Ventilator-associated Events and Pediatric Ventilator-associated Events Analysis

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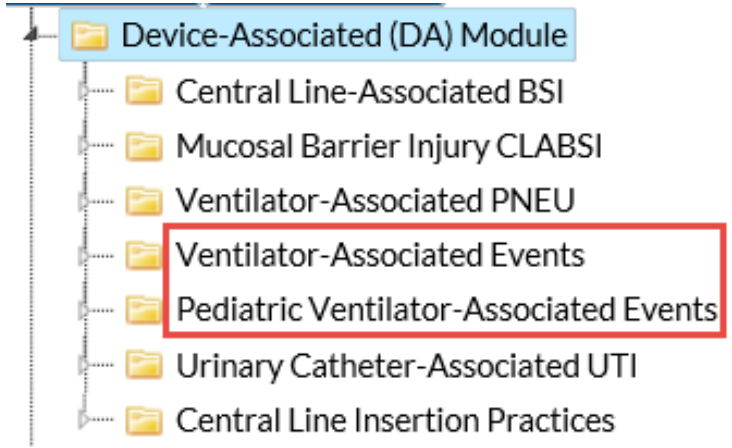
Objectives

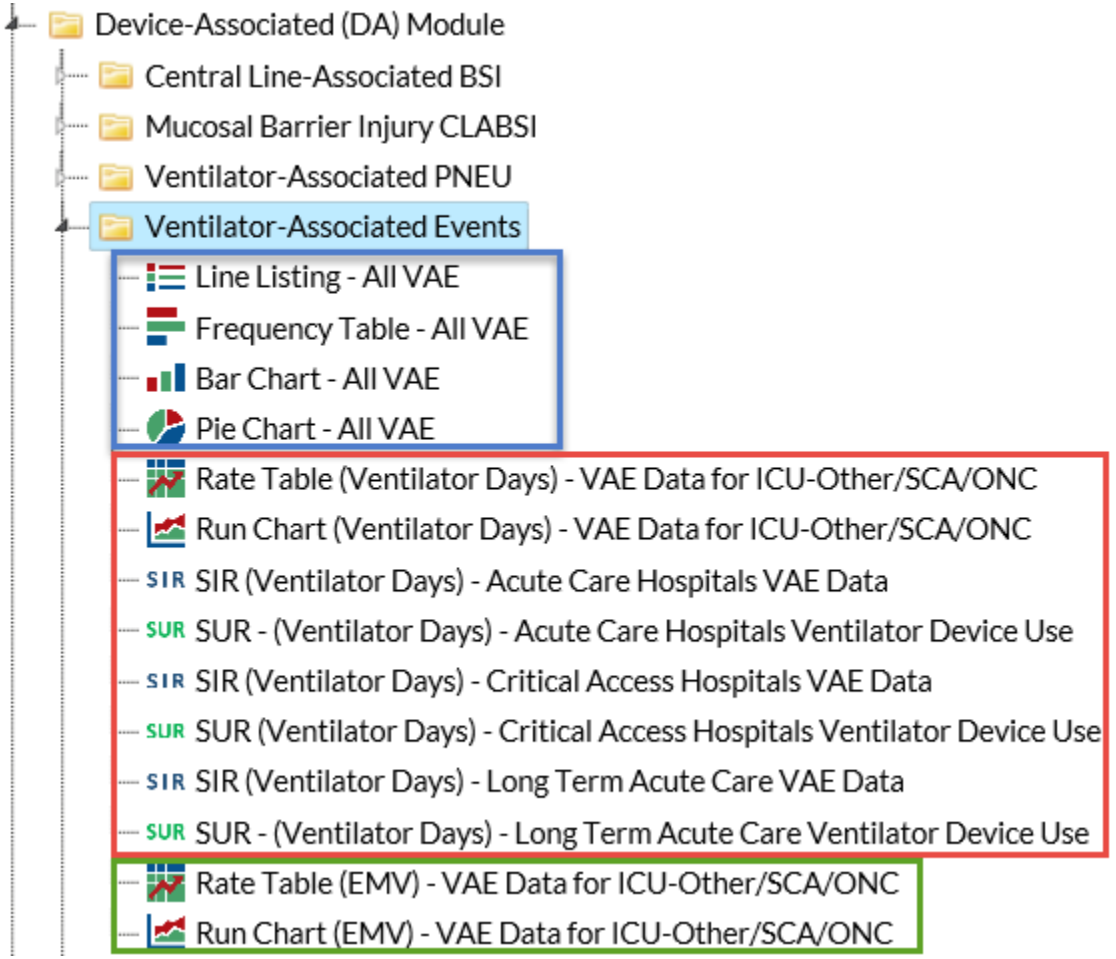
- Understand the standardized infection ratio (SIR) and its use in the interpretation of Ventilator-associated events (VAE)
- Explain the SIR analysis reports and interpretation of the results
- Introduce analysis for the new Pediatric Ventilator-associated events (PedVAE)

Ventilator-associated Events (VAE)

