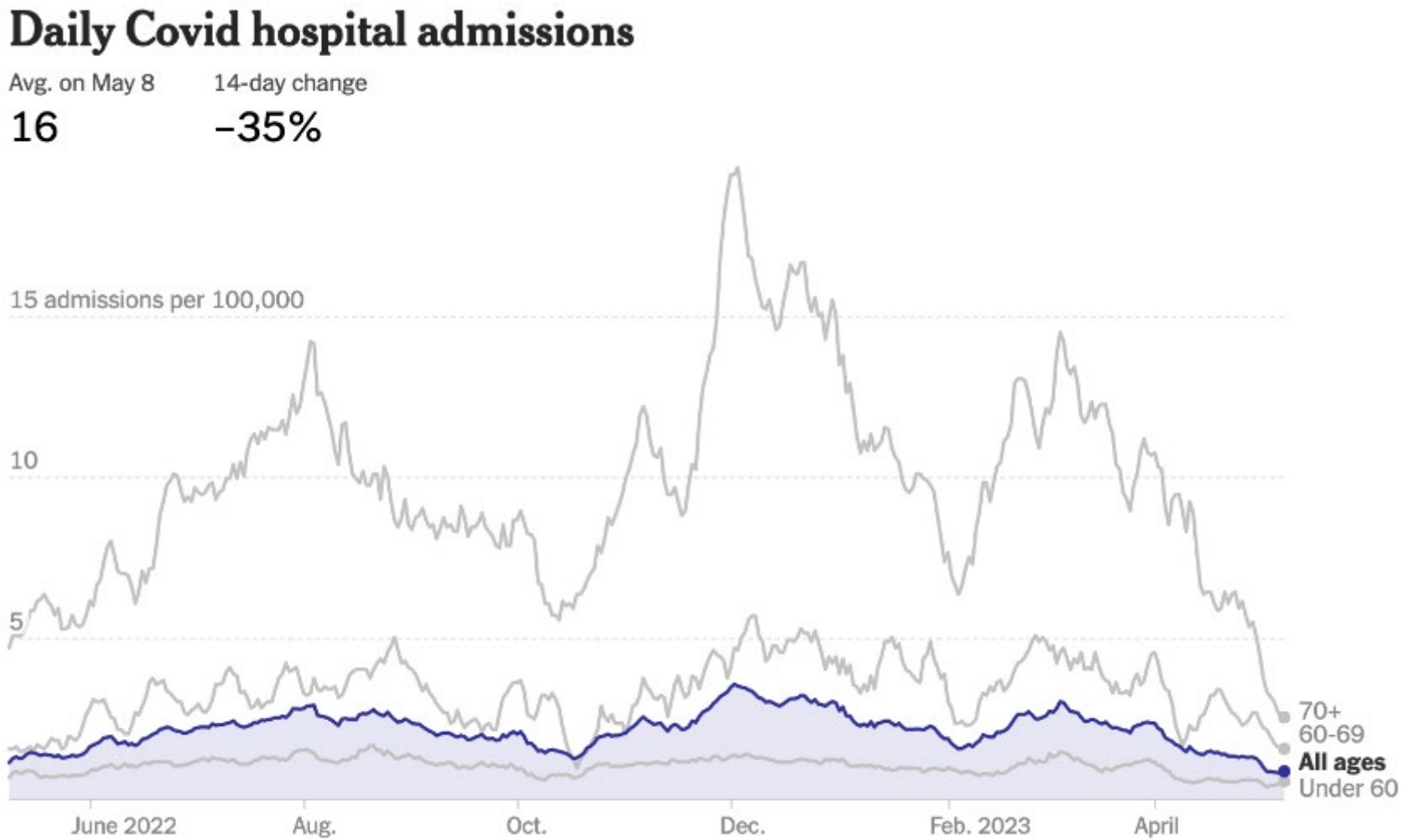
3

Review recommendations for prevention of all types of HAP



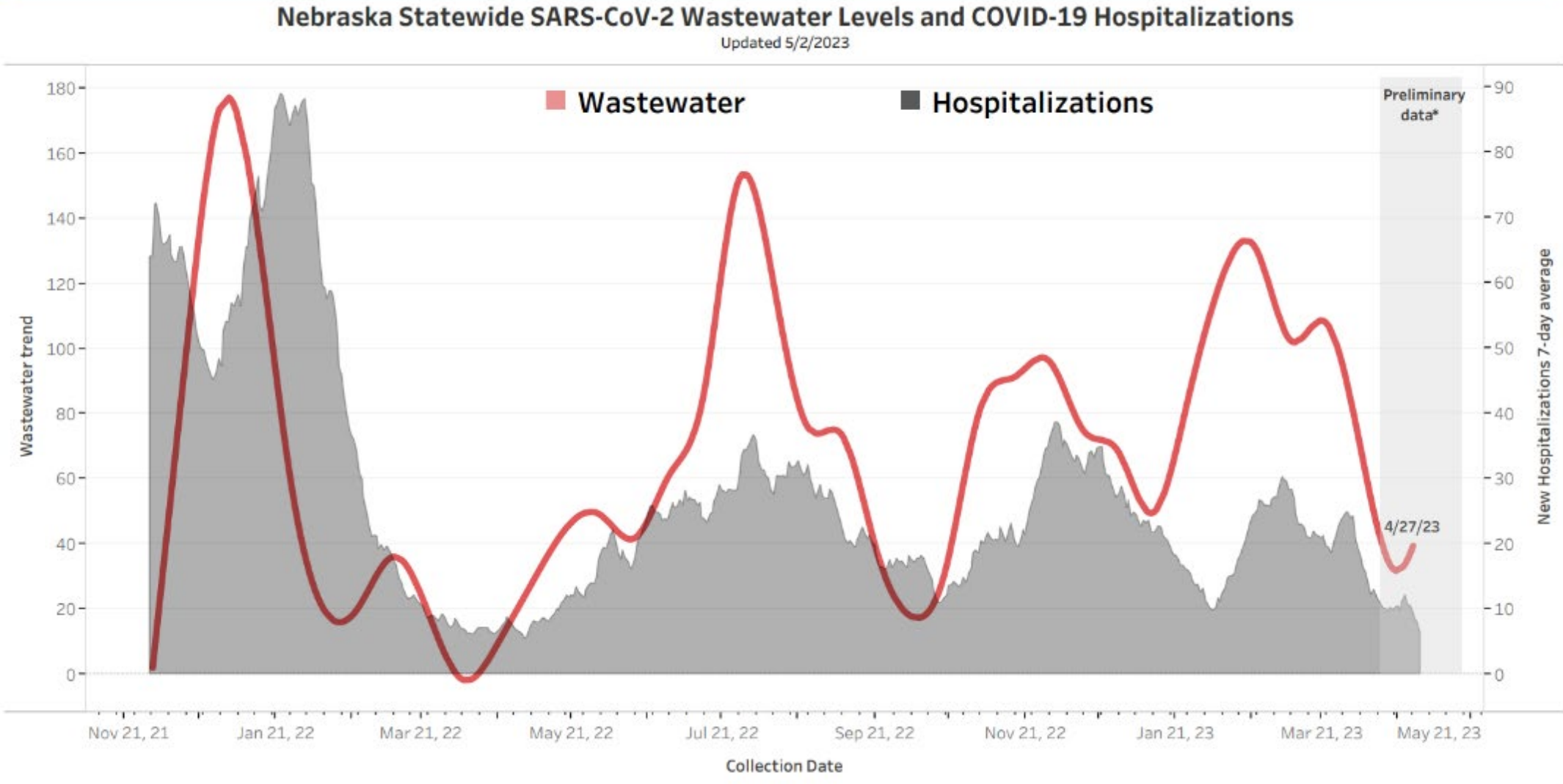
But First, COVID Update

