UPDATE: Slide 73 (C. difficile risk adjustment model for Inpatient Rehabilitation Facilities) has been added to this presentation since the original posting of these slides.
Objectives

- Describe risk adjustment used in the LabID SIR calculations (2015 baseline)
- Demonstrate how to run and interpret SIRs
- Discuss techniques for ensuring SIR data quality and troubleshooting analysis reports

This presentation will focus on the risk adjustment used for the *C. difficile* SIR for acute care hospitals. Additional slides are available at the end of the presentation that cover MRSA bacteremia SIRs and LabID analysis reports in other healthcare settings.

*CDI = *C. difficile* LabID Event
NHSN Reports for LabID Events
Report Types

- **Line List:**
  - Review event-level details
  - Categorization of community-onset (CO) vs. healthcare facility-onset (HO)
  - Determine which events are counted in the SIR
  - Customize the line list!
Report Types

- **Frequency Table:**
  - Total counts of events
  - Number of CO/CO-HCFA/HO
  - Number of events identified in different units
Report Types

- **Bar/Pie Chart:**
  - Visual depiction of counts of events
Report Types

- **Rate Table:**
  - Monthly incidence and prevalence rates
  - Displays total events and denominators
    - Good for data quality review!
  - All facility types use this same report option
SIR Reports

- Risk adjusted measure
- Offers a comparison to the national baseline data (2015 baseline)
- 4 report options:
  - Acute Care Hospitals (ACHs)
  - Critical Access Hospitals (CAHs)
  - **NEW**: Inpatient Rehab Facilities (IRFs) & IRF units within hospital
  - **NEW**: Long-term Acute Care Hospitals (LTACs)
SIR Reports

--- SIRs on 2015 baseline
--- In and Off-plan data

--- Preview of data submitted for CMS Quality Reporting
--- SIRs on 2015 baseline
--- In-plan data only

--- SIRs for ACHs/CAHs only (2010-2011 baseline)
--- In and Off-plan data
--- Historic LabID rates submitted to CMS for IRFs & LTACs (through 2016)
SIR Report & Risk Adjustment
Fundamental Rules for the MRSA & CDI LabID Event SIR

1. LabID SIRs are only available for facility-wide (FacWideIN) surveillance
   - SIRs cannot be calculated for any individual unit*
   - If interested in unit-specific metrics: add them to monthly reporting plan & use rate tables

2. SIRs for most settings are only calculated once all 3 months of data are entered for a quarter
   - Risk adjustment calculations use quarterly variables
   - If interested in monthly data before the quarter is complete, use rate tables

* Exception: CMS-certified IRF units within a hospital
LabID Event SIR Report

National Healthcare Safety Network
SIR for CDI FacwideIN LabID in Acute Care Hospital (2015 baseline)
As of February 27, 2017 at 11:50 AM
Date Range: BS2_LABID_RATE SCDF summary Yr After and Including 2015

<table>
<thead>
<tr>
<th>Facility Org ID</th>
<th>Location</th>
<th>Summary Yr/Qtr</th>
<th>Months</th>
<th>CDIF Facility Incident HO LabID Event Count</th>
<th>Number Predicted</th>
<th>Patient Days</th>
<th>SIR</th>
<th>SIR p-value</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>10401</td>
<td>FACWIDEIN</td>
<td>2015Q1</td>
<td>3</td>
<td>4</td>
<td>6.627</td>
<td>10621</td>
<td>0.604</td>
<td>0.3132</td>
<td>0.192, 1.456</td>
</tr>
<tr>
<td>10401</td>
<td>FACWIDEIN</td>
<td>2015Q2</td>
<td>3</td>
<td>3</td>
<td>3.873</td>
<td>10520</td>
<td>0.775</td>
<td>0.7161</td>
<td>0.197, 2.108</td>
</tr>
</tbody>
</table>

1. This report includes facility-wide inpatient data from acute care hospitals for 2015 and forward.
2. The SIR is only calculated if number predicted (numPred) is >= 1. Lower bound of 95% Confidence Interval only calculated when number of observed events > 0.
3. The # of predicted events is calculated based on national 2015 NHSN data. It is adjusted for inpatient community-onset CDI prevalence rate, ED/OBS reporting, CDI test type, medical school teaching status, facility type, # beds, and # ICU beds.
4. Events from rehabilitation wards and behavioral health/psych wards with a unique CCN are excluded. Information on how to determine which events are counted in the SIR can be found here: http://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf
5. If any risk factor data are missing, the record is excluded from the SIR.

Source of aggregate data: 2015 NHSN CDI LabID Data
Data contained in this report were last generated on February 22, 2017 at 5:04 PM.

