HEALTH HOLDING

HAFER ALBATIN HEALTH CLUSTER MATERNITY AND CHILDREN HOSPITAL

Department:	Infection Prevention and Control Department		
Document:	Multidisciplinary Policy and Procedure (MPP)		
Title:	Ventilator-Associated Events (VAE) Adult and Pediatrics		
Applies To:	Nurses, Technician and Respiratory Therapist		
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1. PURPOSE:

1.1 To provide guidelines to assess patients for the presence of events meeting the VAE definition.

2. DEFINITONS:

2.1 VAE events are identified by using a combination of objective criteria: deterioration in respiratory status after a period of stability or improvement on the ventilator, evidence of infection or inflammation, and laboratory evidence of respiratory infection.

2.2 Ventilator:

2.2.1 Defined as a device to assist or control respiration continuously, inclusive of the weaning period, through a tracheostomy or by endotracheal intubation. The ventilator has to be in place for >2 days

2.2.2 Any device used to support, assist or control respiration (inclusive of the weaning period) through the application of positive pressure to the airway when delivered via an artificial airway, specifically an oral/nasal endotracheal or tracheostomy tube.

2.2.3 Lung expansion devices such as intermittent positive-pressure breathing (IPPB); nasal positive end-expiratory pressure (nasal PEEP); and continuous nasal positive airway pressure (CPAP, hypoCPAP) are not considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g., ET-CPAP).

2.3 Three tiers of VAE definitions

2.3.1 hierarchical o Ventilator-associated condition (VAC)

2.3.2 Infection-related ventilator-associated complications (IVAC

2.3.3 Possible ventilator-associated pneumonia (PVAP)

3. POLICY:

3.1 The VAE definition algorithm is for use in surveillance; it is not a clinical definition algorithm and is not intended for use in the clinical management of patients.

3.2 Surveillance settings: VAE surveillance can be done in any adult inpatient location where denominator data can be collected. Currently it is implemented in adult ICUs and SCA, step-down units, and wards. Pediatric and neonatal units should conduct PedVAE surveillance.

3.3 Patients on Airway Pressure Release Ventilation (APRV) or related modes of mechanical ventilation (e.g., BiLevel, Bi Vent, BiPhasic, PCV+, DuoPAP) are INCLUDED in VAE protocol, but the VAE period of stability or improvement on the ventilator and the period of worsening oxygenation should be determined by changes in FiO2 only, since changes in PEEP may not be applicable to APRV.

4. PROCEDURE:

4.1 Surveillance methodology

4.1.1 •Active •Patient based •Prospective •Priority-directed targeted •Yield risk-adjusted incidence rates

4.2 Ventilator removal and reinsertion:

4.2.1 If ventilator was removed and reinserted before a full calendar day without a ventilator, then continue the day count

4.2.2 Therefore if the patient is without a ventilator for at least one full calendar day (NOT to be read as 24 hours), then start a new day count.

4.2.3 Episode of mechanical ventilation: the period of days during which the patient was mechanically ventilated for some portion of each consecutive day. See attachment 7.1.

4.3 Date of event (DOE):

4.3.1 The date of onset of worsening oxygenation.

4.3.2 This is defined as the first calendar day of the required ≥ 2-day period of worsening oxygenation following a ≥ 2-day period of stability or improvement on the ventilator.

4.4 Infection Window Period: See attachment 7.2

4.4.1 It is usually a 5-day period and includes the 2 days before, the day of, and the 2 days after the VAE event date (i.e., the first day of worsening oxygenation, the day of VAE onset).

4.4.2 However, it could be shorter if VAE occurs early in the course of mechanical ventilation (cannot include the first 2 days on ventilator)

4.4.3 The earliest day on which VAE criteria can be fulfilled is day 4 of mechanical ventilation (where the day of intubation and initiation of mechanical ventilation is day 1)

4.4.5 The earliest date of event for VAE (the date of onset of worsening oxygenation) is day 3 of mechanical ventilation

4.5 Location of attribution:

4.5.1 The inpatient location where the patient was assigned on the date of the VAE event, which is further defined as date of onset of worsening oxygenation.

4.5.2 OR/Post Anesthesia Care Unit/Recovery Room/dialysis unit /ERs cannot be considered a location of attribution for VAE Transfer Rule:

4.5.3 If a VAE develops on the day of transfer or the day following transfer from one inpatient location to another in the same facility or to a new facility (where the day of transfer is day 1), the event is attributed to the transferring location. Example:

4.5.3.1 Patient on a ventilator in the SICU who has had improving oxygenation for 3 days is transferred to the MICU, still on the ventilator. On the day of transfer, after the patient has arrived in the MICU, the patient experiences an acute decompensation, requiring an increase of 0.30 (30 points) in FiO2 that persists during the following calendar day. VAC criteria are met on calendar day 2 in the MICU.Because the onset of worsening oxygenation occurred on the day of transfer to the MICU, the VAC event is attributed to the SICU.

4.6 Multiple Transfers: See attachment 7.3

4.6.1 If the patient has been transferred to more than one location on the date of VAE, or the day before, attribute the VAE to the first location in which the patient was housed the day before the VAE's date of event.

