THE NHSN STANDARDIZED INFECTION RATIO (SIR)

A Guide to the SIR

Updated March 2018. Please see Page 2.

The Standardized Infection Ratio (SIR) is the primary summary measure used by the National Healthcare Safety Network (NHSN) to track healthcare-associated infections (HAIs). As NHSN grows, both in its user-base and surveillance capability, the SIR continues to evolve. Highlighting the SIR and changes resulting from an updated baseline, this document is intended to serve both as guidance for those who are new to this metric as well as a useful reference for more experienced infection prevention professionals.

National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

CORRECTIONS AND UPDATES AS OF MARCH 2018

Recent changes to this document are listed here:

- Page 29: The variable "anesthesia" was removed from the All SSI SIR risk adjustment model for carotid endarterectomy (CEA)
- Page 39: Updates to the CDI test type values included in each risk adjustment "category" for 2018
- Page 40: Updated footnote under the CDI IRF risk adjustment table to account for collection of CDI test type on IRF unit's MDRO denominator form
- Page 43: New hyperlink in "Additional Resources" for the CLABSI/CAUTI SIR Troubleshooting Guide
- Minor edits made to terminology and/or punctuation for consistency and clarity

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Overview of the Standardized Infection Ratio (SIR)

What is the SIR?

The standardized infection ratio (SIR) is a summary measure used to track HAIs at a national, state, or local level over time. The SIR adjusts for various facility and/or patient-level factors that contribute to HAI risk within each facility. The method of calculating an SIR is similar to the method used to calculate the Standardized Mortality Ratio (SMR), a summary statistic widely used in public health to analyze mortality data. In HAI data analysis, the SIR compares the actual number of HAIs reported to the number that would be predicted, given the standard population (i.e., NHSN baseline), adjusting for several risk factors that have been found to be significantly associated with differences in infection incidence. In other words, an SIR greater than 1.0 indicates that more HAIs were observed than predicted; conversely, an SIR less than 1.0 indicates that fewer HAIs were observed than predicted. SIRs are currently calculated in NHSN for the following HAI types: central line-associated bloodstream infections (CLABSI), mucosal barrier injury laboratory-confirmed bloodstream infections (MBI-LCBI), catheter-associated urinary tract infections (CAUTI), surgical site infections (SSI), *Clostridium difficile* infections (CDI), methicillin-resistant *Staphylococcus aureus* bloodstream infections (MRSA), and ventilator-associated events (VAE).

Why not rates?

In the past, NHSN has published annual HAI rates for device-associated infections. These rates, or pooled means, were calculated using aggregate data reported to NHSN. The total number of infections was divided by the applicable number of device days for that time period. However, a problem with strictly using pooled mean rates is that they cannot reflect differences in risk between populations, and therefore lose comparability over time and across entities. For example, calculating rates from two facilities serving entirely different patient populations can lead to an unfair comparison. One solution to this problem is the stratification of pooled means, as was done with location-stratified CLABSI and CAUTI pooled means. However, this method only allows for comparison of rates within strata, and does not lend itself to calculating an overall performance metric for a facility.

Instead, the SIR allows users to summarize data by more than a single stratum (e.g., location or procedure category), adjusting for differences in the incidence of infection among the strata. For example, NHSN allows users to obtain one CLABSI SIR for their facility, adjusting for all locations reported. Similarly, users can also obtain one CLABSI SIR for all intensive care units in their facility.

Additionally, the SIR allows for a comparison to the national benchmark from a baseline time period, and can be used to measure progress from a single point in time. In other words, the SIR permits comparisons between the number of infections experienced by a facility, group, or state to the number of infections that were predicted to have occurred based on national data (i.e., baseline data).

How is the SIR calculated?

The SIR is calculated by dividing the number of observed infections by the number of predicted infections. The number of predicted infections is calculated using multivariable regression models generated from nationally aggregated data during a baseline time period. These models are applied to a facility's denominator and risk factor data to generate a predicted number of infections. Please refer to the SIR Guide Supplement at the end of this document for more details regarding the models.

$$SIR = \frac{Observed\ (O)\ HAIs}{Predicted\ (P)\ HAIs}$$

In order to enforce a minimum precision criterion, **SIRs are currently not calculated when the number of predicted infections is less than 1.0**. This rule was instituted to avoid the calculation and interpretation of statistically imprecise SIRs, which typically have extreme values.

Calculating the Number of Predicted Infections

The number of predicted infections in NHSN is calculated based on the 2015 national HAI aggregate data and is adjusted for each facility using variables found to be significant predictors of HAI incidence. NHSN uses either a logistic regression model or a negative binomial regression model to perform this calculation. Logistic regression models are used when there is an opportunity for a single outcome for each exposure (e.g., SSI following a procedure). Negative binomial regression models are used when estimating incidence from a summarized population (e.g., CLABSIs in a Medical ICU). Examples in applying each model type are provided below.

❖ Example: Logistic Regression Model (SSI)

The logistic regression model is the specific type of model used for surgical site infection risk adjustment. At a high level, the model uses a set of fixed parameters (adjustment variables) to predict the log-odds of a surgical site infection following an inpatient procedure. To obtain the total number of predicted SSIs, the following steps are completed in NHSN:

1. Determine the log-odds for each procedure
2. Convert the log-odds into a probability, or risk of infection $(\hat{p})$, for each procedure
3. Sum the risk of infections across all procedures in a given timeframe

The sum of the risks from a set of procedures will amount to the total number of predicted infections for that same set of procedures. *Table 1* below shows the risk factors found to be significant for abdominal hysterectomy (HYST) procedures (Complex 30-Day model) in NHSN. Note that each risk factor's contribution to the SIR varies, as represented by the parameter estimate for each factor. Parameter estimates describe the relationship between the variable and the risk of SSI; positive parameter estimates indicate that the risk of SSI increases with

increasing values of the variable. Negative parameter estimates indicate that the risk of SSI decreases with increasing values of the variable.

Table 1. Risk Factors for SSI HYST: Complex 30-Day Model (2015 Baseline)

Factor	Parameter Estimate	P-value	Variable Coding
Intercept	*-5.1801*	-	-
Diabetes	0.3247	<0.0001	**Yes**= 1 **No**= 0
ASA Score	0.4414	<0.0001	**1**= 1 **2**= 2 **3**= 3 **4/5**= 4
Body Mass Index (BMI)	0.1106	0.0090	**≥ 30**= 1 **< 30**= 0
Patient Age	-0.1501	<0.0001	**Patient's age**/10
Oncology Hospital	0.5474	0.0005	**Oncology hospital**= 1 **Non-oncology hospital**= 0

The parameter estimates from *Table 1* can be plugged into the following general logistic regression formula:

$$logit\ (\hat{p}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i$$, where:

α = Intercept

β_i = Parameter Estimate

X_i = Value of Risk Factor (Categorical variables= 1 if present, 0 if not present. Refer to "Variable Coding" column in Table 1 above.)

i = Number of Predictors

The probability of SSI is calculated using the logistic regression model above, by utilizing the relationship between the log-odds and the probability (risk). Let's say we have a patient (Patient 1) who is 32 years old, has diabetes, and a BMI score of 29. She had an ASA score of 2 and her procedure took place in an oncology hospital. We can use the model above to plug in these values as shown below:

$$logit\,(\hat{p}) = -5.1801 + 0.3247(DIABETES) + 0.4414(ASA) + 0.1106(BMI) - 0.1501(AGE) + 0.5474(ONCOLOGY\ HOSPITAL)$$

$$logit\,(\hat{p}) = -5.1801 + 0.3247(1) + 0.4414(2) + 0.1106(0) - 0.1501(3.2) + 0.5474(1) = -3.9055$$

The value -3.9055 is the log-odds of SSI for Patient 1. To convert this value into the risk of SSI ($\hat{p}$), we must use the logit function below:

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

$$\hat{p} = \frac{e^{-3.9055}}{1 + e^{-3.9055}}$$

$$\hat{p} = 0.020$$

Note that this can also be interpreted as a 2.0% risk of SSI for Patient 1. The probability of SSI is calculated for each procedure and then summed across all procedures to give the total number of predicted SSIs for this population. *Table 2* provides a partial list of 100 hypothetical patients who have undergone this particular procedure type and demonstrates how the total number of predicted SSIs is calculated.

Table 2. Risk Factors for 100 Patients Undergoing a HYST Procedure (Complex 30-Day model)

Patient	Diabetes	ASA score	BMI	Age	Oncology Hospital	SSI Identified?	Probability of SSI ($\hat{p}$)
1	Y	2	29	32	Y	1	0.020
2	N	3	35	49	Y	0	0.019
3	N	5	20	51	Y	1	0.026
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
100	N	4	27	27	Y	0	0.037
TOTAL						**8** (observed SSIs)	**6.750** (predicted SSIs)

Notice in the above table that the probability of SSI is different for each patient, given the risk factors present during the reported procedure.

The SIR can now be calculated for those 100 procedures as follows:

$$SIR = \frac{Observed\ (O)\ HAIs}{Predicted\ (P)\ HAIs} = \frac{8}{6.750} = 1.190$$

❖ Example: Negative Binomial Regression Model

Negative binomial regression models are used to calculate the number of predicted events for CLABSI, MBI-LCBI, CAUTI, VAE, MRSA bacteremia LabID, and *C. difficile* (CDI) LabID under the 2015 baseline. Below is a general formula for a 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

As an example, *Table 3* below represents the negative binomial regression model used to calculate the number of predicted healthcare facility-onset (HO) CDI LabID events in acute care hospitals under the 2015 baseline.

Table 3. Risk Factors Used in the Acute Care Hospital CDI LabID Event Model

Factor	Parameter Estimate	P-value
Intercept	-8.9463	<0.0001
Community-onset (CO) Admission Prevalence Rate	0.7339	<0.0001
CDI test type= EIA	-0.1579	<0.0001
CDI test type= NAAT	0.1307	<0.0001
# ICU beds: ≥ 43	0.7465	<0.0001
# ICU beds: 20-42	0.7145	<0.0001
# ICU beds: 10-19	0.6261	<0.0001
# ICU beds: 5-9	0.4394	<0.0001
Oncology hospital (facility type = HOSP-ONC)	1.2420	<0.0001
General acute care hospital (facility type = HOSP-GEN)	0.3740	<0.0001
Total facility bed size	0.0003	<0.0001
CDI LabID surveillance in ED or 24-hour observation location(s)	0.1119	<0.0001
Teaching facility (major, graduate, or undergraduate)	0.0331	0.0028

The SIR for *C. difficile* LabID events in an acute care hospital is calculated on the facility-wide inpatient (FacWideIN) level for each quarter. More information on the details of the LabID Event SIR calculations can be found in the SIR Guide Supplement at the end of this document.