- One row per quarter
- FacWideIN
- Title includes facility type & baseline year
- Footnotes!
  - Risk adjustment
  - Exclusion rules
  - Dataset generation date/time
### LabID Event SIR Report

- **2016Q1 example**

<table>
<thead>
<tr>
<th>Facility Org ID</th>
<th>Location</th>
<th>Summary Yr/Qtr</th>
<th>Months</th>
<th>CDIF Facility Incident HO LabID Event Count</th>
<th>Number Predicted</th>
<th>Patient Days</th>
<th>SIR</th>
<th>SIR p-value</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>10401</td>
<td>FACWIDEIN</td>
<td>2016Q1</td>
<td>3</td>
<td></td>
<td>2.410</td>
<td>3827</td>
<td>0.830</td>
<td>0.8734</td>
<td>0.139, 2.742</td>
</tr>
</tbody>
</table>

- **Months = 3**
- **SIR Numerator: # of incident, HO CDI events = 2**
- **SIR Denominator: # predicted = 2.410**
- **Total patient days for the quarter = 3,827**
- **SIR = 2 / 2.410 = 0.830**
- **P-value = 0.8734, 95% confidence interval includes 1: *Not statistically significant***
Which Events are Counted in the FacWideIN SIR Numerator?

- **MRSA Bacteremia:**
  - Blood specimens from inpatient units, *excluding* Rehab & Psych units with unique CCN
  - Specimens collected on Day 4 or later after admission (healthcare facility-onset, HO)
  - No positive test in the previous 14 days in any location

- **C. difficile (CDI):**
  - Inpatient units only, *excluding* Rehab & Psych units with unique CCN
  - Specimens collected on Day 4 or later (healthcare facility-onset, HO)
  - Specimens classified by NHSN as “Incident”
    - > 56 days after the most recent positive CDI specimen

* More information about all algorithms for LabID SIRs: [https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf](https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf)
How Do I Know Which Events Are Counted for FacWideIN?

- Run a LabID Event Line List
- Review indicator variable on far right of the list:
  - FWCDIF_facIncHOCount (CDI) or FWMRSA_bldIncCount (MRSA)

### National Healthcare Safety Network
#### Line Listing - All CDIF LabID Events
As of: February 22, 2017 at 11:50 AM
Date Range: LABID EVENTS specDateYQ 2016Q1 to 2016Q4

<table>
<thead>
<tr>
<th>patID</th>
<th>eventID</th>
<th>spcOrgType</th>
<th>location</th>
<th>outpatient</th>
<th>onset</th>
<th>cdiAssay</th>
<th>admitDate</th>
<th>specimenDate</th>
<th>FWCDIF_facIncHOCount</th>
<th>FWCDIF_admPrevCOCCount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1002</td>
<td>59455</td>
<td>CDIF</td>
<td>REHB_IRF_Y</td>
<td>N</td>
<td>HO</td>
<td>Incident</td>
<td>01/01/2016</td>
<td>01/12/2016</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>101</td>
<td>59957</td>
<td>CDIF</td>
<td>OBS</td>
<td>Y</td>
<td>CO</td>
<td>Incident</td>
<td>01/01/2016</td>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>101</td>
<td>59958</td>
<td>CDIF</td>
<td>BURN</td>
<td>N</td>
<td>HO</td>
<td>Incident</td>
<td>02/12/2016</td>
<td>02/25/2016</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2201</td>
<td>61762</td>
<td>CDIF</td>
<td>BURN</td>
<td>N</td>
<td>HO</td>
<td>Incident</td>
<td>01/15/2016</td>
<td>02/01/2016</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2201</td>
<td>61763</td>
<td>CDIF</td>
<td>OBS</td>
<td>Y</td>
<td>CO</td>
<td>Recurrent</td>
<td></td>
<td>02/14/2016</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2202</td>
<td>61765</td>
<td>CDIF</td>
<td>OBS</td>
<td>Y</td>
<td>CO</td>
<td>Recurrent</td>
<td></td>
<td>03/15/2016</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Hospitals With a CMS-Certified Rehab (IRF) Unit

- Hospitals with an IRF unit have two separate SIRs submitted to CMS:
  - 1. FacWideIN SIR for the acute care hospital
  - 2. IRF Unit SIR

- We strongly encourage review of both SIRs

- The SIR for the IRF Unit uses different risk adjustment than acute care hospital’s FacWideIN SIR

- The SIR for the IRF Unit uses a different algorithm to determine which events are counted in the numerator

CMS Reports
- Acute Care Hospitals (Hospital IQR)
- Critical Access Hospitals (Hospital IQR)
- Inpatient Rehabilitation Facilities (IRFQR)
- Long Term Acute Care Hospitals (LTCHQR)
Which LabID Events are Counted in the SIR for IRF Units?