Ventilator-associated Reports

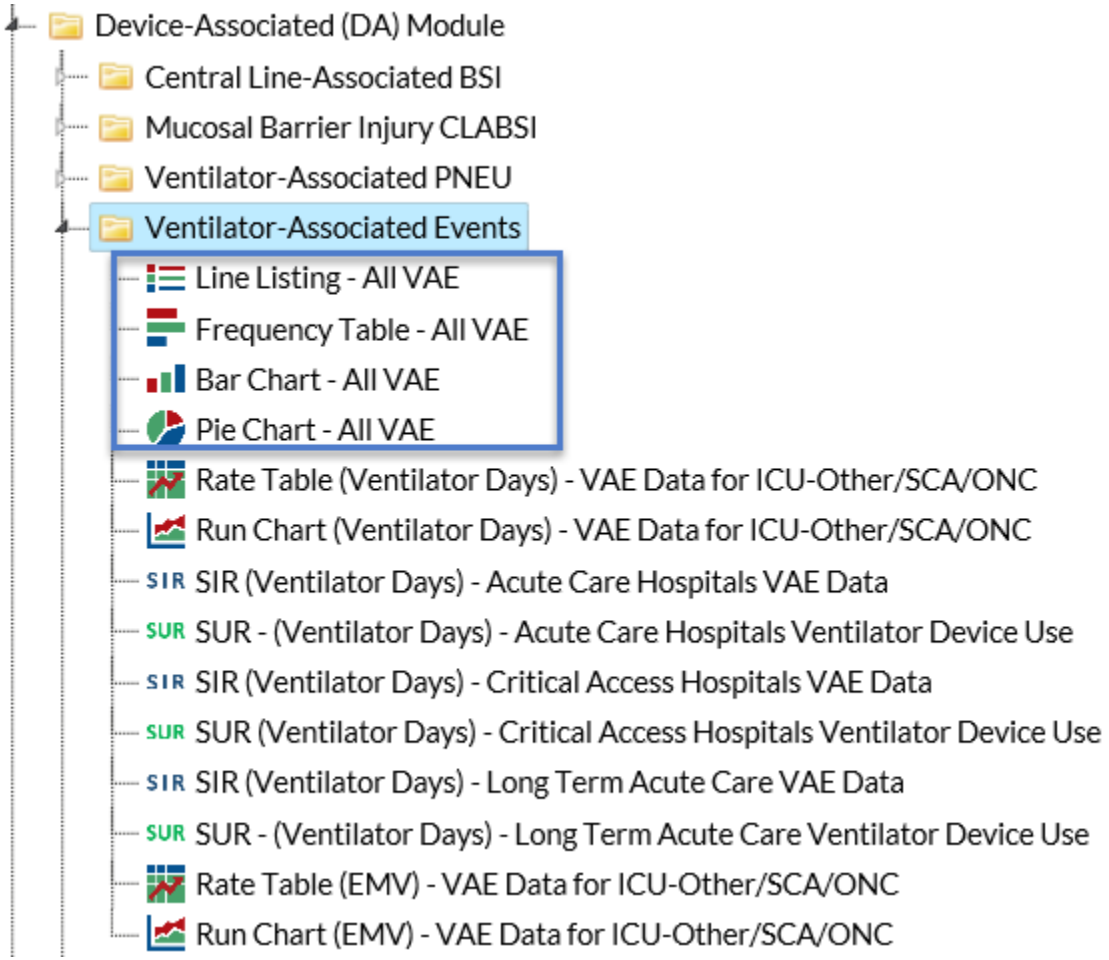


- Ventilator-associated reports located within the Device-associated Module



VAE Analysis Options

- Line Lists
  - Gives event level details
- Frequency Table
  - Provides location level event counts for specific events: Infection-related Ventilator-Associated Complication (IVAC), Possible Ventilator- Associated Pneumonia (PVAP), Ventilator-Associated Condition (VAC), and total VAE
- Bar Chart and Pie Chart
  - Graphical representation of VAE data



VAE Analysis Options – Frequency Table

- Location specific event count
- Columns by VAE category - IVAC, PVAP, VAC, and total
- Provides total event count

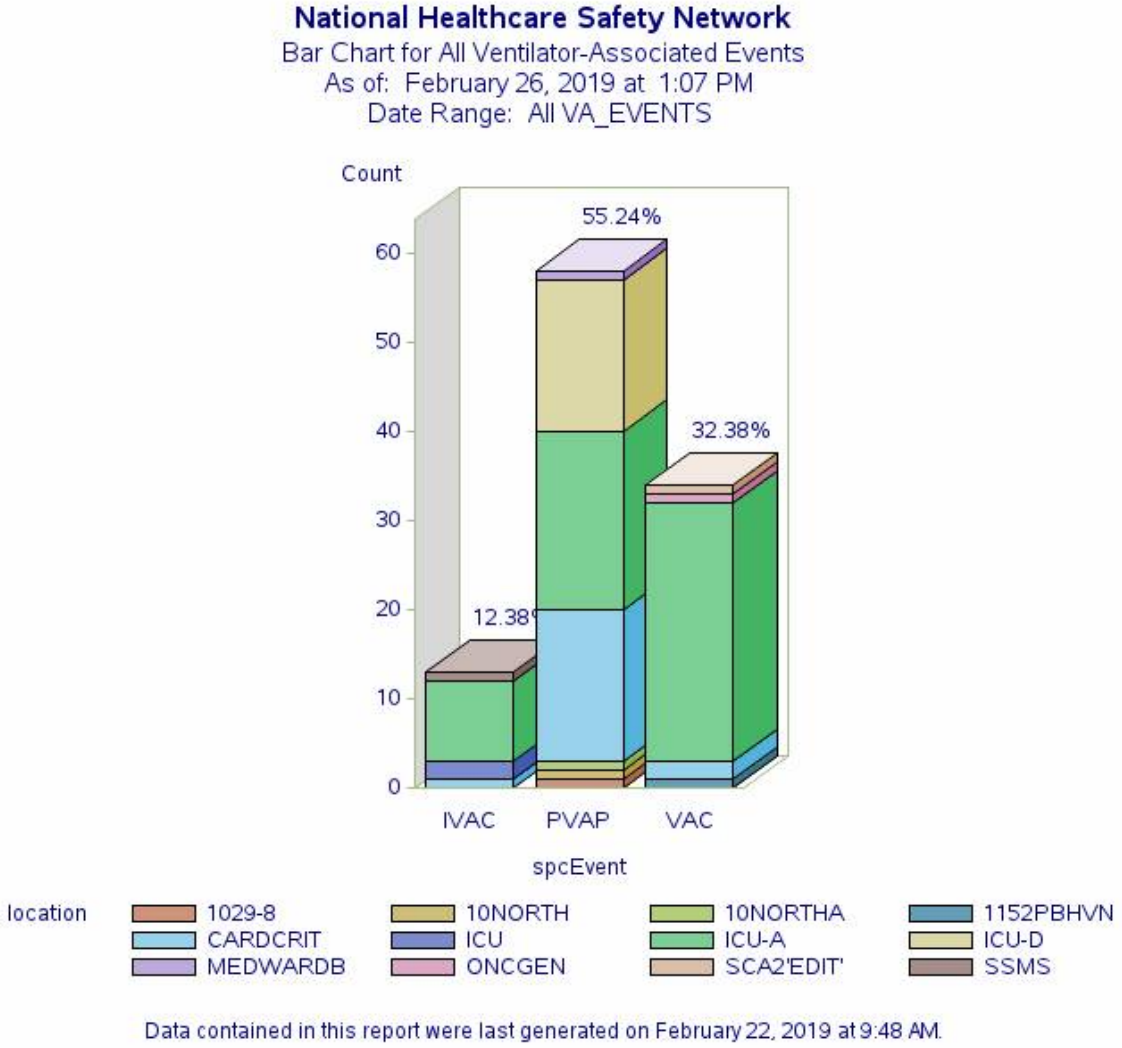
National Healthcare Safety Network
Frequency Table for All Ventilator-Associated Events
As of: February 26, 2019 at 10:43 AM
Date Range: VA_EVENTS evntDateYr 2018 to 2018