4.7 Repeat Infection time frame (RIT)

4.7.1 A new VAE cannot be identified or reported until a 14-day period has elapsed after the day of onset of worsening oxygenation (the event date, day 1). However, the period of stability can be diagnosed during the defined 14 days Secondary BSIs:

4.7.2 Secondary BSIs may be reported for PVAP events but NOT reported for VAC or IVAC events provided that:

4.7.2.1 The organism identified from blood specimen matches an organism identified from an appropriate respiratory specimen (respiratory secretions, pleural fluid and lung tissue).

4.7.2.2 Collection times: respiratory specimen have been collected during the 5-day infection window and the positive blood specimen collected during the 14-day event period starting by the date of event.

4.7.2.3 In cases where PVAP is met with only the histopathology criterion and there is a positive blood specimen a secondary BSI is not reported.

4.7.3 Do not limit reporting to just those organisms isolated in culture. For example, influenza A identified by PCR in respiratory specimen and culture of blood specimen, a secondary BSI is reported.

4.8 Measurements of oxygen requirement

4.8.1 Fraction of inspired oxygen (FiO2) is oxygen concentration (%) is typically maintained below 0.5 even with ventilation, to avoid oxygen toxicity. Natural air includes 20.9% oxygen, which is equivalent to FiO2 of 0.21.

4.8.2 Positive end-expiratory pressure (PEEP) is the pressure in the lungs above atmospheric pressure applied by a ventilator. A small amount of applied PEEP (0 to 5 cmH2O) is used in most mechanically ventilated patients to mitigate endexpiratory alveolar collapse

4.9 Daily minimum PEEP. See attachment 7.4

4.9.1 The lowest value of PEEP during a calendar day that is set on the ventilator and maintained for at least 1 hour

4.9.2 In the event that ventilator settings are monitored and recorded less frequently than once per hour or where there is no value that is documented to have been maintained for at least one hour, the daily minimum PEEP is simply the lowest value of PEEP set on the ventilator during the calendar day.

4.10 Daily minimum FiO2. See attachment 7.5

4.10.1 The lowest value of FiO2 during a calendar day that is set on the ventilator and maintained for at least 1 hour

4.10.2 In the event that ventilator settings are monitored and recorded less frequently than once per hour or where there is no value that has been maintained for at least one hour, the daily minimum FiO2 is simply the lowest value of FiO2 set on the ventilator during the calendar day.

4.11 Layers of VAE events. See attachment 7.6

4.11.1 Ventilator-Associated Condition (VAC): After a period of stability or improvement on the ventilator sustained for ≥ 2 calendar days, the patient has one of the following indicators of worsening oxygenation;

4.11.1.1 Increase in daily minimum FiO2 values of ≥ 0.20 points or

4.2.11.1 Increase in daily minimum PEEP values of ≥ 3 cm H2O

4.11.2 Infection-related Ventilator-Associated Complication (IVAC): See attachment 7.7.
After meeting the criteria of VAC, the patient meets the following two criteria;

4.11.2.1 Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm3 or ≤ 4,000 cells/mm3

4.11.2.2 A new antimicrobial agent(s) is started, and is continued for ≥ 4 calendar days.

4.11.3 New antimicrobial agent:

4.11.3.1 Any agent initiated on or after the third calendar day of mechanical ventilation AND in the VAE Window Period

4.11.3.2 The agent is considered new for the purposes of this definition if it was NOT given to the patient during the 2-days before the window

4.11.3.3 Qualifying Antimicrobial Day (QAD): day on which the patient was administered an antimicrobial agent that was determined to be "new" within the VAE Window Period

4.11.3.4 Four consecutive QADs are needed to meet the IVAC antimicrobial criterion

4.11.3.5 The requirement for 4 consecutive QADs can be met with 4 days of therapy with the same antimicrobial (with a gap of no more than 1 calendar day between administrations of that antimicrobial) or it can be met with 4 days of therapy with multiple antimicrobial agents, as long as each antimicrobial was started within the VAE Window Period.

4.11.4 •**Possible Ventilator-Associated Pneumonia (PVAP):** After meeting the criteria of VAC or IVAC, the patient meets one of the following criteria;

4.11.5 Criterion 1: Positive culture of respiratory specimens without the requirement for purulent respiratory secretions. See attachment 7.8

4.11.5.1 Endotracheal aspirate, ≥ 105 CFU/ml or corresponding semi-quantitative result

4.11.5.2 Bronchoalveolar lavage, ≥ 104 CFU/ml or corresponding semi-quantitative result
4.11.5.3 Lung tissue, ≥ 104 CFU/g or corresponding semi-quantitative result
4.11.5.4 Protected specimen brush, ≥ 103 CFU/ml or corresponding semi-quantitative result

4.11.6 Criterion 2: Purulent respiratory secretions plus organisms identified from defined respiratory specimens (to include qualitative culture, or quantitative/semi-quantitativeculture without sufficient growth to meet criterion #1):
4.11.6.1 Sputum
4.11.6.2 Endotracheal aspirate
4.11.6.3 Bronchoalveolar lavage
4.11.6.4 Lung tissue
4.11.6.5 Protected specimen brush

4.11.7 Criterion 3: One of the following positive tests: Organism identified from pleural fluid, Lung histopathology, Legionella detection, or viral detection.
4.11.7.1 Organism identified from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
4.11.7.2 Lung histopathology, defined as:
4.11.7.2.1 abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli;
4.11.7.2.2 evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms);
4.11.7.2.3 evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue
4.11.7.3 Diagnostic test for Legionella species
4.11.7.4 Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