- **MRSA Bacteremia:**
  - Blood specimens from CMS-certified Rehab unit
  - Specimens collected on Day 4 or later after being transferred to Rehab unit
  - No positive test in the previous 14 days in any Rehab unit within the facility

- **C.difficile (CDI):**
  - Specimens collected in CMS-certified Rehab unit
  - Specimens collected on Day 4 or later after being transferred to Rehab unit
  - No positive test in the previous 14 days in any Rehab unit within the facility

- Run a LabID Line List and review IRF unit indicator variables: MRSA_IRFbldIncCount or CDIF_IRFIncCount

More information about LabID SIR algorithms: [https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf](https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf)
2016 Q1 Example
SIR Denominator

- Negative binomial regression model used to calculate # predicted events for your facility
  - Risk adjustment differs based on the type of facility
- Data quality steps to ensure accuracy
- Inaccurate data entry into NHSN -> inaccurate SIR

<table>
<thead>
<tr>
<th>Facility Org ID</th>
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<th>Months</th>
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<th>95% Confidence Interval</th>
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</thead>
<tbody>
<tr>
<td>10401</td>
<td>FACWIDEIN</td>
<td>2016Q1</td>
<td>3</td>
<td>2</td>
<td>2.410</td>
<td>3827</td>
<td>0.830</td>
<td>0.8734</td>
<td>0.139, 2.742</td>
</tr>
</tbody>
</table>
Acute Care Hospitals – \textit{C.\textit{difficile}} (CDI)
Number of Predicted Events: CDI in Acute Care Hospitals

- Negative binomial regression model incorporates 7 different factors & total patient days
- Inaccurate risk adjustment variables = inaccurate SIR!

### 7 Variables Used to Calculate Acute Care Hospital's # Predicted CDI Events

1. Inpatient community-onset prevalence rate
2. CDI test type
3. Medical school affiliation *(from annual survey)*
4. Number of ICU beds *(from annual survey)*
5. Total number of inpatient beds *(from annual survey)*
6. Facility type
7. Reporting CDI from an ED or 24 hr observation unit

# 1. Inpatient community-onset prevalence rate
Inpatient Community-Onset (CO) Prevalence Rate

- # Inpatient CO CDI events / # Admissions * 100
- CO = LabID event collected on Day 1, 2, 3 of patient admission
  - Facility admit date: first date patient is transferred to inpatient unit
- Prevalence rate includes data from inpatient locations only
- Based on your facility’s prevalence rate for the ENTIRE QUARTER
  - All 3 months of data entry for the quarter must be complete
  - Quarterly prevalence rate is used to predict # of CDI events per quarter

\[
\text{cdif\_admPrevCOCount / numAdms} * 100
\]
Inpatient CO Prevalence Rate

- **What does this mean?**
  - CDI SIRs are *not* available on a monthly level
  - By default, CDI SIR report will calculate an SIR per quarter

![Modify SIR - ACH CDI FacwideIN LabID Data](image)

**SIR for CDI FacwideIN LabID in Acute Care Hospital (2015 baseline)**

<table>
<thead>
<tr>
<th>orgID</th>
<th>location</th>
<th>summaryYQ</th>
<th>months</th>
<th>CDIF_facIncHOCount</th>
<th>numPred</th>
<th>numberdays</th>
<th>SIR</th>
<th>SIR_pval</th>
<th>sir95ci</th>
</tr>
</thead>
<tbody>
<tr>
<td>10401</td>
<td>FACWIDEIN</td>
<td>2016Q1</td>
<td>3</td>
<td>2</td>
<td>4.150</td>
<td>4220</td>
<td>0.482</td>
<td>0.2982</td>
<td>0.081, 1.592</td>
</tr>
<tr>
<td>10401</td>
<td>FACWIDEIN</td>
<td>2016Q2</td>
<td>3</td>
<td>0</td>
<td>1.213</td>
<td>2273</td>
<td>0.000</td>
<td>0.2974</td>
<td>2.470</td>
</tr>
</tbody>
</table>
Adjust “Group by” to SummaryYM?
Outlier Prevalence Rate Exclusion

- Similar to the original baseline, exclusion rule for outlier prevalence rate
- If facility’s inpatient CO prevalence rate is above pre-determined threshold, the # of predicted events and SIR cannot be accurately calculated for that quarter
- Outlier threshold under new baseline = 2.6 CO events per 100 admissions
- In this situation, data are still considered “complete” and submitted to CMS for Quality Reporting, given that all reporting requirements are met

More information & example:

Review Inpatient CO Prevalence Rate for Accuracy

- Run facility’s CDI Rate Tables to review prevalence rate

- Check numerator and denominator for accuracy
  - Run a CDI Line List to see which patients are counted in this prevalence rate (use this indicator: FWCDIF_admPrevCOCCount)
  - Confirm accurate # of admissions for the quarter
## Review Admission Counts for Accuracy

<table>
<thead>
<tr>
<th>Location Code *:</th>
<th>FACWIDEIN - Facility-wide Inpatient (FacWIDEIn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month *:</td>
<td>February</td>
</tr>
<tr>
<td>Year *:</td>
<td>2016</td>
</tr>
</tbody>
</table>

