

1.18 Calculation of Measure Score

The National Healthcare Safety Network (NHSN) is a system for tracking healthcare-associated infections (HAIs) using data from US healthcare facilities. NHSN provides facility leaders, state health departments, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate HAIs.

NHSN began tracking HAIs in around 300 hospitals and now serves over approximately 38,000 medical facilities. Current participants include acute care hospitals, long-term acute care hospitals, psychiatric hospitals, rehabilitation hospitals, outpatient dialysis centers, ambulatory surgery centers, and nursing homes, with hospitals (over 6,000) and dialysis facilities representing most of the facilities reporting data.

Establishing this system for tracking and preventing HAIs across the county required NHSN to understand key baseline data about facilities and healthcare. Information that allows NHSN to measure the incidence rates of HAIs represented in these baseline data includes:

- Facility demographics (like number of beds and medical school affiliation)
- Units within facilities (like the type of medical services or care provided on a unit)
- Surveillance data about infections (if, when, and where they occur)

The standardized infection ratio (SIR) is a summary metric used by healthcare facilities, CDC, and other public health organizations to track the incidence of HAIs over time. The SIR compares the number of HAIs reported (numerator) to the number that would be predicted (denominator), given the standard population (i.e., national baseline), adjusting for various facility and/or patient-level risk factors that have been found to be significantly associated with differences in HAI incidence. When interpreting the SIR, a value 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.

The MRSA Bacteremia LabID Event SIR compares the actual number of MRSA Bacteremia LabID Events reported to the number of MRSA Bacteremia LabID Events that would be predicted. The number of predicted infections is calculated using multivariable regression models generated from nationally aggregated data during a baseline period. These models are applied to a facility's denominator and risk factor data to generate a predicted number of infections. To enforce a minimum precision criterion, facility SIRs are only calculated when the number of predicted infections is at least 1.0. This rule was instituted to avoid the calculation and interpretation of statistically imprecise SIRs, which typically have extreme values.

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

1.Total the number of annually observed (numerator) MRSA Bacteremia LabID Events across the facility.

2. Calculate the number of predicted (denominator) MRSA Bacteremia LabID Events for the facility.

The number of predicted infections is the estimated number of MRSA Bacteremia LabID Events for the facility considering several facility factors reported to NHSN. The model is based on aggregated national data reported to NHSN during a specific timeframe (i.e. baseline year 2022). The negative binomial generalized linear model is utilized for MRSA Bacteremia LabID Events. As a national surveillance HAI tracking system that US healthcare facilities must report data to, NHSN must characterize risk of infection in the most efficient way. To minimize the burden of data collection on facilities, NHSN risk models utilize patient location and facility characteristics that are already reported by all facilities. NHSN does not collect additional patient characteristics for inclusion in the risk model because this would create additional burden for facilities.

Negative binomial regression models are used to estimate incidence from a summarized population. The general negative binomial regression formula is:

$$\log(\lambda) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i, \text{ where:}$$

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

3. Divide the number of observed MRSA Bacteremia LabID Events by the number of predicted MRSA Bacteremia LabID Events to obtain the standardized infection ratio (SIR).

- If the SIR is greater than 1.0, then more HAIs were observed than predicted based on the 2022 national aggregate data.
- If the SIR is less than 1.0, then fewer HAIs were observed than predicted based on the 2022 national aggregate data.
- If the SIR equals 1.0, then the same number of HAIs were observed as predicted based on the 2022 national aggregate data.

The tables below represent the variables found to be statistically significant predictors of MRSA Bacteremia LabID Events and are used in the negative binomial regression model to calculate the number of predicted healthcare facility-onset MRSA Bacteremia LabID Events in hospital inpatients under the 2022 baseline data.

The negative binomial generalized linear models for acute care hospitals and critical access hospitals are listed below.

Acute Care Hospitals

Parameter		Estimate	Standard Error	Pvalue
Intercept		-11.6685	0.1598	<.0001
Outpatient CO prevalence rate	2. 0.013 <= EDRate < 0.040	0.2471	0.0437	<.0001
	3. 0.040 <= EDRate < 0.064	0.3537	0.0448	<.0001
	4. 0.064 <= EDRate < 0.085	0.4703	0.0492	<.0001
	5. 0.085 <= EDRate	0.6112	0.0483	<.0001
	1. No ED/Obs or EDRate < 0.013	0	0	.

Inpatient CO prevalence rate	2. 0 < InpCOPrevRate < 0.042	0.1259	0.0336	0.0002
	3. 0.042 <= InpCOPrevRate < 0.071	0.2238	0.0374	<.0001
	4. 0.071 <= InpCOPrevRate	0.3538	0.0343	<.0001
	1. Zero InpCOPrevRate	0	0	.
Average length of stay	2. 2.6 <= avgLOS < 4.8	0.5149	0.121	<.0001
	3. 4.8 <= avgLOS < 5.2	0.6104	0.1238	<.0001
	4. 5.2 <= avgLOS	0.765	0.1211	<.0001
	1. 1 <= avgLOS < 2.6	0	0	.
Proportion of total beds that are ICU	2. 0.061 <= ICUbedPropn < 0.161	0.1856	0.0667	0.0054
	3. 0.161 <= ICUbedPropn < 0.232	0.2758	0.0685	<.0001
	4. 0.232 <= ICUbedPropn	0.4254	0.0714	<.0001
	1. 0 <= ICUbedPropn < 0.061	0	0	.
Total number of beds	2. 67 <= numbeds	0.2204	0.0783	0.0049
	1. 1 <= numbeds < 67	0	0	.
Medical school affiliation	M	0.1188	0.0264	<.0001
	U,G,N	0	0	.
Facility type (based on NHSN enrollment):	GEN,ONC	0.2477	0.0799	0.0019
	CHLD,WOMCHILD,MIL,ORTHO,SURG,WOM	0	0	.

Critical Access Hospitals

Parameter		Estimate	Standard Error	Pvalue
Intercept	Intercept	-11.3451	0.2029	<.0001
Outpatient CO prevalence rate	EDrate_GRP 1:EDrate>0	0.9991	0.2773	0.0003
	EDrate_GRP 0:EDrate 0 or missing	0	.	.
Inpatient CO prevalence rate	COrate_GRP 1:COrate>0	0.8824	0.3418	0.0098
	COrate_GRP 0:Corate=0	0	.	.