Advanced NHSN Analysis: Focus on SSI and LabID Data

Maggie Dudeck, MPH, CPH
Epidemiologist

NHSN Training Course

Atlanta, GA

March 12-14, 2014

National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

Objectives

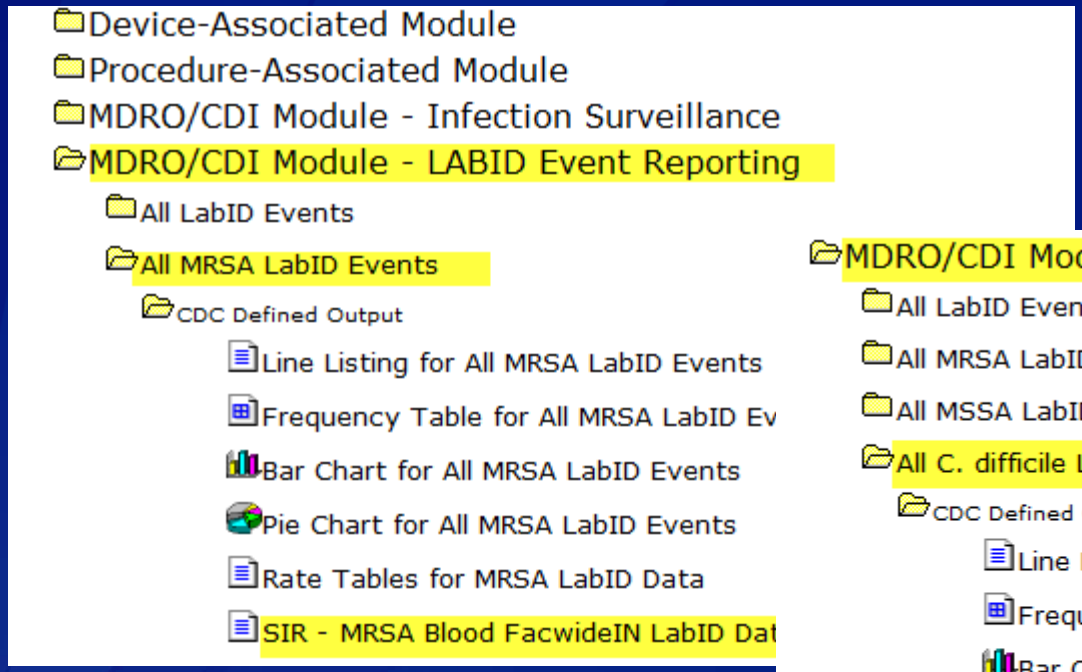
- Demonstrate the use of frequency tables for event-level data.
- Describe and interpret the SIR for surgical site infections and laboratory identified (LabID) events using real-world scenarios.
- Discuss the importance of precision, and practical significance
- Illustrate the use of internal comparisons

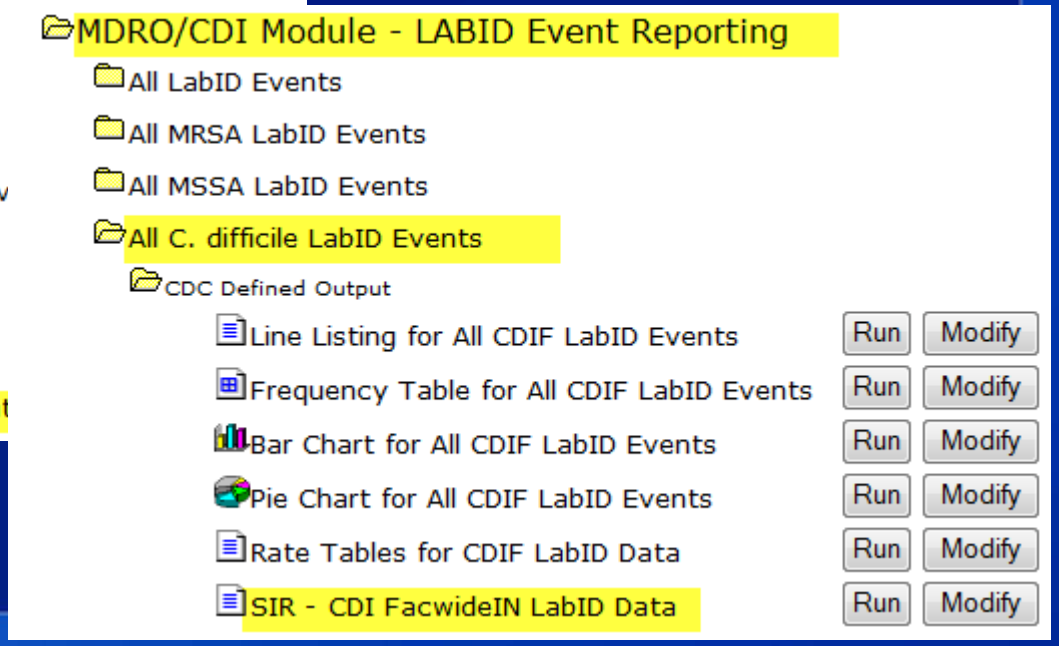
Example #1
LabID SIRs

- Your facility has completed reporting LabID data for 2013. You are specifically interested in looking at your facility's CDI LabID data for the second half of 2013 (i.e., July – December). You decide to start with the SIR.