Frequency Percent Row Pct Col Pct	Table of location by spcEvent		
	spcEvent		
location	PVAP	VAC	Total
3 CENTRAL	1 5.26 25.00 12.50	3 15.79 75.00 27.27	4 21.05
3W	4 21.05 80.00 50.00	1 5.26 20.00 9.09	5 26.32
5 WESTT	0 0.00 0.00 0.00	3 15.79 100.00 27.27	3 15.79
CARDCRIT	2 10.53 100.00 25.00	0 0.00 0.00 0.00	2 10.53
CC_ONC	0 0.00 0.00 0.00	1 5.26 100.00 9.09	1 5.26
MED ICU	1 5.26 25.00 12.50	3 15.79 75.00 27.27	4 21.05
Total	8 42.11	11 57.89	19 100.00

Fabricated data

VAE Analysis Options – Bar Chart

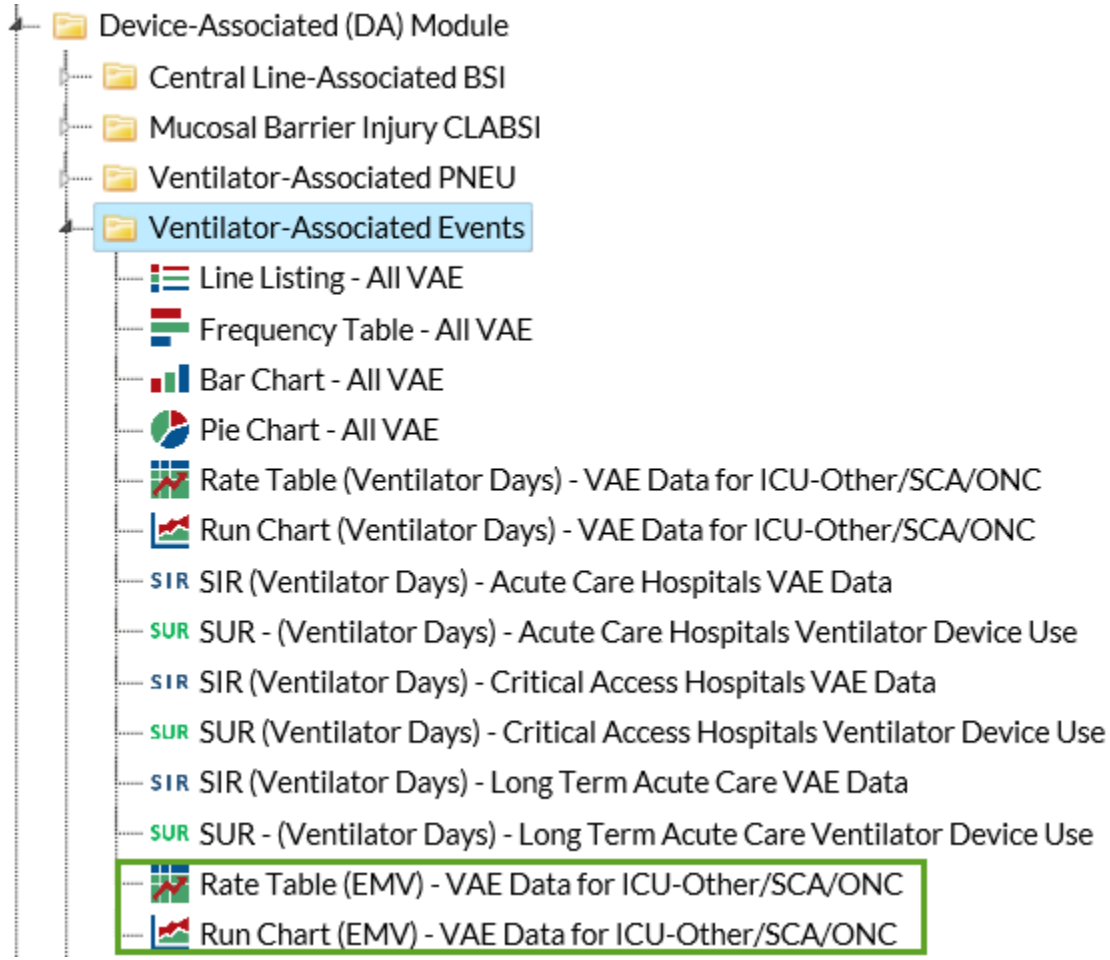
- Graphical representation of VAE data by location and VAE category