### General

<table>
<thead>
<tr>
<th>Setting</th>
<th>Inpatient</th>
<th>Total Facility Patient Days *: 1400</th>
<th>Total Facility Admissions *: 987</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting: Outpatient</td>
<td></td>
<td>Total Facility Encounters:</td>
<td></td>
</tr>
</tbody>
</table>

If monitoring **MDRO** in a FACWIDE location, then subtract all counts from patient care units with unique CCN (IRF and IPF) from Totals:

- MDRO Patient Days *: 1400
- MDRO Admissions *: 987
- MDRO Encounters:

If monitoring **C. difficile** in a FACWIDE location, then subtract all counts from patient care units with unique CCNs (IRF and IPF) as well as NICU and Well Baby counts from Totals:

- CDI Patient Days *: 1400
- CDI Admissions *: 15
- CDI Encounters:
Quarterly inpatient CO prevalence rates are used in the CDI SIR calculation for acute care hospitals. Based on this, which of the following is true?

A. My hospital is not required to enter community-onset events into NHSN

B. The CDI SIR will count community-onset events in the SIR numerator

C. CDI SIRs can only be calculated accurately for a quarter time period or longer (i.e., no monthly SIRs)

D. The # of monthly admissions on the FacWideIN denominator form has no impact on the CDI SIR

C. CDI SIRs can only be calculated accurately for a quarter time period or longer (i.e., no monthly SIRs)
C: CDI SIRs can only be calculated accurately for a quarter time period or longer (i.e., no monthly SIRs)

- The quarterly community-onset prevalence rate is used to predict the number of *quarterly* healthcare facility-onset events.
- Because of this, monthly SIRs cannot be calculated.
#2 – *C. difficile* Laboratory Test Type
CDI Test Type

- Entered on FacWideIN monthly denominator form: March, June, Sept, Dec
- Majority of hospitals should not select “Other”
- Use the pre-populated drop-down
- ***PCR = NAAT (nucleic acid amplification test)***
Running SIRs Before the Quarter is Complete

- “We entered January and February LabID data, but have not entered March data. Why can’t I see January or February 2017 in the CDI SIR report?”
  - CDI test type has not been selected for Q1; therefore, Q1 is incomplete

- When running CDI SIR report on an incomplete quarter, second table will appear in the report called “Incomplete Months”
  - Jan and Feb are considered “Incomplete” until March data are entered
  - **Hint:** Make sure your time period includes at least one complete quarter
Running SIRs Before 2017 Q1 is Complete

Modify "SIR - ACH CDI FacwideIn LabID Data"

- Show descriptive variable names (Print List)
- Analysis Data Set

**Title/Format**

**Time Period**

**Filters**

**Display Options**

**Time Period:**

- **Date Variable**: summaryYQ
- **Beginning**: 2016Q4
- **Ending**: 

**Modify "SIR - ACH CDI FacwideIn LabID Data"**

- **Group by**: summaryYQ

Enter Date variable/Time period at the time you click the Run button.
### National Healthcare Safety Network

**SIR for CDI FacwideIN LabID in Acute Care Hospital (2015 baseline)**

As of: March 15, 2017 at 3:24 PM  
Date Range: BS2_LABID_RATESCDIF summaryYQ After and Including 2016Q4

<table>
<thead>
<tr>
<th>location</th>
<th>summaryYQ</th>
<th>months</th>
<th>CDIF_facincHOCount</th>
<th>numPred</th>
<th>numPatdays</th>
<th>SIR</th>
<th>SIR_pval</th>
<th>sir95ci</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACWIDEIN</td>
<td>2016Q4</td>
<td>3</td>
<td>3</td>
<td>3.808</td>
<td>8386</td>
<td>0.788</td>
<td>0.7396</td>
<td>0.200, 2.144</td>
</tr>
</tbody>
</table>

### National Healthcare Safety Network

**CDI Data - Incomplete Months Excluded for SIR**

As of: March 15, 2017 at 3:24 PM  
Date Range: BS2_LABID_RATESCDIF summaryYQ After and Including 2016Q4

<table>
<thead>
<tr>
<th>location</th>
<th>summaryYM</th>
<th>DIF_labidCount</th>
<th>numPatDays</th>
<th>numAdms</th>
<th>cdiTestType</th>
<th>numBeds</th>
<th>medAff</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACWIDEIN</td>
<td>2017M01</td>
<td>3</td>
<td>10520</td>
<td>708</td>
<td></td>
<td>226</td>
<td>Y</td>
</tr>
<tr>
<td>FACWIDEIN</td>
<td>2017M02</td>
<td>1</td>
<td>10621</td>
<td>708</td>
<td></td>
<td>226</td>
<td>Y</td>
</tr>
</tbody>
</table>
Incorporating CDI Test Type into Risk Adjustment