LabID SIRs

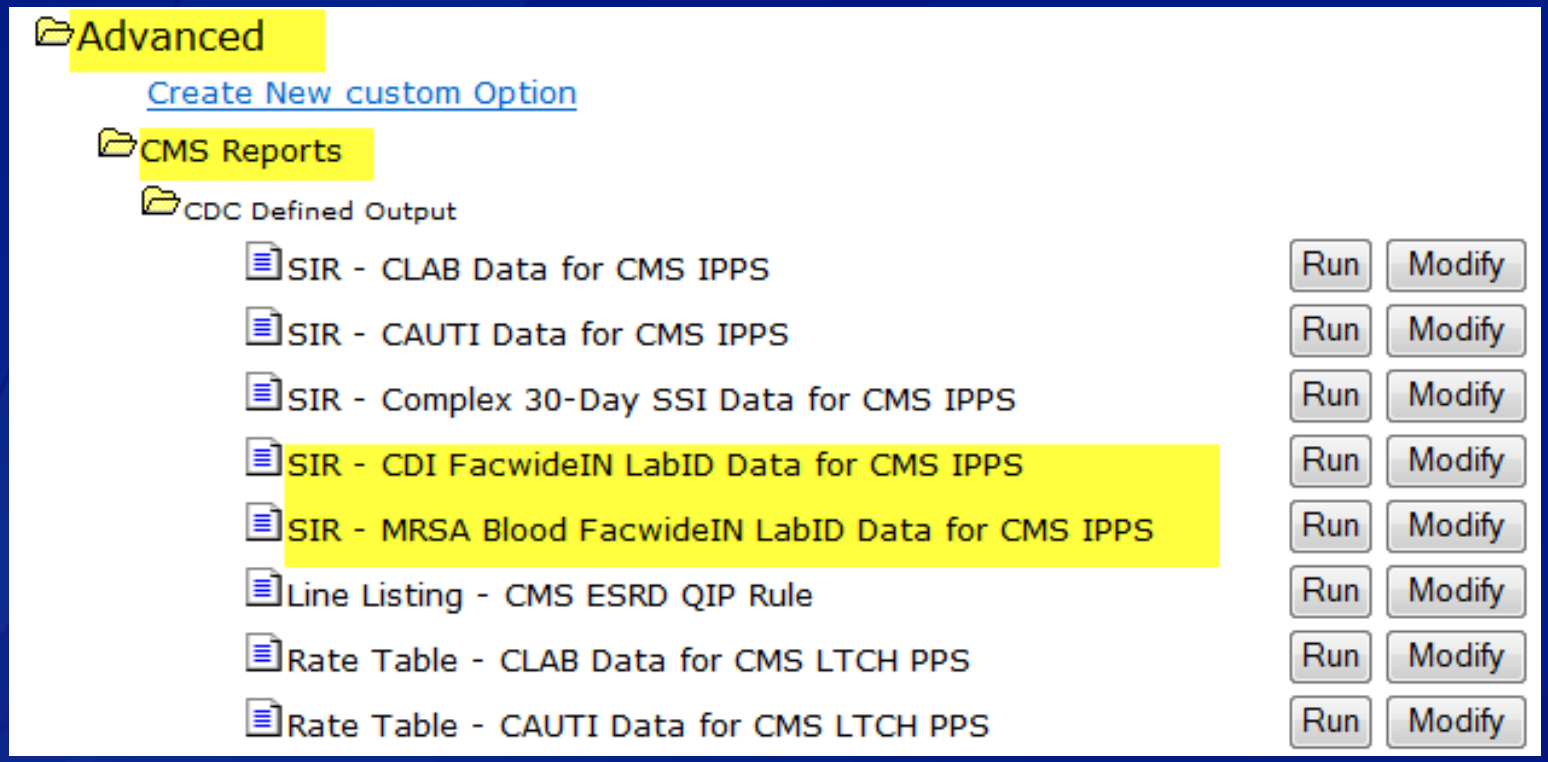
- SIRs are available for both CDI LabID and MRSA bacteremia LabID for Acute Care Hospitals





LabID SIRs for CMS

- SIRs are also available for both CDI LabID and MRSA bacteremia LabID for CMS-related reporting



Expected # of HAIs
CDI and MRSA bacteremia LabID

- **For both MRSA bacteremia and CDI LabID SIRs, the number expected is calculated at the facility quarter-level using negative binomial regression.**
  - **Why quarterly**? When analyzing baseline data at CDC, we identified high variability in prevalence rate (a risk factor) from month-to-month. To alleviate this variability, we used quarterly prevalence rates – thus allowing only quarterly-level SIRs or greater.
- **Available for overall, inpatient facility-wide (FACWIDEIN) surveillance only**
  - **WHY?** CDC was tasked with developing a measure for the CMS Hospital IQR Program for MRSA and CDI. In addition, FACWIDEIN surveillance data for these organisms had the most sufficient data with which to risk adjust at a national level.