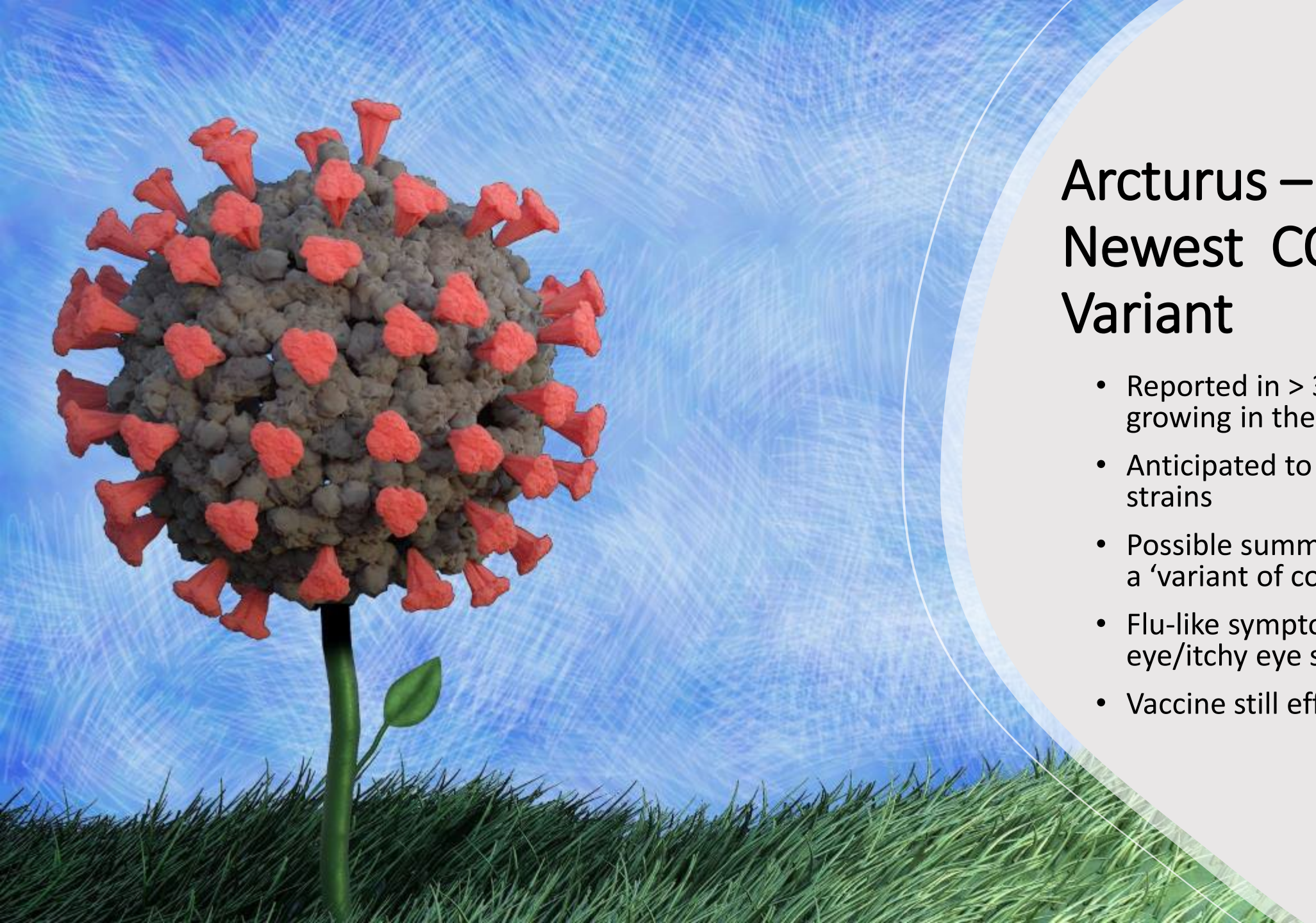
Nebraska COVID Hospital Cases – May 8, 2023



https://www.nytimes.com/interactive/2023/us/nebraska-covid-cases.html?auth=login-google

