



Patient Safety Component: Pediatric Ventilator-associated Event (PedVAE) Surveillance

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Learning Objectives

At the conclusion of this presentation, participants will be able to:

- Explain Pediatric Ventilator-associated Events (PedVAE) key terms
- Determine Daily Minimum Values
- Apply the PedVAE surveillance algorithm
- Locate resources for PedVAE surveillance and reporting, including the PedVAE Calculator

PedVAE Surveillance - History

Ventilated Patients: Risks

- Ventilated patients are at high risk for complications and poor outcomes
- Ventilator associated complications can lead to
 - longer duration of mechanical ventilation
 - longer stays in the intensive care unit (ICU) and hospital
 - increased healthcare costs
 - increased risk of morbidity and mortality

Neonatal Ventilated Patients: Risks

- In preterm neonates, prolonged mechanical ventilation for respiratory distress syndrome can contribute to the development of chronic lung disease
- Prolonged mechanical ventilation in extremely low birthweight infants is also associated with neurodevelopmental delay

PedVAE Surveillance: Development

- **Pediatric and Neonatal VAE Surveillance Working Group** convened in 2012 to explore use of the adult Ventilator-Associated Event (VAE) algorithm in pediatric and neonatal inpatient locations
 - Insufficient data available to inform development of a pediatric VAE definition

PedVAE Surveillance: Evidence Base

- Publication* in 2016 on the use of a pediatric VAE-like definition demonstrated detection of events defined by changes in FiO_2 and Mean Airway Pressure were associated with increases in length of stay and mortality

*Cocoros NM, Kleinman K, Priebe GP, et al. Ventilator-Associated Events in Neonates and Children--A New Paradigm. Crit Care Med. 2016 Jan;44:14-22.

Ventilator-Associated Events in Neonates and Children--A New Paradigm*

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***See also p. 233.**

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Objectives: To identify a pediatric ventilator-associated condition definition for use in neonates and children by exploring whether potential ventilator-associated condition definitions identify patients with worse outcomes.
Design: Retrospective cohort study and a matched cohort analysis.
Setting: Pediatric, cardiac, and neonatal ICUs in two U.S. hospitals.
Patients: Children 18 years old or younger ventilated for at least 1 day.
Interventions: None.
Measurements and Main Results: We evaluated the evidence of worsening organization via a range of thresholds for increases in daily minimum fraction of inspired oxygen (by 0.20, 0.25, and 0.30) and daily minimum mean airway pressure (by 4, 5, 6, and 7 cm H₂O). We required worsening organization to be sustained for at least 2 days after at least 2 days of stability. We matched patients with a ventilator-associated condition to those without and used Cox proportional hazards models to estimate the risk of death.

PedVAE Surveillance: Implementation

- Pediatric and Neonatal VAE Surveillance Working Group consensus reached to begin development of PedVAE, with plans to implement as an available event in NHSN
- PedVAE field testing conducted in 2017
- PedVAE made available as an NHSN surveillance event starting January 2019



Pediatric Ventilator-Associated Event (PedVAE)

For use in neonatal and pediatric locations only

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Introduction

Mechanical ventilation is an essential, life-saving therapy for patients with critical illness and respiratory failure. Hundreds of thousands of patients receive mechanical ventilation in the United States each year [1-3]. These patients are at high risk for complications and poor outcomes, including death [1-5]. Ventilator-associated pneumonia (VAP), sepsis, Acute Respiratory Distress Syndrome (ARDS), pulmonary embolism, barotrauma, and pulmonary edema are among the complications that can occur in patients receiving mechanical ventilation. Such complications can lead to longer duration of mechanical ventilation, longer stays in the ICU and hospital, increased healthcare costs, and increased risk of disability and death. In preterm neonates, prolonged mechanical ventilation for respiratory distress syndrome can contribute to the development of chronic lung disease [6]. Prolonged mechanical ventilation in extremely low birthweight infants is also associated with neurodevelopmental delay [7].

Surveillance for ventilator-associated events in the National Healthcare Safety Network (NHSN) prior to 2013 was limited to VAP. Traditional VAP definitions, including the NHSN PNEU definitions (revised in 2002), have well-described limitations [8-11]. They typically require radiographic evidence of pneumonia, although data suggest that chest radiograph findings do not accurately identify VAP. The subjectivity and variability inherent in chest radiograph technique, interpretation, and reporting make chest imaging ill-suited for inclusion in a definition algorithm to be used for the potential purposes of public reporting, inter-facility comparisons, and pay-for-reporting and pay-for-performance programs. Another major limitation of the available VAP definitions is their reliance on specific clinical signs or symptoms, which are subjective and may be poorly or inconsistently documented in the medical record.

PedVAE Surveillance - Resources

Accessing PedVAE Resources

NHSN webpage: <https://www.cdc.gov/nhsn/index.html>

National Healthcare Safety Network (NHSN)

CDC's National Healthcare Safety Network is the nation's most widely used healthcare-associated infection tracking system. NHSN provides facilities, states, regions, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate healthcare-associated infections.

In addition, NHSN allows healthcare facilities to track blood safety errors and important healthcare process measures such as healthcare personnel influenza vaccine status and infection control adherence rates.



COVID-19 Modules and Dashboards

COVID-19 reporting and vaccination resources for all healthcare facilities.



[NHSN Requirements & Recommendations for Application Use](#)

Resources by Facility

NHSN Components

[Acute Care / Critical Access Hospitals](#)

[Ambulatory Surgery Centers](#)

[Long-term Acute Care Hospitals](#)

[Long-term Care Facilities](#)

[Inpatient Rehabilitation Facilities](#)

[Inpatient Psychiatric Facilities](#)

[Dialysis Facilities](#)

[View All Facilities](#)

About NHSN

CDC's NHSN is the largest HAI reporting system in U.S.