Methods for CDI and MRSA bacteremia LabID

published March 2013

Risk Adjustment for Healthcare Facility-Onset *C. difficile* and MRSA Bacteremia Laboratory-identified Event Reporting in NHSN

Margaret A. Dudeck, MPH, CPH, Lindsey M. Weiner, MPH, Paul J. Malpiedi, MPH, Jonathan R. Edwards, MStat, Kelly D. Peterson, BBA, Dawn M. Sievert, PhD

Background

The Centers for Disease Control and Prevention (CDC) introduced the Multidrug-Resistant Organism and *Clostridium difficile* Infection (MDRO/CDI) Module in the National Healthcare Safety Network (NHSN) in March 2009 to enable reporting of CDI, methicillin-resistant *Staphylococcus aureus* (MRSA), and other MDROs. State reporting mandates beginning in 2009, coupled with reporting incentives that the Centers for Medicare and Medicaid Services (CMS) initiated in 2013, account for rapid uptake of the MDRO/CDI Module by acute care hospitals. Use of data from this Module for prevention, public reporting, and payment purposes places a premium on adherence to methodologically sound surveillance practices, including risk adjustment of proxy infection measures. This report describes the risk modeling that CDC applied to laboratory-identified (LabID) event CDI and MRSA bacteremia data submitted to NHSN, the results of which have been incorporated into the analysis options in the NHSN application.

Methods

This analysis was limited to LabID event CDI and MRSA bacteremia surveillance data reported from facilities as in-plan, overall inpatient facility-wide (FacWideIn) during the 2010-2011 baseline time period. As of July 2, 2012, 893 and 759 facilities reported at least one month of CDI and [illegible]

Available at: http://www.cdc.gov/nhsn/PDFs/mrsa-cdi/RiskAdjustment-MRSA-CDI.pdf

Expected # of HAIs
CDI and MRSA bacteremia LabID

#of predicted LabID events

$$= e^{(\beta 0 + \beta 1 X1 + \beta 2 X2 + \ldots)} * \text{patient days}$$

Where:

β = parameter estimate

X = presence of risk factor

Baseline data = 2010-2011

Risk Model
CDI LabID

Model to predict healthcare facility-onset (HO) CDI LabID events, NHSN, 2010-2011.		
Effect	Parameter Estimate	p-value
Intercept	-7.8983	<0.0001
CDI Test Type (NAAT vs. non-NAAT/EIA others)	0.3850	<0.0001
CDI Test Type (EIA vs. non-NAAT/EIA others)	0.1606	0.0013
CO Admission prevalence rate (continuous)	0.3338	<0.0001
Facility Bedsize (>245 vs. ≤100)	0.2164	<0.0001
Facility Bedsize (101-245 vs. ≤ 100)	0.0935	0.0022
Medical School Affiliation (Major teaching vs. Undergraduate/Non-Teaching)	0.1870	<0.0001
Medical School Affiliation (Graduate vs. Undergraduate/Non-Teaching)	0.0918	0.0038

Dudeck MA, Weiner LM, Malpiedi PJ, et al. Risk Adjustment for Healthcare Facility-Onset C. difficile and MRSA Bacteremia Laboratory-identified Event Reporting in NHSN. Published March 12, 2013. Available at: http://www.cdc.gov/nhsn/pdfs/mrsa-cdi/RiskAdjustment-MRSA-CDI.pdf.

Quick note about CDI Test Type

- **CDI LabID SIRs for 2012-2013 will use the information reported on the most recent annual hospital survey**
- **SIRs for 2014 and forward will use the CDI Test type reported for each quarter.**
  - CDI Test type will be asked on the Monthly denominator form for the last month of each calendar-year quarter.
    - March
    - June
    - September
    - December

MDRO and CDI Prevention Process and Outcome Measures Monthly Reporting

*required for saving **conditionally required based upon monitoring selection in Monthly Reporting Plan

Facility ID #: _____ *Month: _____ *Year: _____ *Location Code: _____

Setting: Inpatient **Total Patient Days: _____ **Total Admissions: _____

Setting: Outpatient (or Emergency Room) Total Encounters: _____

If monitoring *C. difficile* in a FACWIDE location, then subtract NICU & Well Baby counts from Totals:

**§ Patient Days: _____ **§ Admissions: _____ **§ Encounters: _____

**For this quarter, what is the primary testing method for *C. difficile* used most often by your facility's laboratory or the outside laboratory where your facility's testing is performed? (check one)