Nebraska SARS-CoV-2 Wastewater Surveillance Report



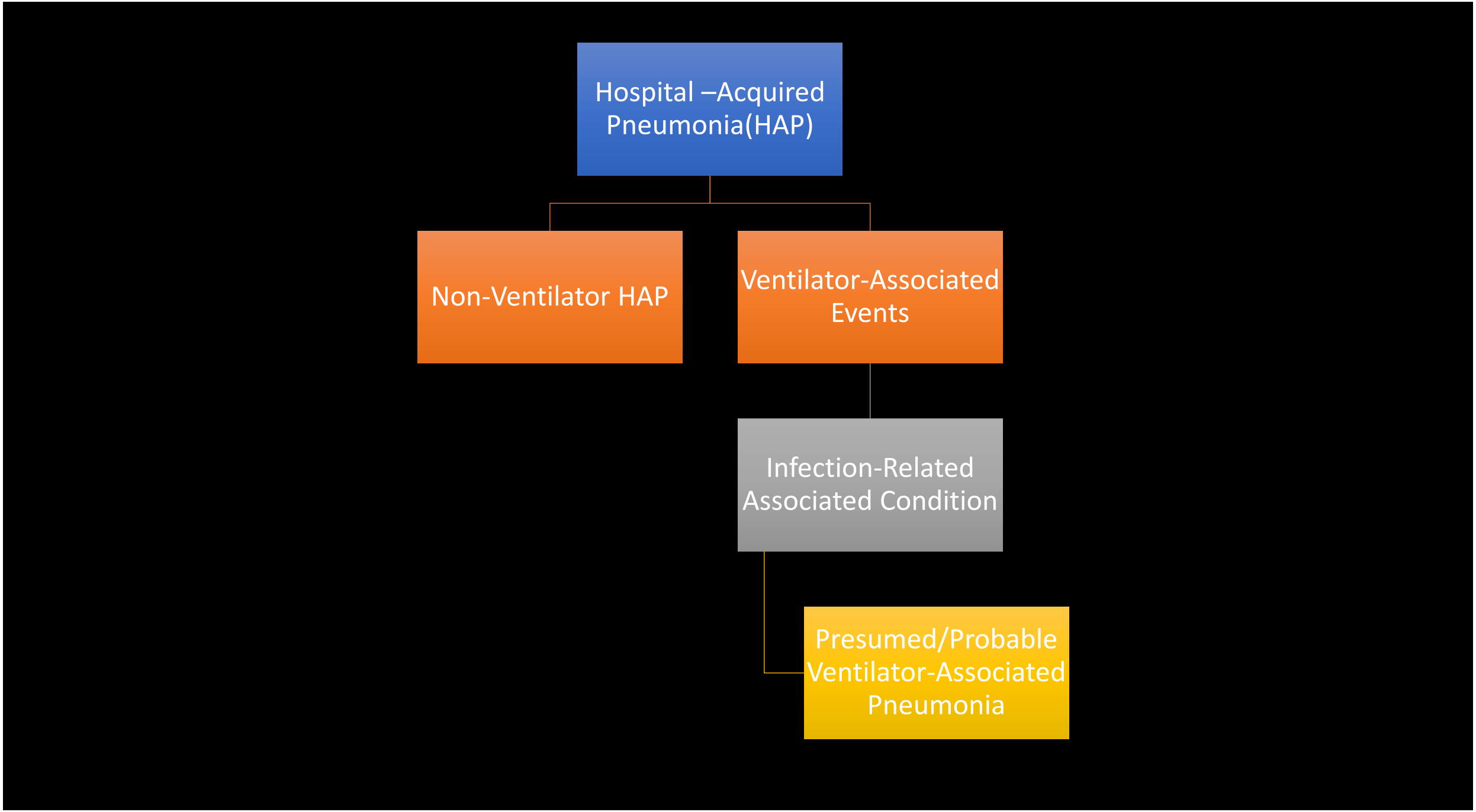


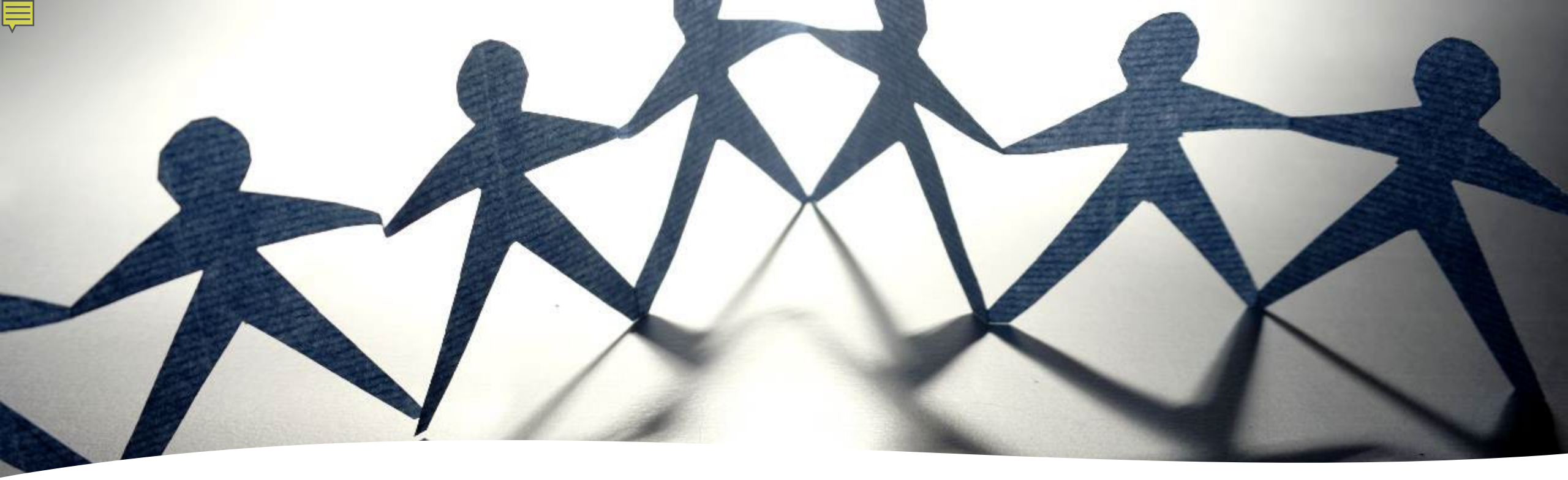
Arcturus – Newest COVID Variant

- Reported in > 30 countries and growing in the US
- Anticipated to take over current strains
- Possible summer surge; but not a ‘variant of concern’
- Flu-like symptoms, more pink-eye/itchy eye symptoms
- Vaccine still effective

Community-Acquired to Hospital-Acquired

The Different Pathophysiology of Pneumonias


Hospital –Acquired Pneumonia(HAP)
Non-Ventilator HAP