Enroll New Facility

For first-time facility enrollment

NHSN Training

Self-paced trainings, videos & quick learns

Data & Reports

See national and state reports using NHSN data

Newsletters

View NHSN newsletters

NHSN Application

NHSN Member Login

CMS Requirements

CMS reporting requirements through NHSN

Analysis Resources

Analysis resources and guides for the PS Component

Data Validation & Guidance

Data Validation & Guidance

CDA Submission Support (CSSP)

Toolkits, FAQs, webinars & resources

ACH Modules & Events

Access relevant training, protocols, data collection forms and supporting materials for each module.

AUR Module

Antimicrobial Use & Resistance Options

BSI Events

Bloodstream Infections

CLIP Events

Central Line Insertion Practice Adherence

MDRO & CDI Events

Multidrug-Resistant Organism & *C. difficile* Infections

PedVAE

Pediatric Ventilator-associated Events

HCP COVID-19 Vaccination

Healthcare Personnel Safety Component

PNEU Events

Pneumonia (PedVAP) Events

SSI Events

Surgical Site Infection Events

UTI Events

Urinary Tract Infections

VAE

Ventilator-associated Events

HCP Flu Vaccination

Healthcare Personnel Safety Component

HCP Exposure

Healthcare Personnel Safety Component

Available PedVAE Resources

PedVAE webpage:

<https://www.cdc.gov/nhsn/psc/pedvae/index.html>

- Protocol
- Calculator
- Training
- FAQs
- Forms
- And more!

Pediatric Ventilator-associated Events (PedVAE)

[Print](#)

Available In-Plan for Pediatric and Neonatal Inpatient Locations Only.

PedVAP surveillance using the [PNEU](#) protocol continues to be available for in-plan surveillance for pediatric locations only. See [VAE](#) for in-plan surveillance for adult locations

! Not available for Inpatient Psychiatric Facilities (IPFs)

PedVAE Calculator

operates based upon the currently posted PedVAE protocol.

PedVAE Training

Educational Roadmap

CMS Requirements

HAI Checklists

FAQs

[PedVAE](#)

[Analysis](#)

[Annual Surveys](#)

Protocols

[Chapter 11: Pediatric Ventilator-Associated Event \(PedVAE\) Protocol – January 2024](#) [PDF – 600 KB]

[2024 Patient Safety Component Summary of Updates](#) [PDF – 248 KB]

Supporting Chapters

[Chapter 1: NHSN Overview – January 2024](#) [PDF – 350 KB]

[Chapter 3: Patient Safety Monthly Reporting Plan – January 2024](#) [PDF – 300 KB]

[Chapter 15: CDC Location Labels and Location Descriptions – January 2024](#) [PDF – 1 MB]

[Chapter 16: NHSN Key Terms – January 2024](#) [PDF – 300 KB]

PedVAE Surveillance – Inclusion Criteria

Ventilator Definition

- **Ventilator:** 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.
- **Note:** Ventilation and lung expansion devices that deliver positive pressure to the airway (for example, CPAP, BiPAP, Bi-level, IPPB, and PEEP) via non-invasive means (for example, nasal prongs, nasal mask, full face mask, total mask, etc.) are not considered ventilators unless positive pressure is delivered via an artificial airway (oral/nasal endotracheal or tracheostomy tube).

PedVAE Surveillance: Eligible Patients

- Ventilated inpatients in acute care hospitals, long term acute care hospitals, inpatient rehabilitation facilities
- Patients in pediatric and neonatal locations where denominator data (patient days and ventilator days) can be collected
 - Ventilated adults in pediatric locations are included in PedVAE surveillance – regardless of age

PedVAE Surveillance: Ineligible Patients

- Patients on extracorporeal life support or paracorporeal membrane oxygenation are not eligible for VAE surveillance
 - Ineligibility only applies to periods of time while receiving this form of support
- Patients in non-acute care locations in acute care facilities (such as a chronic care unit)
- Pediatric patients in adult inpatient locations
 - Ventilated pediatric patients in adult locations are included in adult VAE surveillance

Other Inclusion Criteria

- INCLUDE patients on
 - High Frequency Oscillatory or Jet Ventilation
 - Airway Pressure Release Ventilation (APRV)
- INCLUDE patients who are receiving mechanical ventilation while also receiving
 - Prone positioning
 - Surfactant
 - Corticosteroids
 - Nitric oxide therapy
 - Helium-oxygen mixture (heliox)
 - Epoprostenol therapy

Knowledge Check #1

A mechanically ventilated pediatric patient was admitted to the adult ICU. Can PedVAE surveillance be performed for this patient?

A. Yes

B. No



Knowledge Check #1 - Rationale

A mechanically ventilated pediatric patient was admitted to the adult ICU. Can PedVAE surveillance be performed for this patient?

No. PedVAE surveillance is location based, not age based. PedVAE surveillance can only be conducted in pediatric and neonatal inpatient locations.

PedVAE Definition – Overview

Reminder: The PedVAE 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.

PedVAE Definition: Algorithm Summary

Patient initiated on mechanical ventilation



Identification of a baseline period of stability or improvement, followed by a sustained period of worsening oxygenation



Pediatric Ventilator-associated Event (PedVAE)

PedVAE Determination

- PedVAEs are determined by identification of deterioration in respiratory status after a period of stability or improvement on the ventilator
- Assessed by monitoring two key parameters that reflect oxygenation status in neonatal and pediatric ventilated patients:
 - Fraction of Inspired Oxygen - FiO_2
 - Mean Airway Pressure - MAP

FiO₂: Fraction of Inspired Oxygen

- Fraction of Oxygen in inspired gas
 - FiO₂ of room air is 0.21
 - Oxygen concentration of room air is 21%
- FiO₂ is a setting on the ventilator and is one of the key parameters that can be adjusted depending on the patient's oxygenation requirements
- FiO₂ values of 0.21, 21%, and 21 are used interchangeably

MAP: Mean Airway Pressure

- Mean Airway Pressure – Mean (average) pressure exerted on the airway and lungs from the beginning of inspiration until the beginning of the next inspiration (inspiratory cycle)
- MAP is a measured/calculated value (not a ventilator setting) that is determined by
 - PEEP - Positive End-Expiratory Pressure
 - PIP - Peak Inspiratory Pressure
 - Inspiratory time
 - Frequency

Knowledge Check #2

For the purposes of PedVAE surveillance, what does MAP mean?