- ☐ Enzyme immunoassay (EIA) for toxin
- ☐ Cell cytotoxicity neutralization assay
- ☐ Nucleic acid amplification test (NAAT) (e.g., PCR, LAMP)
- ☐ Glutamate dehydrogenase (GDH) antigen plus EIA for toxin (2-step algorithm)
- ☐ GDH plus NAAT (2-step algorithm)
- ☐ GDH plus EIA for toxin, followed by NAAT for discrepant results
- ☐ Toxigenic culture (*C. difficile* culture followed by detection of toxins)
- ☐ Other (specify): _____

("Other" should not be used to name specific laboratories, reference laboratories, or the brand names of C. difficile tests; most methods can be categorized accurately by selecting from the options provided. Please ask your laboratory or conduct a search for further guidance on selecting the correct option to report.)

More about CDI Test Type…

- If "Other" is selected when a more appropriate response is available on the form, your facility's data will not be risk-adjusted to the most appropriate level.
- "Other" should not be used to name specific laboratories, reference laboratories, or the brand names of C. difficile tests; most methods can be categorized accurately by selecting from the options provided.

Risk Model
MRSA Bacteremia LabID

Model to predict healthcare facility-onset (HO) MRSA bacteremia LabID events, NHSN, 2010-2011.		
Effect	Parameter Estimate	p-value
Intercept	-10.2368	<0.0001
Admission prevalence rate (continuous)	2.2760	<0.0001
Facility Bedsize (>400 vs. ≤400)	0.3672	<0.0001
Medical School Affiliation (Major teaching vs. all others)	0.3248	<0.0001

Dudeck MA, Weiner LM, Malpiedi PJ, et al. Risk Adjustment for Healthcare Facility-Onset C. difficile and MRSA Bacteremia Laboratory-identified Event Reporting in NHSN. Published March 12, 2013. Available at: http://www.cdc.gov/nhsn/pdfs/mrsa-cdi/RiskAdjustment-MRSA-CDI.pdf.

Applying Risk Model
MRSA Bacteremia LabID

- **Sample Facility Profile:**
  - 450 bed, major medical school-affiliated hospital
  - In Q1, 2013: 23,500 patient days, 11,000 admissions, and 22 CO MRSA bacteremia LabID events

[**exp** -10.2368
+ 0.3672(**bedsize > 400***)
+ 0.3248(**medical school affiliation = major***)
+ 2.2760(**CO MRSA prevalence rate**)] x **patient days**

*For these risk factors, if present = 1; if not = 0

Applying Risk Model
MRSA Bacteremia LabID

- **Sample Facility Profile:**
  - 450 bed, major medical school-affiliated hospital
  - In Q1, 2013: 23,500 patient days, 11,000 admissions, and 22 CO MRSA bacteremia LabID events

[**exp** -10.2368
+ 0.3672(**1**)
+ 0.3248(**1**)
+ 2.2760(**0.20**)] x **23,500**

= **2.65 expected HO MRSA bacteremia LabID events**

General Interpretation of the SIR EXAMPLE: CDI SIR

Org ID	Location	Summary Yr/Half	Months	CDIF Facility Incident HO LabID Event Count	CDIF Facility Incident HO LabID Number Expected	Patient Days	SIR	SIR p-value	95% Confidence Interval
10018	FACWIDEIN	2013H2	6	45	36.042	43838	1.249	0.1448	0.922, 1.656

- During the second half of 2013, our facility identified 45 incident healthcare facility onset (HO) CDI LabID events.
- Based on the national baseline data, 36.042 incident HO CDI LabID events were expected.
- This yields an SIR of 1.249.

0%

QUESTION #1

The p-value is:

1. A probability
2. The difference between two measures.
3. Evidence of how rare an outcome is that it would not have happened just by chance
4. How much higher or lower our rate is compared to the benchmark.
5. Both 1 and 4
6. Both 1 and 3

1 2 3 4 5 6

Question #2

Which of the following statements are true regarding 95% Confidence Intervals?

1. The 95% CI tells us that we're 95% confident that our SIR is different than the national SIR.
2. The 95% CI tells us that we are confident that it contains the *true* SIR.
3. If the 95% CI includes our SIR, then there's no statistical significance.
4. If the 95% CI does not include 1, then there is a statistically significant difference.
5. Both 1 and 4
6. Both 2 and 4

10

Countdown

1 2 3 4 5 6

Question #3: How would you interpret the data in this table?

Org ID	Location	Summary Yr/Half	Months	CDIF Facility Incident HO LabID Event Count	CDIF Facility Incident HO LabID Number Expected	Patient Days	SIR	SIR p-value	95% Confidence Interval
10018	FACWIDEIN	2013H2	6	45	36.042	43838	1.249	0.1448	0.922, 1.656

0% 1. Our facility identified 25% more HO CDI events than predicted.