Ventilator-Associated Events
Infection-Related Associated Condition
Presumed/Probable Ventilator-Associated Pneumonia



Burden of HAP

- HAP is the most common nosocomial infection
- Impacting ~1 in 100 patients
- NV-HAP = 60-70% of all HAPs
- Approximately 5-10% of patients on a ventilator develop VAEs
- NV-HAP, VAE and VAP all carry increased morbidity, mortality, LOS and cost
- Attributable mortality from VAP is ~10% but varies based on type and severity of illness

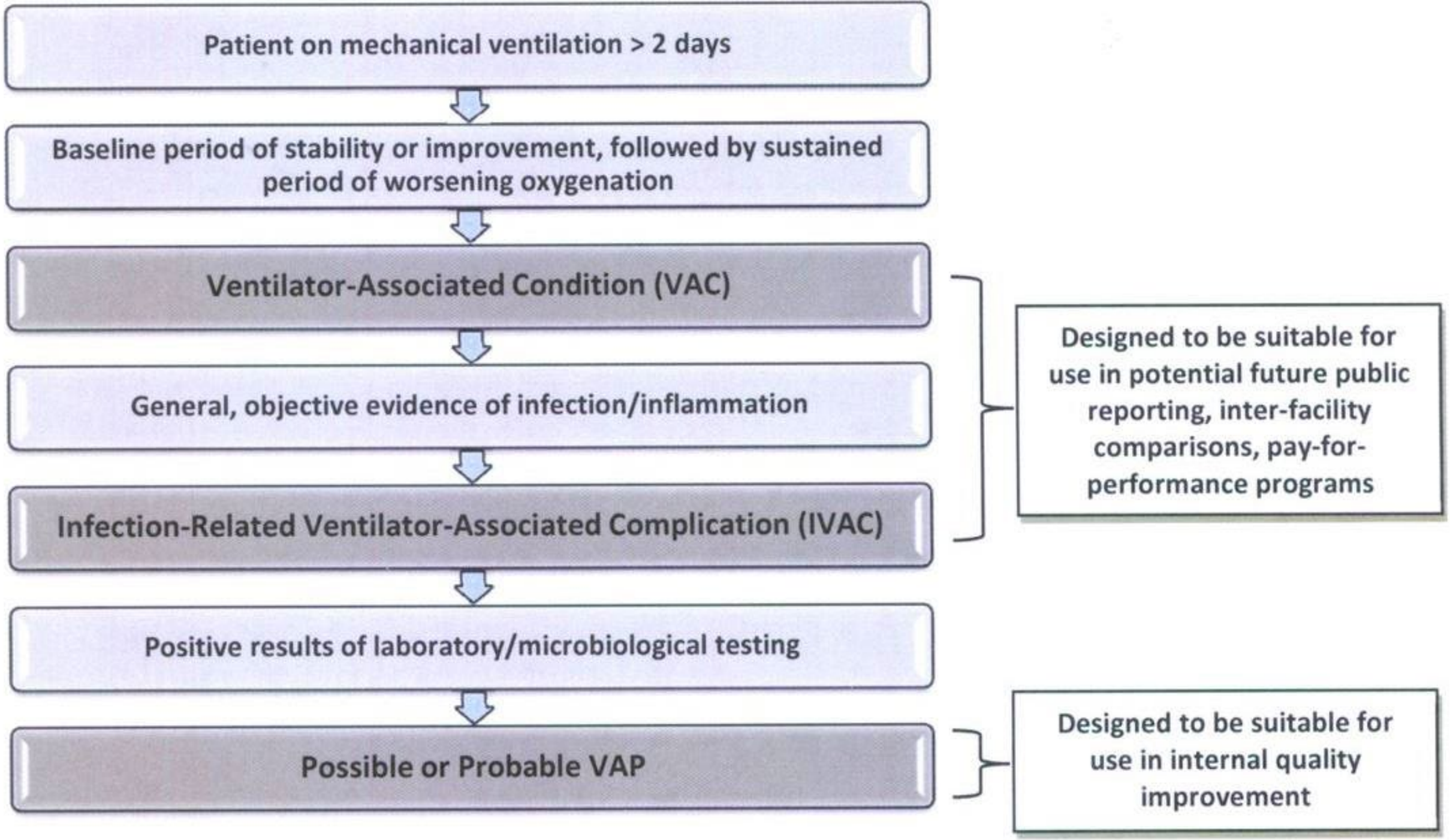
VAE vs VAP – Why Does It Matter?

