Analyzing Device-Associated Data: Standardized Utilization Ratios (SURs)

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NHSN Annual Training

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Learning Objectives

- Defining the Standardized Utilization Ratio (SUR)
- Device Utilization Ratios (DURs)
- Difference between the DUR and the SUR
- Calculating the SUR
- Running and interpreting the SUR report in NHSN

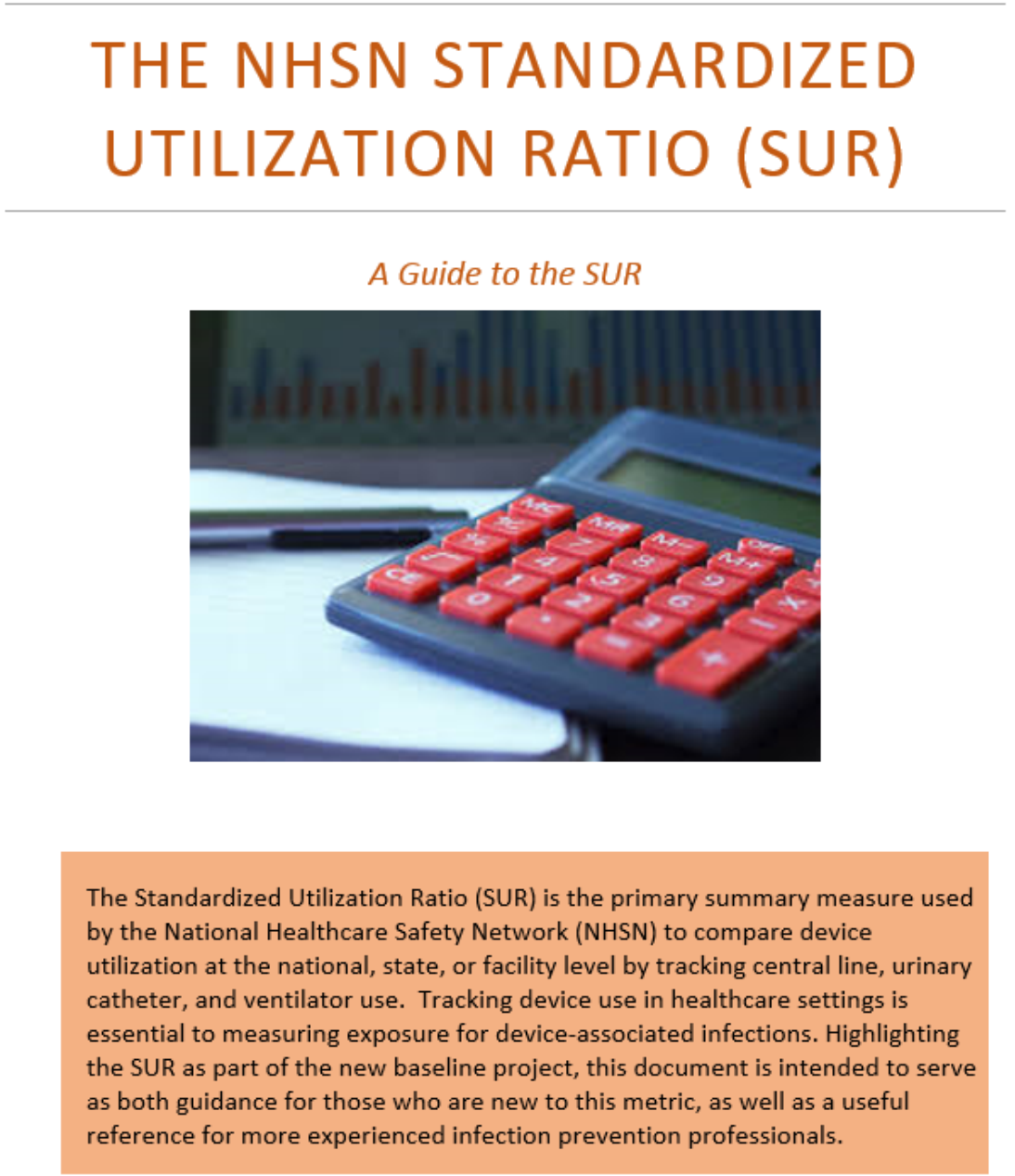
Defining the Standard Utilization Ratio (SUR)

What is a SUR?

