Using NHSN Analysis for SSI Prevention

First Step: Understand the SIR

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Healthcare-Associated Infections Program
Center for Health Care Quality
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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 (synonyms) 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.

(A facility can’t have a fraction of an infection occur.)
Observed SSIs

\[ \text{SIR} = \frac{\text{Observed SSIs}}{\text{Predicted SSIs}} \]

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

\[ \text{SIR} = \frac{4}{2.5} = 1.6 \]
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
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)
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.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Duration</th>
<th>ASA</th>
<th>Medical School Aff.</th>
<th>SSI</th>
<th>Probability of SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>117</td>
<td>4</td>
<td>Y</td>
<td>0</td>
<td>0.050</td>
</tr>
<tr>
<td>2</td>
<td>53</td>
<td>95</td>
<td>2</td>
<td>N</td>
<td>0</td>
<td>0.004</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>107</td>
<td>2</td>
<td>Y</td>
<td>1</td>
<td>0.033</td>
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</tr>
<tr>
<td>100</td>
<td>37</td>
<td>128</td>
<td>4</td>
<td>Y</td>
<td>1</td>
<td>0.050</td>
</tr>
</tbody>
</table>

**TOTAL**  
Observed (O)  
Expected (E)  

**SIR** = O/E = 3/2.91 = 1.03

- **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

- **a)** Interpreted as a 5.0% risk of SSI for patient 1.
- **b)** Probability of SSI calculated for each surgical patient.
How do I interpret the SSI SIR?

Example #1: Overall SSI SIR

<table>
<thead>
<tr>
<th>Org ID</th>
<th>Summary Yr</th>
<th>Procedure Count</th>
<th>infCount</th>
<th>All SSI Model Number Expected</th>
<th>All SSI Model SIR</th>
<th>All SSI Model SIR p-value</th>
<th>All SSI Model 95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>10018</td>
<td>2009</td>
<td>524</td>
<td>13</td>
<td>6.687</td>
<td>1.94</td>
<td>0.0196</td>
<td>1.150, 3.091</td>
</tr>
</tbody>
</table>

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

- **SIR is not a rate**
  - It is a ratio 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

\[ \text{SIR} = \frac{\text{Observed SSIs}}{\text{Predicted/Expected}} \]
Improving Risk-Adjusted Measures of Surgical Site Infection for the National Healthcare Safety Network

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

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 life table 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 846,659 procedures and 16,147 primary incisional SSIs (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 model (0.66 [range, 0.54–0.77]) 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 model.

Infect Control Hosp Epidemiol. 2011;32(10):976-86

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