VAE is NOT synonymous with VAP

Only 25-33% of VAEs are due to pneumonia; 'mild' pneumonia may not meet ventilator requirements

VAE is considered a quality metric given associated poor outcomes with VAE

VAE is increasingly demonstratable to be preventable with implementation of best practices


Patient on mechanical ventilation > 2 days
Baseline period of stability or improvement, followed by sustained period of worsening oxygenation
Ventilator-Associated Condition (VAC)
General, objective evidence of infection/inflammation
Infection-Related Ventilator-Associated Complication (IVAC)
Positive results of laboratory/microbiological testing
Possible or Probable VAP
Designed to be suitable for use in potential future public reporting, inter-facility comparisons, pay-for-performance programs
Designed to be suitable for use in internal quality improvement

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

AND

After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:

1) Increase in daily minimum FiO_2 of ≥ 0.20 (20 points) over the daily minimum FiO_2 in the baseline period, sustained for ≥ 2 calendar days.

2) Increase in daily minimum PEEP values of ≥ 3 cmH_2O over the daily minimum PEEP in the baseline period, sustained for ≥ 2 calendar days.

Example

Date	PEEP (min)	FiO2 (min)
Jan 1	10	100
Jan 2	5	50
Jan 3	5	40
Jan 4	5	40
Jan 5	8	60
Jan 6	8	50
Jan 7	8	40
Jan 8	5	40
Jan 9	5	40

VAE

Klompas, Michael. *American journal of respiratory and critical care medicine* 192.12 (2015): 1420-1430.

Patient meets criteria for VAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:

1) Temperature > 38 °C or < 36°C, **OR** white blood cell count ≥ 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.

*See Appendix for eligible agents.

Patient meets criteria for VAC and IVAC

AND

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections)
   - Defined as secretions from the lungs, bronchi, or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells per low power field [lpf, x100].
   - If the laboratory reports semi-quantitative results, those results must be equivalent to the above quantitative thresholds.

OR

2) Positive culture (qualitative, semi-quantitative or quantitative) of sputum*, endotracheal aspirate*, bronchoalveolar lavage*, lung tissue, or protected specimen brushing*

**Excludes the following:*

- Normal respiratory/oral flora, mixed respiratory/oral flora or equivalent
- *Candida* species or yeast not otherwise specified
- Coagulase-negative *Staphylococcus* species
- *Enterococcus* species

Compendium Updates

Infection Control & Hospital Epidemiology (2022), **43**, 687–713
doi:10.1017/ice.2022.88

SHEA

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent ventilator-associated pneumonia, ventilator-associated events, and nonventilator hospital-acquired pneumonia in acute-care hospitals: 2022 Update

Michael Klompas MD, MPH[1,2], Richard Branson MSc, RRT[3], Kelly Cawcutt MD, MS[4], Matthew Crist MD[5], Eric C. Eichenwald MD[6,7], Linda R. Greene RN, MPS, CIC[8], Grace Lee MD[9], Lisa L. Maragakis MD, MPH[10], Krista Powell MD, MPH[5], Gregory P. Priebe MD[11], Kathleen Speck MPH[12], Deborah S. Yokoe MD, MPH[13] and Sean M. Berenholtz MD, MHS[12,14,15]

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,

Essential Practices

Intervention	Quality of Evidence
Avoid intubation & prevent reintubation Use HF 02 or NIPPV when safe & feasible	High
Provide early enteral vs parenteral nutrition	High
Change the ventilator circuit only if visibly soiled or malfunctioning	High
Maintain & improve physical conditioning	Moderate
Minimize Sedation Avoid benzos in favor of other agents Use a protocol to minimize sedation Implement a ventilator liberation protocol	Moderate
Provide oral care with toothbrushing but *without* chlorhexidine	Moderate
Elevate head of bed to 30-45	Low

Additional Approaches

- Good evidence that the intervention improves outcomes in some populations, but may confer some risk in others.
- May lower VAP rates but insufficient data to determine impact on duration of mechanical ventilation, LOS or mortality

Additional Approaches

Intervention	Quality of Evidence
Use selective oral or digestive decontamination in countries and ICUs with low prevalence of antibiotic resistant organisms	High
Utilize endotracheal tubes with subglottic secretion drainage ports for patients expected to require >48-72 hours of mechanical ventilation	Moderate
Consider early tracheostomy	Moderate
Consider post-pyloric rather than gastric feeding for patients with gastric intolerance or at high risk for aspiration	Moderate

