Using NHSN Analysis for SSI Prevention

First Step: Understand the SIR

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HAI Liaison Program
Healthcare-Associated Infections Program
Center for Health Care Quality
California Department of Public Health

Interpreting Surveillance Data

Requires

- Consistent use of standardized methods and definitions; consistent level of intensity for case-finding
- Capture of sufficient patient level risk factor data for each surgical procedure performed
- Application of risk adjustment methods for meaningful comparisons (i.e. of your hospital data over time or to national/state referent data)

Using Your NHSN SSI Data

- Use NHSN Analysis features to
  - Check your data for complete and accurate reporting
  - Calculate SIRs to compare to national data
- Feedback your analyzed SSI data to hospital units, medical/ surgical services, hospital leadership (not only the ICC)
- Use infection data for prevention; assess progress over time

NHSN Standardized Infection Ratio (SIR)

- Driven by need for a **summary measure**
  - e.g. replaces multiple rate comparisons for SSI
- Adjusts for differences in infection risk
  - e.g. by type of procedure, and the associated risk factors of the patients undergoing each type of procedure in your hospital
- SIR compares number of SSI reported by your hospital with the "expected" or "predicted" number based on NHSN data (referent period 2006-2008)

Interpreting SSI SIR

- Value of **1.0 =** number of SSI observed in your hospital is the **same as the predicted** number of SSI as compared to national referent data
  - Less than 1.0 = fewer SSI than predicted
  - Greater than 1.0 = more SSI than predicted

Note: NHSN will calculate SIRs for your hospital procedure data ***only*** when the predicted number of SSI is >1

(You can't have less than a whole person infected.)

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$$SIR = \frac{\text{Observed SSIs}}{\text{Predicted SSIs}}$$

Example:

Your hospital has 4 SSI after 100 Hip prosthesis (HPRO) procedures. Based on your mix of surgical patients undergoing HPRO, national data predict you should have 2.5 SSI. SIR is calculated as

$$SIR = \frac{4}{2.5} = 1.6$$

NHSN SSI Risk Stratification (old) vs. Risk Adjustment using the SIR (new)

- NHSN legacy *(no longer used)*: Stratified risk for every procedure using 0-3 Risk Index
  - 1 point for ASA >2, Wound class C or D, Duration >75th percentile

- NHSN new: Adjusts for individual patient risk
  - Risk models developed, specific to each procedure*
  - Includes only the variables found to be associated with SSI risk
  - Risk factors weighted based on contribution to SSI risk

Example: SSI risk factors for HPRO models
Age, Anesthesia type, ASA score, surgical duration, HPRO type, medical school affiliation, number of beds, trauma status

*published in *ICHE*, Oct 2011

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Risk Adjustment of your SSI Data

- Every patient undergoing a procedure in your hospital has a calculated risk for SSI (done "behind the scenes" in NHSN)
- Based on your hospital's surgical patient population, the expected (predicted) number of SSI is calculated by adding up all your risk probabilities

Example: HYST Procedures
Factors in the risk adjustment model that add to SSI risk are

- Age equal to or younger than 44 years
- ASA score of 3, 4, or 5
- Duration of surgery longer than 100 minutes (incision to close time)
- Procedure done at hospital major teaching hospital (from NHSN Annual Survey)

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Example continued:

This table represents a partial list of 100 hypothetical patients who have undergone **a HYST procedure** and the risk factors present for each.

Patient	Age	Duration	ASA	Medical School Aff.	SSI	Probability of SSI
1	40	117	4	Y	0	0.050
2	53	95	2	N	0	0.004
3	30	107	2	Y	1	0.033
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
100	37	128	4	Y	1	0.050
				TOTAL	Observed (O)	Expected (E)
					3	2.91
				SIR= O/E =3/2.91 = 1.03		

a) Interpreted as a 5.0% risk of SSI for patient 1

b) Probability of SSI calculated for each surgical patient

c) SSI probabilities are added together to get the predicted (expected) number of SSI for your surgical patient population

d) SSI that occur in your surgical patients is the observed number

e) SSI SIR 1.03 is not different than expected/ predicted
- 3 SSI observed
- 2.91 SSI expected

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How do I interpret the SSI SIR?