Fabricated data

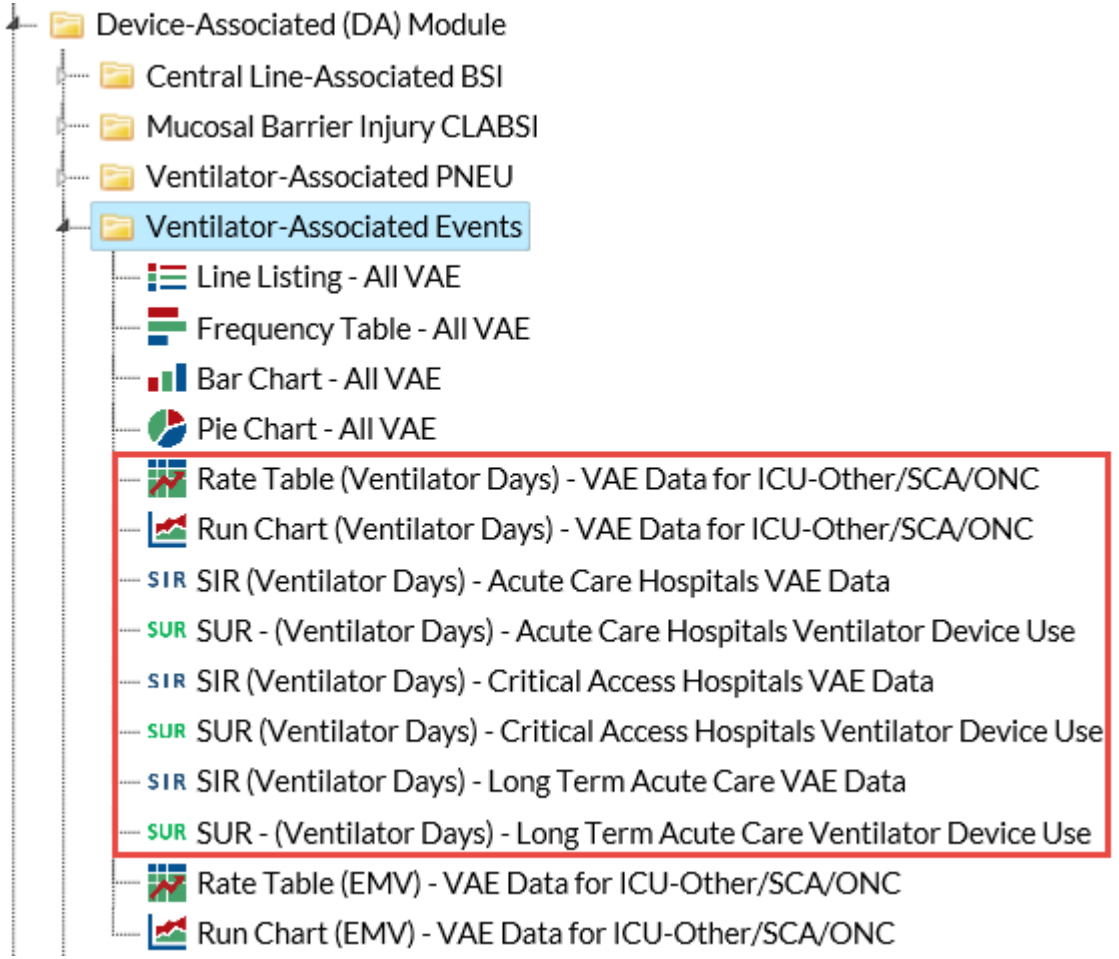
VAE Analysis Options

- EMV Rate Table
  - Location level rate data for Episodes for Mechanical Ventilation (EMV)
  - EMV denominator represents the sum of the number of episodes of mechanical ventilation that occurred in that location during the month
  - VAE EMV Rate
    - (VAEs / Number of EMV) * 100



VAE Analysis Options

- Ventilator Days SIR, SUR, and rate table options
  - Standardized Infection Ratio
    - Acute Care Hospitals
    - Critical Access Hospitals
    - Long Term Acute Care Hospitals
  - Standardized Utilization Ratio
  - Rate tables
    - ICU-Other/SCA/ONC



VAE Analysis Options – Rate Table

- VAE Rate Table
  - Provides location level event counts, device days, patient days, device utilization, and VAE category
  - VAE Rate
    - (VAE Count / Vent Days) * 1000
  - Ventilator Utilization Ratio
    - Vent Days / Patient Days

National Healthcare Safety Network
Rate Table (Ventilator Days) for Ventilator-Associated Event Data for ICU-Other/SCA/ONC
Total VAE
As of: January 23, 2019 at 10:32 AM
Date Range: All BS2_VAE_RATE SICU_SCA

orgid=10000 ccn=32M22222 loccdc=IN:ACUTE:CC:C

location	summaryYM	VAECount	numVentDays	VAERate	numPatDays	VentDU	vaeCategory
CMICU_N	2017M04	0	0	.	880	0.000	Total VAE
CMICU_N	2017M05	1	35	28.571	900	0.039	Total VAE
CMICU_N	2017M06	0	0	.	400	0.000	Total VAE