Generally Not Recommended

- Inconsistently associated with lower VAP rates and no impact or negative impact on duration of mechanical ventilation, LOS or mortality
- No impact on VAP rates, average duration of mechanical ventilation, LOS or mortality

Generally Not Recommended

Intervention	Quality of Evidence
Oral care with chlorhexidine	Moderate
Probiotics	Moderate
Ultrathin polyurethane ET cuffs	Moderate
Taperated ET cuffs	Moderate
Automated control of ET cuff pressure	Moderate
Frequent cuff-pressure monitoring	Moderate
Silver-coated ETs	Moderate
Kinetic beds	Moderate
Prone positioning	Moderate
Chlorhexidine bathing	Moderate
Stress-ulcer prophylaxis	Moderate
Monitoring residual gastric volumes	Moderate
Early parenteral nutrition	Moderate

No Recommendation

- No impact on VAP rates or other patient outcomes, unclear impact on costs
  - Closed endotracheal suctioning systems

Burden of NV-HAP

- Most Common HAI
- ~50% require ICU
- ~20% need mechanical ventilation
- Length-of-stay longer by up to ~15 days
- Up to 30% crude mortality

Risk Factors for NV-HAP

- Age > 65
- Depressed CNS
- Post-surgical patients
- Limited mobility
- Enteral feedings*
- Malnutrition
- Use of gastric acid suppressants
- Hyperglycemia

Chen, Zhihui, et al. *BMC Pulmonary Medicine* 22.1 (2022): 1-11.

2020 Call To Action on NV-HAP

Surveillance & Prevention Barriers

- Definitions
- Surveillance
- Not YET reportable
- Leadership buy-in
- Evidence-based preventative strategies