Example #1: Overall SSI SIR

Org ID	Summary Yr	Procedure Count	infCountAll	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	2009	524	13	6.687	1.94	0.0196	1.150, 3.091

- During 2009, there were 524 procedures performed and 13 SSIs identified.
- Based on the NHSN 2006-2008 baseline data, 6.687 SSIs were expected.
- This results in an SIR of 1.94 (13/6.687), signifying that during this time period our facility identified 94% more SSIs than expected.
- The p-value and 95% Confidence Interval indicate that the number of observed SSIs is significantly higher than the number of expected SSIs.

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Example #2: SSI SIR by Procedure and Half-Year

Org ID	Procedure Code	Summary Yr/Half	Procedure Count	infCountAll	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	HPRO	2009H1	26	1	0.295	.	.	
10018	HPRO	2009H2	102	0	1.432	0.00	.	

- During the first half of 2009 (2009H1), there were 26 HPRO procedures performed and 1 SSI identified.
- Based on the NHSN 2006-2008 baseline data, <1 SSI was expected and therefore, a precise SIR could not be calculated.

- **During the second half of 2009 (2009H2), there were 102 HPRO procedures and 0 SSI.**
- **The expected number of SSI was 1.432. The SIR is 0 because no SSI were reported.**

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What SSI SIR options are available?

There are eight different SSI SIR output options available – four output options by procedure and four output options by surgeon.

- Procedure-Associated Module
  - All Procedure-Associated Events
  - SSI
    - CDC Defined Output

Line Listing - All SSI Events	Run	Modify
Frequency Table - All SSI Events	Run	Modify
Bar Chart - All SSI Events	Run	Modify
Pie Chart - All SSI Events	Run	Modify
SIR - Complex AR SSI Data by Procedure	Run	Modify
SIR - Complex AR SSI Data by Surgeon	Run	Modify
SIR - In-plan Complex AR SSI data by Procedure	Run	Modify
SIR - In-plan Complex AR SSI data by Surgeon	Run	Modify
SIR - All SSI Data by Procedure	Run	Modify
SIR - All SSI Data by Surgeon	Run	Modify
SIR - In-plan All SSI Data by Procedure	Run	Modify
SIR - In-plan All SSI data by Surgeon	Run	Modify
Line Listing - Incomplete Procedures for SSI SIR	Run	Modify

Terminology

$$SIR = \frac{\text{Observed SSIs}}{\text{Predicted/Expected}}$$

- SIR is <u>not</u> a rate*
  - It is a <u>ratio</u> derived from 2 different rates
  - Compares 1 number to another
  - Refer to it as a value or simply as the SIR (NOT an SSI rate)
- The terms "predicted" and "expected" are used interchangeably
  - ACS uses and many surgeons understand "O/E" ratios
  - "Predicted" may be preferred
    - "Expected" to a consumer raises concern of complacency, i.e. we expect SSI to occur so we are not doing enough to prevent them
    - "Expected" is also not aligned with the paradigm shift that we can achieve HAI Elimination

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References

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ORIGINAL ARTICLE

Improving Risk-Adjusted Measures of Surgical Site Infection for the National Healthcare Safety Network

Yi Mu, PhD;[1] Jonathan R. Edwards, MStat;[1] Teresa C. Horan, MPH;[1]
Sandra I. Berrios-Torres, MD;[1] Scott K. Fridkin, MD[1]

(See the commentary by Moehring et al, on pages 987–989.)

BACKGROUND. The National Healthcare Safety Network (NHSN) has provided simple risk adjustment of surgical site infection (SSI) rates to participating hospitals to facilitate quality improvement activities; improved risk models were developed and evaluated.