- The SUR is a risk-adjusted, scalable summary measure for device use.
- Summary measure used by NHSN to compare device utilization at the national, state and facility level.
  - Device Types
    - Central Lines
    - Urinary Catheters
    - Ventilators
- SUR adjusts for various facility and/or location-level factors that contribute to device use and have been found to be significantly associated with differences in device utilization.

A Guide to the SUR

- The SUR Guide is live as of January 2018!
- Mirrors the SIR Guide
  - Includes definition, calculation steps, and models for each device and facility type



https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sur-guide-508.pdf

Differences between SURs and DURs

DURs for Local Measurement

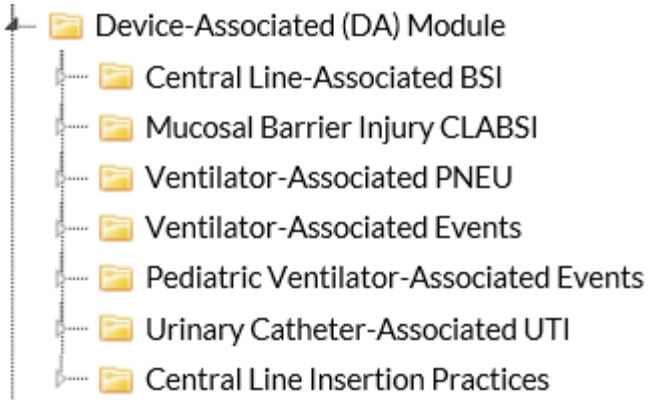
- Previously updated with pooled mean data on a yearly basis
- Pooled means were stratified by the patient care location
- Did not reflect differences in other factors that may describe levels of device use

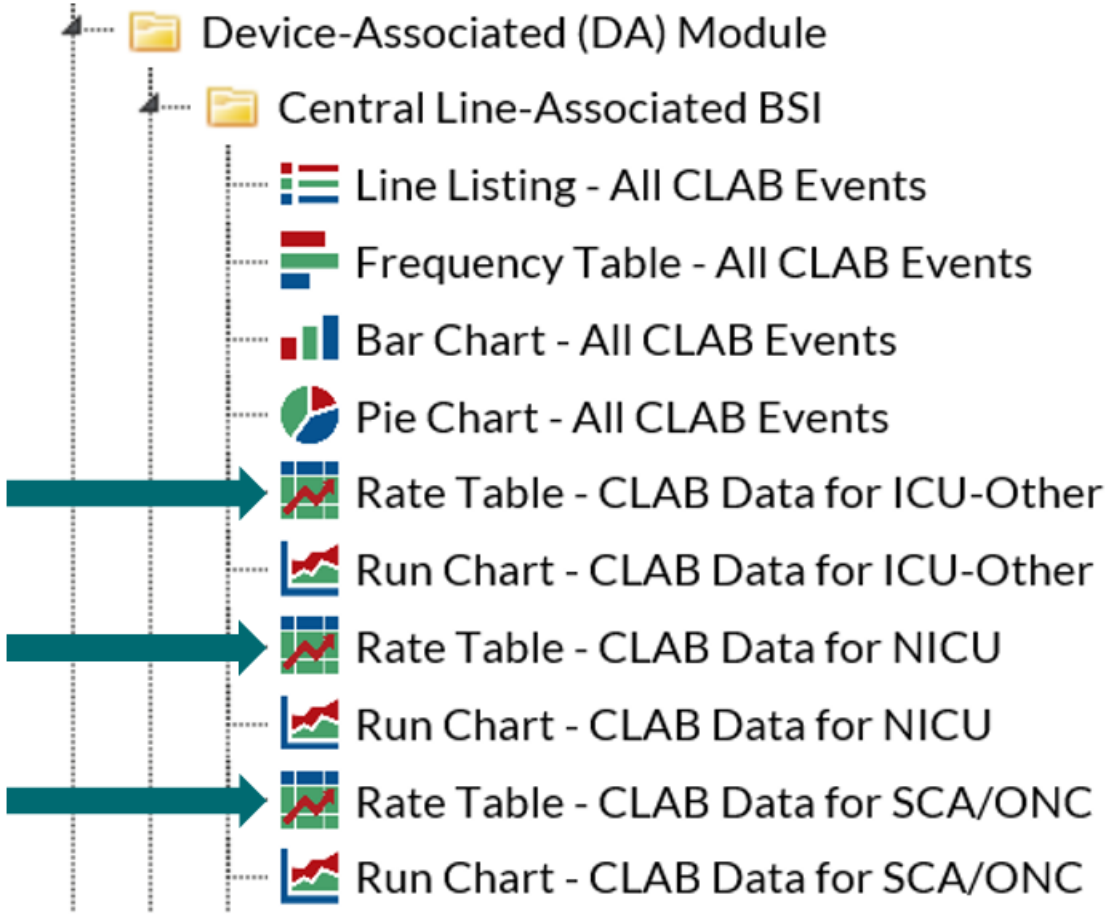
$$\text{DUR} = \frac{\#\ device\ days}{\#\ patient\ days}$$