We can input the model details from *Table 3* into the general negative binomial regression formula for CDI in acute care hospitals:

 # predicted HO CDI =

Exp [-8.9463
+ 0.7339 (CO prevalence rate)
- 0.1579 (CDI test type = EIA)
+0.1307 (CDI test type = NAAT)
+ 0.7465 (ICU beds ≥ 43)
+ 0.7145 (ICU beds: 20 – 42)
+ 0.6261 (ICU beds: 10-19)
+ 0.4394 (ICU beds: 5-9)
+1.2420 (Oncology hospital)
+ 0.3740 (General hospital)
+ 0.0003 (Total facility bed size)
+ 0.1119 (Reporting from ED or 24 hr. Obs)
+ 0.0331 (Teaching hospital)] X CDI patient days

For most variables shown in parentheses in the equation above, you would replace the variable name (and therefore, multiply each parameter estimate) with a "1" or "0" depending on whether that factor is present in your facility (Yes= "1", No= "0"). The inpatient CO prevalence rate and total number of beds are continuous variables and should be replaced with the actual values of the inpatient CO prevalence rate and total number of beds. The last step in the equation is to multiply the resulting value by the appropriate HAI denominator (i.e., patient days for MRSA/CDI events, or device days for CLABSI/MBI/CAUTI/VAE). In this example, we multiply by CDI patient days.

Let's walk through an example of calculating the number of predicted CDI events for an acute care hospital for 2015 Q1. The facility in our example has reported 5,000 CDI patient days and 5 healthcare facility-onset CDI LabID events in 2015 Q1. After running the CDI rate tables in NHSN, the facility records that their 2015 Q1 CO admission prevalence rate was 1.25 per 100 admissions. The facility was using a NAAT CDI test type, has 5 ICU beds, is enrolled in NHSN as a children's non-teaching hospital, and has 100 total beds. The facility has an Emergency Department, and is thus reporting CDI data from this location per NHSN protocol.

In our example hospital, the completed formula looks like this:

Exp [-8.9463
+ 0.7339 (1.25)
- 0.1579 (0)
+0.1307 (1)
+ 0.7465 (0)
+ 0.7145 (0)
+ 0.6261 (0)
+ 0.4394 (1)
+1.2420 (0)
+ 0.3740 (0)
+ 0.0003 (100)
+ 0.1119 (1)
+ 0.0331 (0)] X 5,000 = **3.321 predicted CDI LabID events**

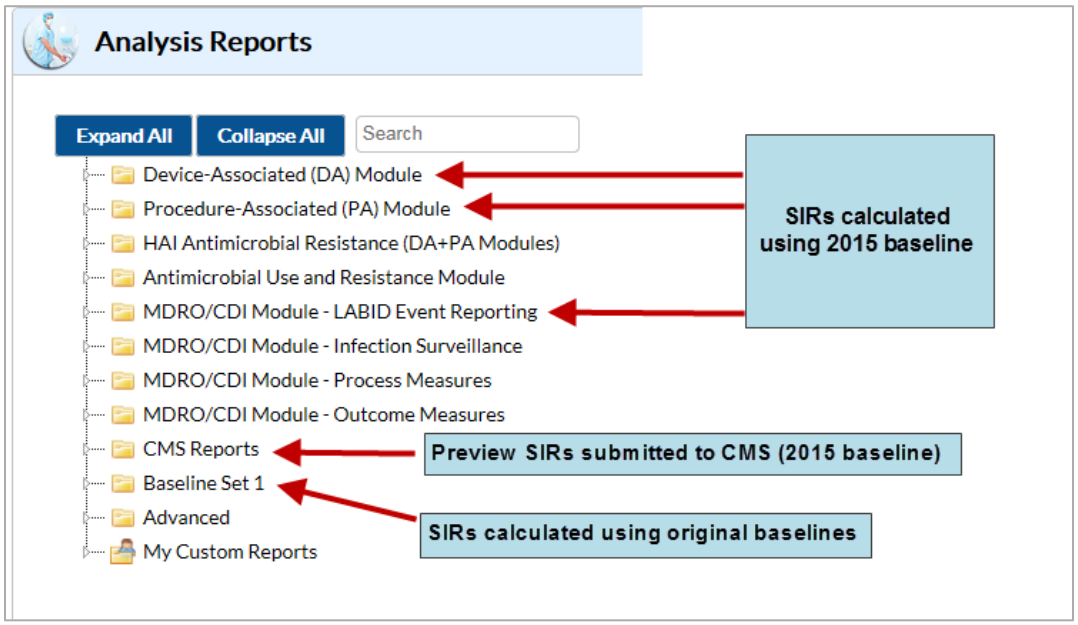
Because the facility was not using EIA test type, was not a general or oncology hospital, and was not a teaching hospital, the associated parameters in the model were not met. Therefore, the parameter estimates for each of those variables were multiplied by 0 and fell out of the equation.

To calculate the CDI LabID SIR, divide the number of observed HO CDI LabID events by the number of predicted HO CID LabID events. In our example:

$$SIR = \frac{5\ observed\ HO\ CDI\ LabID\ events}{3.321\ predicted\ HO\ CDI\ LabID\ events} = 1.506$$

What SIR reports are available?

To run analysis reports in NHSN, users must first generate analysis data sets (Analysis > Generate Data Sets). NHSN recommends users regenerate data sets after entering new data into the application or before creating new reports. After data sets have been regenerated, users can select Analysis > Reports from the NHSN homepage to view HAI-specific folders. The SIR reports located in the HAI-specific folders will be calculated using the 2015 baselines and risk adjustment models. In addition, SIR reports are available that mirror the data submitted to the Centers for Medicare & Medicaid Services (CMS) Quality Reporting Programs. These reports can be found in the analysis folder titled "CMS Reports".



SIRs can be generated for data through 2016 using the original NHSN baselines by running reports in the "Baseline Set 1" reports folder. Data representing a later time period (i.e., starting in January 2017) can only be analyzed in NHSN using the new 2015 rebaseline models. Year 2016 is the final year of data that can use the original models to calculate SIRs. See Additional Resources for information about the original SIR baselines.

Note: SIRs calculated under the original baseline cannot be directly compared to SIRs calculated under the updated baseline. For information about comparisons and reviewing SIRs over time, refer to the slides presented during the Rebaseline Part II- November 2016 Webinar, found here: https://www.cdc.gov/nhsn/pdfs/rebaseline/rebaseline-webinar-p2.pdf.

How do I Interpret the SIRs?

SIR

- If the SIR > 1.0, then more HAIs were observed than predicted, based on the 2015 national aggregate data.
- If the SIR < 1.0, then fewer HAIs were observed than predicted, based on the 2015 national aggregate data.
- If the SIR= 1.0, then the same number of HAIs were observed as predicted, based on the 2015 national aggregate data.
- Remember, the SIR is only calculated when the number of predicted infections is at least 1.0. When the predicted number of infections is less than 1.0, facilities have a few options for reviewing and interpreting HAI data in NHSN:
    - A longer time period can be included in the SIR calculation in order to reach the threshold of 1.0 predicted infection.
    - Infection rates can be used to track internal HAI incidence over time.
    - Run the TAP Reports to review the CAD (cumulative attributable difference, which is the difference between the number of observed infections and the number of predicted infections, multiplied by the SIR goal). Information and guidance about running TAP reports can be found in Additional Resources.

P-value

- In the context of the SIR, the p-value is a statistical measure that tells us whether the number of observed infections is statistically significantly different than the number of predicted infections (i.e., whether the SIR is significantly different from 1.0). NHSN calculates p-values using a mid-P exact test.
- Given the typical cutoff value of 0.05, if the p-value ≤ 0.05, we can conclude that the number of observed infections is statistically significantly different than the number of predicted infections.
- If the p-value > 0.05, then we can conclude that the number of observed infections is not statistically significantly different than the number of predicted infections.

95% Confidence Interval

- The 95% confidence interval is a statistical range of values in which we have a high degree of confidence that the true SIR lies.

- If the confidence interval does not include the value of 1, then the SIR is significantly different than 1 (i.e., the number of observed infections is significantly different than the number of predicted infections).
    - Example: 95% confidence interval= (0.85, 0.92)
- If the confidence interval includes the value of 1, then the SIR is not significantly different than 1 (i.e., the number of observed infections is not significantly different than the number of predicted infections).
    - Example: 95% confidence interval= (0.85, 1.24)
- If the SIR is 0.000 (i.e., the observed infection count is 0 and the number of predicted infections is ≥ 1.0), then the lower bound of the 95% confidence interval will not be calculated.

As an example, let's take a look at the CLABSI SIR output. Below is a table showing the overall CLABSI SIR for a hospital during the first quarter of 2015.

orgID	summaryYQ	infCount	numPred	numcldays	SIR	SIR_pval	sir95ci
10018	2015Q1	5	2.365	1850	2.114	0.1251	0.775, 4.686

- During the first quarter (January– March) of 2015 ("summaryYQ"), there were 5 CLABSIs identified in our facility ("infCount"), and we observed a total of 1,850 central line days ("numcldays") from the locations under surveillance.
- Based on the NHSN 2015 baseline data, 2.365 CLABSIs were predicted ("numPred") in our facility.
- This results in an SIR of 2.114 (5/2.365), signifying that during this time period, our facility identified more CLABSIs than were predicted.
- Because the p-value ("SIR_pval") is above the significance level of 0.05 and the 95% confidence interval ("sir95ci") includes the value of 1, we can conclude that our facility's SIR is not statistically significant; in other words, our facility did not observe a statistically significantly different number of CLABSIs than predicted.

When analyzing these data as a Group user, an additional overall SIR will be calculated for all facilities in the Group. More information about using the Group function in NHSN can be found here: https://www.cdc.gov/nhsn/group-users/index.html.

SIR Guide Supplement: Risk Adjustment Factors Included in the SIR Calculations, 2015 Baseline

Introduction to the SIR Guide Supplement

The following pages contain information on the risk factors used in the calculation of the number of predicted events for each HAI and facility type under the 2015 SIR baseline. This information is provided in order to aide in the interpretation of the SIR calculations produced by NHSN. The tables displayed in this document list the variables included in each risk adjustment model*, as well as parameter estimates and standard errors. Some risk adjustment variables are broken into different levels, or categories (i.e., categorical variables), while other variables are treated as continuous variables without any categorization. Standard errors reflect the precision of the parameter estimate.

- Categorical variables:
  Example: "medical school affiliation" in the CAUTI Acute Care Hospital model, page 20

Variables are categorized based on significant differences in HAI risk between the categories. Parameter estimates reflect the nature of the relationship between the variable and the risk of HAI. In the case of categorical variables, the risk of HAI in an individual category is compared to the risk of HAI in the "referent" category. A positive parameter estimate indicates that the risk of HAI in that category (and therefore, the number of predicted HAIs) is higher compared to the risk of HAI in the referent category. A negative parameter estimate indicates that the HAI risk in that category is lower compared to the HAI risk in the "referent" category.

- Continuous variables:
  Example: "facility bed size" in the CDI Acute Care Hospital model, page 38

Parameter estimates reflect the nature of the relationship between the variable and the risk of HAI (and therefore, the number of predicted HAIs). For continuous variables, a positive parameter estimate indicates that the risk of HAI increases as the variable increases, while negative parameter estimates indicate that the risk of HAI decreases as the variable increases.