METHODS. Data reported to the NHSN for all operative procedures performed from January 1, 2006, through December 31, 2008, were analyzed. Only SSIs related to the primary incision site were included. A common set of patient- and hospital-specific variables were evaluated as potential SSI risk factors by univariate analysis. Some ific variables were available for inclusion. Stepwise logistic regression was used to develop the specific risk models by procedure category. Bootstrap resampling was used to validate the models, and the c-index was used to compare the predictive power of new procedure-specific risk models with that of the models with the NHSN risk index as the only variable (NHSN risk index model).

RESULTS. From January 1, 2006, through December 31, 2008, 847 hospitals in 43 states reported a total of 849,659 procedures and 16,147 primary incisional SSIs (risk, 1.90%) among 39 operative procedure categories. Overall, the median c-index of the new procedure-specific risk was greater (0.67 [range, 0.59–0.85]) than the median c-index of the NHSN risk index models (0.60 [range, 0.51–0.77]); for 33 of 39 procedures, the new procedure-specific models yielded a higher c-index than did the NHSN risk index models.

CONCLUSIONS. A set of new risk models developed using existing data elements collected through the NHSN improves predictive performance, compared with the traditional NHSN risk index stratification.

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AJIC major articles

National Healthcare Safety Network (NHSN) report: Data summary for 2006 through 2008, issued December 2009

Jonathan R. Edwards, MStat, Kelly D. Peterson, BBA, Yi Mu, PhD, Shailendra Banerjee, PhD, Katherine Allen-Bridson, RN, BSN, CIC, Gloria Morrell, RN, MS, MSN, CIC, Margaret A. Dudeck, MPH, Daniel A. Pollock, MD, and Teresa C. Horan, MPH
Atlanta, Georgia

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This report is a summary of Device-Associated (DA) and Procedure-Associated (PA) module data collected and reported by hospitals and ambulatory surgical centers participating in the National Healthcare Safety Network (NHSN) from January 2006 through December 2008 as reported to the Centers for Disease Control and Prevention (CDC) by July 6, 2009. This report updates previously published DA and PA module data from the NHSN.[1]

The NHSN was established in 2005 to integrate and supersede 3 legacy surveillance systems at the CDC: the National Nosocomial Infections Surveillance (NNIS) system, the Dialysis Surveillance Network (DSN), and the National Surveillance System for Healthcare Workers (NaSH). Similar to the NNIS system, NHSN facilities voluntarily report their health care–associated infection (HAI) surveillance data for aggregation into a single national database for the following purposes:

- Estimation of the magnitude of HAIs
- Monitoring of HAI trends
- Facilitation of interfacility and intrafacility comparisons with risk-adjusted data that can be used for local quality improvement activities
- Assistance to facilities in developing surveillance and analysis methods that permit timely recognition of patient safety problems and prompt intervention with appropriate measures.

In addition, many facilities use these same data to comply with state reporting mandates. Identity of all NHSN facilities is kept confidential by the CDC in accordance with Sections 304, 306, and 308(d) of the Public Health Service Act [42 USC 242b, 242k, and 242m(d)].

METHODS

Special Edition!

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NHSN National Healthcare Safety Network

evention (CDC) News

Your Guide to the Standardized Infection Ratio (SIR)

With the new version of NHSN (version 6.3), new output options are available that will permit the calculation of standardized infection ratios (SIRs) for central line-associated bloodstream infection (CLABSI) and surgical site infection (SSI) data. Each of these measures fall in line with the State-Specific Healthcare-associated Infections Summary Data Report, published by CDC. For SSIs, we will make the transition from SSI rates to the SSI SIR with this new version of the NHSN tool. The SSI SIR is the result of logistic regression modeling that considered all procedure-level data collected by NHSN facilities in order to provide better risk adjustment than afforded by the risk index. In addition, the SSI SIR provided to facilities within NHSN will be more precise and be calculated only if appropriate for comparisons. As we make this transition, we understand that you will have numerous questions, including how to operationalize this new statistic in your facility to drive prevention practices. This guide is intended to answer some of these questions.

STANDARDIZED INFECTION RATIO (SIR)

What is a standardized infection ratio (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 patients of varying 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

For more information about this training document, please email InfectionControl@cdph.ca.gov

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