- Calculated if the number of patient days > 0
- DURs can be anything between 0 and 1
- Must be stratified by many levels to be comparable to others

DURs for Local Measurement

- DURs are found in the rate table outputs under the Device Associated Module
- There are separate rate tables for location type and outputs are stratified by location





DURs and SURs

DURs:

- **Similar to a rate:**

$$\frac{\#\ device\ days}{\#\ patient\ days}$$

- **Is calculated as long as # patient days > 0**
- **DURs can be anything between 0 to 1**
- **Must be stratified by many levels to be comparable to others**

SURs

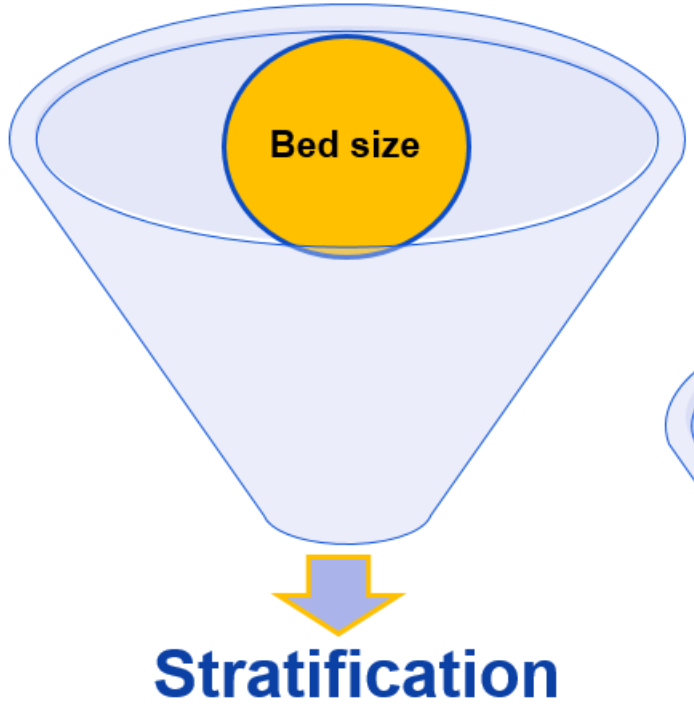
- **Similar to the SIR and SAAR:**

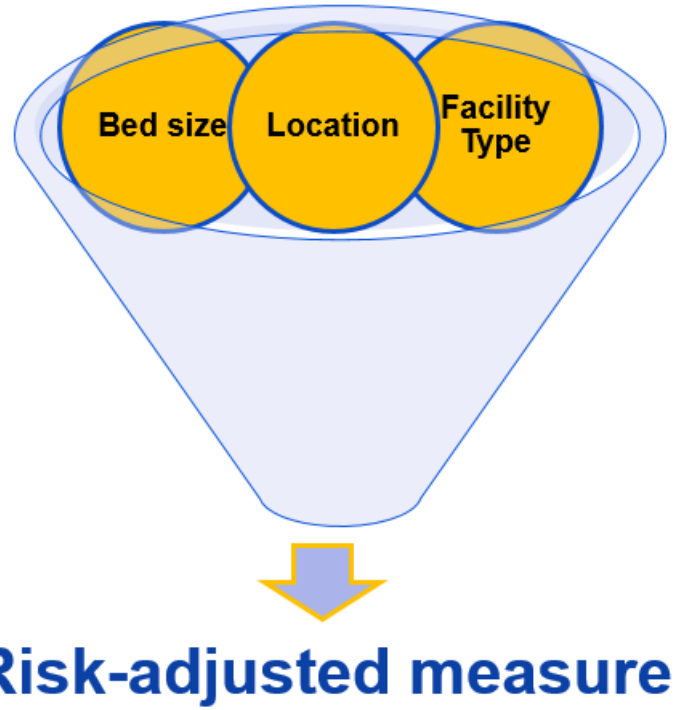
$$\frac{\#\ observed\ device\ days}{\#\ predicted\ device\ days}$$