- 3 categories of test type used in risk adjustment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDI Test Type*: EIA</td>
<td>-0.1579</td>
<td>0.0246</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>CDI Test Type*: NAAT</td>
<td>0.1307</td>
<td>0.0219</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>CDI Test Type*: OTHER</td>
<td>REFERENT</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

- **EIA category**: EIA for toxin / GDH antigen + EIA for toxin (2-step)
  - Negative parameter estimate
- **NAAT category**: NAAT / GDH + NAAT (2-step) / GDH + EIA + NAAT / NAAT + EIA
  - Positive parameter estimate
- **OTHER**: all other test types, including “free text” entry
  - No risk adjustment for test type is applied for this category
Incorrect CDI Test Type Entry

If PCR is not indicated correctly (NAAT), may cause SIR to be high. Facility may be penalized unfairly!

For this quarter, what is the method for *C. difficile* used most often by your facility’s laboratory?

- OTH: Other (specify)
- Other (specify): PCR
How Does Risk Adjustment Work?

Hospital A:
- 293 beds
- Q1 data:
  - ~ 3,000 admissions
  - ~ 15,000 patient days
- Used **PCR** to detect CDI for Q1
  - Sensitive test!
  - We would expect this hospital to identify more CDI events because of their test type

\[
SIR = \frac{\text{# of Observed CDI cases}}{\text{# of Predicted CDI cases}}
\]

\[
SIR = \frac{17}{14.1} = 1.21
\]
How Does Risk Adjustment Work?

Hospital A Changes Test Type!
- Switched to EIA for Q2
  - Less sensitive than PCR
  - We would expect this hospital to now identify fewer CDI events

- Q2 data:
  ~ 3,000 admissions
  ~ 15,500 patient days

\[
SIR = \frac{\text{# of Observed CDI cases}}{\text{# of Predicted CDI cases}}
\]

\[
SIR = \frac{9}{7.50} = 1.20
\]
Comparison

Hospital A using PCR, Q1 data:
SIR = 17 / 14.1 = \textbf{1.21}

Hospital A using EIA, Q2 data:
SIR = 9 / 7.5 = \textbf{1.20}

- The # of predicted events accounts for the type of CDI test
  - More sensitive CDI test = more predicted infections
- Example assumes all risk factors stayed constant from Q1 – Q2 except CDI test type and inpatient CO prevalence rate
- A change in CDI test type \textit{alone} will not cause a drastic change in SIR
- Exceptions
Conclusion & Recap: CDI Test Type

- Selection of CDI test type is REQUIRED in order to calculate the SIR
  - CDI test type is not entered into NHSN until the last month of the quarter
  - Therefore, all 3 months of data entry must be completed for the quarter
  - SIRs are not available on a monthly basis

- At the end of each quarter, review CDI test type for accuracy
  - Manually review March, June, Sept, or Dec FacWideIN denominator
  - Run a Summary Data Line List (groups)
  - If using PCR, select **NAAT** as test type
Apply Your Knowledge

Your new hospital data analyst is reviewing CDI SIRs on Hospital Compare, and notices the SIR from your facility is much higher than the state’s SIR.

The analyst explains that your high CDI SIR must be a result of your facility using PCR testing. PCR is a sensitive testing method and may therefore cause your hospital to identify more CDI events, resulting in a high SIR.

Is the analyst’s logic correct?
Your new hospital data analyst is reviewing CDI SIRs on Hospital Compare, and notices the SIR from your facility is much higher than the state’s SIR.

The analyst explains that your high CDI SIR must be a result of your facility using PCR testing to identify *C. difficile*. PCR is a sensitive testing method and may therefore cause your hospital to identify more CDI events, resulting in a high SIR.

Is the analyst’s logic correct?

A. Yes

B. No

✓ B. No
B: No

- The SIR accounts (i.e., risk adjusted) for CDI test type. If we are using a sensitive test, the number of predicted events will reflect this.
### 7 Variables Required to Calculate Acute Care Hospital's # Predicted CDI Events

<table>
<thead>
<tr>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inpatient community-onset prevalence rate</td>
</tr>
<tr>
<td>2. CDI test type</td>
</tr>
<tr>
<td>3. Medical school affiliation</td>
</tr>
<tr>
<td>4. Number of ICU beds</td>
</tr>
<tr>
<td>5. Total number of inpatient beds</td>
</tr>
<tr>
<td>6. Facility type</td>
</tr>
<tr>
<td>7. Reporting CDI from an ED or 24 hr observation unit</td>
</tr>
</tbody>
</table>
Medical School Affiliation and Total/ICU Bed Size

- Reported each year on the annual hospital survey
- Any teaching status: major, graduate, or undergraduate
- # ICU beds are broken into 5 categories for risk adjustment:
  - 0-4, 5-9, 10-19, 20-42, 43+
- Total # beds is a continuous variable in the model