4.12 Collection of denominator data for VAE
4.12.1 Manual, daily: Patient days and ventilator days should be collected at the same time, every day, for each location performing surveillance to ensure that differing collection methods don't inadvertently result in device days being > patient days.
4.12.2 Electronic sources: When patient days and ventilator days are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually

4.13 Analysis of VAE. See attachment 7.9.
4.13.1 VAE rates and ventilator DUR should be presented by unit (for example, adult ICU, pediatric ICU…etc).
4.13.2 VAE rates and ventilator DUR in neonatal ICU should be presented by unit and birthweight categories (which includes A = ≤750 g; B = 751-1000 g; C = 1001-1500g; D = 1501-2500 g; E = >2500 g).
4.13.3 VAE SIR and ventilator SUR can be presented for single locations and can be summarized across multiple locations, adjusting for differences in the incidence of infection or device utilization (respectively) between different location types.
4.13.4 In neonatal ICU, VAE SIR and ventilator SUR can be additionally summarized across birthweight categories, adjusting for differences in the incidence of infection or device utilization (respectively) between different birthweight categories.

4.14 Pediatric Ventilator-Associated Event
4.14.1 Pediatric Ventilator-Associated Event (PedVAE):
4.14.1.1 VAE surveillance in pediatric and neonatal population.
4.14.1.2 Detection of a PedVAE is determined by identification of deterioration in respiratory status after a period of stability or improvement on the ventilator using two key parameters.

4.14.2 Surveillance settings:
- 4.14.2.1 VAE surveillance can be done in pediatric and neonatal inpatient location where denominator data can be collected.
- 4.14.2.2 Can be implemented in pediatric and neonatal ICUs and SCA, step-down units, and wards.

4.14.3 Surveillance methodology: • Active • Patient based • Prospective • Priority-directed targeted• Yield risk-adjusted incidence rates

4.14.4 Eligibility of patients:
- 4.14.4.1 Patients on specific modes of mechanical ventilation:
  - 4.14.4.1.1 High frequency oscillatory or jet ventilation (HFO)
  - 4.14.4.1.2 Airway pressure release ventilation (APRV)-FiO2 parameter only
- 4.14.4.2 Patients who are receiving a conventional mode of mechanical ventilation while receiving:
  - 4.14.4.2.1 Surfactant
  - 4.14.4.2.2 Corticosteroids
  - 4.14.4.2.3 Prone positioning
  - 4.14.4.2.4 Nitric oxide therapy
  - 4.14.4.2.5 Helium-oxygen mixture
  - 4.14.4.2.6 Epoprostenol therapy

4.14.5 Exclusions:
- 4.14.5.1 Patients on extracorporeal life support or paracorporeal membrane oxygenation
- 4.14.5.2 Non-acute care locations in acute care facilities
- 4.14.5.3 Pediatric patients in adult locations

4.14.6 PedVAE is similar to VAE in the following definitions:
- 4.14.6.1 Ventilator definition
- 4.2.14.2 Date of event: the date of onset of worsening oxygenation
- 4.14.6.3 Location of attribution and transfer rule are similar to VAE
- 4.14.6.4 14-day event period: 14-day period, starting on the day of onset of worsening oxygenation (the date of event, day 1). A new PedVAE cannot be identified or reported until this 14-day period has elapsed.
- 4.14.6.5 Episode of Mechanical Ventilation: Defined as a period of days during which the patient was mechanically ventilated for some portion of each consecutive day.
- 4.14.6.6 Location of attribution and transfer rule

4.14.7 PedVAE is different from VAE in the following:
- 4.14.7.1 Use of mean airway pressure (MAP) instead of PEEP.
- 4.14.7.2 Locations are only pediatric and neonatal locations.
- 4.14.7.3 No differentiation to VAC, IVAC, PVAP (so it is comparable to VAC in VAE).
- 4.14.7.4 No secondary BSI can be attributed to PedVAE.

4.14.8 Daily Minimum FiO2:
- 4.14.8.1 The lowest value of FiO2 during a calendar day that is set on the ventilator and maintained for > 1 hour.
- 4.14.8.2 If there is no value that has been maintained for >1 hour then select the lowest value available regardless of the period of time in which the setting was maintained
  - 4.14.8.2.1 Ventilation initiated late in the calendar day
  - 4.14.8.2.2 Ventilation discontinued early in the calendar day
  - 4.14.8.2.3 Ventilator settings very unstable throughout the day
- 4.14.8.3 If FiO2 is recorded every 15/30 minutes, 5/3 consecutive recordings of FiO2 are needed to meet the required >1 hour minimum duration
- 4.14.8.4 Increase in the daily minimum FiO2 of at least 0.25 (25 points) over the daily minimum FiO2 of the first day in the baseline period is one of two criteria that can be used in meeting the PedVAE definition.

4.14.9 Mean Airway Pressure (MAP):

4.14.9.1 The average pressure exerted on the airway and lungs from the beginning of inspiration until the beginning of the next inspiration.

4.14.9.2 Daily minimum MAP is the lowest value documented during the calendar day (not necessarily maintained for > 1 hour)

4.14.9.3 A sustained increase in the daily minimum MAP of ≥ 4 cmH2O following a period of stability or improvement on the ventilator is one of two criteria that can be used in meeting the PedVAE definition.