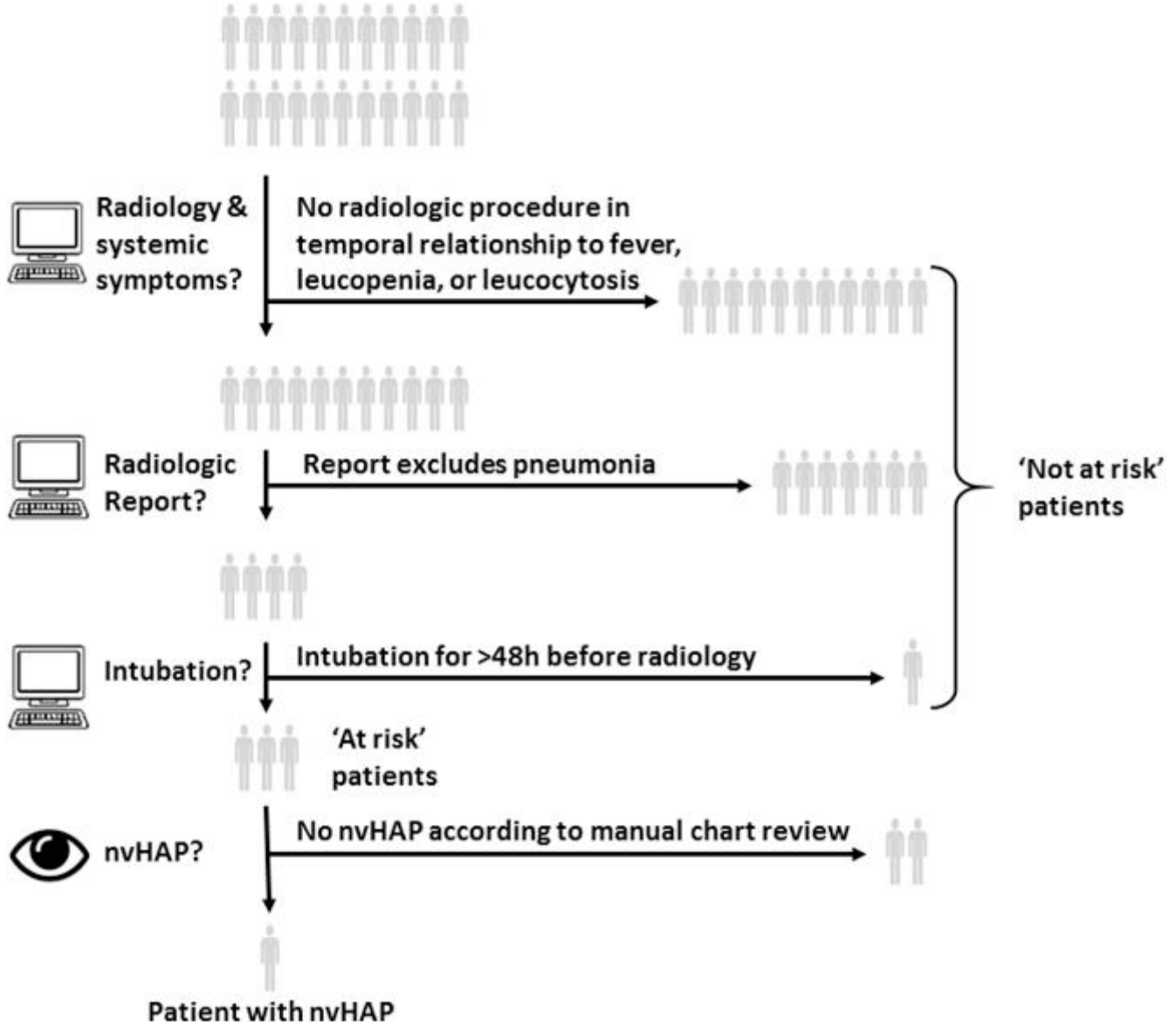
Defining NV-HAP

Factor	Definition
Clinical features of NV-HAP	
Inclusion criteria	≥ 3 days hospitalization Not receiving mechanical ventilation
Worsening oxygenation sustained for ≥2 calendar days	Drop in pulse oximetry from ≥95% on ambient air to <95% on ambient air, or Initiation of supplemental oxygen, or Escalation of supplemental oxygen (flow rate or device)
Fever or Abnormal WBC	Temperature ≤36 or ≥38 °C, or WBC <4,000 or ≥12,0000 cells/mm^3
Recognition/response by clinical team	
Performance of chest imaging	Evidence of order or procedure code for chest radiograph or computerized tomography
Initiation of new antibiotics	Administration of selected antimicrobials (supplement B) Not previously administered in past 2 days ≥3 days of administration

Stern, Sarah E., et al. *Infection Control & Hospital Epidemiology* (2023): 1-7.

TWO Reasons Clinical Assessments May Not Be Adequate

Surveillance for NV-HAP



Wolfensberger, A., et al. *Clinical Microbiology and Infection* 25.11 (2019): 1428-e7.

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NV-HAP

Paucity of data, but increasing frequency

Recommendations:

- Oral care – toothbrushing
- Diagnose and manage dysphagia
- Early mobility
- Prevent nosocomial viral spread

The Joint Commission – Prevent NV-HAP Via:

- Maintaining regular oral care
- Maintaining patient mobility
- Elevating the head of the patient's bed
- Reducing the use of acid-suppressing medications
- Minimizing sedation
- Performing dysphagia screening in high-risk patients
- Using modified diets and feeding strategies for patients with abnormal swallowing
- Following standardized processes to place and manage feeding tubes
- Breathing exercises
- Using chest physiotherapy
- Using incentive spirometry
- Educating the patient and family about NVHAP prevention

https://www.jointcommission.org/-/media/tjc/newsletters/quick-safety-61-nvha-pneumonia-final-9-3-21.pdf

The Joint Commission – Additional Actions

Obtain	Obtain buy-in from leadership and health care providers about the importance of NVHAP prevention
Overcome	Overcome beliefs that NVHAP prevention strategies such as oral hygiene and mobility are optional tasks rather than standard-of-care interventions
Procure	Procure supplies necessary to implement effective interventions
Educate	Educate staff about the risks of NVHAP and prevention methods such as aspiration precautions
Provide	Provide training on techniques to encourage patients to comply with oral care and maintaining mobility.
Implement	Implement processes that make oral care and mobility an expectation for routine care of nonventilated patients.
Evaluate	Evaluate workflows from a systems perspective and establish processes that facilitate the prevention of NVHAP (e.g., ensuring efficient access to supplies, and providing job aids where necessary).
Evaluate	Evaluate patients for swallowing issues and adjust nutrition and feeding assistance based on this evaluation.

The Joint Commission – Additional Actions

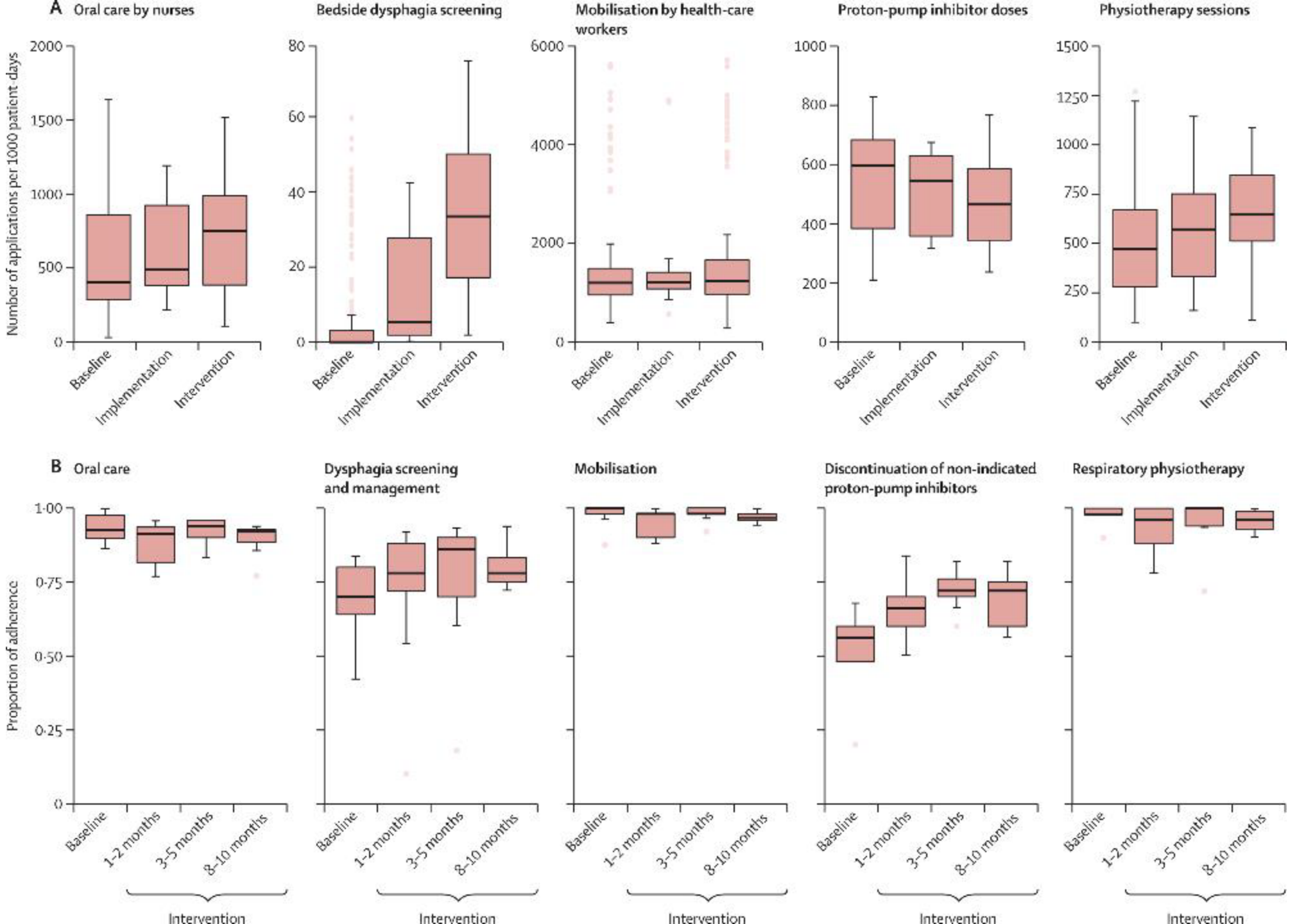
Educate	Educate patients on risks and prevention methods that are implemented in the health care setting and should be continued after discharge.
Empower	Empower patients and family members to ask for assistance with oral care, feeding, and mobility and obtaining any needed supplies.
Perform	Perform outcome and/or process surveillance to determine rates of infection and compliance with processes to prevent NVHAP
Consider	Consider using standardized definitions such as those promulgated by the CDC to allow for aggregation of data and comparison infection rates with other organizations.
Develop	Develop operational NVHAP tracking systems to assess the impact of prevention initiatives
Implement	Implement processes to sustain NVHAP prevention for the long term