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*Exceptions:

Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection (MBI-LCBI) data: The variables included in the MBI risk adjustment model for acute care hospitals are shown on page 19. The MBI-LCBI SIR is not submitted to CMS under the Hospital Inpatient Quality Reporting Program. Full model details including parameter estimates will be available in a separate publication.

VAE and IVAC Plus data: Parameter estimates are shown only for Long-Term Acute Care Hospitals (LTACHs), which are required to report these data under the CMS Long Term Care Hospital Quality Reporting Program. Full VAE and IVAC Plus model details for additional facility types will be available in a separate publication.

SSI data: Parameter estimates are shown for colon (COLO) and abdominal hysterectomy (HYST) procedures under the Complex 30-Day Model used for CMS Hospital Inpatient Quality Reporting Program. Full model details for all procedures under the All SSI Model and the Complex A/R Model will be available in a separate publication.

Risk Adjustment Factors Included in the SIR Calculation: 2015 Baseline

CLABSI – Central Line-Associated Bloodstream Infection

The number of predicted CLABSIs is calculated using a negative binomial regression model (see page 8 above for more information). Inpatient locations that were previously excluded from the original baseline are now included in the SIR under the 2015 baseline (e.g., Telemetry Ward, Mixed Acuity Ward). In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN. CLABSI events reported to NHSN as mucosal barrier injury (MBI-LCBI) are excluded from the numerator of the CLABSI SIR.

The number of predicted CLABSIs calculated under the 2015 baseline is risk adjusted based on the following variables found to be statistically significant predictors (*risk adjustment updated May 2017)*:

Table 1. CLABSI in Acute Care Hospitals (non-NICU locations)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-7.6320*	*0.0606*	*<0.0001*
CDC Location Code: Adult Critical Care Units, Oncology Critical Care Units *Medical Cardiac Critical Care* *Surgical Cardiothoracic Critical Care* *Medical Critical Care* *Medical/Surgical Critical Care* *Neurologic Critical Care* *Neurosurgical Critical Care* *Medical Oncology Critical Care* *Medical/Surgical Oncology Critical Care* *Pediatric Oncology Critical Care* *Surgical Oncology Critical Care* *Prenatal Critical Care* *Respiratory Critical Care* *Surgical Critical Care*	0.3257	0.0435	<0.0001
CDC Location Code: Pediatric Critical Care *Pediatric Burn Critical Care* *Pediatric Cardiothoracic Critical Care* *Pediatric Medical/Surgical Critical Care* *Pediatric Medical Critical Care* *Pediatric Neurosurgical Critical Care* *Pediatric Surgical Critical Care* *Pediatric Trauma Critical Care*	0.5694	0.0699	<0.0001
CDC Location Code: Burn Critical Care (Adult)	1.4269	0.1125	<0.0001
CDC Location Code: Trauma Critical Care (Adult)	0.6288	0.0835	<0.0001
CDC Location Code: Specialty Care Areas *Inpatient Dialysis* *Solid Organ Transplant (adult)* *Solid Organ Transplant (pediatric)*	0.3817	0.1303	0.0034

Table 1, continued. CLABSI in Acute Care Hospitals (non-NICU locations)

Parameter	Parameter Estimate	Standard Error	P-value
CDC Location Code: Step-down Units *Adult Step-down Unit* *Oncology Step-down Unit* *Pediatric Step-down Unit* *Step-down Neonatal Nursery (Level II)*	0.2155	0.0521	<0.0001
CDC Location Code: Select Adult Wards *Medical Ward* *Medical/Surgical Ward* *Neurology Ward* *Neurosurgical Ward* *Surgical Ward* *Telemetry Ward*	0.1797	0.0427	<0.0001
CDC Location Code: Oncology Wards *ONC General Hematology/Oncology Ward* *ONC Pediatric General Hematology/Oncology Ward* *ONC Leukemia Ward* *ONC Leukemia/Lymphoma Ward* *ONC Lymphoma Ward* *ONC Solid Tumor Ward*	0.3762	0.0550	<0.0001
CDC Location Code: Oncology Stem Cell Transplant Wards *ONC Hematopoietic Stem Cell Transplant Ward (adult)* *ONC Pediatric Hematopoietic Stem Cell Transplant Ward*	0.7041	0.0816	<0.0001
CDC Location Code: Pediatric Wards & Nurseries *Pediatric Behavioral Health Ward* *Pediatric Burn Ward* *Pediatric Medical Ward* *Pediatric Medical/Surgical Ward* *Pediatric Neurosurgical Ward* *Well Baby Nursery (Level I)* *Pediatric Neurology Ward* *Pediatric Orthopedic Ward* *Pediatric Rehabilitation Ward (non-CMS)* *Pediatric Surgical Ward*	0.1911	0.0704	0.0067
CDC Location Code: All Other Wards *Adult Mixed Acuity* *Mixed Age Mixed Acuity* *Pediatric Mixed Acuity* *Oncology Mixed Acuity* *Antenatal Care Ward* *Burn Ward* *Behavioral Health/Psych Ward* *Adolescent Behavioral Health Ward* *Ear/Nose/Throat Ward* *Gastrointestinal Ward* *Gerontology Ward* *Genitourinary Ward*	REFERENT	-	-

Table 1, continued. CLABSI in Acute Care Hospitals (non-NICU locations)

Parameter	Parameter Estimate	Standard Error	P-value
Gynecology Ward *Jail Unit* *Labor and Delivery Ward* *Labor, Delivery, Recovery, Postpartum Suite (LDRP)* *Orthopedic Ward* *Plastic Surgery Ward* *Postpartum Ward* *Pulmonary Ward* *Rehabilitation Ward (non-CMS)* *Stroke (Acute) Ward* *Orthopedic Trauma Ward* *Vascular Surgery Ward* *Chronic Care Unit* *Chronic Behavioral Health/Psychiatric Unit* *Inpatient Hospice* *Chronic Ventilator Dependent* *Chronic Rehabilitation Unit*	REFERENT *(continued from previous page)*	-	-
Facility bed size*: ≥ 224 beds	0.2567	0.0471	<0.0001
Facility bed size*: 94 - 223 beds	0.1155	0.0493	0.0192
Facility bed size*: ≤ 93 beds	REFERENT	-	-
Medical school affiliation*: Major	0.2625	0.0211	<0.0001
Medical school affiliation*: Graduate	0.1492	0.0244	<0.0001
Medical school affiliation*:Undergraduate/Non-teaching	REFERENT	-	-
Facility type: (based on NHSN enrollment) *Children's* *Military* *Veterans' Affairs* *Women's* *Women's and Children's*	0.1432	0.0526	0.0065
Facility type: (based on NHSN enrollment) *General Acute Care* *Oncology* *Orthopedic* *Psychiatric* *Surgical*	REFERENT	-	-

***** Facility bed size and medical school affiliation are taken from the Annual Hospital Survey.

Table 2. CLABSI in Acute Care Hospitals (NICU locations)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-7.2573*	*0.0553*	*<0.0001*
Birthweight A: ≤ 750 grams	1.2780	0.0745	<0.0001
Birthweight B: 751-1000 grams	0.9780	0.0791	<0.0001
Birthweight C: 1001-1500 grams	0.4579	0.0843	<0.0001
Birthweight D & E: 1501-2500 grams and > 2500 grams	REFERENT	-	-

Table 3. CLABSI in Critical Access Hospitals (CAHs)

Parameter	Parameter Estimate	Standard Error	P-value
*Intercept**	*-8.2066*	*0.1967*	*<0.0001*

***** None of the variables investigated were statistically significantly associated with CLABSIs in CAHs. The predicted number of CLABSI events for CAHs is calculated using the 2015 national CAH CLABSI pooled mean (i.e., intercept-only model).

Table 4. CLABSI in Long-Term Acute Care Hospitals (LTACHs)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-7.8328*	*0.1307*	*<0.0001*
Location Type: ICU	0.6716	0.1031	<0.0001
Location Type: Ward	REFERENT	-	-
Facility bed size*: ≥ 45 beds	0.2819	0.0686	<0.0001
Facility bed size*: < 45 beds	REFERENT	-	-
Average length of stay*: ≥ 28 days	0.1481	0.0708	0.0365
Average length of stay*: < 28 days	REFERENT	-	-
Proportion of admissions on a ventilator*: ≥ 0.328	0.3907	0.0971	<0.0001
Proportion of admissions on a ventilator*: ≥ 0.125 and < 0.328	0.2127	0.0859	0.0133
Proportion of admissions on a ventilator*: < 0.125	REFERENT	-	-
Proportion of admissions on hemodialysis*: ≥ 0.138	0.5785	0.1341	<0.0001
Proportion of admissions on hemodialysis*: ≥ 0.008 and < 0.138	0.5090	0.1296	<0.0001
Proportion of admissions on hemodialysis*: < 0.008	REFERENT	-	-

* Facility bed size, average length of stay, and admission proportions are taken from the Annual LTACH Survey. Average length of stay is calculated as: total # of annual patient days / total # of annual admissions.

Table 5. CLABSI in Inpatient Rehabilitation Facilities (IRFs): Free-standing Rehabilitation Hospitals and CMS-Certified IRF Units Within a Hospital

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-8.6717*	*0.3579*	*<0.001*
Proportion of admissions with stroke*: ≥ 0.135	0.7707	0.3222	0.0168
Proportion of admissions with stroke*: < 0.135	REFERENT	-	-
Proportion of admissions in other non-specific diagnostic categories*: ≥ 0.197	0.4452	0.2051	0.0300
Proportion of admissions in other non-specific diagnostic categories*: < 0.197	REFERENT	-	-

***** Admission proportions are taken from the Annual IRF Survey. "Other non-specific diagnostic categories" include all other primary diagnoses not listed specifically on the Annual IRF Survey.

Risk Adjustment Factors Included in the SIR Calculation: 2015 Baseline

MBI-LCBI – Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection

The number of predicted MBI-LCBIs is calculated using a negative binomial regression model (see page 8 above for more information) and is only available for acute care hospitals. Only CLABSI events reported to NHSN as mucosal barrier injury (MBI-LCBI) are included in the numerator of the MBI-LCBI SIR. In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN.

**Note:* The variables included in the MBI risk adjustment model for acute care hospitals are shown below. The MBI-LCBI SIR is not submitted to CMS under the Hospital Inpatient Quality Reporting Program. Full model details including parameter estimates will be available in a separate publication.*

The number of predicted MBI-LCBI events calculated under the 2015 baseline is risk adjusted based on the following variables found to be statistically significant predictors:

Table 1. MBI-LCBI in Acute Care Hospitals

Facility Type	Risk Factors
Acute Care Hospitals	• CDC Location • Facility bed size* • Medical school affiliation*

* Facility bed size and medical school affiliation are taken from the Annual Hospital Survey.