4.14.9.3.1 MAP values of 0-8 cmH2O are considered equal to 8 cmH2O

4.14.9.3.2 Any day where daily minimum MAP is 0-8 cmH20 will be assigned a daily minimum MAP value of 8 cmH20

4.14.9.4 For patients ≥ 30 days:

4.14.9.4.1 MAP values 0-10 cmH2O are considered equal to 10 cmH2O

4.14.9.4.2 Any day where daily minimum MAP is 0-10 cmH20 will be assigned a daily minimum MAP value of 10 cmH20.

4.14.10 Baseline Period:Baseline period is ≥ 2 calendar days of stable or decreasing daily minimum FiO2 or MAP values and immediately precedes the first day of increased daily minimum MAP or FiO2

4.14.11 Worsening of oxygenation: The patient has at least one of the following :

4.14.11.1 Increase in daily minimum FiO2 of ≥ 0.25 (25 points) over the daily minimum FiO2 of the first day in the baseline period, sustained for ≥ 2 calendar days.
OR

4.14.11.2 Increase in daily minimum MAP values of ≥ 4 cmH2O over the daily minimum MAP of the first day in the baseline period, sustained for ≥ 2 calendar days.

4.14.12 PedVAE diagnosis:

4.14.12.1 Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 2 calendar days of stable or decreasing daily minimum FiO2 or MAP values.

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

4.14.12.2.1 Increase in daily minimum FiO2 of ≥ 0.25 (25 points) over the daily minimum FiO2 of the first day in the baseline period, sustained for ≥ 2 calendar days.

4.14.12.2.2 Increase in daily minimum MAP values of ≥ 4 cmH2O over the daily minimum MAP of the first day in the baseline period, sustained for ≥ 2 calendar days

4.14.13 Analysis of PedVAE: See attachment 7.10

4.14.13.1 PedVAE rates and ventilator DUR should be presented by unit (for example, pediatric ICU, pediatric cardiac ICU...etc).

4.14.13.2 PedVAE rates and ventilator DUR in neonatal ICU should be presented by unit and birthweight categories (which includes A = ≤750 g; B = 751-1000 g; C = 1001-1500 g; D = 1501-2500 g; E = >2500 g).

5. MATERIALS AND EQUIPMENT:

5.1 Forms and Records:

5.1.1 Ventilator-Associated Event (VAE) Checklist

5.1.2 VENTILATOR ASSOCIATED EVENT (VAE) MONITORING FORM

5.1.3 SURVEILLANCE FORM: Ventilator-Associated Event (VAE) and PedVae

5.2 Materials and Equipment

5.2.1 N/A

6. RESPONSIBILITIES:

6.1 Infection Prevention and Control department
6.2 Doctors, Respiratory Therapist , Nurses in ICUs

7. APPENDICES:

7.1 Episode of mechanical ventilation:
7.2 Infection Window Period
7.3 Multiple Transfers:
7.4 Daily minimum PEEP
7.5 Daily minimum FiO2.
7.6 Layers of VAE events.
7.7 Qualifying Antimicrobial Day (QAD):
7.8 Criterion 1:Threshold values for cultured specimens used in the diagnosis of Pneumonia
7.9 Analysis of VAE
7.10 Analysis of PedVAE:

8. REFERENCES:

8.1 Healthcare associated Infections (HAIs) Second Edition. MOH Surveillance Manual II . Last updated: November 2023.
8.2 National Healthcare Safety Network (NHSN).Ventilator-Associated Event (VAE) . January 2023.

9. APPROVALS:

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Reviewed by:	Dr. Thamer Naguib	Medical Director		December 24, 2024
Reviewed by:	Mr. Fahad Hazam Al Shammari	Hospital Director & IPC Committee Chairman		December 29,2024

Attachment: Forms and Records:

5.1.1 Ventilator-Associated Event (VAE) Checklist

Patient Information	
Medical Record No (MRN):	
Patient Name (4 names)	Age/Gender:
Nationality (Specify):	Telephone No.:
Address type: Primary home □	
Date Admitted to Facility:	Date on Mechanical Ventilation:

Ventilator-Associated Event (VAE) Summary		
Criterion	Criterion Met	Date of Event (DOE)
VAC	☐	
IVAC	☐	
PVAP	☐	

Please refer to Chapter 10 Ventilator-Associated Event (VAE) of the Patient Safety Manual for additional information.

Documentation Review Checklist		
Ventilator-Associated Event (VAE) - Ventilator-Associated Condition (VAC)		
Elements:	Element Met	Date
The patient has at least *one* of the following:		
• Baseline period of stability* on the ventilator	☐	
• Baseline period of improvement* on the ventilator	☐	
AND immediately following a period of stability or improvement (as above), 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 daily minimum FiO_2 of the first day in the baseline period, sustained for ≥ 2 calendar days	☐	
2. Increase in daily minimum** PEEP values of ≥ 3 cm $H_2O^{\dagger}$ over daily minimum PEEP of the first day in the baseline period, sustained for ≥ 2 calendar days	☐	

Note:
**Stability or improvement is defined by ≥ 2 calendar days of stable or decreasing daily minimum FiO_2 or PEEP values. The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or FiO_2.*
***Daily minimum defined by lowest value of FiO_2 or PEEP during a calendar day that is maintained for > 1 hour.*
†Daily minimum PEEP values of 0-5 cm H_2O are considered equivalent for the purposes of VAE surveillance.