Is your hospital a teaching hospital for physicians and/or physicians-in-training? * Y - Yes
  If Yes, what type:  ○ MAJOR  ○ GRADUATE  ○ UNDERGRADUATE

Number of beds set up and staffed in the following location types (as defined by NHSN):
  a. ICU beds (including adult, pediatric, and neonatal levels II/III and III): * 45
  b. All other inpatient locations: * 100

Total Number of Beds Set Up and Staffed: 145
#6. Facility Type

<table>
<thead>
<tr>
<th>7 Variables Required to Calculate Acute Care Hospital's # Predicted CDI Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inpatient community-onset prevalence rate</td>
</tr>
<tr>
<td>2. CDI test type</td>
</tr>
<tr>
<td>3. Medical school affiliation</td>
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<tr>
<td>7. Reporting CDI from an ED or 24 hr observation unit</td>
</tr>
</tbody>
</table>
Facility Type

- Three categories for CDI risk adjustment:
  - Cancer Hospital (*HOSP-ONC*)
  - General Acute Care Hospital (*HOSP-GEN*)
  - Specialty Hospital (e.g., Orthopedic, Children’s)

- Facility type was indicated during enrollment into NHSN

*Critical Access Hospitals, Inpatient Rehab, and Long Term Acute Care have a separate risk adjustment model and are not included in any category*
#7. Reporting from ED or 24 hr Observation

## 7 Variables Required to Calculate Acute Care Hospital’s # Predicted CDI Events

1. Inpatient community-onset prevalence rate
2. CDI test type
3. Medical school affiliation
4. Number of ICU beds
5. Total number of inpatient beds
6. Facility type
7. Reporting CDI from an ED or 24 hr observation unit
CDI Specimens Collected in ED and Observation Units

- Used to determine which events are counted in the SIR numerator
- For example:
  - Patient has a positive CDI event in ED.
  - Patient is transferred to an inpatient unit. 10 days after admission, patient has a second positive CDI event.

- First CDI event in the ED will not be counted in the SIR
- Second CDI event occurred 10 days after admission
  - Event will be labeled as “HO” on the CDI Line List
  - Event will **NOT** be counted in the SIR (i.e., second event within 56 days)
Surveillance in ED/Observation Unit Impacts Risk Adjustment (# predicted)

- Indicator variable included in risk adjustment
- “For this quarter, is the facility reporting CDI LabID data from an ED or 24 hour observation location?” (Yes/No)
  - Baseline analysis found facilities with these locations had more HO CDI events compared to facilities without
- For data quality: If you have an ED/24 hr observation, make sure it is mapped and included in LabID surveillance efforts
- If facility does not have an ED/24 hr observation, will still receive risk adjustment from the other variables in the model

How does NHSN incorporate outpatient CDI surveillance into the CDI SIR?

A. Events from ED/24 hr Obs. units are used to categorize subsequent events for the same patient, which impacts the numerator of the CDI SIR

B. Outpatient data are not incorporated into the CDI SIR

C. Surveillance of CDI within ED/24 hr Obs. units contributes to the risk adjustment, impacting the # of predicted events (SIR denominator)

D. Both A and C

Knowledge Check
Answer

- D: Both A and C

  - Events from ED and observation units are used to categorize subsequent CDI events as “recurrent”, which excludes those subsequent events from being counted in the SIR
  - CDI surveillance in ED and observation units is included as a risk factor in the CDI SIR
Final Component in the SIR: Number of Patient Days

- Final variable used in the SIR calculation
- Review monthly CDI Patient Days for accuracy
  - SIR report will show quarterly patient days
  - Summary Data Line List
  - Manually review each month’s denominator record
You can calculate # of predicted events yourself!

\[ \text{# predicted HO CDI} = \exp[-8.9463 + 0.7339 \text{ (CO prevalence rate)} - 0.1579 \text{ (CDI test type = EIA)} + 0.1307 \text{ (CDI test type = NAAT)} + 0.7465 \text{ (ICU beds \geq 43)} + 0.7145 \text{ (ICU beds: 20 – 42)} + 0.6261 \text{ (ICU beds: 10-19)} + 0.4394 \text{ (ICU beds: 5-9)} + 1.2420 \text{ (Oncology hospital)} + 0.3740 \text{ (General hospital)} + 0.0003 \text{ (Total facility bed size)} + 0.1119 \text{ (Reporting from ED or 24 hr. Obs)} + 0.0331 \text{ (Teaching hospital)}] \times \text{CDI patient days} \]
All Facilities: Three Keys to an Accurate LabID SIR

1. Confirm 3 months of data for each quarter

2. Review number of events and patient days for accuracy

3. Be aware of risk factors used in the SIR calculation: review for accuracy!

Your facility’s high CDI SIR on Hospital Compare is still concerning, and you want to investigate this further. Which of the following steps can you take to look into this?