Risk Adjustment Factors Included in the SIR Calculation: 2015 Baseline

CAUTI – Catheter-Associated Urinary Tract Infection

The number of predicted CAUTIs is calculated using a negative binomial regression model (see page 8 above for more information). Previously excluded inpatient locations from the original baseline are included in the SIR under the 2015 baseline (e.g., Telemetry Ward, Mixed Acuity Ward). In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN.

The number of predicted CAUTIs calculated under the 2015 baseline is risk adjusted based on the following variables found to be statistically significant predictors (*risk adjustment updated July 2017)*:

Table 1. CAUTI in Acute Care Hospitals

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-10.2667*	*0.1618*	*<0.0001*
CDC Location Code: Burn Critical Care	3.3318	0.1580	<0.0001
CDC Location Code: Cardiac Critical Care	2.5703	0.1301	<0.0001
CDC Location Code: Medical Critical Care	2.3834	0.1250	<0.0001
CDC Location Code: Neurologic Critical Care and Neurosurgical Critical Care	3.3675	0.1285	<0.0001
CDC Location Code: Surgical Critical Care	2.7034	0.1270	<0.0001
CDC Location Code: Trauma Critical Care	3.1104	0.1344	<0.0001
CDC Location Code: Other Critical Care *Surgical Cardiothoracic Critical Care* *Medical/Surgical Critical Care* *Prenatal Critical Care* *Respiratory Critical Care*	2.3661	0.1214	<0.0001
CDC Location Code: Oncology Critical Care/Step-down *Oncology Medical Critical Care* *Oncology Medical/Surgical Critical Care* *Surgical Oncology Critical Care* *Pediatric Oncology Critical Care* *Oncology Mixed Acuity Unit* *Oncology Step-Down Unit*	2.2171	0.2239	<0.0001
CDC Location Code: Pediatric Cardiothoracic Critical Care	2.0965	0.2322	<0.0001
CDC Location Code: Other Pediatric Critical Care *Pediatric Burn Critical Care* *Pediatric Medical/Surgical Critical Care* *Pediatric Medical Critical Care* *Pediatric Neurosurgical Critical Care* *Pediatric Surgical Critical Care* *Pediatric Trauma Critical Care*	2.6419	0.1461	<0.0001
CDC Location Code: Mixed Acuity *Adult Mixed Acuity Unit* *Pediatric Mixed Acuity Unit* *Mixed Age Mixed Acuity Unit*	2.3378	0.1416	<0.0001
CDC Location Code: Adult Step-down Unit	2.4800	0.1235	<0.0001

Table 1, continued. CAUTI in Acute Care Hospitals

Parameter	Parameter Estimate	Standard Error	P-value
CDC Location Code: Pediatric Step-down Unit *Neonatal Step-down Nursery (Level II)* *Pediatric Step-down Unit*	2.3616	0.5351	<0.0001
CDC Location Code: Solid Organ Transplant *Solid Organ Transplant SCA* *Pediatric Solid Organ Transplant SCA*	2.3900	0.1979	<0.0001
CDC Location Code: Adult Burn Ward	2.4564	0.3396	<0.0001
CDC Location Code: Behavioral/Psychiatric Ward	3.2503	0.2207	<0.0001
CDC Location Code: Pulmonary Ward	2.5024	0.1664	<0.0001
CDC Location Code: Rehabilitation Ward (non-CMS)	3.3578	0.2700	<0.0001
CDC Location Code: Neurology and Stroke *Neurologic Ward* *Neurosurgical Ward* *Stroke Ward*	2.8223	0.1314	<0.0001
CDC Location Code: Orthopedic Ward *Orthopedic Ward* *Orthopedic Trauma Ward*	1.9992	0.1300	<0.0001
CDC Location Code: Other Wards *Inpatient Dialysis SCA* *Gerontology Ward* *Jail Unit* *Medical Ward* *Telemetry Ward*	2.3576	0.1216	<0.0001
CDC Location Code: Other Wards *Ear, Nose, Throat Ward* *Gastroenterology Ward* *Genitourinary Ward* *Medical/Surgical Ward* *Plastic Surgery Ward* *Surgical Ward* *Vascular Surgery Ward*	2.2532	0.1210	<0.0001
CDC Location Code: Hematology *General Hematology/Oncology Ward* *Hematopoietic Stem Cell Transplant Ward*	2.6125	0.1315	<0.0001
CDC Location Code: Pediatric Oncology *Pediatric Hematology/Oncology Ward* *Pediatric Hematopoietic Stem Cell Transplant Ward*	2.7077	0.2915	<0.0001
CDC Location Code: Adult Oncology Wards *Leukemia Ward* *Lymphoma Ward* *Leukemia/Lymphoma Ward* *Solid Tumor Ward*	2.2253	0.2001	<0.0001
CDC Location Code: Pediatric Wards *Adolescent Behavioral Ward* *Pediatric Behavioral Ward* *Pediatric Burn Ward* *Pediatric Medical/Surgical Ward*	1.8899	0.1712	<0.0001

Table 1, continued. CAUTI in Acute Care Hospitals

Parameter	Parameter Estimate	Standard Error	P-value
Pediatric Medical Ward *Pediatric Neurosurgical Ward* *Pediatric Neurologic Ward* *Pediatric Orthopedic Ward* *Pediatric Rehabilitation Ward (non-IRF)* *Pediatric Surgical Ward* *Well-baby Nursery*	*See above*	*See above*	*See above*
CDC Location Code: Chronic Care *Chronic Care Unit* *Chronic Behavioral Health/Psychiatric Unit* *Chronic Rehabilitation Unit* *Inpatient Hospice* *Ventilator Dependent Unit*	2.7695	0.1855	<0.0001
CDC Location Code: Labor and Delivery, Gynecology *Antenatal Ward* *Gynecology Ward* *Labor and Delivery Ward* *Labor, Delivery, Postpartum Ward* *Postpartum Ward*	REFERENT	-	-
Medical school affiliation*: Major	0.3744	0.0195	<0.0001
Medical school affiliation*: Graduate	0.1313	0.0220	<0.0001
Medical school affiliation*:Undergraduate/Non-teaching	REFERENT	-	-
Facility bed size*: ≥ 215 beds	0.4901	0.0429	<0.0001
Facility bed size*: 87-214 beds	0.2871	0.0445	<0.0001
Facility bed size*: ≤ 86 beds	REFERENT	-	-
Facility type: (based on NHSN enrollment) *General Acute Care Hospital* *Military Hospital* *Psychiatric Hospital* *Oncology Hospital* *Veterans' Affairs Hospital*	0.3927	0.1069	0.0002
Facility type: Children's Hospital	0.4888	0.1556	0.0017
Facility type: (based on NHSN enrollment) *Orthopedic Hospital* *Surgical Hospital* *Women's Hospital* *Women's and Children's Hospital*	REFERENT	-	-

* Medical school affiliation and facility bed size are taken from the Annual Hospital Survey.

Table 2. CAUTI in Critical Access Hospitals (CAHs)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-7.3337*	*0.0970*	*<0.0001*
Medical school affiliation*: Undergraduate	1.3191	0.4744	0.0054
Medical school affiliation*:Major/Graduate/Non-teaching	REFERENT	-	-

***** Medical school affiliation is taken from the Annual Hospital Survey.

Table 3. CAUTI in Long-Term Acute Care Hospitals (LTACHs)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-6.8683*	*0.0773*	*<0.0001*
Average length of stay*: ≥ 29.33 days	0.5379	0.0837	<0.0001
Average length of stay*: 26.42 – 29.32 days	0.2779	0.0876	0.0015
Average length of stay*: ≤ 26.41 days	REFERENT	-	-
Setting**: Freestanding	0.1700	0.0716	0.0176
Setting**: Within a Hospital	REFERENT	-	-
Location Type: ICU	0.3153	0.1072	0.0033
Location Type: Ward	REFERENT	-	-

* Average length of stay is taken from the Annual LTACH Survey. It is calculated as: total # of annual patient days / total # of annual admissions.

** LTACH Setting (free-standing vs. within a hospital) is taken from the Annual LTACH Survey.

Table 4. CAUTI in Inpatient Rehabilitation Facilities (IRFs): Free-standing Rehabilitation Hospitals and CMS-Certified IRF Units Within a Hospital

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-6.8305*	*0.0848*	*<0.0001*
Setting*: Within a Hospital	0.2897	0.0841	0.0006
Setting*: Freestanding	REFERENT	-	-
Proportion of admissions with traumatic and non-traumatic spinal cord dysfunction**: ≥ 0.05	0.3603	0.0832	<0.0001
Proportion of admissions with traumatic and non-traumatic spinal cord dysfunction**: < 0.05	REFERENT	-	-
Proportion of admissions with stroke**: ≥ 0.24	0.2750	0.0798	0.0006
Proportion of admissions with stroke**: < 0.24	REFERENT	-	-

* IRF Setting is taken from the Annual IRF Survey and NHSN enrollment/location mapping data. "Within a hospital" includes CMS-certified IRF units mapped as locations within a hospital, as well as Rehabilitation hospitals enrolled as unique facilities in NHSN in which the facility indicated "healthcare facility-based" on their annual IRF survey.

** Proportion of annual admissions with primary diagnoses are taken from the Annual IRF Survey and are calculated as: # of admissions with the primary diagnosis (stroke, or traumatic/non-traumatic spinal cord dysfunction) / total # of annual admissions.

Risk Adjustment Factors Included in the SIR Calculation: 2015 Baseline

VAE – Ventilator-Associated Events

A. Total VAE

The number of predicted VAE events is calculated using a negative binomial regression model (see page 8 above for more information). Separate VAE SIRs are available for "Total VAE" and "IVAC Plus". The "Total VAE" SIR includes events identified as ventilator-associated condition (VAC), infection-related ventilator-associated complication (IVAC), and possible ventilator-associated pneumonia (pVAP). In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN.

Note: Parameter estimates are shown only for Long-Term Acute Care Hospitals (LTACHs), which are required to report VAE data under the CMS Long Term Care Hospital Quality Reporting Program. Total VAE and IVAC Plus model details for additional facility types will be available in a separate publication.

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:

Table 1. Total VAE in Long-Term Acute Care Hospitals (LTACHs)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-8.3689*	*0.3361*	*<0.0001*
Facility bed size†: ≥ 32 beds	0.4645	0.1562	0.0030
Facility bed size†: < 32 beds	REFERENT	-	-
Proportion of admissions on hemodialysis*: > 0.11	-0.4098	0.1190	0.0006
Proportion of admissions on hemodialysis*: ≤ 0.11	REFERENT	-	-
Proportion of admissions on ventilator*: > 0.18	0.9313	0.1813	<0.0001
Proportion of admissions on ventilator*: ≤ 0.18	REFERENT	-	-
Location type: ICU	0.4118	0.1598	0.0099
Location type: Ward	REFERENT	-	-
Average length of stay**: ≥ 25 days	1.0940	0.2602	<0.0001
Average length of stay**: < 25 days	REFERENT	-	-

† Facility bed size is taken from the Annual LTACH Survey.
* Proportion of annual admissions on a ventilator (or hemodialysis) is taken from the Annual LTACH Survey. It is calculated as: number of admissions on a ventilator (or hemodialysis) / total # of annual admissions.
**Average length of stay is taken from the Annual LTACH Survey. It is calculated as: # annual patient days/ # annual admissions.