Comments/Notes:

Ventilator-Associated Event (VAE)		
Infection-related Ventilator-Associated Complication (IVAC)		
Element	Element Met	Date
Patient must meet VAC to be eligible for IVAC	☐	
On or after calendar day 3 of mechanical ventilation (MV) and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets *both* of the following:		
Patient has *one* of the following:		
• Temperature > 38°C (>100.4°F)	☐	
• Temperature < 36°C (<96.8°F)	☐	
• White blood cell count ≥ 12,000 cells/mm^3	☐	
• White blood cell count ≤ 4,000 cells/mm^3	☐	
AND Patient meets *all* of the following:		
• A new antimicrobial agent(s)* is started	☐	
• The new antimicrobial agent(s)** is continued for ≥ 4 qualifying antimicrobial days(QAD)	☐	

Note:
**The agent is considered new for the purposes of this definition if it was NOT given to the patient on either of the 2 days preceding the current start date.*
***See table titled "List of Antimicrobial Agents Eligible for IVAC, PVAP"*

Comments/Notes:

Ventilator-Associated Event (VAE)		
Possible Ventilator-Associated Pneumonia (PVAP)		
Elements:	**Element Met**	**Date**
Patients must meet VAC and IVAC to be eligible for PVAP	☐	
AND Patient must meet *one* of the following criteria on or after calendar day 3 of MV and within 2 calendar days before orafter the onset of worsening oxygenation (Refer to VAE Protocol for organisms excluded from meeting PVAP):		
1. Criterion 1: Positive culture of *one* of the following specimens, meeting quantitative or semi-quantitative[†] thresholds as outlined in the protocol, without the requirement for purulent respiratory secretions:		
• Endotracheal aspirate, ≥ 10^5 CFU/ml *or corresponding semi-quantitative result*	☐	
• Bronchoalveolar lavage, ≥ 10^4 CFU/ml or corresponding semi-quantitative result	☐	
• Lung tissue, ≥ 10^4 CFU/g or corresponding semi-quantitative result	☐	
• Protected specimen brush, ≥ 10^3 CFU/ml *or corresponding semi-quantitative result*	☐	
2. Criterion 2: Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain ≥ 25 neutrophils and ≤ 10 squamous epithelial cells per low power field [lpf, x100])[†] PLUS organism identified from *one* of the following specimens (to include qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet Criterion 1):		
• Sputum	☐	
• Endotracheal aspirate	☐	
• Bronchoalveolar lavage	☐	
• Lung tissue	☐	
• Protected specimen brush	☐	
3. Criterion 3: *One* of the following positive tests:		
• Organism identified from pleural fluid (where the specimen was obtained during thoracentesis or within 24 hours of chest tube placement; pleural fluid specimens collected after a chest tube is repositioned or from a chest tube in place,> 24 hours are not eligible for PVAP)	☐	
• Lung histopathology, defined as: 1) abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli; 2) evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae, or yeast forms); 3) evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue	☐	
• Diagnostic test for *Legionella* species	☐	
• Diagnostic test on respiratory secretions for influenza virus, respiratory syncytialvirus adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus	☐	
Note: If the laboratory reports semi-quantitative results, those results must correspond to the quantitative thresholds. Refer to Table 2 and Table 3.		
Comments/Notes:		

5.1.2 VENTILATOR ASSOCIATED EVENT (VAE) MONITORING FORM

وزارة الصحة
Ministry of Health

General Directorate of Infection Prevention and Control
Ministry of Health- Riyadh KSA
SURVEILLANCE FORM

VENTILATOR ASSOCIATED EVENT (VAE) MONITORING FORM

GDIPC Surveillance

Name of patient							File Number			Bed no.	
Admission date							Location				
MV date											
DATE	MV DAY	PEEP MIN	FiO2 MIN	Temp >38°C or < 36°	WBC ≥ 12,000 or ≤ 4,000	ABX name	SPECIMEN	POLYS/ EPIS	ORGANISM (specify the CFU/ml or count: +4;+3,+2)	VAE type (VAC, IVAC or PVAP)	Comment

MV = mechanical ventilation. PEEP min = Daily minimum PEEP. FiO2 min = Daily minimum FiO2. Temp min = Daily minimum temperature. Temp max = Daily maximum temperature. WBC min = Daily minimum white blood cell count. WBC max = Daily maximum white blood cell count. ABX = antimicrobial agents. Polys / epis = Polymorphonuclear leukocytes and squamous epithelial cells from respiratory specimen.

