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 facilities, states, regions, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate HAIs.

NHSN began tracks HAIs in over 39,000 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 the majority of facilities reporting data.

NHSN is our source of national data to promote comparisons between facilities and serves as the population for standardized metrics. Establishing this system for tracking and preventing HAIs across the county required NHSN to understand key baseline data about facilities and healthcare. Information about 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), as well as surveillance data about infections (if, when, and where they occur) allow NHSN to measure the incidence rates of HAIs represented in these baseline data.

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 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 *Clostridioides difficile* (CDI) LabID event standardized infection ratio (SIR) compares the actual number of CDI LabID events reported to the number of CDI 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 time 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) CDI LabID events across the facility.

2. Calculate the number of predicted (denominator) CDI LabID events for the facility.
   The number of predicted infections is the estimated number of events (i.e. CDI LabID events) for the facility considering several facility-level 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 CDI LabID events. As a national surveillance HAI tracking system that US healthcare facilities are required to report data to, NHSN must characterize risk of infection in the most efficient way. As such, to reduce facility burden, NHSN risk models use patient location and facility factors that are reported by all facilities to NHSN. Due to the burden that additional data collection would impose on the many facilities that are required to report to NHSN, it is not feasible to collect additional patient characteristics for inclusion in the risk model.

Negative binomial regression models are used when estimating incidence from a summarized population. The general formula for the negative binomial regression model is $\log(\lambda) = \alpha + \beta 1X1 + \beta 2X2 + \cdots + \beta iXi$, where:

α = Intercept
βi = Parameter estimate
Xi = Value of risk factor (categorical variables: 1 if present, 0 if not present)
i = Number of predictors

3. Divide the number of observed CDI LabID events by the number of predicted CDI 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 CDI LabID events and are used in the negative binomial regression model to calculate the number of predicted healthcare facility-onset CDI LabID events in hospital inpatients under the 2022 baseline data.

The negative binomial generalized linear model for acute care hospitals, oncology hospitals, long-term acute care hospitals, and inpatient rehabilitation facilities are listed below.

Acute Care Hospitals

Parameter		Estimate	Standard Error	P-value
Intercept		-10.1452	0.1063	<.0001
Inpatient Community Onset (CO) prevalence rate	**2: (0, 0.064)**	0.1118	0.0338	0.0010
	3: [0.064, 0.104)	0.2443	0.0339	<.0001
	4: [0.104, 0.152)	0.3211	0.0340	<.0001

Parameter		Estimate	Standard Error	P-value
	5: [0.152, 0.213)	0.4296	0.0341	<.0001
	6: [0.213, 0.301)	0.5137	0.0346	<.0001
	7: [0.301, 0.461)	0.6666	0.0349	<.0001
	8: >=0.461	0.7994	0.0371	<.0001
	1: 0	0.0000	0.0000	.
CDI test type	**EIA or GDH+EIA or Other**	0.0960	0.0260	0.0002
	NAAT	0.2868	0.0193	<.0001
	NAAT+EIA_2step	0.0000	0.0000	.
Outpatient Community onset prevalence rate	**2: [0.012, 0.025)**	0.1064	0.0221	<.0001
	3: [0.025, 0.048)	0.2240	0.0215	<.0001
	4: >=0.048	0.2914	0.0224	<.0001
	1: <0.012 or noData	0.0000	0.0000	.
Facility type	**GEN-CHLD-MIL**	0.6225	0.0977	<.0001
	HOSP-ONC	1.6881	0.1326	<.0001
	Specialty-other	0.0000	0.0000	.
Number of ICU beds	**2: 5-45**	0.3330	0.0499	<.0001
	3: 46-79	0.3876	0.0525	<.0001
	4: >=80	0.5765	0.0526	<.0001
	1: 0-4	0.0000	0.0000	.
Medical school affiliation	**M/N/G**	0.1677	0.0224	<.0001
	U	0.0000	0.0000	.
Average length of stay	**>=5.4**	0.0895	0.0173	<.0001
	<5.4	0.0000	0.0000	.

Critical Access Hospitals

Parameter		Estimate	Standard Error	P-value
Intercept		-9.4938	0.1903	<.0001
Outpatient CO prevalence rate	**>0**	0.4943	0.0883	<.0001
	0 or noData	0.0000	0.0000	.
Inpatient CO prevalence rate	**>=0.313**	0.4895	0.0909	<.0001
	<0.313	0.0000	0.0000	.
CDI test type	**NAAT**	0.3893	0.0955	<.0001
	EIA or Other	0.0000	0.0000	.
Average length of stay	**>=2.6**	0.5290	0.1794	0.0032
	<2.6	0.0000	0.0000	.
Total number of beds	**<25**	0.2403	0.0909	0.0082
	>=25	0.0000	0.0000	.

Inpatient Rehabilitation Facilities

Parameter		Estimate	Standard Error	P-value
Intercept		-9.4497	0.1627	<.0001
Free-standing HOSP-REHAB with inpatient CO prevalence rate	**HOSP-REHAB_>0COrate**	0.3824	0.1100	0.0005
	IRFunit or 0 CO	0.0000	0.0000	.
Average daily census	**>=51.3**	0.2127	0.0657	0.0012
	<51.3	0.0000	0.0000	.
CDI test type	**NAAT or Other**	0.2352	0.0578	<.0001
	EIA	0.0000	0.0000	.
Proportion of admissions with stroke	**1: <0.185**	0.3108	0.0973	0.0014
	2: [0.185, 0.321)	0.1862	0.0908	0.0402
	3: >=0.321	0.0000	0.0000	.
Proportion of admissions with orthopedic conditions	**<0.110**	0.3103	0.0691	<.0001
	>=0.110	0.0000	0.0000	.
Proportion of admissions with traumatic spinal cord dysfunction	**<0.016**	0.1660	0.0640	0.0095
	>=0.016	0.0000	0.0000	.
Proportion of admissions with non-traumatic spinal cord dysfunction	**>=0.012**	0.2822	0.1323	0.0330
	<0.012	0.0000	0.0000	.

Long-Term Acute Care Facilities

Parameter		Estimate	Standard Error	P-value
Intercept		-9.6565	0.2476	<.0001
Proportion of admissions on hemodialysis	**>0**	0.9840	0.2174	<.0001
	0	0.0000	0.0000	.
Inpatient CO prevalence rate	**>0**	0.4575	0.1121	<.0001
	0	0.0000	0.0000	.
Number of ICU beds	**>0**	0.1707	0.0772	0.0271
	0	0.0000	0.0000	.
Proportion of admissions on a ventilator	**>=0.141**	0.2363	0.0915	0.0099
	<0.141	0.0000	0.0000	.
Proportion of beds that are high observation	**<0.238**	0.3083	0.0979	0.0016
	>=0.238	0.0000	0.0000	.
Average length of stay	**1: <25.3**	0.4027	0.1157	0.0005
	3: >=29.4	0.2451	0.0982	0.0126
	2: [25.3, 29.4)	0.0000	0.0000	.