- **SURs are only calculated when: # predicted device days ≥ 1**
- **SURs can be anything >0**
- **Risk-adjustment method: Logistic Regression Model**
  - **Baseline: 2015 NHSN data**

Why Not Device Utilization Ratios (DURs)

- **Less device use = less exposure**
  - What's the best way to measure exposure?
- **Stratification vs Logistic modeling**
  - DURs- only comparable across the strata they are in (location, facility type)
  - Logistic models- bring in multiple variables of interest





1. KNOWLEDGE CHECK!

True or False: SURs can only be a number between 0 and 1.

A. True
B. False

Answer

- False.
  - SURs are a ratio that can be any number above 0, so they could be between 0 and 1, but they can also be larger

Calculating the SUR

What is a SUR?

- Compares the actual number of observed device days reported to the number of predicted device days given the standard population

$$SUR^{*} = \frac{\#\ observed\ device\ days}{\#\ predicted\ device\ days}$$

  - SURs > 1.0 indicates more device days were observed than predicted
  - SURs < 1.0 indicates less device days were observed than predicted

- SURs are only calculated with number of predicted device days ≥ 1.0

* Baseline 2015 NHSN data

Calculating Number of Predicted Device Days

- All SUR models are based on a logistic regression model.
- The first step is to find logit $\hat{p}$:

$$\text{Logit}(\hat{p}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i$$

α = intercept

β = Parameter Estimate

X_i = Value of Factor (Categorical Variables = 1, if present, 0 if not present)

$_i$ = Number of Predictors

Calculating Number of Predicted Device Days for Birthweight Code A

Example: Let's say we have a Level III NICU summary denominator data record for a general hospital with a major teaching affiliation and a bed size of 300. Patient days for the different birthweight codes are as follows: 155 for birthweight code A, 82 for birthweight code B, 90 for birthweight code C, and a combined total of 56 patient days for both birthweight codes D and E. The number of central line days for birthweight code A were 105, 55 in birthweight code B, 80 in birthweight code C, and a combined total of 30 central line days in birthweight codes D and E.

Birthweight Code	Major Teaching Affiliation	NICU	General Hospital	Facility Bed Size	Patient Days	Central Line Days
A	Y	Y	Y	300	155	105
B	Y	Y	Y	300	82	55
C	Y	Y	Y	300	90	80
D/E	Y	Y	Y	300	56	30

Factors Predicting Unit Level Central Line Use in NICU

Factor	Variable Code	Code	Parameter Estimate	p-value
Intercept	-	-	-1.7745	<0.0001
Major Teaching Hospital	Yes	1	0.1538	<0.0001
	No	0		
General Hospital	General	1	-0.5650	<0.0001
	Other	0		
Location	IN:ACUTE:CC:NURSE	1	0.1781	<0.0001
	IN:ACUTE:CC_STEP:NURS	0		
Facility Bed Size	≥460	0	0.2783	<0.0001
	325 - 459	0	0.1770	<0.0001
	212- 324	1	0.0987	0.0330
	36 - 211	0		
Birth Weight	A	1	1.3932	<0.0001
	B	0	1.0765	<0.0001
	C	0	0.6419	<0.0001
	D/E	0		

Calculating Number of Predicted Device Days for Birthweight Code A

1. Calculate the log-odds (logit) of Central line use by adding the values of the parameter estimates applicable to the example data

$$\text{Logit}(\hat{p}) = -1.7745 + 0.1538\ (\text{Major teaching hospital}) - 0.5650\ (\text{General Hospital}) + 0.1781\ (\text{NICU}) + 0.0987\ (\text{Bedsize Between 212 – 324}) + 1.3932\ (\text{Birthweight Code A})$$

$$\text{Logit}(\hat{p}) = -1.7745 + 0.1538\ (1) - 0.5650\ (1) + 0.1781\ (1) + 0.0987\ (1) + 1.3932\ (1)$$

The value **-0.5157** is the log-odds of central line device use in birthweight code A