VAE Type: VAC- Increase in daily min FiO2 of ≥0.20 (20%) over the daily minimum FiO2 of the first day in the baseline period, sustained for ≥ 2 calendar days OR Increase in daily min PEEP values of ≥ 3cmH2O over the daily min PEEP of the first day in the baseline period sustained for ≥ 2 calendar days; IVAC- Temperature < 36°C or > 38°C, white blood cell counts ≤ 4,000 cells/mm3 or ≥ 12,000 cells/mm3); a new antimicrobial agent started and continued for ≥4 days; PVAP- 1-positive culture (ETA; BAL; Lung Tissue, Protective specimen brush); 2- purulent resp. secretions (lungs, bronchi, trachea ≥ 25 neutrophils and ≤ 10 squamous epithelial cells PLUS organism from sputum; endotracheal asp; bronchial lavage; lung tissue; protected specimen brush; 3- positive test in pleural fluid; lung histopath; dx test for legionella spec; dx test for influenza virus, RSV, Adenovirus, parainfluenza virus, rhinovirus, coronavirus

5.1.3SURVEILLANCE FORM: Ventilator-Associated Event (VAE) and PedVAE Checklist

General Directorate of Infection Prevention and Control
Ministry of Health- Riyadh KSA
SURVEILLANCE FORM

GDIPC Surveillance

Ventilator-Associated Event (VAE)

****required for completion**

*Medical Record No (MRN):	National ID/IQAMA #:
Patient Name (4 names)	Client ID:
*Gender: F M	Age: Nationality (Specify):
*Event Type: VAE	*Date of Event:
Post-procedure VAE: Yes No	Date of Procedure:
*Date Admitted to Facility:	*Location:
*Location of Mechanical Ventilation Initiation: _____	*Date Initiated: __/__/____ *APRV: Yes No (Airway Pressure Release Ventilation)

Event Details

*Specific Event: ☐ *VAC* ☐ *IVAC* ☐ *Possible VAP*

*Specify Criteria Used:

STEP 1: Ventilator Associated Condition (VAC)

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

☐ Increase in daily minimum* FiO2 of ≥ 0.20 (20 points) over the daily minimum FiO2 of the first day in the baseline period, sustained for ≥ 2 calendar days.

OR ☐ Increase in daily minimum* PEEP values of ≥ 3 cmH2O over the daily minimum PEEP of the first day in the baseline period† sustained for ≥ 2 calendar days.

**Daily minimum defined by lowest value of FiO2 or PEEP during a calendar day that is maintained for > 1 hour.*
**Daily minimum PEEP values of 0-5 cmH2O are considered equivalent for the purposes of VAE surveillance.*

STEP 2: Infection- related Ventilator Associated Complication (IVAC)

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

☐ Temperature > 38°C or < 36° **OR** ☐ White blood cell count ≥ 12,000 or ≤ 4,000 cells/mm^3

AND

☐ A new antimicrobial agent(s) is started, and is continued for ≥ 4 qualifying antimicrobial days (QAD).

STEP 3: Possible Ventilator Associated Pneumonia (PVAP)

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 (taking into account organism exclusions specified in the protocol):

☐ **Criteria 1:**

Positive culture of one of the following specimens, meeting quantitative or semi quantitative thresholds* as outlined in protocol, without requirement for purulent respiratory secretions:

a. Endotracheal aspirate, ≥ 10 5 CFU/ml or corresponding semi-quantitative result
b. Bronchoalveolar lavage, ≥ 10 4 CFU/ml or corresponding semi-quantitative result
c. Lung tissue, ≥ 10 4 CFU/g or corresponding semi-quantitative result
d. Protected specimen brush, ≥ 10 3 CFU/ml or corresponding semi-quantitative result

☐ **Criteria 2**

Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain **>25 neutrophils** and **<10 squamous epithelial cells per low power field [lpf, x100])** * **PLUS organism** identified from one of the following specimens (to include qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet criterion # 1):

a. Sputum b. Endotracheal aspirate c. Bronchoalveolar lavage d. Lung tissue e. Protected specimen brush

** If the laboratory reports semi-quantitative results, those results must correspond to the quantitative thresholds.*
* If organism identified, specify the name: _____

☐ **Criteria 3**

One of the following positive tests:

a. *Organism identified from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
b. Lung histopathology, defined as:
1) abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli;
2) evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms);
3) evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue
c. Diagnostic test for Legionella species
d. Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

*Secondary Bloodstream Infection: Yes No	
**Died: Yes No	VAE Contributed to Death: Yes No
Discharge Date:	*Pathogens Identified: Yes No *If Yes, specify name of Organism:

Prepared by: _____

Pediatric Ventilator-Associated Event (PedVAE) Checklist

Patient Information	
Medical Record No (MRN):	
Patient Name (4 names)	**Age/Gender:**
Nationality (Specify):	**Telephone No.:**
Address type: Primary home ☐	
Date Admitted to Facility:	**Date on Mechanical Ventilation:**

Pediatric Ventilator-Associated Event (PedVAE) Summary		
Criterion	**Criterion Met**	**Date of Event (DOE)**
PedVAE	☐	
Please refer to Chapter 11 Pediatric Ventilator-Associated Event (PedVAE) of the Patient Safety Manual for additional information.		