- A. Mean Arterial Pressure
- B. Mean Airway Pressure



Knowledge Check #2 - Rationale

For the purposes of PedVAE surveillance, what does MAP mean?

Mean Airway Pressure

(For purposes of PedVAE surveillance, MAP is **NOT** Mean Arterial Pressure)

Daily Minimum Values

Daily Minimum Values

- FiO₂ ventilator settings and MAP values documented during the calendar day are used to identify the daily minimum FiO₂ and daily minimum MAP values
- FiO₂ settings and MAP values are typically recorded in the paper or electronic medical record, on respiratory therapy and/or nursing flow sheets, in the section of the flow sheet that pertains to respiratory status/mechanical ventilation
- Use a calendar day, not any other “24-hour capture period”

Daily Minimum Values Continued

- When determining the daily minimum values for FiO_2 and MAP, you will use all documented values that are recorded throughout the calendar day during times when the patient is receiving support from an eligible mode of mechanical ventilation
 - Include FiO_2 and MAP values documented during weaning/mechanical ventilation liberation trials as long as the patient is receiving ventilator support during those trials
 - Exclude FiO_2 and MAP values documented during periods of time when the patient is on extracorporeal life support or paracorporeal membrane oxygenation

Daily minimum FiO₂

- The daily minimum FiO₂ is defined as the **lowest documented FiO₂ setting that was maintained for > 1 hour during a calendar day**
- If there is no setting that has been maintained for > 1 hour, then select the lowest setting regardless of the period of time in which the setting was maintained

Daily Minimum FiO₂ Continued

- The PedVAE protocol provides examples of how > 1 hour is to be determined to ensure standardization across all facilities
 - If documenting every 15 minutes, 5 consecutive recordings at the same setting are needed (for example, at 09:00, 09:15, 09:30, 09:45 and 10:00)
 - If documenting every 30 minutes, 3 consecutive recordings at the same setting are needed (for example, at 09:00, 09:30, and 10:00)
 - If documenting every hour, 2 consecutive recordings at the same setting are needed (for example, at 09:00 and 10:00)

Identify the Daily Minimum FiO₂ for Monday

- Select the lowest value recorded for the calendar day that is maintained for > 1 hour

	Monday 12am	3am	4am	6am	9am	12pm	3pm	9pm	11pm
FiO ₂	0.80	0.70	0.90	0.80	0.80	0.75	0.75	0.75	0.75

- **Monday: 0.75** is the daily minimum FiO₂. The lowest value of 0.70 was not maintained for > 1 hour.

Identify the daily minimum FiO₂ for Monday and Tuesday

- Ventilation is initiated late in the calendar day on Monday

	Monday		Tuesday					
	2300	2330	0030	0100	0300	0600	0900	1200
FiO ₂	0.70	0.80	0.80	0.80	0.80	0.75	0.75	0.80

- **Monday:** 0.70 is the daily minimum FiO₂ - there was no value maintained for > 1 hour
 - Do not look to the next calendar day to determine if a setting was maintained > 1 hour
- **Tuesday:** 0.75 is the daily minimum FiO₂ - the lowest value maintained for > 1 hour

Daily minimum MAP

- The daily minimum MAP is defined as the **lowest value documented during a calendar day regardless of how long the value is maintained**
- When determining the daily minimum MAP, if MAP values include a decimal place, then round the MAP value to the nearest whole number. For example:
 - A MAP of 10.00 – 10.49 is rounded to 10
 - A MAP of 10.50 – 10.99 is rounded to 11

Daily minimum MAP continued

- For patients < 30 days old MAP values of 0-8 cmH₂O are considered **equal to 8 cmH₂O**
 - Any day where daily minimum MAP is 0-8 cmH₂O will be assigned a daily minimum MAP value of **8 cmH₂O**.
- For patients ≥ 30 days old MAP values 0-10 cmH₂O are considered **equal to 10 cmH₂O**
 - Any day where daily minimum MAP is 0-10 cmH₂O will be assigned a daily minimum MAP value of **10 cmH₂O**.

Identify the Daily Minimum MAP for a Patient < 30 Days old

- Select the lowest value recorded for each calendar day regardless of how long it was maintained

	Monday 12 am	3am	6am	9am	12pm	3pm	6pm	9pm
MAP	8	6	8	5 (8)	5	8	10	10

- Monday:** Daily minimum MAP is 8 cmH₂O
- Explanation:** The lowest documented value is 5 cmH₂O; however, for patients < 30 days old, MAP values 0-8 = 8.

Identify the Daily Minimum MAP for a Patient ≥ 30 Days Old

- Select the lowest value recorded for each calendar day regardless of how long it was maintained

	Monday 12 am	3am	6am	9am	12pm	3pm	6pm	9pm
MAP	8	6	8	5(10)	5	8	10	10

- Monday:** Daily minimum MAP is **10 cmH₂O**
- Explanation:** The lowest documented value is 5 cmH₂O; however, for patients ≥ 30 days old, MAP values 0-10 = 10.