Articles

Prevention of non-ventilator-associated hospital-acquired pneumonia in Switzerland: a type 2 hybrid effectiveness–implementation trial

Aline Wolfensberger MD [a †], Lauren Clack PhD [a b †], Stefanie von Felten PhD [c], Mirjam Faes Hesse MA [a], Dirk Saleschus MA [a], Marie-Theres Meier RN [a], Katharina Kusejko PhD [a], Prof Roger Kouyos PhD [a], Prof Leonhard Held PhD [c], Hugo Sax MD [a d]

- NVHAP bundle implementation
- Reduced NVHAP by 31%


A
Oral care by nurses
Bedside dysphagia screening
Mobilisation by health-care workers
Proton-pump inhibitor doses
Physiotherapy sessions
Number of applications per 1000 patient-days
2000
1500
1000
500
0
80
60
40
20
0
6000
4000
2000
0
1000
800
600
400
200
0
1500
1250
1000
750
500
250
0
Baseline
Implementation
Intervention
B
Oral care
Dysphagia screening and management
Mobilisation
Discontinuation of non-indicated proton-pump inhibitors
Respiratory physiotherapy
Proportion of adherence
1·00
0·75
0·50
0·25
0
Baseline
1–2 months
3–5 months
8–10 months
Intervention

Key Points

HAP is the most common Healthcare-Associated Infection; led by NV-HAP

Prevention of VAE/VAP improves patient outcomes, costs & length-of-stay

Call to action to start monitoring, and actively working to prevent, NV-HAP

Selected References

- https://www.cdc.gov/nhsn/psc/vae/index.html
- Munro, Shannon C., et al. "Nonventilator hospital-acquired pneumonia: A call to action: Recommendations from the National Organization to Prevent Hospital-Acquired Pneumonia (NOHAP) among nonventilated patients." *Infection Control & Hospital Epidemiology* 42.8 (2021): 991-996.
- Wolfensberger, Aline, et al. "Prevention of non-ventilator-associated hospital-acquired pneumonia in Switzerland: a type 2 hybrid effectiveness–implementation trial." *The Lancet Infectious Diseases* (2023).
- Papazian, Laurent, Michael Klompas, and Charles-Edouard Luyt. "Ventilator-associated pneumonia in adults: a narrative review." *Intensive care medicine* 46.5 (2020): 888-906
- https://www.jointcommission.org/-/media/tjc/newsletters/quick-safety-61-nvha-pneumonia-final-9-3-21.pdf
- Wolfensberger, A., et al. "Development and validation of a semi-automated surveillance system—lowering the fruit for non-ventilator-associated hospital-acquired pneumonia (nvHAP) prevention." *Clinical Microbiology and Infection* 25.11 (2019): 1428-e7.
- Stern, Sarah E., et al. "Electronic surveillance criteria for non–ventilator-associated hospital-acquired pneumonia: Assessment of reliability and validity." *Infection Control & Hospital Epidemiology* (2023): 1-7.
- Baker, Dian L., and Karen K. Giuliano. "Prevention practices for nonventilator hospital-acquired pneumonia: A survey of the Society for Healthcare Epidemiology of America (SHEA) Research Network (SRN)." *Infection Control & Hospital Epidemiology* 43.3 (2022): 379-380.
- Chen, Zhihui, et al. "Derivation and validation of a nomogram for predicting nonventilator hospital-acquired pneumonia among older hospitalized patients." *BMC Pulmonary Medicine* 22.1 (2022): 1-11.
- Klompas, M. "Barriers to the adoption of ventilator-associated events surveillance and prevention." *Clinical Microbiology and Infection* 25.10 (2019): 1180-1185.