National Healthcare Safety Network
Rate Table (Ventilator Days) for Ventilator-Associated Event Data for ICU-Other/SCA/ONC
Total VAE
As of: January 23, 2019 at 10:32 AM
Date Range: All BS2_VAE_RATE SICU_SCA

orgid=10000 ccn=32M22222 loccdc=IN:ACUTE:CC:M

location	summaryYM	VAECount	numVentDays	VAERate	numPatDays	VentDU	vaeCategory
FICU	2017M03	0	2	0.000	100	0.020	Total VAE
MED ICU	2018M05	1	100	10.000	200	0.500	Total VAE
MICU-2	2017M01	1	75	13.333	405	0.185	Total VAE

VAE Analysis Options – Rate Table

- Stratified by VAE category
  - Total VAE
  - Total IVAC Plus
  - Total VAP

National Healthcare Safety Network
Rate Table (Ventilator Days) for Ventilator-Associated Event Data for ICU-Other/SCA/ONC
Total VAE
As of: February 26, 2019 at 9:43 AM
Date Range: BS2_VAE_RATE SICU_SCA summaryYr 2018 to 2019

orgid=10018 ccn=12345 loccdc=IN:ACUTE:CC:S

location	summaryYM	VAECount	numVentDays	VAERate	numPatDays	VentDU	vaeCategory
ICU-A	2018M07	1	45	22.222	450	0.100	Total VAE

Data contained in this report were last generated on February 26, 2019 at 9:36 AM.

National Healthcare Safety Network
Rate Table (Ventilator Days) for Ventilator-Associated Event Data for ICU-Other/SCA/ONC
Total IVAC Plus
As of: February 26, 2019 at 9:43 AM
Date Range: BS2_VAE_RATE SICU_SCA summaryYr 2018 to 2019

orgid=10018 ccn=12345 loccdc=IN:ACUTE:CC:S

location	summaryYM	VAECount	numVentDays	VAERate	numPatDays	VentDU	vaeCategory
ICU-A	2018M07	0	45	0.000	450	0.100	Total IVAC Plus

Data contained in this report were last generated on February 26, 2019 at 9:36 AM.

A Review: The Standardized Infection Ratio (SIR)

- SIR – A summary statistic that compares the number of healthcare-associated infections (HAIs) that were reported to the number of HAIs that were predicted to occur, based on a calculation using data for HAI events that occurred in a given referent time period

$$\textbf{SIR} = \frac{\#\ observed\ HAIs}{\#\ predicted\ HAIs}$$

Total VAE SIR - Number Predicted

- Negative Binomial Regression Model

$log\ (\lambda) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i$, where:

α = Intercept

β_i = Parameter Estimate

X_i = Value of Risk Factor (Categorical variables: 1 if present, 0 if not present)

i = Number of Predictors

A Guide to the SIR: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

Risk Factors in the Total VAE Model for Facility Types

Facility Type	Risk Factors
Acute Care Hospitals	• CDC Location • Medical School affiliation and facility bed size[1] • Facility Type
Critical Access Hospitals (CAH)	Intercept-only model
Long-Term Acute Care Hospitals (LTACHs)	• CDC Location • Facility bed size, Proportion of admissions on hemodialysis, Proportion of admissions on ventilator, and Average length of stay

- Proportion of annual admissions on a ventilator (or hemodialysis) is calculated as: number of admissions on a ventilator (or hemodialysis) / total # of annual admissions
- Average length of stay is calculated as: # annual patient days/ # annual admissions

Total VAE in Long-Term Acute Care Hospitals (LTACHs)

- The number of predicted "Total VAE" events calculated under the 2015 baseline is risk adjusted based on the following variables found to be statistically significant predictors of Total VAE incidence
- As of October 1, 2018, the LTCHQR program no longer requires LTACs to submit VAE data

Parameter	Parameter Estimate
Intercept	-8.3689
Facility bed size: ≥ 32 beds	0.4645
Facility bed size: < 32 beds	REFERENT
Proportion of admissions on hemodialysis: > 0.11	-0.4098
Proportion of admissions on hemodialysis: ≤ 0.11	REFERENT
Proportion of admissions on ventilator: > 0.18	0.9313
Proportion of admissions on ventilator: ≤ 0.18	REFERENT
Location type: ICU	0.4118
Location type: Ward	REFERENT
Average length of stay: ≥ 25 days	1.0940
Average length of stay: < 25 days	REFERENT

Risk Factors in the IVAC Plus Model for Facility Types

Facility Type	Risk Factors
Acute Care Hospitals	• CDC Location • Medical School affiliation and facility bed size[1]
Long-Term Acute Care Hospitals (LTACHs)	• Facility bed size, Proportion of admissions on ventilator, and Average length of stay

- Proportion of annual admissions on a ventilator is calculated as: number of admissions on a ventilator / total # of annual admissions
- Average length of stay is calculated as: # annual patient days/ # annual admissions

IVAC Plus - Number Predicted

- Negative Binomial Regression Model – same as Total VAE
- Model for IVAC Plus in Long-Term Acute Care Hospitals (LTACHs)

Parameter	Parameter Estimate
Intercept	-9.9593
Facility bed size: ≥ 32 beds	1.1201
Facility bed size: < 32 beds	REFERENT
Proportion of admissions on a ventilator: > 0.18	0.7130
Proportion of admissions on a ventilator: ≤ 0.18	REFERENT
Average length of stay: ≥ 25 days	0.8166
Average length of stay: < 25 days	REFERENT

VAE SIR Report

National Healthcare Safety Network

SIR for Ventilator-Associated Event Data for Acute Care Hospitals (2015 Baseline) - By OrgID

As of: January 30, 2019 at 11:36 AM

Date Range: BS2_VAE_RATESICU_SCA summaryYr 2018 to 2018

vaeCategory=Total VAE orgid=10000 medType=' '

orgid	ccn	summaryYr	infCount	numPred	numventdays	SIR	SIR_pval	SIR95CI	vaeCategory
10000	32M22222	2018	1	2.264	740	0.441	0.1078	0.738, 7.896	Total VAE

1. This report includes in-plan VAE data from acute care hospitals for 2015 and forward. Excludes Chronic Care locations.