Identify the Daily Minimum MAP

- Select the lowest value recorded for each calendar day regardless of how long it was maintained

	Monday 12 am	3am	6am	9am	12pm	3pm	6pm	9pm
MA P	12.4	11.7	12.9	12.2	12.8	11.9	12.7	13.2
	12	12	13	12	13	12	13	13

- Monday:** Daily minimum MAP is **12 cmH₂O**
- Explanation:** Remember to round MAP values as follows:
 - MAP decimals of .00 - .49 are rounded down to the nearest whole number
 - MAP decimals of .50 - .99 are rounded up to the nearest whole number

Knowledge Check #3

Daily minimum MAP is defined as the lowest MAP value documented during the calendar day, regardless of how long the value is maintained.



A. True

B. False

Knowledge Check #3 - Rationale

- Daily minimum MAP is the lowest MAP value documented during the calendar day, regardless of how long the value is maintained.
- When determining the daily minimum MAP, keep the following in mind:
 - MAP values documented to the decimal place are rounded to the nearest whole number
 - For patients < 30 days old, MAP values of 0-8 cmH₂O are assigned a MAP value of 8
 - For patients ≥ 30 days old, MAP values of 0-10 cmH₂O are assigned a MAP value of 10

Applying the PedVAE Algorithm

PedVAE Surveillance Algorithm

The PedVAE Surveillance Algorithm is located on p. 11-8 in the PedVAE protocol

(<https://www.cdc.gov/nhsn/pdfs/pscmanual/pedvae-current-508.pdf>)

Figure 1: Pediatric Ventilator-Associated Events (PedVAE) Surveillance Algorithm

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

*Daily minimum FiO_2 is defined as 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 patients < 30 days old, daily minimum MAP values 0-8 $\text{cm H}_2\text{O}$ are considered equal to 8 cmH_2O for the purposes of surveillance.
For patients ≥ 30 days old, daily minimum MAP values 0-10 cmH_2O are considered equal to 10 cmH_2O for the purposes of surveillance.

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 ≥ 0.25 (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 cmH_2O over the daily minimum MAP of the first day in the baseline period, sustained for ≥ 2 calendar days.

Pediatric Ventilator-Associated Event (PedVAE)

Meeting the PedVAE Definition

- Patients must be mechanically ventilated for some portion of the day for at least 4 consecutive calendar days to fulfill PedVAE criteria (where the day of intubation or initiation of mechanical ventilation is day 1)
 - At least **2 days** of stability or improvement
 - At least **2 days** of evidence of worsening oxygenation

Daily Minimum Values: Application

- The daily minimum FiO_2 and daily minimum MAP values are used to determine both the period of stability or improvement and the period that indicates worsening oxygenation
- Stability or improvement and worsening are not identified by comparing FiO_2 settings and MAP values that occur during a calendar day but by comparing the daily minimum values from calendar day to calendar day

Parameters: Assessment

- The period of stability or improvement and the evidence of worsening oxygenation must occur in the same parameter
- Each parameter is assessed independently of the other – PedVAE may be met only in the FiO_2 parameter, only in the MAP parameter, or in both parameters

Period of Stability or Improvement

- **Period of Stability or Improvement:** ≥ 2 calendar days of stable or decreasing daily minimum FiO₂ or MAP values

Stability:

Vent day	FiO2
1	40
2	40
3	40

Improvement:

Vent day	FiO2
1	50
2	40
3	30

- **Baseline Period:** the 2 calendar days immediately preceding the first day of evidence of worsening oxygenation

Evidence of Worsening Oxygenation

- **Evidence of Worsening Oxygenation:** 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 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.

OR

- Increase in daily minimum MAP values of **$\geq 4 \text{ cmH}_2\text{O}$** over the daily minimum MAP of the first day in the baseline period, sustained for ≥ 2 calendar days.

Knowledge Check #4

PedVAE can be met with a baseline period of stability or improvement in the FiO_2 parameter and a period of worsening oxygenation in the MAP parameter.

- A. True
- B. False

Knowledge Check #4 - Rationale

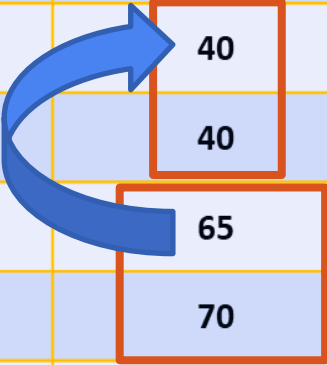
- When meeting the PedVAE definition the baseline period of stability or improvement and the period of worsening oxygenation must occur in the same parameter.
- The FiO_2 parameter and the MAP parameter are assessed independently of the other.
- PedVAE can be met in only the FiO_2 parameter, or in only the MAP parameter, or in both parameters.

PedVAE Determination: FiO₂ Parameter

A baseline period of stability or improvement in the **FiO₂ parameter** is immediately followed by an increase in the daily minimum FiO₂ of **≥ 0.25 (25 points)** over the daily minimum FiO₂ of the first day in the baseline period that is sustained for ≥ 2 calendar days

Operationalizing PedVAE FiO₂: Example 1

Vent Day	Daily Minimum MAP	Daily Minimum FiO ₂
1	13	60
2	10	40
3	10	40
4	12	65
5	12	70
6	10	70
7	8	60
8	8	60

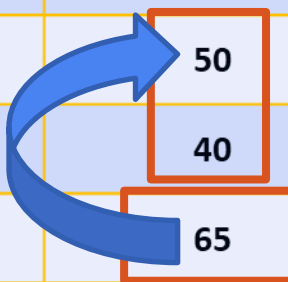


PedVAE met

- Baseline period of stability
- Increase of ≥ 0.25 (25 points) over the first day of the baseline period
- Sustained for ≥ 2 calendar days

Operationalizing PedVAE FiO₂: Example 2

Vent Day	Daily Minimum MAP	Daily Minimum FiO ₂
1	13	60
2	10	50
3	10	40
4	12	65
5	12	70
6	10	70
7	8	60
8	8	60