0% 2. Our facility's CDI LabID rate is 25% higher than the national average

0% 3. Although our SIR is above 1, it is not significantly higher than 1, based on statistical evidence.

0% 4. SIR indicates that we identified significantly more infections than predicted, when looking at the statistical evidence.

0% 5. Both 1 and 3.

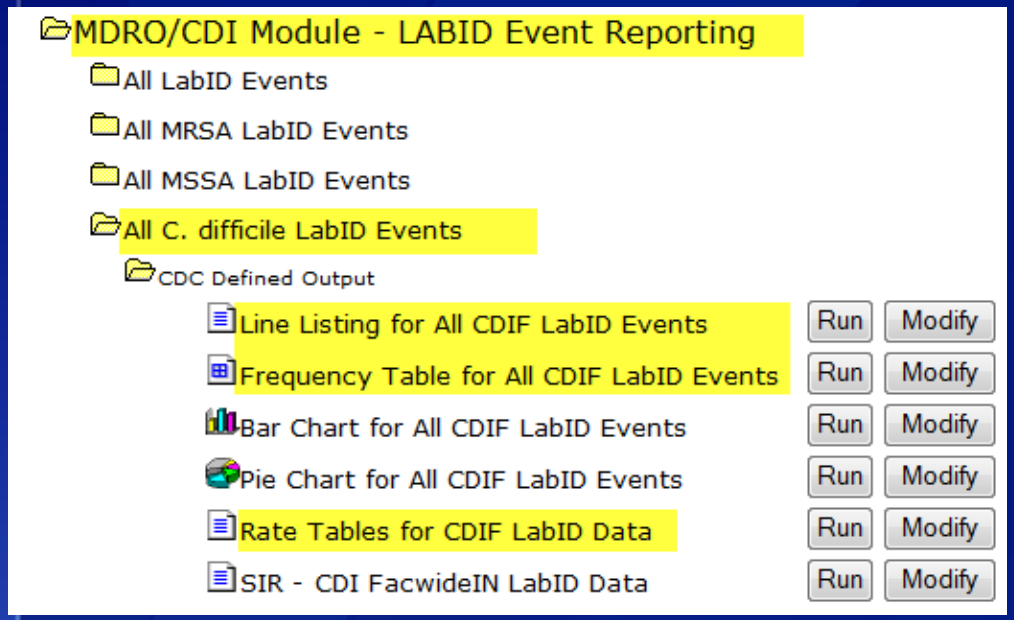
10

Countdown

What other pieces of information can complement the CDI LabID SIR?

- **Prevalence Rates**
  - Community-onset (CO)
  - Community-onset, Healthcare facility-associated (CO-HCFA)
- **Identification of trends by patient care area**
- **Identification of temporal trends during this time period**
- **Comparison to previous time periods within your hospital**
  - Particularly if any targeted prevention efforts were implemented

Obtaining Rates



- **Single Rate Table output option for CDI LabID includes various types of rates (e.g., CO prevalence, HO incidence)**
- **All LabID rates are described in the MDRO/CDI Module Protocol**

MDRO/CDI Module Protocol:
http://www.cdc.gov/nhsn/PDFs/pscManual/12pscMDRO_CDADcurrent.pdf

LabID Rates

- As with other rates in NHSN, these rates can be run by month, quarter, half-year, year, or other cumulative time period
- Can obtain FACWIDEIN rates, as well as location-specific rates (if your facility has chosen to report location-specific denominators)

The importance of data quality…

- Here is our original CDI LabID SIR with "NAAT" indicated as the CDI Test Type.

Org ID	Location	Summary Yr/Half	Months	CDIF Facility Incident HO LabID Event Count	CDIF Facility Incident HO LabID Number Expected	Patient Days	SIR	SIR p-value	95% Confidence Interval
10018	FACWIDEIN	2013H2	6	45	36.042	43838	1.249	0.1448	0.922, 1.656

- But let's say that we selected "Other" for CDI Test Type and indicated "PCR" in the specification field.

Org ID	Location	Summary Yr/Half	Months	CDIF Facility Incident HO LabID Event Count	CDIF Facility Incident HO LabID Number Expected	Patient Days	SIR	SIR p-value	95% Confidence Interval
10018	FACWIDEIN	2013H2	6	45	24.525	43838	1.835	0.0002	1.354, 2.433

Example #2
SSI SIR

- You have been performing SSI surveillance for 7 procedure categories and have been reporting these data to NHSN
- You have been asked to report a measurement of your facility's SSI experience for these procedures for 2013 at your next committee meeting.
- You decide to use the SIR…

Why not use a rate?

- **Previously, SSIs were measured using rates that were calculated from the Basic Risk Index**
- **Limitations to using the Basic Risk Index:**
  - Risk index relies on three risk factors only
  - These same risk factors must differentiate risk for all types of procedures
  - The relative contribution of these factors are constrained to be equal

Why not use a rate?