Calculating Number of Predicted Device Days for Birthweight Code A

2. To convert this value into the probability of the central line use ($\hat{p}$), we must use the formula below:

$$\hat{p} = \frac{e^{logit(\hat{p})}}{1 + e^{logit(\hat{p})}}$$

$$\hat{p} = \frac{e^{-0.5157}}{1 + e^{-0.5157}}$$

$$\hat{p} = 0.3739$$

Calculating Number of Predicted Device Days for Birthweight Code A

3. Multiply the probability of central line use by the observed inpatient days to obtain the number of predicted central line days:

Number of predicted central line days = 0.3739 x 155

Number of predicted central line days = 57.955

Once all the number of predicted central line days is calculated for each birthweight code, they can be summed. The sum is the total number of predicted central line days for the specific month in the NICU unit.

Calculating Number of Predicted Device Days

- Table 2.Predicted Device Days for Level III NICU

Birthweight Code	Major Teaching Affiliation	NICU	General Hospital	Facility Bed Size	Patient Days	Central Line Days	Probability of CL use (p̂)	Predicted Device Days
A	Y	Y	Y	300	155	105	0.3739	57.9545
B	Y	Y	Y	300	82	55	0.3031	24.8542
C	Y	Y	Y	300	90	80	0.2215	19.935
D/E	Y	Y	Y	300	56	30	0.1291	7.2296
Total						270		109.9733

- $\text{SUR} = \frac{\#\ observed\ device\ days}{\#\ predicted\ device\ days} = \frac{270}{109.9733} = 2.4551$
- 2.4551 is greater than 1, therefore there were more observed devices days than predicted.

Running and Interpreting SURs in NHSN

Summary Denominators: Device days

Denominators of Specialty Care Area/Oncology

Mandatory fields marked with *

Facility ID *: DHQP MEMORIAL HOSPITAL (ID 10018)
Location Code *: ONC M - ONC MEDICAL CRITICAL CARE
Month *: June
Year *: 2017

Denominator Data

		Report No Events
Total Patient Days * :	50	
Temporary Central Line Days * :	25	TCLAB : ☑
Permanent Central Line Days * :	25	PCLAB : ☐
Urinary Catheter Days :		CAUTI: ☐
Ventilator Days :		VAE : ☐ PedVAP : ☐
APRV Days :		
Episodes of Mechanical Ventilation :		

Neonatal Intensive Care Unit

Mandatory fields marked with *

Facility ID *: DHQP MEMORIAL HOSPITAL (ID 10018)
Location Code *: NICU - LEVEL 3 NICU
Month *: October
Year *: 2018