No PedVAE

- Baseline period of improvement
- ≥ 0.25 (25 points) increase is not over the first day in the baseline period

Operationalizing PedVAE FiO₂: Example 3

Vent Day	Daily Minimum MAP	Daily Minimum FiO ₂
1	13	60
2	10	40
3	10	40
4	12	65
5	12	50
6	10	40
7	8	40
8	8	40



No PedVAE

- Baseline period of stability
- ≥ 0.25 (25 points) increase over the baseline period is not sustained for ≥ 2 days

PedVAE Determination: MAP Parameter

A baseline period of stability or improvement in the **MAP parameter** is immediately followed by an increase in the daily minimum MAP of $\geq 4 \text{ cmH}_2\text{O}$ over the daily minimum MAP of the first day in the baseline period that is sustained for ≥ 2 calendar days

Operationalizing PedVAE MAP: Example 1

*patient < 30 days old – MAP values 0-8 = 8

Vent Day	Daily Minimum MAP	Daily Minimum FiO ₂
1	13	60
2	8 (7)*	
3	8 (7)*	
4	12	
5	12	
6	10	
7	8	40
8	8	40

PedVAE met

≥ 2-day period of stability
in MAP parameter

≥ 2-day period of worsening in
MAP parameter with an increase
of ≥ 4 cm H₂O over the first day
of the baseline period

Operationalizing PedVAE MAP: Example 2

*patient ≥ 30 days old – MAP values 0-10 = 10

Vent Day	Daily Minimum MAP	Daily Minimum FiO ₂
1	13	60
2	10 (7)*	
3	10 (7)*	
4	12	
5	12	
6	10	40
7	8	40
8	8	40

No PedVAE

≥ 2 -day period of stability
in MAP parameter

Increase in MAP parameter does not
meet the requirement of ≥ 4 cm H₂O
over the first day of the baseline period

Operationalizing PedVAE MAP: Example 3

*patient ≥ 30 days old – MAP values 0-10 = 10

Vent Day	Daily Minimum MAP	Daily Minimum FiO ₂
1	13	60
2	10 (7)*	
3	10 (7)*	
4	14	
5	14	
6	10	
7	8	40
8	8	40

PedVAE met

≥ 2-day period of stability in MAP parameter

≥ 2-day period of worsening in MAP parameter with an increase of ≥ 4 cm H₂O over the first day of the baseline period

Date of Event

- The date of onset of worsening oxygenation (day 1 of the required ≥ 2 -day period of worsening oxygenation following a ≥ 2 -day period of stability or improvement on the ventilator)
 - Earliest date of event for PedVAE is mechanical ventilation day 3 (first day of worsening oxygenation)
 - The first two days of mechanical ventilation can establish the baseline period

14-Day Event Period

- PedVAEs are defined by a 14-day period
- The Date of Event is day 1 of the 14-day Event Period
 - A new PedVAE cannot be reported until the 14-day period has elapsed
 - For example, if a PedVAE is reported with a date of event March 1, this sets a 14-day event period March 1 - 14, and the earliest date a new PedVAE can be detected and reported is March 15
 - The 2 days of stability or improvement for a new PedVAE can occur during the previous 14-day event period

Date of Event: Determination (patient < 30 days old)

Vent Day	MAPmin	FiO ₂ min
1	13	60
2	8 (7)	40
3	8 (7)	40
4	12	65
5	12	50
6	10	40
7	8	40
8	8	40

- Date of event = Mechanical Vent (MV) day 4 (first day of worsening oxygenation)
- 14-day event period = MV day 4 – MV day 17

PedVAE Calculator


PedVAE Calculator Access

<https://www.cdc.gov/nhsn/psc/pedvae/index.html>

Pediatric Ventilator-associated Events (PedVAE)

Available In-Plan for Pediatric and Neonatal Inpatient Locations Only.

PedVAP surveillance using the [PNEU](#) protocol continues to be available for in-plan surveillance for pediatric locations only. See [VAE](#) for in-plan surveillance for adult locations

 Not available for Inpatient Psychiatric Facilities (IPFs)

PedVAE Calculator

operates based upon the currently posted PedVAE protocol.



PedVAE Calculator Access- cont.

<https://www.cdc.gov/nhsn/pedvae-calculator/index.html>

Pediatric Ventilator-Associated Event Calculator

Version 1.0

Welcome to Version 1.0 of the PedVAE Calculator. Version 1.0 operates based upon the currently posted PedVAE protocol.

The Calculator is a web-based tool that is designed to help you learn how the PedVAE surveillance definition algorithm works and assist you in making PedVAE determinations.

Please note that the PedVAE Calculator will not ask you to enter any patient identifiers (other than dates of mechanical ventilation, which you can change as you see fit). The PedVAE Calculator does not store any patient data that you enter, and it will not report any data that you enter or any PedVAE determinations to the NHSN. You will not be able to export data entered into the Calculator.

If you have questions or suggestions about the Calculator, please feel free to send them to the NHSN mailbox, nhsn@cdc.gov.



Pediatric Ventilator-Associated Event Calculator

Version 1.0

(must have javascript enabled)

PedVAE Calculator: Instructions

National Healthcare Safety Network (NHSN)

[CDC](#) > [NHSN](#) > [Materials for Enrolled Facilities](#)

NHSN Pediatric Ventilator-Associated Event (PedVAE) Calculator Ver. 1.0

Welcome to the Pediatric Ventilator-Associated Event Calculator. Version 1.0 operates based upon the currently posted PedVAE protocol. It is strongly encouraged that you thoroughly review the [PedVAE protocol](#).