Table 2. Summary of Risk Factors in the Total VAE Model for Other Facility Types

Facility Type	Risk Factors
Acute Care Hospitals	• CDC Location Code • Medical school affiliation† and facility bed size† • Facility type
Critical Access Hospitals (CAH)	Intercept-only model*
Inpatient Rehabilitation Facilities (IRF)	No SIR available^

Table 2 footnotes:

† Medical school affiliation and facility bed size are taken from the Annual Hospital Survey.

***** None of the variables investigated were statistically significantly associated with Total VAE in CAHs. These facilities will have the predicted number of events calculated using the 2015 national pooled mean (i.e., intercept-only model).

^ Insufficient data were reported to NHSN. Therefore, SIRs are not available for Total VAE in IRFs.

B. Infection-related Ventilator-Associated Complication (IVAC) Plus

The number of predicted VAE events is calculated using a negative binomial regression model (see page 8 above for more information). Separate VAE SIRs are available for "Total VAE" and "IVAC Plus". The "IVAC Plus" SIR includes events identified as IVAC and possible ventilator-associated pneumonia (pVAP). In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN.

Note: Parameter estimates are shown only for Long-Term Acute Care Hospitals (LTACHs), which are required to report VAE data under the CMS Long Term Care Hospital Quality Reporting Program. Total VAE and IVAC Plus model details for additional facility types will be available in a separate publication.

The number of predicted "IVAC Plus" events calculated under the 2015 baseline is risk adjusted based on the following variables found to be statistically significant predictors of "IVAC Plus" incidence:

Table 1. IVAC Plus in Long-Term Acute Care Hospitals

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-9.9593*	*0.5891*	*< 0.0001*
Facility bed size†: ≥ 32 beds	1.1201	0.3633	0.0020
Facility bed size†: < 32 beds	REFERENT	-	-
Proportion of admissions on a ventilator*: > 0.18	0.7130	0.3151	0.0236
Proportion of admissions on a ventilator*: ≤ 0.18	REFERENT	-	-
Average length of stay**: ≥ 25 days	0.8166	0.4157	0.0495
Average length of stay**: < 25 days	REFERENT	-	-

† Facility bed size is taken from the Annual LTACH Survey.

***** Proportion of annual admissions on a ventilator is taken from the Annual LTACH Survey. It is calculated as: number of admissions on a ventilator / total # of annual admissions.

** Average length of stay is taken from the Annual LTACH Survey. It is calculated as: total # of annual patient days / total # of annual admissions.

Table 2. Summary of Risk Factors in the IVAC Plus Model for Other Facility Types

Facility Type	Risk Factors
Acute Care Hospitals	• CDC Location Code • Medical school affiliation† • Facility bed size†
Critical Access Hospitals (CAH)	No SIR Available^
Inpatient Rehabilitation Facilities (IRF)	No SIR Available^

† Medical school affiliation and facility bed size are taken from the Annual Hospital Survey.

^ Insufficient data were reported to NHSN. Therefore, SIRs are not available for 'IVAC Plus' in CAHs or IRFs.

Risk Adjustment Factors Included in the SIR Calculation: 2015 Baseline

SSI – Surgical Site Infections

The number of predicted SSI events is calculated using a logistic regression model (see page 5 above for more information). The SSI SIR is calculated for facilities who enroll in NHSN as acute care hospitals or critical access hospitals. Under the 2015 SIR baseline, procedures and associated SSI events occurring in adult and pediatric patients are modeled separately. There are three SSI SIR models available for inpatient adult procedures (and associated SSIs) and two models available for inpatient pediatric procedures (and associated SSIs). Please see *Table 1* below for a summary of the SSI SIR models. Under the 2015 SIR baseline, procedures, regardless of closure methods, are included in the SIR calculation, as long as the inclusion criteria listed below are met and none of the exclusion criteria apply.

Table 1. Summary of SSI Models

SSI SIR Model	Inclusion Criteria	Patient Population
All SSI SIR Model	• Includes only inpatient procedures • Includes Superficial, Deep & Organ/Space SSIs • Superficial & Deep Incisional SSIs limited to primary incisional SSIs only • Includes SSIs identified on admission, readmission & via post-discharge surveillance	• Procedures in adult patients • Procedures in pediatric patients
Complex Admission/Readmission (A/R) SSI Model	• Includes only inpatient procedures • Includes only Deep Incisional Primary SSIs & Organ/Space SSIs • Includes only SSIs identified on Admission/Readmission to facility where procedure was performed • Used for the annual CDC publication of national benchmarks	• Procedures in adult patients • Procedures in pediatric patients
Complex 30-Day SSI model (used for CMS IPPS)	• Includes only in-plan, inpatient COLO and HYST procedures in adult patients (i.e., ≥ 18 years of age) • Includes only Deep Incisional Primary SSIs and Organ/Space SSIs with an event date within 30 days of the procedure • Includes SSIs regardless of detection method • Used only for CMS IPPS reporting and for public reporting on Hospital Compare	• Procedures in adult patients

Exclusion Criteria

In addition to the above inclusion criteria, there is also a list of exclusion criteria that applies to all the SSI SIR models. This list is often referred to as the universal exclusion criteria. The list of exclusion criteria applies to both procedures and the associated SSI events. Often the reason for excluding procedures and SSI events from the SIR calculation is due to potential data quality issues. It is important that facilities review their data for quality assurance and to determine the reason for exclusion from the SIR calculation.

Note: When a procedure is excluded from the denominator, the associated SSI event is excluded from the numerator.

Table 2. Universal Procedure/SSI Event Exclusions

General Exclusions
Gender= 'Other'
Outpatient procedures and resulting SSIs
Present at time of surgery (PATOS) is 'Yes'
SSIs that are reported as superficial incisional secondary (SIS) or deep incisional secondary (DIS)
Exclusions due to potential data quality issues or outliers
Age at the time of procedure is greater than 109 years
Closure technique is missing
ASA score is missing
Gender is missing
Adult patients ≥ 18 years: if BMI is less than 12 or greater than 60*
Pediatric patients < 18 years: if BMI less than 10.49 or greater than 65.79**
Procedure duration less than 5 minutes
Procedure duration is greater than IQR5 *(please see Table 4 in the SSI Section for more information)*
Facility-level Exclusions
Data from ambulatory surgery centers (ASCs) and long-term acute care hospitals (LTACHs)
Medical affiliation is missing or medical affiliation is 'Y' and medical type is missing (*from Annual Facility Survey*)
Number of beds is missing (*from Annual Facility Survey*)

*This BMI exclusion applies to all procedures on adult patients in all 3 SSI models (All SSI, Complex A/R, Complex 30-Day).
**This BMI exclusion applies to all procedures on pediatric patients, in both applicable SSI models (All SSI and Complex A/R). CDC Growth Charts are used to assess BMI in pediatric patients, calculated using height, weight, age, and gender.
Additional clarification on the BMI exclusion rule for pediatric procedures: Although there are BMI thresholds for procedures performed on pediatric patients (10.49-65.79), there is an additional level of consideration made for the biological plausibility of a given BMI using the patient's age and gender. After applying the BMI outlier exclusion rule, we review the BMIs for the remaining pediatric procedures to determine if they are biologically plausible based on the patient's age and gender. So essentially, we take age and gender into consideration along with the calculated BMI. Only procedures in which the patient's BMI meets the inclusion rule (10.49-65.79), **and** in which the patient's BMI is biologically plausible based on age and gender, are included in the SIR. The determination of biologically plausible BMIs is made using the macro available at this site: https://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm.

Predictive Risk Factors by SSI Models

The number of predicted events calculated under the 2015 baseline for SSI is risk adjusted based on the following variables found to be statistically significant predictors of SSIs. The following tables (*3a-3f*) list the factors included in each procedure-specific model, grouped by the three SSI models outlined above. In some procedure-specific models, the interaction of age and gender is considered as a single factor. It is listed as age-gender interaction. In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN.

Note: Parameter estimates are shown for colon (COLO) and abdominal hysterectomy (HYST) procedures under the Complex 30-Day Model used for CMS Hospital Inpatient Quality Reporting Program. Full model details for all procedures under the All SSI Model and the Complex A/R Model will be available in future resources.

Table 3a. Colon Procedures, Complex 30-Day Model

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-3.6601*	*0.0678*	*<0.0001*
Diabetes: Yes	0.0821	0.0303	0.0066
Diabetes: No	REFERENT	-	-
ASA score: 1, 2, 3/4/5	0.3028	0.0237	<0.0001
Gender: Male	0.1036	0.0225	<0.0001
Gender: Female	REFERENT	-	-
Age (Patient's age/10)	-0.1396	0.0075	<0.0001
BMI: ≥ 30	0.1259	0.0234	<0.0001
BMI: < 30	REFERENT	-	-
Closure technique: Other (non-Primary)	0.2383	0.0494	<0.0001
Closure technique: Primary	REFERENT	-	-
Oncology Hospital: Yes	0.5437	0.0937	<0.0001
Oncology Hospital: No	REFERENT	-	-

Table 3b. Abdominal Hysterectomy Procedures, Complex 30-Day Model

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-5.1801*	*0.1057*	*< 0.0001*
Diabetes: Yes	0.3247	0.0605	<0.0001
Diabetes: No	REFERENT	-	-
ASA score: 1, 2, 3, 4/5	0.4414	0.0350	<0.0001
BMI: ≥ 30	0.1106	0.0423	0.0090
BMI: < 30	REFERENT	-	-
Age (Patient's age/10)	-0.1501	0.0180	<0.0001
Oncology Hospital: Yes	0.5474	0.1578	0.0005
Oncology Hospital: No	REFERENT	-	-

Table 3c. Predictive Risk Factors from the All SSI Logistic Regression Model, Adults ≥ 18 years of age

NHSN Operative Procedure	Risk Factor(s)-All SSI Model, Adults
AAA	procedure duration
AMP	anesthesia, wound class, hospital bed size*, age, procedure duration
APPY	gender, wound class, hospital bed size*, closure, procedure duration, BMI
AVSD	procedure duration
BILI	gender, emergency, trauma, wound class, hospital bed size*, scope, age, procedure duration
BRST	ASA score, age , procedure duration, BMI
CARD	emergency, medical school affiliation*, age, procedure duration , BMI
CABG	gender, diabetes, trauma, medical school affiliation*, hospital bed size*, age, procedure duration, BMI, age-gender interaction