- **SSI Rates have been replaced by SSI SIRs**
  - SSI Rates output options still exist in the "Advanced" folder
  - You can still obtain your facility's SSI rates using Basic Risk Index, however NHSN pooled mean and comparison statistics for SSI Rates are no longer available
  - SIRs use several risk factors to build logistic regression models for improved risk adjustment
  - Due to the complexity of these models, we are unable to publish risk-stratified rates

Expected SSIs

- The number of expected SSIs is calculated by summing the procedure risk for all procedures included in the summarized calculation (e.g., all procedures for 2013)
- The procedure risk is calculated from improved risk models* that use 2006-2008 data as the baseline

*Mu Y et al. Infect Control Hosp Epidemiol 2011;32(10):970-986.

Available NHSN Risk Factors
from 2006-2008

For All Procedures		
General anesthesia	Age	
Wound class	Emergency	Gender
ASA score	Trauma	Endoscope
Duration of procedure	Bed size[Δ]	Med School Affiliation[Δ]

For C-section		
Duration of labor		
Weight	Height	Estimated blood loss

For Spinal fusion	
Diabetes Mellitus	
Spinal level	Approach/Technique

For Hip/Knee prosthesis	
Total/Partial	Primary/Revision

[Δ]Hospital-level factor

Logistic Regression Model
SSI after VHYS (N=19,056)*

Factor	Parameter Estimate	OR	p-value
Intercept	*-5.89*	-	-
Age (≤44 vs >44)	0.66	1.94	<0.0001
ASA (>2 vs ≤2)	0.42	1.51	0.0363
Duration (>100 vs ≤100)	0.50	1.65	0.0011
Med school affiliation (Y vs N)	0.89	2.42	<0.0001

* Mu Y et al. Infect Control Hosp Epidemiol 2011;32(10):970-986.

Logistic Model for VHYS:

Factor	Parameter Estimate
Intercept	*-5.89*
Age (≤44)	0.66
ASA (3/4/5)	0.42
Duration (>100 min)	0.50
Med school affiliation (Y)	0.89

$$\text{logit}(\hat{p}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

$$= -5.89 + 0.66\,(\text{Age} \leq 44^*) + 0.42\,(\text{ASA} > 2^*) + 0.50\,(\text{Duration} > 100^*) + 0.89\,(\text{Med school affiliation}^*)$$

*For these risk factors, if present = 1; if not = 0

Example VHYS Patient #1
Risk Factors

- Age = 40
- ASA score = 4
- Duration = 117 min
- Med school affiliation = Y

Logistic Model
Calculation for Example VHYS Patient #1

$$\text{logit}(\hat{p}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

$$\text{logit}(\hat{p}) = -5.89 + 0.66\,(1) + 0.42\,(1) + 0.50\,(1) + 0.89\,(1) = \underline{-3.42}$$

Solve for $\hat{p}$: $\hat{p} = e^{\text{logit}(\hat{p})} / (1 + e^{\text{logit}(\hat{p})})$

$$\hat{p} = e^{-3.42} / (1 + e^{-3.42}) = \mathbf{0.032} \text{ or } 3.2\% \text{ risk}$$

List of Patient Risk Factors
SSI after VHYS

Patient	Age	Duration	ASA Score	Med School Affiliation	SSI	Prob of SSI ($\hat{p}$)
1	40	117	4	Y	0	**0.032**
2	53	95	2	N	0	**0.003**
3	30	107	2	Y	1	**0.019**
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
100	37	128	4	Y	1	**0.032**
		Total			**O = 3**	**E = 2.91**

Standardized Infection Ratio (SIR) = 3 / 2.91 = 1.0

Procedure Risk – COLO*

$$\text{logit}(\hat{p}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta_i X_i$$

Where α = intercept

β_i = parameter estimate

X_i = presence of risk factor

Risk Factor	Parameter Estimate
Intercept	*-3.89*
Age10	-0.02
Anesthesia (Y)	0.38
ASA (>2)	0.30
Duration10	0.03
Endoscope (N)	0.13
Med School affiliation (N)	0.14
Bedsize (>500)	0.26
Wound class (CO/D)	0.09

National Healthcare Safety Network
Line Listing - COLOs 2011H1 with Risk

As of: May 2, 2012 at 10:25 AM
Date Range: PROCEDURES procDateYH 2011H1 to 2011H1

Procedure ID	Procedure Date	Age on Proc Date	General Anesthesia?	ASA Class	Duration of Procedure - hr	Duration of Procedure - min	Endoscopic Approach?	Medical School Affiliated	Number of Beds	Wound Class	Risk using All SSI Model
232407	04/20/2011	88	Y	1	3	14	N	Y	566	CO	0.0643
232408	04/21/2011	87	Y	2	4	10	N	Y	566	CO	0.0742
232409	04/22/2011	87	Y	1	1	22	N	Y	566	CO	0.0482
232410	04/27/2011	87	Y	5	2	2	N	Y	566	CC	0.0653
232411	05/03/2011	86	Y	1	2	42	N	Y	566	CC	0.0545
232412	05/05/2011	84	Y	3	3	20	N	Y	566	CC	0.0800
232413	05/12/2011	84	Y	3	1	40	N	Y	566	CC	0.0621

* Mu Y et al. Infect Control Hosp Epidemiol 2011;32(10):970-986.