A. Address any alerts on the home screen and run the CDI SIR in NHSN
B. Confirm FacWideIN denominator data entry
C. Review all risk adjustment variables used for the SIR
D. Compare this SIR to previous CDI SIRs to determine if there is a significant change over time
E. All of the above

Knowledge Check
E: All of the above

While reviewing your SIR in NHSN, it’s important to:
- Clear any Alerts on the home screen
- Review numerator and denominator data entry
- Generate new analysis datasets if needed
- Confirm risk adjustment variables
- Know your Data! Compare SIR to previous quarters

Consult the LabID SIR Troubleshooting Guide for answers to common questions: [https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf](https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf)
Additional Resources

- **LabID SIR Troubleshooting Guide**
  - Why are some events not counted in the SIR?
  - Why are some months excluded from the SIR?
  - Why can’t I see an SIR for a certain time period?
    https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/mrsacdi_tips.pdf

- **NHSN’s SIR Guide**
  - Risk adjustment
  - Explanation of regression models and each variable included

- **LabID Event SIRs for CMS**
  - Step-by-step review
    https://www.cdc.gov/nhsn/cms/index.html
March 2017 NHSN Training

APPENDIX: Analyzing MRSA Bacteremia SIRs, and SIR reports from non-acute care facility settings
Number of Predicted Events: MRSA Bacteremia

- Negative binomial regression model
- Incorporates 6 different factors & total patient days

<table>
<thead>
<tr>
<th>6 Variables Required for # Predicted MRSA events</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inpatient community-onset prevalence rate - QUARTERLY</td>
</tr>
<tr>
<td>2. *Average length of stay</td>
</tr>
<tr>
<td>3. Medical school affiliation <em>(annual survey)</em></td>
</tr>
<tr>
<td>4. Number of ICU beds <em>(annual survey)</em></td>
</tr>
<tr>
<td>5. Facility type</td>
</tr>
<tr>
<td>6. *Outpatient community-onset prevalence rate - QUARTERLY</td>
</tr>
</tbody>
</table>

- Variables in bold were not previously discussed
- Quarterly prevalence rates used in risk adjustment
Number of Predicted Events: MRSA Bacteremia

- Quarterly inpatient and quarterly outpatient CO prevalence rates are used in the MRSA bacteremia SIR calculation

- Therefore, MRSA bacteremia SIRs in acute care hospitals require that data from the entire quarter have been entered into NHSN

- Accurate SIRs can only calculated for a quarter time period, or longer
Average Length of Stay

- Average # of days patients stay in the facility
- Derived from the annual survey
- Total annual patient days / total annual admissions

### 6 Variables Used for # Predicted MRSA events

1. Inpatient community-onset prevalence rate
2. Average length of stay
3. Medical school affiliation
4. Number of ICU beds
5. Facility type
6. Outpatient community-onset prevalence rate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Length of Stay**: ≥5.1 days</td>
<td>0.2787</td>
<td>0.0343</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Average Length of Stay**: 4.3-5.0 days</td>
<td>0.0955</td>
<td>0.0341</td>
<td>0.0050</td>
</tr>
<tr>
<td>Average Length of Stay**: 0-4.2 days</td>
<td>REFERENT</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Outpatient Community-Onset Prevalence Rate

- Combines MRSA bacteremia data from any ED or 24 hour observation (obs) location in the facility

\[
\frac{\text{# unique CO MRSA bacteremia events in ED/24hr Obs}}{\text{total # encounters for the quarter}} \times 100
\]

- Calculated for entire quarter
- If no ED or 24 hr Observation location – that’s ok! Will still receive risk adjustment based on other variables in the model.
Review Outpatient Prevalence Rate

- Currently, users can review location-specific outpatient rates:

<table>
<thead>
<tr>
<th>summaryYM</th>
<th>location</th>
<th>MRSA_bldCount</th>
<th>numencounters</th>
<th>MRSA_bldPrevRate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015M01</td>
<td>ED</td>
<td>1</td>
<td>1515</td>
<td>0.066</td>
</tr>
<tr>
<td>2015M02</td>
<td>ED</td>
<td>1</td>
<td>2015</td>
<td>0.050</td>
</tr>
<tr>
<td>2015M03</td>
<td>ED</td>
<td>4</td>
<td>1007</td>
<td>0.397</td>
</tr>
</tbody>
</table>

- Data quality check: Review # encounters and outpatient CO events
- Risk adjustment uses a combined prevalence rate across all ED/OBS locations
  - Will be built into NHSN rate tables in the coming months, mid-2017
Other Healthcare Settings

- Acute Care Hospitals (Hospital IQR)
- Critical Access Hospitals (Hospital IQR)
- Inpatient Rehabilitation Facilities (IRFQR)
- Long Term Acute Care Hospitals (LTCHQR)
- PPS-Exempt Cancer Hospitals (PCHQR)
Critical Access Hospitals (CAHs): CDI SIR