Table 3c, Continued

NHSN Operative Procedure	Risk Factor(s)-All SSI Model, Adults
CEA	diabetes, wound class
CHOL	diabetes, ASA score, wound class, scope, age, procedure duration
COLO	diabetes, trauma, anesthesia, ASA score, wound class, medical school affiliation*, hospital bed size*, scope, closure technique, age, procedure duration, BMI
CRAN	trauma, ASA score, age, procedure duration, BMI, wound class
CSEC	diabetes, emergency, anesthesia, ASA score, wound class, medical school affiliation*, hospital bed size*, age, procedure duration, BMI, duration of labor
FUSN	gender, diabetes, emergency, trauma, ASA score, hospital bed size*, procedure duration, BMI, spinal level, approach, medical school affiliation*
FX	gender, diabetes, ASA score, wound class, closure technique, age, procedure duration, BMI
GAST	ASA score, wound class, scope, age, procedure duration, BMI
HER	gender, ASA score, wound class, medical school affiliation*, hospital bed size*, scope, age, procedure duration, BMI
HPRO	diabetes, trauma, anesthesia, ASA score, wound class, hospital bed size*, age, procedure duration, BMI, procedure type
HTP	closure technique
HYST	diabetes, ASA score, medical school affiliation*, hospital bed size*, scope, age, procedure duration, BMI, oncology
KPRO	gender, anesthesia, ASA score, wound class, medical school affiliation*, age, procedure duration, BMI, procedure type
KTP	wound class, age, procedure duration
LAM	diabetes, ASA score, hospital bed size*, BMI, age
LTP	age
NECK	procedure duration
NEPH	oncology
OVRY	age, BMI, diabetes, medical school affiliation*, scope, wound class
PACE	age
PRST	medical school affiliation*, number of beds
PVBY	BMI, diabetes, procedure duration, medical school affiliation*, wound class
REC	ASA score, anesthesia, procedure duration, gender
RFUSN	age, BMI, procedure duration, hospital bed size*
SB	ASA score, emergency, trauma, medical school affiliation*, oncology
SPLE	ASA score
THOR	ASA score, procedure duration, oncology
THYR	*Intercept-only model*‡
VHYS	ASA score, medical school affiliation*, age, procedure duration, BMI
VSHN	age
XLAP	anesthesia, ASA score, procedure duration, emergency, gender, oncology, scope

Table 3c Footnotes:

* These risk factors are taken from the Annual Facility Survey.

‡ None of the variables investigated were statistically significantly associated with SSI risk in these procedure categories. As a result, the overall pooled mean will be used in the SIR calculation (i.e., intercept-only model).

Table 3d. Predictive Risk Factors from the Complex A/R SSI Logistic Regression, Adults ≥ 18 years of age

NHSN Operative Procedure	Risk Factor(s) - Complex A/R SSI Model, Adults
AAA	*Intercept-only model‡*
AMP	anesthesia, wound class, hospital bed size*, age
APPY	gender, wound class, hospital bed size*, procedure duration
AVSD	*Intercept-only model‡*
BILI	gender, emergency, trauma, hospital bed size*, scope, age, procedure duration
BRST	ASA score, closure technique, age, duration, BMI
CARD	emergency, medical school affiliation*, age, procedure duration, BMI
CABG	gender, diabetes, ASA score, trauma, wound class, medical school affiliation*, hospital bed size*, age, procedure duration, BMI, age-gender interaction
CEA	wound class
CHOL	gender, diabetes, ASA score, wound class, hospital bed size*, age, procedure duration, age-gender interaction
COLO	gender, diabetes, trauma, anesthesia, ASA score, wound class, hospital bed size*, scope, closure technique, age, procedure duration, BMI
CRAN	diabetes, trauma, ASA score, age, duration, wound class
CSEC	emergency, ASA score, wound class, medical school affiliation*, hospital bed size*, age, procedure duration, duration of labor
FUSN	gender, diabetes, trauma, ASA score, medical school affiliation*, hospital bed size*, procedure duration, BMI, spinal level, approach
FX	gender, diabetes, ASA, wound class, closure, age, procedure duration, BMI
GAST	wound class, scope, age, procedure duration, BMI
HER	gender, ASA score, wound class, medical school affiliation*, hospital bed size*, scope, age, procedure duration, BMI
HPRO	diabetes, trauma, anesthesia, ASA score, wound class, medical school affiliation*, hospital bed size*, age, procedure duration, BMI, procedure type
HTP	Closure technique
HYST	diabetes, ASA score, hospital bed size*, scope, age, procedure duration, BMI
KPRO	gender, trauma, anesthesia, ASA score, wound class, medical school affiliation*, hospital bed size*, age, procedure duration, BMI, procedure type
KTP	procedure duration, diabetes, ASA score, hospital bed size*, BMI
LAM	diabetes, ASA score, hospital bed size*, BMI
LTP	age
NECK	procedure duration
NEPH	*Intercept-only model‡*
OVRY	wound class
PACE	age
PRST	*Intercept-only model‡*

Table 3d, Continued

NHSN Operative Procedure	Risk Factor(s) - Complex A/R SSI Model, Adults
PVBY	BMI, diabetes, procedure duration, number of beds
REC	ASA score, procedure duration, number of beds, oncology
RFUSN	age, procedure duration, number of beds
SB	gender, age, procedure duration, oncology
SPLE	ASA score
THOR	procedure duration, medical school affiliation*
THYR	*Intercept-only model*‡
VHYS	medical school affiliation*
VSHN	age
XLAP	ASA score, closure technique, diabetes, procedure duration, emergency, gender, scope, wound class, trauma

* These risk factors are taken from the Annual Facility Survey.

‡ None of the variables investigated were statistically significantly associated with SSI risk in these procedure categories. As a result, the overall pooled mean will be used in the SIR calculation (i.e., intercept-only model).

Table 3e. Predictive Risk Factors from the All SSI Logistic Regression Model, Pediatrics < 18 years of age

NHSN Operative Procedure	Risk Factor(s) - All SSI SIR Model, Pediatrics
AAA	*Intercept-only model*‡
AMP	*No SIR available*^
APPY	emergency, wound class, age, procedure duration
AVSD	*No SIR available*^
BILI	trauma
BRST	*No SIR available*^
CARD, age ≥ 2	ASA score, BMI, age, diabetes, scope
CARD, age < 2	emergency, medical school affiliation*, procedure duration
CABG	*No SIR available*^
CEA	*No SIR available*^
CHOL	*Intercept-only model*‡
COLO	ASA score, medical school affiliation*, age, procedure duration, closure technique, wound class
CRAN	*Intercept-only model*‡
CSEC	duration of labor
FUSN, age ≥ 2	ASA score, age, BMI, spinal level
FUSN, age < 2	*No SIR available*^
FX	procedure duration, closure technique
GAST	*Intercept-only model*‡
HER	*Intercept-only model*‡
HPRO	*Intercept-only model*‡
HTP	*No SIR available*^
HYST	hospital bed size*, procedure duration

Table 3e, Continued

NHSN Operative Procedure	Risk Factor(s) - All SSI SIR Model, Pediatrics
KPRO	*Intercept-only model*‡
KTP	*Intercept-only model*‡
LAM	age, procedure duration
LTP	*Intercept-only model*‡
NECK	*No SIR available*^
NEPH	*No SIR available*^
OVRY	*Intercept-only model*‡
PACE	*Intercept-only model*‡
PRST	*No SIR available*^
PVBY	*No SIR available*^
REC	*Intercept-only model*‡
RFUSN	*Intercept-only model*‡
SB, age ≥ 2	BMI
SB, age < 2	scope, wound class
SPLE	*Intercept-only model*‡
THOR	age, trauma
THYR	*No SIR available*^
VHYS	*No SIR available*^
VSHN	*Intercept-only model*‡
XLAP	*Intercept-only model*‡

***** These risk factors are taken from the Annual Facility Survey.
^ Insufficient data (i.e., < 50 procedures) were reported to NHSN. Therefore, SIRs are not available for these procedures.
‡ None of the variables investigated were statistically significantly associated with SSI risk in these procedure categories. As a result, the overall pooled mean will be used in the SIR calculation (i.e., intercept-only model).

Table 3f. Predictive Risk Factors from the Complex A/R SSI Logistic Regression, Pediatrics < 18 years of age

NHSN Operative Procedure	Risk Factor(s) - Complex A/R SSI Model, Pediatrics
AAA	*No SIR available*^
AMP	*No SIR available*^
APPY	hospital bed size*, procedure duration, wound class
AVSD	*No SIR available*^
BILI	trauma
BRST	*No SIR available*^
CARD	procedure duration, age
CABG	*No SIR available*^
CEA	*No SIR available*^
CHOL	*Intercept-only model*‡
COLO	Closure technique, wound class, age, trauma, procedure duration
CRAN, age ≥ 2	BMI, anesthesia

Table 3f, Continued

NHSN Operative Procedure	Risk Factor(s) - Complex A/R SSI Model, Pediatrics
CRAN, age < 2	*Intercept-only model*‡
CSEC	duration of labor
FUSN, age ≥ 2	ASA score, BMI
FUSN, age < 2	*No SIR available*^
FX	procedure duration, closure technique
GAST	*No SIR available*^
HER	*Intercept-only model*‡
HPRO	*Intercept-only model*‡
HTP	*No SIR available*^
HYST	*Intercept-only model*‡
KPRO	*Intercept-only model*‡
KTP	*Intercept-only model*‡
LAM	*Intercept-only model*‡
LTP	*Intercept-only model*‡
NECK	*No SIR available*^
NEPH	*No SIR available*^
OVRY	*No SIR available*^
PACE	*No SIR available*^
PRST	*No SIR available*^
PVBY	*No SIR available*^
REC	*Intercept-only model*‡
RFUSN	*Intercept-only model*‡
SB	diabetes, wound class
SPLE	*No SIR available*^
THOR	*trauma*
THYR	*No SIR available*^
VHYS	*No SIR available*^
VSHN	age
XLAP	trauma

* These risk factors are taken from the Annual Facility Survey.

^ Insufficient data (i.e., < 50 procedures) were reported to NHSN. Therefore, SIRs are not available for these procedures.

‡ None of the variables investigated were statistically significantly associated with SSI risk in these procedure categories. As a result, the overall pooled mean will be used in the SIR calculation (i.e., intercept-only model).

Procedure Duration Outliers

The **IQR5, also called the procedure duration cutoff point**, is used as an indicator of an extreme outlier for procedure durations when calculating the SSI SIRs. The IQR5 is calculated as five times the interquartile range (Q1-Q3) above the 75th percentile. For example, if the interquartile range is 30 minutes, and the 75th percentile is 100 minutes, the IQR5 would be calculated as: 100 + (30*5) = 250 minutes. Procedures with a duration greater than the IQR5 were excluded from the baseline data and will be excluded from all SSI SIR calculations for your facility.