Documentation Review Checklist		
Pediatric Ventilator-Associated Event (PedVAE)		
Elements:	**Element Met**	**Date**
The patient has at least one of the following:		
• **Baseline period of stability* on the ventilator**	☐	
• **Baseline period of improvement* on the ventilator**	☐	
AND immediately following a period of stability or improvement (as above), patient has at least one of the following indicators of worsening oxygenation:		
1. **Increase in daily minimum FiO_2** of ≥ 0.25 (25 points) over the daily minimum FiO_2 of the first day in the baseline period, sustained for ≥ 2 calendar days**	☐	
2. **Increase in daily minimum MAP† values of ≥ 4 cm H_2O over the daily minimum MAP of the first day in the baseline period, sustained for ≥ 2 calendar days**	☐	
Note:		
****Stability or improvement on the ventilator is defined by ≥ 2 calendar days of stable or decreasing daily minimum FiO_2 or MAP values. The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum FiO_2 or MAP.***		
*****Daily minimum FiO_2 is the lowest value of FiO_2 documented during a calendar day that is maintained for > 1 hour.***		
†Daily minimum MAP is the lowest value documented during the calendar day. For the purposes of surveillance, in patients < 30 days old, daily minimum MAP values of 0-8 cm H_2O are considered equal to 8 cm H_2O; in patients ≥ 30 days old, daily minimum MAP values of 0-10 cm H_2O are considered equal to 10 cm H_2O.		
Comments/Notes:		

APPENDICES:

7.1 Episode of mechanical ventilation:

Hospital days	1	2	3	4	5	6	7
Ventilator days	1	2	3	Extubated (4)	Re-intubated (5)	6	7
Ventilator episodes	1	1	1	1	1	1	1

Hospital days	1	2	3	4	5	6	7
Ventilator days	1	2	3	Extubated (4)	---	Re-intubated (1)	2
Ventilator episodes	1	1	1	1	---	2	2

7.2 Infection Window Period

Ventilator days	10	11	12	13	14	15	16
VAE day	-3	-2	-1	1	2	3	4
Oxygenation	Stable/ improve	Stable/ improve	Stable/ improve	Worsen	Worsen	Worsen	Worsen
DOE		Day2 before	Day1 before	DOE	Day1 after	Day2 after	
Window		1	2	3	4	5	

Ventilator days	1	2	3	4	5	6	7
VAE day	-3	-2	-1	1	2	3	4
Oxygenation	Stable/ improve	Stable/ improve	Stable/ improve	Worsen	Worsen	Worsen	Worsen
DOE		Day2 before	Day1 before	DOE	Day1 after	Day2 after	
Window	Cannot include	Cannot include	1	2	3	4	

7.3 Multiple Transfers:

Date	3/22	3/23	3/24
Locations	Unit A	Unit A Unit B Unit C	Unit C Unit D *VAE was diagnosed*

VAE is attributed to Unit A since Unit A was the first location in which the patient was housed the day before the date of event.

7.4 Daily minimum PEEP

•EXAMPLE: The patient is intubated and the PEEP is set at the following values through the remainder of the calendar day:

Time-1	**6:00 PM**	**7:00 PM**	**8:00 PM**	**9:00 PM**	**10:00 PM**	**11:00 PM**
Value-1	10	8	5	5	8	8

•In the first example, the daily minimum PEEP for the purposes of VAE surveillance is 5 cmH2O. It was the lowest value that is maintained for one hour

Time-2	**6:00 PM**	**7:00 PM**	**8:00 PM**	**9:00 PM**	**10:00 PM**	**11:00 PM**
Value-2	8	5	8	5	8	8

•In the second example, the daily minimum PEEP for the purposes of VAE surveillance is 8 cmH2O. The value 5 cmH2O cannot be used as it was not maintained for one hour

Time-3	**12:00 AM**	**4:00 AM**	**8:00 AM**	**12:00 PM**	**4:00 PM**	**8:00 PM**
Value-3	5	8	5	8	8	10
•In the third example, the daily minimum PEEP is 5 cmH2O. PEEP settings are being monitored and recorded every 4 hours; therefore the lowest recorded PEEP setting for the calendar day is the value used in VAE surveillance.						

7.5 Daily minimum FiO2.

EXAMPLE: The patient is intubated and the FiO2 is set at the following values through the remainder of the calendar day:

Time-1	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Value-1	1.0	0.8	0.5	0.5	0.8	0.8

•In the first example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.5. It was the lowest value that is maintained for one hour

Time-2	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Value-2	0.8	0.8	0.5	0.8	0.5	0.8

•In the second example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.8. The value 0.5 cannot be used as it was not maintained for one hour

Time-3	2:00 PM	4:00 PM	6:00 PM	8:00 PM	10:00 PM	12:00 AM
Value-3	1.00	0.60	0.40	0.50	0.55	0.60
•In the third example, the daily minimum FiO2 is 0.40. FiO2 settings are being monitored and recorded every 2 hours; therefore, the lowest recorded FiO2 setting for the calendar day is the value used in VAE surveillance.						

7.6 Layers of VAE events.

EXAMPLE: In the example below, the baseline period is defined by mechanical ventilation (MV) days 1 through 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum PEEP is ≥ 3 cmH2O greater than the daily minimum PEEP of the first day in the baseline period. Note that there is no VAC on MV day 3, because PEEP values 0-5 cmH2O are considered equivalent for the purposes of this surveillance.

Ventilator day	Daily minimum PEEP (cmH_2O)	Daily minimum FIO_2 (%)	VAE
1	0	100%	
2	0	50%	
3	3	50%	
4	5	50%	
5	8	50%	VAC
6	8	50%	

EXAMPLE: In the example below, the baseline period is defined by mechanical ventilation (MV) days 3 and 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum FiO2 is ≥ 0.20 (20 points) over the daily minimum FiO2 of the first day in the baseline period.