- Available for facilities enrolled in NHSN as “HOSP-CAH”
- SIR numerator: incident, healthcare-facility onset events
- Risk adjustment used for # predicted events:
  - Inpatient Community-Onset Prevalence Rate
    - # Inpatient CO CDI events / # Admissions * 100
    - 2 categories for risk adjustment:
      - Prevalence Rate = 0
      - Prevalence Rate > 0
    - Based on your facility’s prevalence rate for the ENTIRE QUARTER
      - All 3 months of data entry for the quarter must be complete

REMEMBER: Accurate CDI SIRs can only be calculated for an entire quarter, or higher.
Critical Access Hospital (CAH): MRSA Bacteremia SIR

- Available for facilities enrolled in NHSN as “HOSP-CAH”
- # of predicted events uses “intercept-only model”
  - None of the investigated variables were statistically significantly associated with MRSA bacteremia in CAHs
  - # predicted events will be calculated using the overall (unadjusted) national MRSA bacteremia experience in CAHs
  - Monthly SIRs are available for CAHs

Table 2. Critical Access Hospitals (CAHs)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept*</td>
<td>-10.7795</td>
</tr>
</tbody>
</table>

Formula for manual calculation:

\[ \# \text{ predicted} = \exp(-10.7795) \times \text{patient days} \]
LabID Analysis in Long Term Acute Care (LTAC) and Inpatient Rehabilitation Facilities (IRF)

- Historically, LabID data were submitted to CMS in the form of incidence rates.
- Both rates and SIRs are available:
  - Analyze MRSA or CDI Rates:
    - Baseline Set 1 folder: review rates submitted to CMS (through 2016)
    - MDRO/CDI LabID Analysis Folder: review rates for all time periods
  - Analyze MRSA or CDI SIRs, under the 2015 baseline:
    - Either MDRO/CDI LabID Analysis Folder, or CMS Reports Folder
    - SIRs available for 2015 data and forward
LTAC: MRSA Bacteremia SIR

- Risk adjustment used in calculation of # predicted events:
  - Percent of annual admissions on a ventilator
    - Derived from the annual LTAC facility survey
    - \((\frac{\text{# annual admissions on vent}}{\text{total annual admissions}}) \times 100\)
  - Monthly MRSA bacteremia SIRs available for LTACs
**LTAC: CDI SIR**

- SIR numerator: incident, healthcare-facility onset events
- Risk adjustment for # predicted events:
  - 1. Inpatient Community-Onset Prevalence Rate (for the entire quarter)
  - 2. CDI test type
  - 3. Percent of admissions on a ventilator (annual survey)
  - 4. Percent of beds located in single occupancy rooms (annual survey)

---

**Numbers of LTAC beds in the following categories (categories should equal total):**

- a. Intensive care unit (ICU) or critical care beds: * 6
- b. High observation/special care/high acuity beds (not ICU): * 10
- c. General LTAC beds: * 35

Total number of LTAC beds (licensed capacity): 51
Number of single occupancy rooms: * 50
Total number of admissions with one of the following conditions identified on admission:
- a. Ventilator dependence: * 10
- b. Hemodialysis: * 10

---

**REMEMBER:** Accurate CDI SIRs can only be calculated for an entire quarter, or higher.
IRF: MRSA Bacteremia SIR

- SIR numerator:
  - Free-standing Rehab hospitals: incident, healthcare-facility onset
  - Rehab units within a hospital: # of location-incident LabID events

- # of predicted events uses “intercept-only model”
  - None of the investigated variables were statistically significantly associated with MRSA bacteremia in IRFs
  - # predicted events will be calculated using the overall (unadjusted) national MRSA bacteremia experience in IRFs
  - Monthly MRSA bacteremia SIRs available for IRFs

Table 4. Inpatient Rehabilitation Hospitals (IRFs):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept*</td>
<td>-10.8703</td>
</tr>
</tbody>
</table>

Formula for manual calculation:

\[
\# \text{ predicted} = \left[ \exp (-10.8703) \right] * \text{IRF patient days}
\]
IRF: CDI SIR

- Risk adjustment used in calculation of # predicted events:
  - CDI test type
  - Type of IRF (unit within a hospital vs. free-standing IRF)
    - Additional adjustment for free-standing IRFs with reported community-onset (CO) events
  - Percent of admissions with orthopedic conditions (*annual survey*)
  - Percent of admissions with stroke (*annual survey*)
  - Percent of admissions with traumatic and non-traumatic spinal cord dysfunction (*annual survey*)

*REMEMBER: Accurate CDI SIRs can only be calculated for an entire quarter, or higher.*
Helpdesk: NHSN@cdc.gov


For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.