- The calculator recognizes Mean Airway Pressure (MAP) values 0-8 cmH₂O as equal to 8 for patients < 30 days of age and MAP values 0-10 cmH₂O as equal to 10 for patients ≥ 30 days of age and corrects entries according to the PedVAE protocol prior to making a PedVAE determination.
- Daily minimum MAP readings are to be rounded to the nearest whole number using the following method as an example: A MAP value 10.00 - 10.49 is rounded to 10 and a MAP value 10.50 - 10.99 is rounded to 11.
- The calculator finds multiple PedVAEs per patient as long as they conform to the 14 day rule.

To get started, **enter a date below that corresponds to the first day the patient was placed on mechanical ventilation during the mechanical ventilation episode of interest.** You may type in a date or use the popup calendar when it appears. You may only enter dates within the past year. If the patient has been on mechanical ventilation for more than one year during the current mechanical ventilation episode, choose a start date that is more recent but is at least 7 days before the period of interest. [more...](#)

Mechanical Ventilation Start Date:



(mm/dd/yy)

Is the patient's day of life (where date of birth = day of life 1)
less than 30 days on the Mechanical Ventilation Start Date?

Click "more" for additional
instructions on using the
PedVAE Calculator.

Mechanical Ventilation Start Date

*Enter the *actual date* on which mechanical ventilation was initiated

NHSN Pediatric Ventilator-Associated Event (PedVAE) Calculator Ver. 1.0

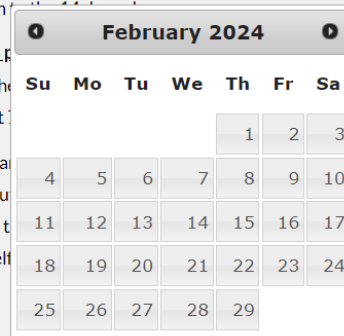
Welcome to the Pediatric Ventilator-Associated Event Calculator. Version 1.0 operates based upon the currently posted PedVAE protocol. It is strongly encouraged that you thoroughly review the [PedVAE protocol](#).

- The calculator recognizes Mean Airway Pressure (MAP) values 0-8 cmH₂O as equal to 8 for patients < 30 days of age and MAP values 0-10 cmH₂O as equal to 10 for patients ≥ 30 days of age and corrects entries according to the PedVAE protocol prior to making a PedVAE determination.
- Daily minimum MAP readings are to be rounded to the nearest whole number using the following method as an example: A MAP value 10.00 - 10.49 is rounded to 10 and a MAP value 10.50 - 10.99 is rounded to 11.
- The calculator finds multiple PedVAEs per patient as long as they conform to the protocol.

To get started, **enter a date below that corresponds to the first day the patient was** mechanically ventilated. You may only enter dates within the current mechanical ventilation episode, choose a start date that is more recent but is at least 1 day before the end of the episode.


The calculator runs locally on your machine. Data that you enter are not stored, nor are they shared with anyone else. If you don't understand something, there are several mechanisms for getting help. Most of the buttons have a question mark icon. If you have a question. Also the explain button will pop up an explanation of the reasoning behind the calculation. You can click and drag it to the side as you work. The explanation will automatically update itself as you change the data.

[less...](#)



mechanical ventilation episode of interest. You may type in a date or use the popup calendar when it appears. You may only enter dates within the current mechanical ventilation episode, choose a start date that is more recent but is at least 1 day before the end of the episode.

enter or change as much data as you like. If you don't understand something, there are several mechanisms for getting help. Most of the buttons have a question mark icon. If you have a question. Also the explain button will pop up an explanation of the reasoning behind the calculation. You can click and drag it to the side as you work. The explanation will automatically update itself as you change the data.

Mechanical Ventilation Start Date:  (mm/dd/yyyy)

Is the patient's day of life (where date of birth = day of life 1) less than 30 days on the Mechanical Ventilation Start Date?

Day of Life

Used to determine which daily minimum MAP value interpretation to apply:

If the patient is less than 30 days old, you will also answer the following:

Mechanical Ventilation Start Date: (mm/dd/yyyy)

Is the patient's day of life (where date of birth = day of life 1) less than 30 days on the Mechanical Ventilation Start Date?

Yes
No

Print

Close

Next

Mechanical Ventilation Start Date: (mm/dd/yyyy)

Is the patient's day of life (where date of birth = day of life 1) less than 30 days on the Mechanical Ventilation Start Date?

Yes

What is the patient's Day of Life (date of birth = day of life 1) on the Mechanical Ventilation Start Date?

1
2
3
4
5
6
7
8
9
10

Print

Close

Next

PedVAE Calculator: Patient < 30 days old

- The patient is < 30 days on the Mechanical Ventilation Start Date

- Enter the Daily Minimum MAP and FiO₂ values and click on **Calculate PedVAE**

Is the patient's day of life (where date of birth = day of life 1) less than 30 days on the Mechanical Ventilation Start Date?

What is the patient's Day of Life (date of birth = day of life 1) on the Mechanical Ventilation Start Date?

MV Day	Date	Day of Life	Min. MAP 0 - 50 (cmH ₂ O)	Min. FiO ₂ (21 - 100)	PedVAE
1	2/1/2024	10	<input type="text" value="5"/>	<input type="text" value="60"/>	
2	2/2/2024	11	<input type="text" value="6"/>	<input type="text" value="60"/>	
3	2/3/2024	12	<input type="text" value="7"/>	<input type="text" value="50"/>	
4	2/4/2024	13	<input type="text" value="12"/>	<input type="text" value="50"/>	
5	2/5/2024	14	<input type="text" value="12"/>	<input type="text" value="40"/>	
6	2/6/2024	15	<input type="text" value="12"/>	<input type="text" value="40"/>	

PedVAE Calculator Determination (patient < 30 days old)

- A **PedVAE** is identified in the **MAP parameter** with a date of event 2/4/2024
- The calculator interprets MAP values of 0-8 cmH₂O as equal to 8 cm H₂O since the patient is < **30 days**

NHSN Pediatric Ventilator-Associated Event (PedVAE) Calculator Ver. 1.0

A Pediatric Ventilator-Associated Event (PedVAE) based on MAP values occurred on 2/4/2024.