2. The SIR is only calculated if the number predicted (numPred) is >= 1. Lower bound of 95% Confidence Interval only calculated when number of observed events > 0.

3. The number of predicted events is calculated based on national aggregate NHSN data from 2015. It is risk adjusted for CDC location, hospital beds, length of stay, and proportion of admissions on hemodialysis, and proportion of admissions on a ventilator.

4. If the risk factor data are missing, the record will be excluded from the SIR.

Source of aggregate data: 2015 NHSN VAE Data

Data contained in this report were last generated on January 22, 2019 at 10:00 AM.

Total VAE SIR

- The “Total VAE” SIR includes events identified as ventilator-associated condition (VAC), infection-related ventilator-associated complication (IVAC), and possible ventilator-associated pneumonia (pVAP)

National Healthcare Safety Network
SIR for Ventilator-Associated Event Data for Acute Care Hospitals (2015 Baseline) - By OrgID
As of: February 26, 2019 at 9:53 AM
Date Range: All BS2_VAE_RATE SICU_SCA

vaeCategory=Total VAE orgid=10018 medType=G

orgid	ccn	summaryYr	infCount	numPred	numventdays	SIR	SIR_pval	SIR95CI	vaeCategory
10018	12345	2018	5	1.974	283	2.532	0.0660	0.928, 5.613	Total VAE

IVAC Plus SIR

- The “IVAC Plus” SIR includes events identified as IVAC and possible ventilator-associated pneumonia (pVAP)

National Healthcare Safety Network

SIR for Ventilator-Associated Event Data for Acute Care Hospitals (2015 Baseline) - By OrgID

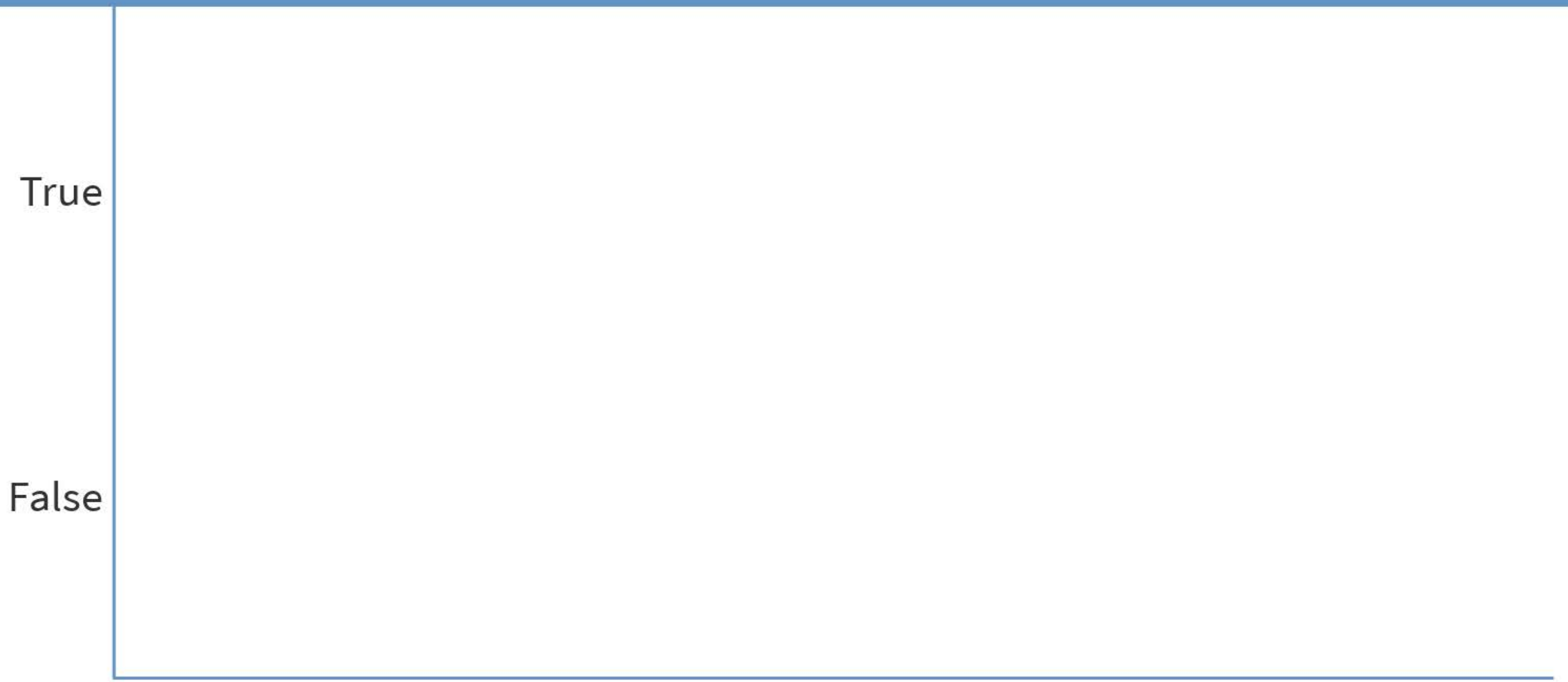
As of: February 26, 2019 at 9:53 AM

Date Range: All BS2_VAE_RATESICU_SCA

vaeCategory=IVAC Plus orgid=10018 medType=G

orgid	ccn	summaryYr	infCount	numPred	numventdays	SIR	SIR_pval	SIR95CI	vaeCategory
10018	12345	2018	3	0.737	283	.	.		IVAC Plus

Knowledge Check: VAE Rate tables provide event level, summary data, and device utilization for facility wide and location level VAE data.