Ventilator day	Daily minimum PEEP (cmH_2O)	Daily minimum FIO_2 (%)	VAE
1	8	100%	
2	6	50%	
3	5	40%	
4	5	40%	
5	6	70%	VAC
6	6	70%	

EXAMPLE: In the example below, there is no VAC, because the FiO2 on MV day 4 is higher than the FiO2 on MV day 3 (and therefore not stable or decreasing) – even though the FiO2 on MV days 3 and 4 meets the 20-point threshold when compared with the daily minimum FiO2 on MV days 5 and 6.

Ventilator day	Daily minimum PEEP (cmH_2O)	Daily minimum FIO_2 (%)	VAE
1	8	100%	
2	6	50%	
3	5	35%	
4	5	40%	
5	6	70%	No event
6	6	70%	

7.7 Qualifying Antimicrobial Day (QAD):

Ventilator days	2	3	4	5	6	7	8
Oxygenation		Stable/ improve	Stable/ improve	Worsen	Worsen		
Antimicrobial agent	Ceftriaxone	Ceftriaxone	Ceftriaxone	Meropenem	Meropenem	Meropenem	Meropenem
QAD				1	2	3	4

• **Meropenem is a new start while ceftriaxone is not as it was given to the patient the day before the 5-day period.**
• **The number of QAD is 4**

Ventilator days	2	3	4	5	6	7	8
Oxygenation		Stable/ improve	Stable/ improve	Worsen	Worsen		
Antimicrobial agent	Ceftriaxone	Ceftriaxone	Ceftriaxone	Meropenem	Imipenem	Piperacillin/ Tazobactam	Piperacillin/ Tazobactam
QAD				1	2	3	4

• **Meropenem, Imipenem and Piperacillin/ Tazobactam are new start while ceftriaxone is not as it was given to the patient the day before the 5-day period.**
• **The number of QAD is 4**

Ventilator days	2	3	4	5	6	7	8
Oxygenation		Stable/ improve	Stable/ improve	Worsen	Worsen		
Antimicrobial agent			Levofloxacin		Levofloxacin		Levofloxacin
QAD			1	2	3	4	5

• **Because there is a gap of no more than 1 calendar day between days of levofloxacin administration, the requirement for 4 consecutive QADs is met**
• **The number of QAD is 5**

Ventilator days	2	3	4	5	6	7	8
Oxygenation		Stable/ improve	Stable/ improve	Worsen	Worsen		
Antimicrobial agent			Vancomycin			Vancomycin	
QAD							

• Because there is a gap of more than 1 calendar day between days of vancomycin administration, the requirement for 4 consecutive QADs is not met
• The number of QAD is 0

7.8 Criterion 1-PVAP: Threshold values for cultured specimens used in the diagnosis of Pneumonia

Specimen collection/technique	Values*
1. Lung tissue	$\geq 10^4$ CFU/g tissue
2. Bronchoscopically (B) obtained specimens	
• Broncho alveolar lavage (B-BAL)	$\geq 10^4$ CFU/ml
• Protected BAL (B-PBAL)	$\geq 10^4$ CFU/ml
• Protected specimen brushing (B-PSB)	$\geq 10^3$ CFU/ml
3. Non bronchoscopically (NB) obtained (blind)specimens	
• Broncho alveolar lavage (NB-BAL)	$\geq 10^4$ CFU/ml
• Protected specimen brushing (NB-PSB)	$\geq 10^3$ CFU/ml
4. Endotracheal aspirate (ETA)	$\geq 10^5$ CFU/ml

*CFU = colony forming units, g = gram, ml = milliliter

Semi-quantitative results:

• Semi-quantitative Results for cultured specimens such as "moderate" or "heavy" or "many" or "numerous" growth, or 2+, 3+, or 4+ growth can meet Criterion 1 of the PVAP surveillance definition
• Semi-quantitative results for purulent respiratory secretions can meet Criterion 2 of the PVAP surveillance definition
✓ Neutrophils: Many, heavy, numerous, 4+, or ≥ 25 neutrophils per low power field (lpf) [x100]
✓ Squamous cells: No, rare, occasional, few, 1+ or 2+, or ≤ 10 squamous epithelial cells per lpf [x100]

7.9 Analysis of VAE

Measure	Calculation	Application
VAE Rates	$\frac{\text{The number of VAEs for a location}}{\text{The number of ventilator days for that location}}$ X1000	Location specific measure
VAE Rates	$\frac{\text{The number of VAEs for a location}}{\text{The number of ventilator episodes for that location}}$ X100	Location specific measure
VAE SIR	$\frac{\text{The number of observed VAEs}}{\text{The number of predicted VAEs}}$	Both location specific and summarized measure
Ventilator DUR	$\frac{\text{The number of ventilator days for a location}}{\text{The number of patient days for that location}}$	Location specific measure
Ventilator SUR	$\frac{\text{The number of observed ventilator days}}{\text{The number of predicted ventilator days}}$	Both location specific and summarized measure

SIR, standardized infection ratio; DUR, device utilization ratio; SUR, standardized utilization ratio

7.10 Analysis of PedVAE:

Measure	Calculation	Application
PedVAE Rates	$\frac{\text{The number of PedVAEs for a location}}{\text{The number of ventilator days for that location}}$ X1000	Location specific measure
PedVAE Rates	$\frac{\text{The number of PedVAEs for a location}}{\text{The number of ventilator episodes for that location}}$ X100	Location specific measure
Ventilator DUR	$\frac{\text{The number of ventilator days for a location}}{\text{The number of patient days for that location}}$	Location specific measure