Click on the "Explain" button to see how this determination was made.

Is the patient's day of life (where date of birth = day of life 1) less than 30 days on the Mechanical Ventilation Start Date?

What is the patient's Day of Life (date of birth = day of life 1) on the Mechanical Ventilation Start Date?

MV Day	Date	Day of Life	Min. MAP 0 - 50 (cmH ₂ O)	Min. FiO ₂ (21 - 100)	PedVAE
1	2/1/2024	10	8 (5)*	60	
2	2/2/2024	11	8 (6)*	60	
3	2/3/2024	12	8 (7)*	50	
4	2/4/2024	13	12	50	± PedVAE
5	2/5/2024	14	12	40	
6	2/6/2024	15	12	40	



PedVAE Calculator: Patient ≥ 30 days old

NHSN Pediatric Ventilator-Associated Event (PedVAE) Calculator Ver. 1.0

No Pediatric Ventilator-Associated Event (PedVAE) detected. Click on the "Explain" button to see an explanation of the PedVAE definition.

- **No PedVAE is identified** because the increase in MAP is not ≥ 4 cmH₂O over the baseline period
- The calculator interprets **MAP values of 0-10 cmH₂O as equal to 10 cmH₂O** for patients ≥ 30 days
- Select the **Explain** button for an explanation of the determination

Is the patient's day of life (where date of birth = day of life 1) less than 30 days on the Mechanical Ventilation Start Date? No ▾

Calculate PedVAE Start Over Explain...

MV Day	Date	Min. MAP 0 - 50 (cmH ₂ O)	Min. FiO ₂ (21 - 100)	PedVAE
1	2/1/2024	10 (5)*	60	
2	2/2/2024	10 (6)*	60	
3	2/3/2024	10 (7)*	50	
4	2/4/2024	12	50	
5	2/5/2024	12	40	
6	2/6/2024	12	40	

Knowledge Check #5

The PedVAE calculator is only as good as the data that are entered. If incorrect data are entered, the PedVAE determination will not be correct.

- A. True
- B. False

Knowledge Check #5 - Rationale

- The PedVAE calculator is only as good as the data that are entered into it.
- Garbage in = Garbage out
- If incorrect data are entered, the PedVAE calculator will provide the wrong determination.
- The PedVAE calculator is a valuable tool to assist with PedVAE determinations, but it is not a substitute for you knowing and understanding the PedVAE protocol and algorithm.

Reporting PedVAE

PedVAE Data Collection Forms and Instructions

<https://www.cdc.gov/nhsn/psc/pedvae/index.html>

- Event forms
- Denominator forms
 - ICU
 - NICU
- Tables of Instructions

Data Collection Forms & Instructions

All Data Collection Forms are Print-only


PedVAE

[Pediatric Ventilator-associated Event \(PedVAE\) form – January 2021 \(57.113\)](#)  [PDF – 190 KB]

- [Customizable form](#)  [DOCX – 60 KB]
- [Table of Instructions](#)  [PDF – 150 KB]

Denominator Forms

ACH

[Denominators for Intensive Care Unit \(ICU\)/Other locations \(not NICU or SCA\) form – January 2021 \(57.118\)](#)  [PDF – 80 KB]

- [Customizable form](#)  [DOCX – 60 KB]
- [Table of Instructions](#)  [PDF – 200 KB]

[Denominators for Neonatal Intensive Care Unit \(NICU\) form – January 2021 \(57.116\)](#)  [PDF – 80 KB]

- [Customizable form](#)  [DOCX – 60 KB]
- [Table of Instructions](#)  [PDF – 200 KB]

PedVAE: Monthly Reporting Plan



Edit Monthly Reporting Plan

Mandatory fields marked with *

Facility ID *:

Month *: February

Year *: 2024

No NHSN Patient Safety Modules Followed this Month

Pediatric and neonatal locations: PedVAE is eligible for selection.

Device-Associated Module

	Locations	CLABSI	VAE	CAUTI	CLIP	PedVAP	PedVAE
	NICU 3 - LEVEL 3 NICU	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	PICU2 - PEDIATRIC ICU	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	MSICU - MEDICAL SURGICAL ICU	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Add Row

Clear All Rows

Copy from Previous Month

PedVAE: Event Information

- Select Event Type: PedVAE
- Fill in Date of Event
- Fill in patient's Location on the Date of Event
- For in-plan events, enter Date Admitted to Facility

Event Information

Event Type *: PedVAE - Pediatric Ventilator-Associated Event

Date of Event *: 02/04/2024

Post-procedure:

MDRO Infection Surveillance *: No, this infection's pathogen/location are not in-plan for Infection Surveillance in the MDRO/CDI Module

Location *: NICU 3 - LEVEL 3 NICU

Date Admitted to Facility *: 01/23/2024

PedVAE: Risk Factors

- Enter Location of Mechanical Ventilation
- Enter Date Mechanical Ventilation Initiated
- For Neonatal Intensive Care Unit (NICU) patients
 - Birth Weight
 - Gestational Age

Risk Factors

Location of Mechanical Ventilation *: NICU 3 - LEVEL 3 NICU

Date Mechanical Ventilation Initiated *: 02/01/2024 2

Birth Weight (grams) *: 1265 Birth Code: C For NICU only Gestational Age (weeks) *: 30

PedVAE: Event Details

- Select the specific criteria used to meet the PedVAE definition
 - FiO_2
 - MAP

Event Details

Specify Criteria Used *

Daily min FiO_2 increase ≥ 0.25 (25 points) for ≥ 2 days[†]