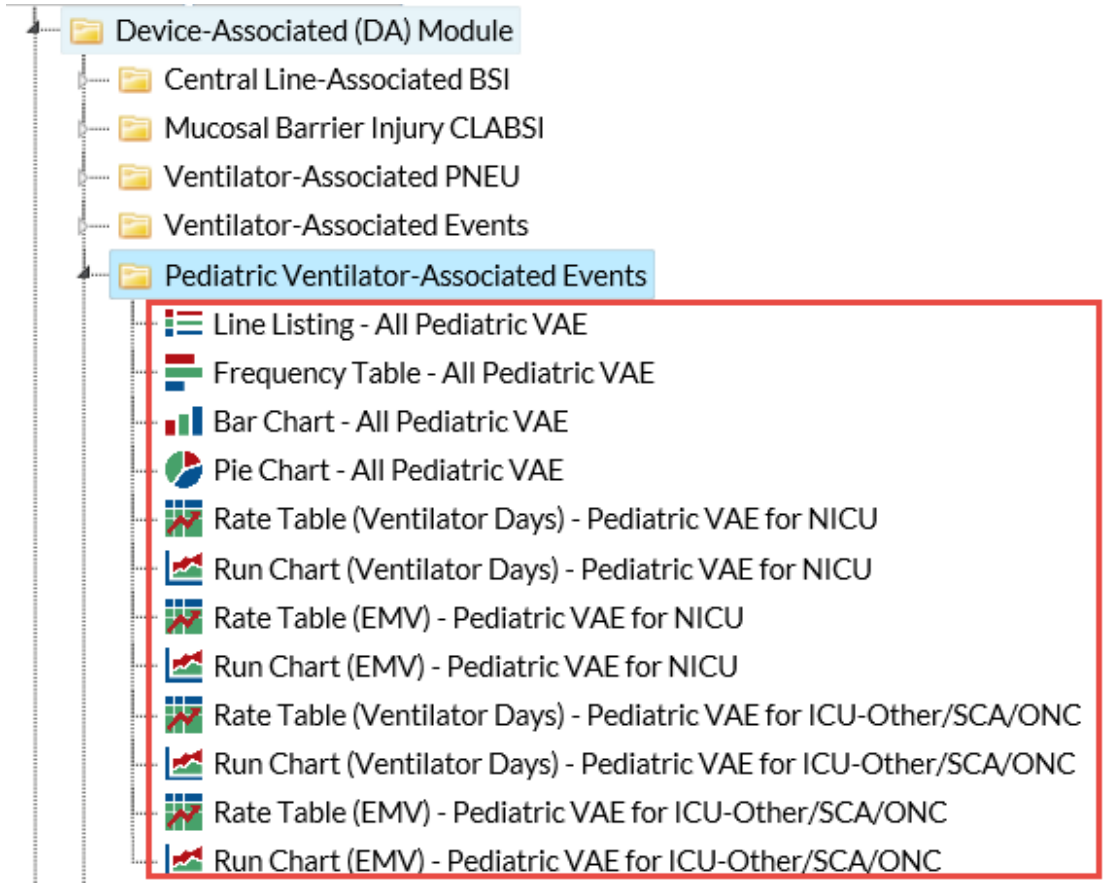
Knowledge Check: VAE Rate tables provide event level, summary data, and device utilization for facility wide and location level VAE data.

False: Rate tables only provide data at a location level. SIR reports will analyze and provide facility wide data.