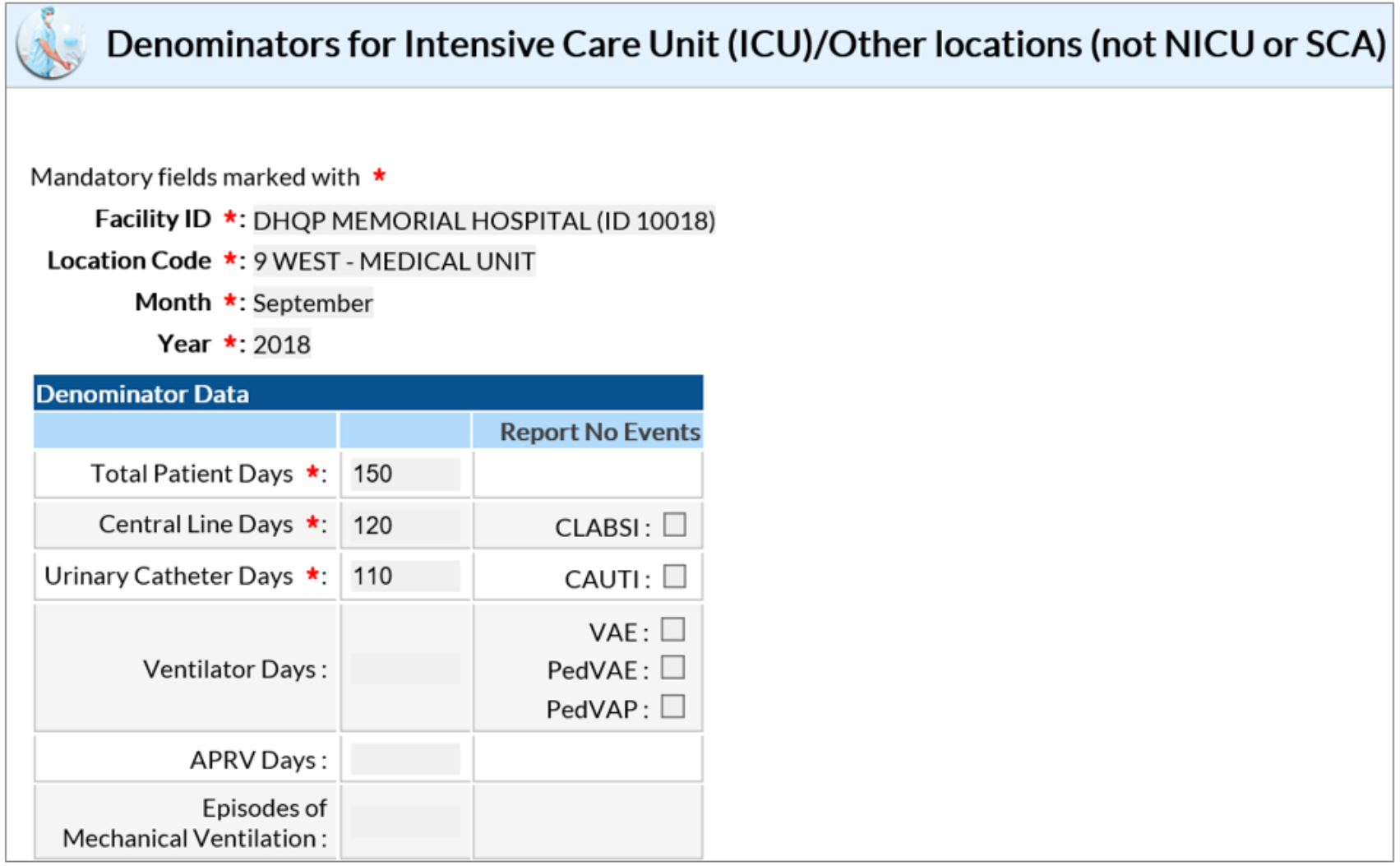
Birth Weights

Birth Weight	Patient Days *	CL Days *	No CLABSI	Vent Days *
<=750	100	30	☑	30
751-1000	200	30	☑	50
1001-1500	400	50	☑	100
1501-2500	200	50	☑	50
>2500	100	20	☑	50

REMEMBER TO GENERATE DATASETS!!!

*All data on slides are completely fictitious.

Summary Denominators: Device days



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

Mandatory fields marked with *

Facility ID *: DHQP MEMORIAL HOSPITAL (ID 10018)