Table 4. IQR5 Values, in Minutes, for NHSN Operative Procedures, Adult and Pediatric Patients

NHSN Operative Procedure	IQR5 (in minutes)	IQR5 (in hours and minutes)	
	Minutes	*Hours*	*Minutes*
AAA	1116	18	36
AMP	300	5	0
APPY	210	3	30
AVSD	471.5	7	51.5
BILI	1295	21	35
BRST	777	12	57
CARD	1001	16	41
CBGB	847	14	7
CBGC	847	14	7
CEA	376	6	16
CHOL	346	5	46
COLO	697	11	37
CRAN	904	15	4
CSEC	170	2	50
FUSN	874	14	34
FX	532	8	52
GAST	489	8	9
HER	521	8	41
HPRO	349	5	49
HTP	1355	22	35
HYST	547	9	7
KPRO	316	5	16
KTP	670	11	10
LAM	687	11	27
LTP	1243	20	43
NECK	1796	29	56
NEPH	774	12	54
OVRY	594	9	56
PACE	311	5	11
PRST	737	12	17
PVBY	850	14	10
REC	1136	18	56
RFUSN	1129	18	49
SB	856	14	16

NHSN Operative Procedure	IQR5 (in minutes)	IQR5 (in hours and minutes)	
	Minutes	*Hours*	*Minutes*
SPLE	1073	17	53
THOR	721	12	1
THYR	506	8	26
VHYS	506	8	26
VSHN	378	6	18
XLAP	724	12	4

Risk Adjustment Factors Included in the SIR Calculation: 2015 Baseline

Methicillin-resistant Staphylococcus aureus (MRSA) Bacteremia Laboratory-Identified Events

The number of predicted MRSA bacteremia LabID events is calculated using a negative binomial regression model (see page 8 above for more information). For most settings, the MRSA bacteremia SIR is only calculated on the facility-wide inpatient, or FacWideIN, level, and cannot be calculated for any individual location (*note: CMS-designated inpatient rehabilitation units within a hospital will receive a separate SIR).* In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN. The SIRs for MRSA bacteremia include only healthcare facility-onset (HO), non-duplicate MRSA blood LabID events in the numerator. Information on which events are counted in the numerator of the MRSA bacteremia SIR can be found here: http://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf.

The number of predicted events calculated under the 2015 baseline for MRSA bacteremia is risk adjusted based on the following variables found to be statistically significant predictors of MRSA bacteremia incidence:

Notes for Acute Care Hospitals: MRSA LabID SIRs for acute care hospitals can only be calculated at the quarter-level or higher. This is because two of the risk factors involving the community-onset prevalence rate require that all community-onset data have been entered for an entire quarter. The quarter's community-onset prevalence rates, both inpatient and outpatient, are used to calculate the number of predicted events for the SIR.

Table 1. MRSA Bacteremia in Acute Care Hospitals

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-11.3759*	*0.1167*	*<0.0001*
Inpatient community-onset prevalence rate*: > 0.037 per 100 admissions	0.3650	0.0286	<0.0001
Inpatient community-onset prevalence rate*: ≤ 0.037 per 100 admissions	REFERENT	-	-
Average length of stay**: ≥ 5.1 days	0.2787	0.0343	<0.0001
Average length of stay**: 4.3-5.0 days	0.0955	0.0341	0.0050
Average length of stay**: 0-4.2 days	REFERENT	-	-
Medical school affiliation‡: Major	0.2585	0.0334	<0.0001
Medical school affiliation‡: Graduate/undergraduate	0.1166	0.0345	0.0007
Medical school affiliation‡: Non-teaching	REFERENT	-	-
Facility type: Oncology Hospital *(HOSP-ONC)*	1.1894	0.2085	<0.0001
Facility type: General Acute Care Hospital *(HOSP-GEN)*	0.4355	0.0897	<0.0001
Facility type: Other Specialty Hospital	REFERENT	-	-
Number of ICU beds‡: ≥ 45	0.5650	0.0898	<0.0001
Number of ICU beds‡: 21-44	0.4599	0.0899	<0.0001
Number of ICU beds‡: 11-20	0.3394	0.0922	0.0002
Number of ICU beds‡: 7-10	0.4720	0.0993	<0.0001
Number of ICU beds‡: 0-6	REFERENT	-	-

Table 1, continued. MRSA Bacteremia in Acute Care Hospitals

Parameter	Parameter Estimate	Standard Error	P-value
Outpatient community-onset prevalence rate ED/24-hour Observation Unit^: > 0.032 per 100 encounters	0.3476	0.0336	<0.0001
Outpatient community-onset prevalence rate ED/24-hour Observation Unit^: > 0 and ≤ 0.032 per 100 encounters	0.1048	0.0330	0.0015
Outpatient community-onset prevalence rate ED/24-hour Observation Unit^: 0 per 100 encounters, or no applicable locations	REFERENT	-	-

* Inpatient community-onset prevalence is calculated as the # of inpatient community-onset MRSA blood events, divided by total admissions x 100. (i.e., MRSA_admPrevBldCount /numadms * 100).

** Average length of stay is taken from the Annual Hospital Survey. It is calculated as: total # of annual patient days / total # of annual admissions.

‡ Medical school affiliation and number of ICU beds are taken from the Annual Hospital Survey.

^ Emergency department (ED)/24-hour observation unit prevalence rate combines MRSA bacteremia data from all EDs and/or 24-hour observation units into a single, de-duplicated prevalence rate. This rate is calculated as the # of unique community-onset MRSA blood events that occurred in an ED or 24-hour observation unit / total encounters * 100. (i.e., MRSA_EDOBSprevCount / numTotencounters * 100). *NOTE: If you do not have an ED or 24-hour observation location that meets the NHSN location definition and thus are not reporting MRSA bacteremia data from these locations, the number of predicted events will be risk adjusted using the referent level of this variable.*

Table 2. MRSA Bacteremia in Critical Access Hospitals (CAHs)

Parameter	Parameter Estimate	Standard Error	P-value
*Intercept**	*-10.7795*	*0.2025*	*<0.0001*

* MRSA LabID SIRs for CAHs can be calculated for any aggregate of time (month, quarter, half-year, or year). None of the variables investigated were statistically significantly associated with healthcare facility-onset MRSA bacteremia in CAHs. The predicted number of events for CAHs will be calculated using the 2015 national CAH MRSA bacteremia pooled mean (i.e., intercept-only model).

Table 3. MRSA Bacteremia in Long-Term Acute Care Hospitals (LTACHs)

Parameter	Parameter Estimate	Standard Error	P-value
*Intercept**	*-9.3095*	*0.0936*	*<0.0001*
Percent of admissions on ventilator**	0.0160	0.0027	<0.0001

* MRSA LabID SIRs for LTACHs can be calculated for any aggregate of time (month, quarter, half-year, or year).

** Percent of annual admissions on a ventilator is taken from the Annual LTACH Survey. It is calculated as: # admissions on a ventilator / total # of annual admissions x 100 (i.e., numAdmvent /numAdmitsSurv * 100).

Table 4. MRSA Bacteremia in Inpatient Rehabilitation Hospitals (IRFs): Free-standing Rehabilitation Hospitals and CMS-Certified IRF Units Within a Hospital

Parameter	Parameter Estimate	Standard Error	P-value
*Intercept**	*-10.8703*	*0.0890*	*<0.0001*

* MRSA LabID SIRs for IRFs can be calculated for any aggregate of time (month, quarter, half-year, or year). None of the variables investigated were statistically significantly associated with healthcare facility-onset MRSA bacteremia in IRFs. Free-standing IRFs and CMS-certified IRF units within a hospital will have the predicted number of events calculated using the 2015 national IRF MRSA bacteremia pooled mean (i.e., intercept-only model).

Risk Adjustment Factors Included in the SIR Calculation: 2015 Baseline

Clostridium difficile (CDI) Laboratory-Identified Events

The number of predicted CDI LabID events is calculated using a negative binomial regression model (see page 8 above for more information). For most settings, the CDI SIR is only calculated on the facility-wide inpatient, or FacWideIN, level, and cannot be calculated for any individual location (*note: CMS-designated inpatient rehabilitation units within a hospital will receive a separate SIR).* In cases when the number of predicted events is less than 1.0, the SIR will not be calculated in NHSN. The SIRs for CDI include only incident, healthcare facility-onset (HO), non-duplicate *C. difficile* LabID events in the numerator. Information on which events are counted in the numerator of the CDI SIR can be found here: http://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf.

For all facility types, the CDI LabID SIR can only be calculated at the quarter-level or higher. Monthly SIRs cannot be calculated due to certain risk factors used in each of the models that require complete data entry for a quarter (e.g., CDI test type is reported on the FacWideIN MDRO denominator form on the 3rd month of each quarter).

The number of predicted events calculated under the 2015 baseline for CDI is risk adjusted based on the following variables found to be statistically significant predictors of CDI incidence:

Table 1. CDI in Acute Care Hospitals

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-8.9463*	*0.0523*	*<0.0001*
Inpatient community-onset prevalence rate*	0.7339	0.0181	<0.0001
CDI test type[+]: EIA	-0.1579	0.0246	<0.0001
CDI test type[+]: NAAT	0.1307	0.0219	<0.0001
CDI test type[+]: OTHER	REFERENT	-	-
Medical school affiliation[‡]: Major, graduate, or undergraduate	0.0331	0.0111	0.0028
Medical school affiliation[‡]: Non-teaching	REFERENT	-	-
Number of ICU beds[‡]: ≥ 43	0.7465	0.0412	<0.0001
Number of ICU beds[‡]: 20- 42	0.7145	0.0395	<0.0001
Number of ICU beds[‡]: 10-19	0.6261	0.0396	<0.0001
Number of ICU beds[‡]: 5-9	0.4394	0.0420	<0.0001
Number of ICU beds[‡]: 0-4	REFERENT	-	-
Facility type: Oncology Hospital (*HOSP-ONC)*	1.2420	0.0765	<0.0001
Facility type: General Acute Care Hospital *(HOSP-GEN)*	0.3740	0.0342	<0.0001
Facility type: Other Specialty Hospital	REFERENT	-	-
Facility bed size[‡]	0.0003	0.0000	<0.0001
Reporting from ED or 24-hour observation unit[^]: YES	0.1119	0.0179	<0.0001
Reporting from ED or 24-hour observation unit[^]: NO	REFERENT	-	-

* Inpatient community-onset (CO) prevalence is calculated as the # of inpatient CO CDI events, divided by total admissions x 100 (i.e., cdif_admPrevCOCount /numCdifadms * 100). The prevalence rate for an entire quarter is used in the risk

Table 1 Footnotes continued:

adjustment. An SIR cannot be calculated for any quarter that has an outlier inpatient CO prevalence rate, defined as greater than 2.6 CO events per 100 admissions.

[+] CDI test type is reported on the FacWideIN MDRO denominator form on the 3rd month of each quarter.

-Starting in 2018 Q1, CDI test type is categorized as:

Nucleic acid amplification test (NAAT): This includes NAAT, GDH + NAAT, and GDH + EIA + NAAT.
Enzyme immunoassay (EIA) for toxin: This includes EIA for toxin, GDH antigen + EIA for toxin, and **NAAT + EIA**
Other: This includes all other CDI test types, including the selection of "Other" and associated free-text entry.