Pediatric VAE

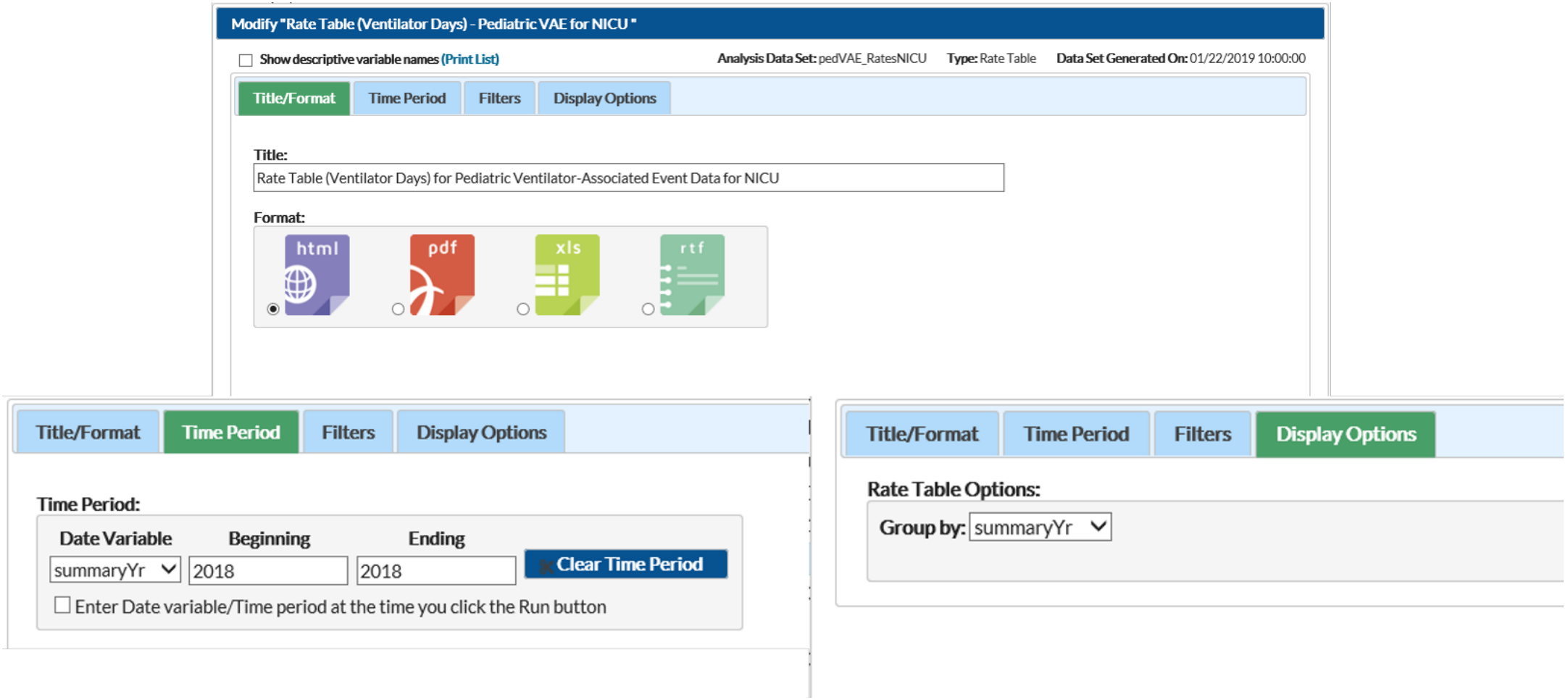
PedVAE reports

- Line Listing
- Frequency Table
- Bar/Pie Chart
- Rate tables for Ventilator days and EMV
  - NICU
  - ICU-Other/SCA/ONC



PedVAE – Rate table

- Report Modification



PedVAE – Ventilator Days Rate Table

- Location specific rate data for Ventilator Days
- PedVAE Rate
  - PedVAECount / numVentDays *1000
- This location has a PedVAE rate of 18.182 per 1000 ventilator days
- Ventilator Utilization Ratio
  - numVentDays / numPatDays

National Healthcare Safety Network

Rate Table (Ventilator Days) for Pediatric Ventilator-Associated Event Data for ICU-Other/SCA/ONC

As of: March 11, 2019 at 2:43 PM

Date Range: PEDVAE RATESICU SCA summaryYM After and Including 2019M01

orgID=10000 loccdc=IN:ACUTE:CC:MS_PED

location	summaryYM	pedVAECount	numVentDays	pedVAERate	numPatDays	VentDU
PICU2	2019M01	2	110	18.182	130	0.846

PedVAE – Ventilator Days Rate Table for NICUs

- Location specific rate data for Ventilator Days for NICUs
- PedVAE Rate
  - PedVAECount / numVentDays *1000
- This NICU location for birthweight A has a pedVAE rate of 11.765 per 1000 ventilator days
- Ventilator Utilization Ratio
  - numVentDays / numPatDays

National Healthcare Safety Network

Rate Table (Ventilator Days) for Pediatric Ventilator-Associated Event Data for NICU

By Birthweight Code

As of: March 11, 2019 at 2:35 PM

Date Range: PEDVAE RATESNICU summaryYM 2019M01 to 2019M01

orgID=10000 loccdc=IN:ACUTE:CC_STEP:NURS

location	birthWtCodeDesc	summaryYM	pedVAECount	numVentDays	pedVAERate	numPatDays	VentDU
NICU	A - <= 750	2019M01	1	85	11.765	90	0.944
NICU	B - 751 -1000	2019M01	0	77	0	86	0.895
NICU	C - 1001-1500	2019M01	0	65	0	79	0.823
NICU	D - 1501 -2500	2019M01	0	40	0	60	0.667
NICU	E - > 2500	2019M01	0	35	0	55	0.636

PedVAE – EMV Days Rate Table

- Location specific rate data for Episodes for Mechanical Ventilation
- The rate per 100 episodes of mechanical ventilation:
  - (PedVAECount / episodes of mechanical ventilation) * 100

National Healthcare Safety Network

Rate Table (EMV) for Ventilator-Associated Event Data for ICU-Other/SCA/ONC

As of: March 11, 2019 at 12:52 PM

Date Range: All PEDVAEEMV RATESICU SCA

orgID=10000 loccdc=IN:ACUTE:CC:MS_PED

location	summaryYM	pedVAECount	numNewEMV	pedVAEEMVRate
PICU2	2019M01	2	3	66.667
PICU2	2019M02	1	2	50.000

PedVAE – EMV Days Rate Table for NICUs

- NICU Location specific rate data for Episodes for Mechanical Ventilation
- Separated by birth weight
- The rate per 100 episodes of mechanical ventilation:
  - (PedVAECount / episodes of mechanical ventilation) * 100

National Healthcare Safety Network

Rate Table (EMV) for Ventilator-Associated Event Data for NICU

By Birthweight Code

As of: March 11, 2019 at 12:50 PM

Date Range: PEDVAEEMV RATESNICU summaryYM 2019M01 to 2019M01

orgID=10000 loccdc=IN:ACUTE:CC_STEP:NURS

location	birthWtCodeDesc	summaryYM	pedVAECount	numNewEMV	pedVAEEMVRate
NICU	B - 751 -1000	2019M01	1	3	33.333
NICU	C - 1001-1500	2019M01	0	2	0
NICU	D - 1501 -2500	2019M01	0	0	.
NICU	E - > 2500	2019M01	1	2	50.000

Resources

- Analysis Reference Guides:

https://www.cdc.gov/nhsn/ps-analysis-resources/reference-guides.html

- NHSN Training Website:

https://www.cdc.gov/nhsn/training/analysis/index.html

- VAE/PEDVAE protocol information:

https://www.cdc.gov/nhsn/enrolled-facilities/index.html

- CMS Requirements:

https://www.cdc.gov/nhsn/cms/index.html

For any other questions, please email NHSN@cdc.gov