Location Code *: 9 WEST - MEDICAL UNIT

Month *: September

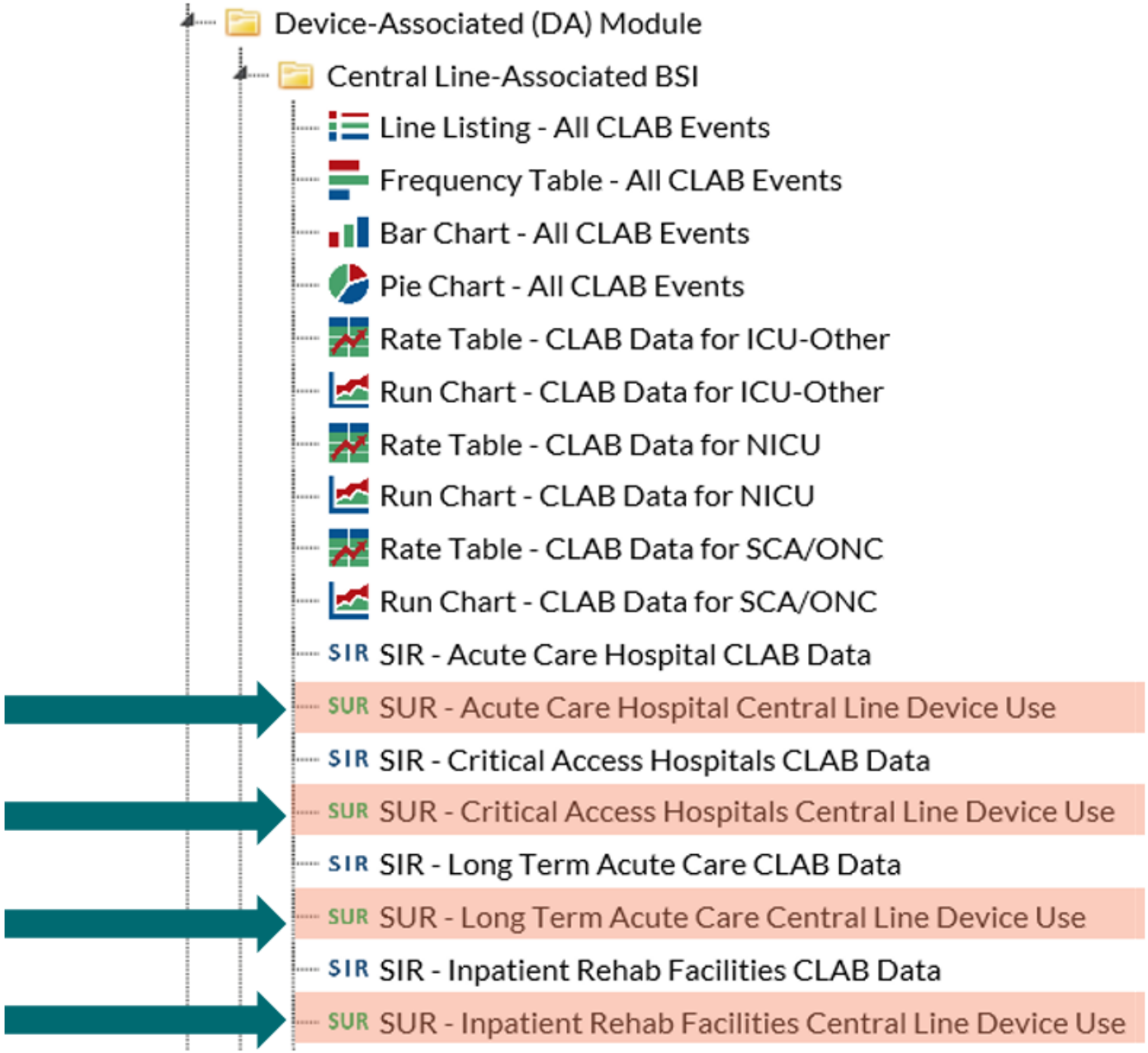
Year *: 2018

Denominator Data		
		Report No Events
Total Patient Days *:	150	
Central Line Days *:	120	CLABSI : ☐
Urinary Catheter Days *:	110	CAUTI : ☐
Ventilator Days :		VAE : ☐ PedVAE : ☐ PedVAP : ☐
APRV Days :		
Episodes of Mechanical Ventilation :		

*All data on slides are completely fictitious.