How do our data look in NHSN?

- **NHSN will calculate SIRs for you**
- **There are multiple SSI SIR options – each containing slightly different results!**
  - TODAY we will use the **All SSI SIR** report
  - The options represent different risk models, based on different subsets of data

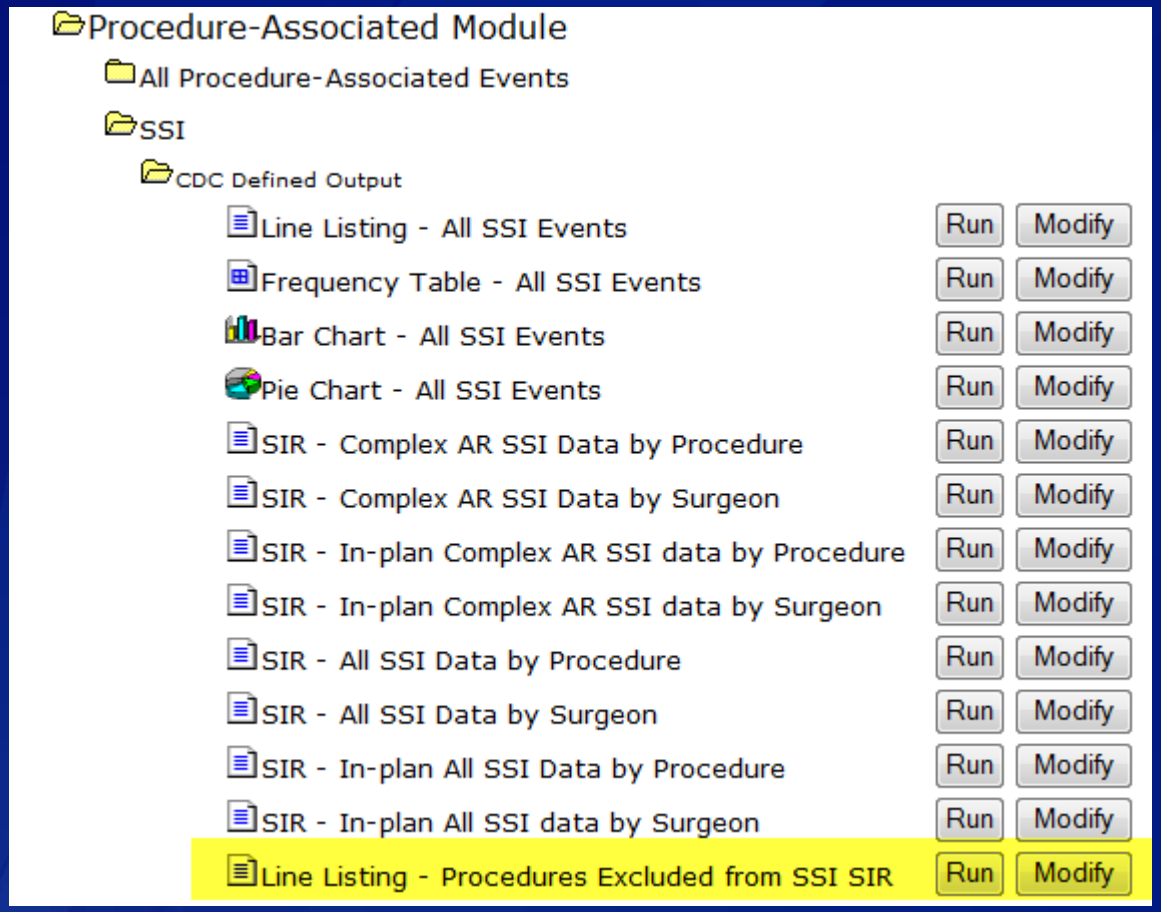
Universal Exclusion Criteria for SSI SIRs

Related to potential data quality issues

- Missing one or more of the required risk factors.
- Procedure duration is <5 minutes or >IQR5, which is defined as five times the interquartile range above the 75th percentile (i.e., extremely high procedure duration). For example, if the interquartile range is 30 minutes (Q3-Q1) and the 75th percentile is 100 minutes, the IQR5 would be 100 +(5*30) = 250 minutes.
- Procedure date is ≤ patient date of birth.
- Patient's age at procedure is ≥ 109 years.
- Wound Class (swClass) = 'U'.
- Approach = 'N' (for FUSN and RFUSN only.)
- Spinal Level = 'N' (for FUSN only.)