Daily min Mean Airway Pressure (MAP) ≥ 4 cm H₂O for ≥ 2 days[†]

[†] after 2+ days of stable or decreasing daily minimum values

PedVAE: Clinical Event

- Select “Yes” if the PedVAE is associated with any clinical diagnoses or events
- If “Yes,” check all that apply
- If “Other” is checked, there is a 200-character limit

Clinical event associated with the PedVAE?: If yes, check all that apply:

- | | |
|---|---|
| <input type="checkbox"/> Ventilator-associated Pneumonia | <input type="checkbox"/> Sepsis or Septic Shock |
| <input type="checkbox"/> Atelectasis | <input type="checkbox"/> Neonatal Respiratory Distress Syndrome (RDS) |
| <input type="checkbox"/> Acute Respiratory Distress Syndrome (ARDS) | <input type="checkbox"/> Bronchopulmonary Dysplasia/Chronic Lung Disease |
| <input type="checkbox"/> Pulmonary Hypertension | <input type="checkbox"/> Reopened Patent Ductus Arteriosus (PDA) |
| <input type="checkbox"/> Pulmonary Edema | <input type="checkbox"/> Weaning from mechanical ventilation or other change in mechanical ventilation approach <u>without</u> clinical worsening |
| <input type="checkbox"/> Pulmonary Hemorrhage | <input type="checkbox"/> Other (specify) <input type="text"/> |

PedVAE: Antimicrobial Agents

- Select “Yes” if an antimicrobial agent listed in the PedVAE Appendix was administered on the Date of Event or within 2 days before or 2 days after
- If “Antimicrobial agent(s) administered?” = Y, record drug (up to 3) and enter the Drug Start date
 - Drug Start date is limited to 1 year prior to current admission date

Antimicrobial agent(s) administered?:

Drug 1 : Drug 1 Start date

Drug 2 : Drug 2 Start date

Drug 3 : Drug 3 Start date

PedVAE: Pathogens

- Pathogen identified from listed specimens: Select “Yes” if a pathogen was detected in any of the specimen types listed with collection dates on the Date of Event or within 2 days before or 2 days after
- Pathogen identified from BLOOD: Select “Yes” if a pathogen was identified from blood with a specimen collection date within 2 days before to 13 days after the Date of Event
- If “Yes” to either, enter up to 3 pathogens

Pathogen identified from one or more of the listed specimens? : If Yes, which specimen type? (check all that apply)

<input type="checkbox"/> Lower Respiratory	<input type="checkbox"/> Upper Respiratory
<input type="checkbox"/> Lung Tissue	<input type="checkbox"/> Pleural Fluid
<input type="checkbox"/> Urine for Legionella or Streptococcus pneumoniae antigen testing	

Pathogen identified from BLOOD? :

Pediatric Location Summary Data



Denominators for Intensive Care Unit (ICU)/Other locations (not NICU or SCA)

Mandatory fields marked with *

Facility ID *: | _____]

Location Code *: PICU2 - PEDIATRIC ICU

Month *: February ▾

Year *: 2024 ▾

Total Patient Days and Ventilator Days are required.

Denominator Data		
		Report No Events
Total Patient Days *	<input type="text"/>	
Central Line Days :	<input type="text"/>	CLABSI : <input type="checkbox"/>
Urinary Catheter Days :	<input type="text"/>	CAUTI : <input type="checkbox"/>
Ventilator Days *	<input type="text"/>	VAE : <input type="checkbox"/> PedVAE : <input type="checkbox"/> PedVAP : <input type="checkbox"/>
APRV Days :	<input type="text"/>	
Episodes of Mechanical Ventilation :	<input type="text"/>	

Sample Values For Estimating Denominator Data		
		Check Box(es) if Sampling Used
Sample Patient Days :	<input type="text"/>	
Sample Central Line Days :	<input type="text"/>	<input type="checkbox"/>
Sample Urinary Catheter Days :	<input type="text"/>	<input type="checkbox"/>

Neonatal ICU Location Summary Data



Neonatal Intensive Care Unit

Mandatory fields marked with *

Facility ID *:

Location Code *: NICU 3 - LEVEL 3 NICU

Month *: February

Year *: 2024

Total Patient Days and Vent Days by Birth Weight are required.

Patient Days and Vent Days by Gestational Age are optional.

Birth Weights

Birth Weight	Patient Days *	CL Days	No CLABSI	Vent Days *	No PedVAE	No PedVAP	EMV	UrC Days
<=750	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
751-1000	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
1001-1500	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
1501-2500	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
>2500	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>

Gestational Ages

Gestational Age	Patient Days	Vent Days	No PedVAE	EMV
Extremely preterm (<28 weeks)	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>
Very preterm (28 to <32 weeks)	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>
Moderate to late preterm (32 to <37 weeks)	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>
Term (>=37 weeks)	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>

In Closing...

Summary

- Today's presentation covered the basics of PedVAE surveillance
 - Key terms
 - Daily minimum values
 - PedVAE surveillance algorithm
 - PedVAE calculator
 - PedVAE reporting

PedVAE Surveillance Resources

- Familiarize yourself with the PedVAE webpage
- Read the PedVAE protocol and the tables of instructions
- Read the PedVAE FAQs
- Review the PedVAE training resources
- Use the PedVAE calculator
- Submit questions and case reviews to the NHSN team (see closing slide for contact information)

For Questions or Concerns, Contact the NHSN Helpdesk

NHSN-ServiceNow to submit questions to the NHSN Help Desk.

The new portal can be accessed at <https://servicedesk.cdc.gov/nhsncsp>. Users will be authenticated using CDC's Secure Access Management Services (SAMS) the same way you access NHSN. If you do not have a SAMS login, or are unable to access ServiceNow, you can still email the NHSN Help Desk at nhsn@cdc.gov.

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333

Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348

E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