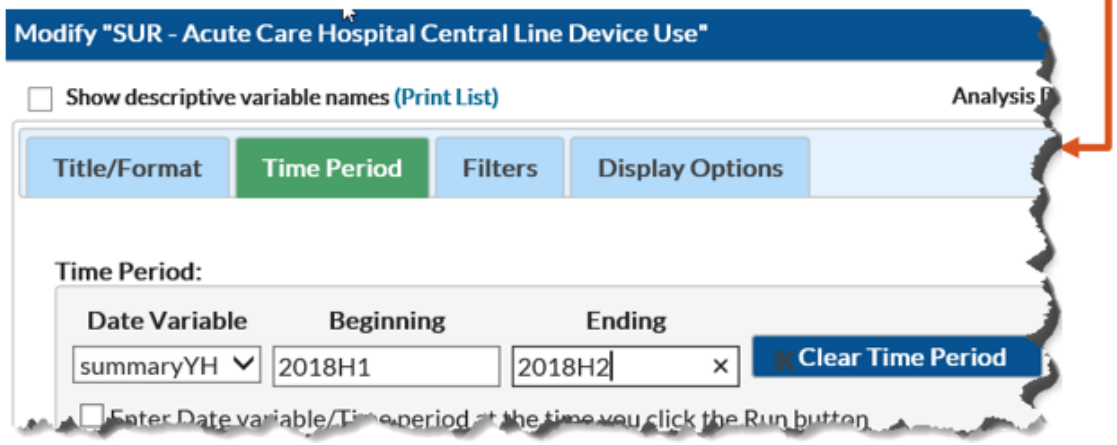
SURs in NHSN

- Available for Facilities and Groups
- Separated by device and facility type

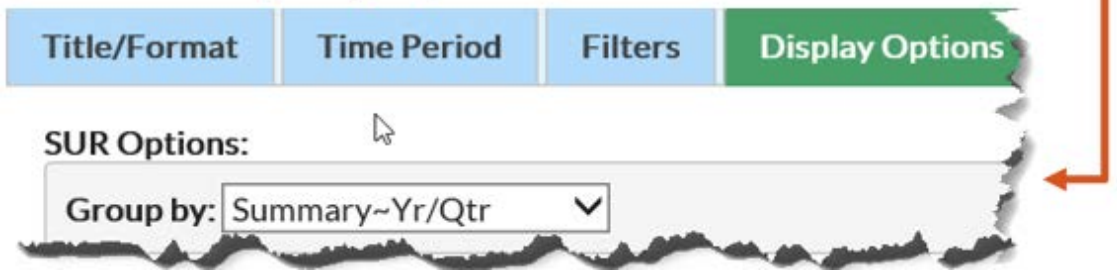


Modifying Your SUR Report in NHSN

1. Time Period tab



2. Display Options tab



3. Filters tab

SURs in NHSN

National Healthcare Safety Network
SUR for Central Line Device Use for Acute Care Hospitals (2015 baseline) - By OrgID
As of: January 23, 2019 at 12:23 PM
Date Range: BS2_CLAB_RATESALL summaryYH 2018H1 to 2018H2
if (((bsiPlan = "Y")))

orgID=10018 medType=M

orgID	ccn	summaryYQ	numCLDays	numPredDDays	SUR	SUR_pval	SUR95CI
10018	12345	2018Q1	900	565.079	1.593	0.0000	1.491, 1.699
10018	12345	2018Q3	1000	487.723	2.050	0.0000	1.926, 2.180
10018	12345	2018Q4	780	845.287	0.923	0.0243	0.860, 0.989

1. This report includes central line utilization data from acute care hospitals for 2015 and forward.
2. The SUR is only calculated if number of predicted device days (numPredDDays) is >= 1. Lower bound of 95% Confidence Interval only calculated when number of observed device days > 0.
3. The predicted device utilization days is calculated based on national aggregate NHSN data from 2015. It is risk adjusted for CDC location, hospital beds, medical school affiliation type, and facility type.

*All data on slides are completely fictitious.

Interpreting your SUR

- Facility 10018 observed 900 central line days
- Based on the 2015 NHSN baseline, there were 556.079 predicted central line days.
- The SUR = 1.593
- The p-value = 0.0000 meaning which is less than 0.05 therefore showing that the SUR is statistically significant
- The 95% CI doesn't cross 1, which also signifies that the SUR is statistically significant because the confidence interval doesn't cross the null.

orgID	ccn	summaryYQ	numCLDays	numPredDDays	SUR	SUR_pval	SUR95CI
10018	12345	2018Q1	900	565.079	1.593	0.0000	1.491, 1.699

2. KNOWLEDGE CHECK!

True or False: SURs above 1 indicate that less devices were utilized than predicted.

A. True
B. False

Answer

- False.
  - SURs greater than 1 indicate more observed device usage than predicted.

National and State SUR Aggregate Data

- National and State SUR reports have been published on the NHSN site

2016 SUR Data Tables

- 2016 National and State HAI Progress Report SUR Data – Acute Care Hospitals [XLS – 282 KB]
- 2016 National and State HAI Progress Report SUR Data – Critical Access Hospital [XLS – 162 KB]
- 2016 National and State HAI Progress Report SUR Data – Inpatient Rehabilitation Facilities [XLS – 92 KB]
- 2016 National and State HAI Progress Report SUR Data – Long-Term Acute Care Hospitals [XLS – 100 KB]

Summary

- DURs are not comparable across facilities and states
- SURs give you the ability to compare your facility over time and compare it to other facilities because it is a risk-adjusted measure
- SURs are calculated by dividing the observed device days by the predicted device days

Resources

- A Guide to the SUR: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sur-guide-508.pdf
- 2016 SUR Date Tables: https://www.cdc.gov/nhsn/datastat/index.html
- How to Run and Interpret SUR Reports in NHSN Quick Reference Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/run-interpret-sur-reports.pdf
- Paving the Path Forward: 2015 Rebaseline: https://www.cdc.gov/nhsn/2015rebaseline/index.html
- https://www.cdc.gov/nhsn/datastat/index.html

Questions?

Thank you!

Send email:
NHSN@CDC.gov

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

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