-Prior to 2018 Q1, CDI test type was categorized as: (*refer to 2018 NHSN protocol changes for details*)

Nucleic acid amplification test (NAAT): This includes NAAT, GDH + NAAT, GDH + EIA + NAAT, and NAAT + EIA.
Enzyme immunoassay (EIA) for toxin: This includes EIA for toxin, and GDH antigen + EIA for toxin.
Other: This includes all other CDI test types, including the selection of "Other" and associated free-text entry.

[‡] Medical school affiliation, number of ICU beds, and facility bed size are taken from the Annual Hospital Survey.

^ If your facility has a designated Emergency Department (ED) or 24-hour observation location meeting the standard NHSN definitions, these locations should be mapped, included in your facility's monthly reporting plan for LabID events, and have appropriate outpatient LabID data reported to NHSN. If you do not have an ED or 24-hour observation location and thus are not reporting CDI data from these locations, your hospital's # predicted events will be risk adjusted using the referent value for this variable.

Table 2. CDI in Critical Access Hospitals (CAHs)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-8.4180*	*0.0879*	*<0.0001*
Inpatient community-onset prevalence rate*: > 0	0.7207	0.1108	<0.0001
Inpatient community-onset prevalence rate*: 0	REFERENT	-	-

* Inpatient community-onset (CO) prevalence rate is calculated as: # of inpatient CO CDI events, divided by total admissions x 100. (i.e., cdif_admPrevCOCount / numCdifadms * 100). The prevalence rate for an entire quarter is used in the risk adjustment.

Table 3. CDI in Long-Term Acute Care Hospitals (LTACHs)

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-7.3345*	*0.0507*	*<0.0001*
Inpatient community-onset prevalence rate*: > 0	0.3683	0.0493	<0.0001
Inpatient community-onset prevalence rate*: 0	REFERENT	-	-
Percent of admissions on a ventilator[‡]: ≥ 27.1%	0.3116	0.0478	<0.0001
Percent of admissions on a ventilator[‡]: ≥ 18% to < 27.1%	0.1463	0.0590	0.0131
Percent of admissions on a ventilator[‡]: < 18%	REFERENT	-	-
CDI test type[^]: NAAT or OTHER	0.1607	0.0444	0.0003
CDI test type[^]: EIA	REFERENT	-	-
Percent of single occupancy rooms[+]: ≤ 77%	0.0963	0.0425	0.0235
Percent of single occupancy rooms[+]: >77%	REFERENT	-	-

* Inpatient community-onset prevalence is calculated as the # of inpatient community-onset CDI events, divided by total admissions * 100. (i.e., cdif_admPrevCOCount / numCdifadms * 100). The prevalence rate for an entire quarter is used in the risk adjustment.

[‡] Percent of annual admissions on a ventilator is taken from the Annual LTACH Survey. It is calculated as: # admissions on a ventilator / total # annual admissions x 100. (i.e., numAdmVent / numAdmitsSurv * 100).

Table 3 Footnotes continued:

^ CDI test type is reported on the FacWideIN MDRO denominator form on the 3rd month of each quarter.

-Starting in 2018 Q1, CDI test type is categorized as:

Nucleic acid amplification test (NAAT) or Other: This includes NAAT, GDH + NAAT, GDH + EIA + NAAT, and all other (non-EIA) CDI test types, including the selection of "Other" and associated free-text entry.
Enzyme immunoassay (EIA) for toxin: This includes EIA for toxin, GDH antigen + EIA for toxin, and **NAAT + EIA.**

-Prior to 2018 Q1, CDI test type was categorized as: (*refer to 2018 NHSN protocol changes for details*)

Nucleic acid amplification test (NAAT) or Other: This includes NAAT, GDH + NAAT, GDH + EIA + NAAT, NAAT + EIA, and all other (non-EIA) CDI test types, including the selection of "Other" and associated free-text entry.
Enzyme immunoassay (EIA) for toxin: This includes EIA for toxin, and GDH antigen + EIA for toxin.

+ Percent of beds located in single occupancy rooms is taken from the Annual LTACH Survey. It is calculated as: # of single occupancy rooms / total number of beds x 100. (i.e., numSingOccRm / numbeds * 100).

Table 4. CDI in Inpatient Rehabilitation Facilities (IRFs): Free-standing Rehabilitation Hospitals and CMS-Certified IRF Units Within a Hospital

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-8.4475*	*0.0689*	*<0.0001*
CDI test type^: NAAT	0.2921	0.0534	<0.0001
CDI test type^: OTHER	0.2163	0.0747	0.0038
CDI test type^: EIA	REFERENT	-	-
CMS-certified IRF Unit within a hospital	0.2188	0.0495	<0.0001
Free-standing HOSP-REHAB with reported community-onset CDI events	0.4168	0.0803	<0.0001
Free-standing HOSP-REHAB with zero reported community-onset CDI events	REFERENT	-	-
Percent of admissions with orthopedic conditions*: ≤ 23.9%	0.2015	0.0427	<0.0001
Percent of admissions with orthopedic conditions*: > 23.9%	REFERENT	-	-
Percent of admissions with traumatic and non-traumatic spinal cord dysfunction*: > 5.2%	0.1657	0.0437	0.0002
Percent of admissions with traumatic and non-traumatic spinal cord dysfunction*: ≤ 5.2%	REFERENT	-	-
Percent of admissions with stroke*: ≤ 23.8%	0.1965	0.0444	<0.0001
Percent of admissions with stroke*: > 23.8%	REFERENT	-	-

^ CDI test type is reported on the FacWideIN or IRF Unit's MDRO denominator form on the 3rd month of each quarter.

-Starting with 2018 Q1, CDI test type is categorized as:

Nucleic acid amplification test (NAAT): This includes NAAT, GDH + NAAT, and GDH + EIA + NAAT.
Enzyme immunoassay (EIA) for toxin: This includes EIA for toxin, GDH antigen + EIA for toxin, and **NAAT + EIA.**
Other: This includes all other CDI test types, including the selection of "Other" and associated free-text entry.

-Prior to 2018 Q1, CDI test type was categorized as: (*refer to 2018 NHSN protocol changes for details*)

Nucleic acid amplification test (NAAT): This includes NAAT, GDH + NAAT, GDH + EIA + NAAT, and NAAT + EIA.
Enzyme immunoassay (EIA) for toxin: This includes EIA for toxin, and GDH antigen + EIA for toxin.
Other: This includes all other CDI test types, including the selection of "Other" and associated free-text entry.

* Percent of annual admissions with primary diagnoses are taken from the Annual IRF Survey, and calculated as the # of admissions with the primary diagnosis / total # of annual admissions x 100.

Using an Intercept-Only Model to Calculate the Number of Predicted Events Example: MRSA Bacteremia LabID Event

Several regression models from the 2015 national baseline are "intercept-only models". For example, none of the investigated variables were found to have a significant association with the incidence of healthcare facility-onset (HO) MRSA bacteremia in critical access hospitals or inpatient rehabilitation facilities. Therefore, the number of predicted events is calculated by applying the following intercept-only formula:

$$Number\ of\ Predicted\ Events = \exp(Intercept\ Value)\ x\ Patient\ Days$$

Let's say a critical access hospital had 1,400 total patient days during a select time period. The number of predicted events would be calculated as:

$$Number\ of\ Predicted\ Events = \exp(-10.7795)\ x\ 1400$$

$$Number\ of\ Predicted\ Events = 0.029$$

Because the number of predicted events is less than 1.0, an SIR will not be calculated for this facility and time period in NHSN.

Additional Resources

- **Information about Transitioning to 2015 SIR Baselines**:

NHSN Rebaseline webpage: *https://www.cdc.gov/nhsn/2015rebaseline/*

NHSN Rebaseline Webinar, Part 1 (Oct 2016):
https://www.cdc.gov/nhsn/pdfs/rebaseline/rebaseline-webinar-p1.pdf

NHSN Rebaseline Webinar, Part 2 (Nov 2016):
https://www.cdc.gov/nhsn/pdfs/rebaseline/rebaseline-webinar-p2.pdf

- **Original SIR Baselines for Acute Care Hospitals:**

CLABSI (original baseline= 2006-2008): *https://www.cdc.gov/nhsn/PDFs/dataStat/2009NHSNReport.pdf*

CAUTI (original baseline= 2009): *https://www.cdc.gov/nhsn/PDFs/NHSNReport_DataSummaryfor2009.pdf*

SSI (original baseline= 2006-2008): *https://www.cdc.gov/nhsn/PDFs/pscManual/SSI_ModelPaper.pdf*

MRSA bacteremia and CDI LabID event (original baseline= 2010-2011):
https://www.cdc.gov/nhsn/pdfs/mrsa-cdi/riskadjustment-mrsa-cdi.pdf

December 2010 Special Edition NHSN Newsletter - Introduction to SIR (original baseline):
https://www.cdc.gov/nhsn/pdfs/newsletters/nhsn_nl_oct_2010se_final.pdf

- **Original SIR Baselines for Long-term Acute Care Hospitals (LTACHs) and Inpatient Rehabilitation Facilities (IRFs):**

CLABSI/CAUTI in LTACHs, and CAUTI in IRFs (original baseline = 2013):
https://www.cdc.gov/nhsn/xls/reportdatatables/nhsn-2013-report.xlsx

- **NHSN Analysis Trainings & Other Resources:**

Analysis Resources, Trainings, and NHSN Data Dictionary:
https://www.cdc.gov/nhsn/ps-analysis-resources/index.html

Targeted Assessment for Prevention (TAP) General Information*: https://www.cdc.gov/hai/prevent/tap.html*

Quick Reference Guides: How to run and interpret NHSN reports (including SIR and TAP reports):
https://www.cdc.gov/nhsn/ps-analysis-resources/reference-guides.html

Troubleshooting CLABSI and CAUTI SIRs:
https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/clabsicauti_sirtroubleshooting.pdf

Troubleshooting SSI SIRs: *https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/ssi-sir_tips.pdf*

Troubleshooting MRSA and CDI LabID Event SIRs:
https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf

Information related to SIRs used for the Centers for Medicare and Medicaid Services (CMS) Quality Reporting Programs: *https://www.cdc.gov/nhsn/cms/index.html*

NHSN Annual Hospital Survey: *https://www.cdc.gov/nhsn/forms/57.103_pshospsurv_blank.pdf*

- Instructions for NHSN Annual Hospital Survey: *https://www.cdc.gov/nhsn/forms/instr/57_103-toi.pdf*

NHSN Annual LTACH Survey: *https://www.cdc.gov/nhsn/forms/57.150_ltacfacsurv_blank.pdf*

- Instructions for NHSN Annual LTACH Survey: *https://www.cdc.gov/nhsn/forms/instr/toi-57.150-ltac.pdf*

NHSN Annual IRF Survey: *https://www.cdc.gov/nhsn/forms/57.151_rehabfacsurv_blank.pdf*

- Instructions for NHSN Annual IRF Survey: *https://www.cdc.gov/nhsn/forms/instr/toi-57.151-irf.pdf*

NHSN Location Mapping: *https://www.cdc.gov/nhsn/pdfs/pscmanual/15locationsdescriptions_current.pdf*