Beginning with 2014 procedures, these values are no longer allowed in NHSN.

Exclusion Criteria for SSI SIRs



- NHSN provides a line listing of all procedures that have been excluded from the SIRs for the reasons listed on the previous slide.

Additional Universal Exclusions

(indicated in the footnotes of the SIRs)

- **SSI SIRs will exclude superficial incisional secondary (SIS) and deep incisional secondary (DIS) SSIs**
- **Under the current baseline (2006-2008), SIRs will exclude procedures and associated SSIs reported with a closure "Other than primary"**

SSI SIR Options in NHSN

All SSI SIR Model	• Includes Superficial, Deep & Organ/Space • Superficial & Deep incisional SSIs limited to primary only • Includes SSIs identified on admission, readmission & via post-discharge surveillance
Complex A/R SSI Model	• Includes <u>only</u> SSIs identified on Admission/Readmission to facility where procedure was performed • Includes <u>only</u> inpatient procedures • Includes <u>only</u> Deep incisional primary & Organ/Space SSIs
Complex 30-day SSI model (used for CMS IPPS)	• Includes only in-plan, inpatient COLO and HYST procedures in adult patients (i.e., ≥ 18 years of age) • Includes only deep incisional primary and organ/space SSIs with an event date within 30 days of the procedure • Uses only age and ASA to determine risk

SSI SIR Models

TABLE 5. Models to Predict All Surgical Site Infections (SSIs) at Primary Incision Site for 39 Procedures, National Healthcare Safety Network (NHSN), 2006–2008

Procedure code	No. of procedures	No. of SSIs	Effect	Estimate	OR (95% CI)	*P*	c-index PSM	c-index RIM	c-index Pr>|*t*|
APPY	6,122	85					.70	.60	.0037
			Intercept	−5.54		<.0001			
			Emergency, Y vs N	0.61	1.84 (1.14–2.99)	.0135			
			Gender, M vs F	0.53	1.70 (1.07–2.68)	.024			
			Bed size, >500 vs ≤500	0.77	2.15 (1.38–3.34)	.0007			
			Wound class, CO vs C/CC	0.63	1.89 (1.07–3.33)	.0294			
			Wound class, D vs C/CC	1.26	3.53 (2.04–6.09)	<.0001			

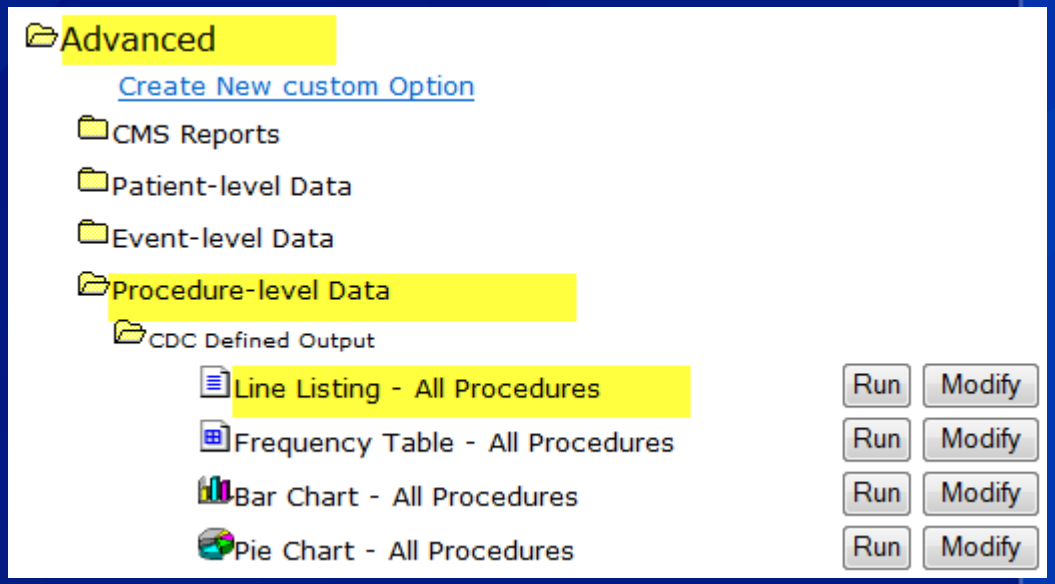
TABLE 6. Multivariate Models Predicting Deep Incisional and Organ/space Surgical Site Infections (SSIs) Detected During Initial Hospitalization or Rehospitalization at the Same Hospital for 39 Procedures Reported to the National Healthcare Safety Network, 2006–2008

Procedure code	No. of procedures	No. of SSIs	Effect	Estimate	OR (95% CI)	*P*	c-index
APPY	5,889	50					.74
			Intercept	−6.62		<.0001	
			Emergency, Y vs N	0.87	2.38 (1.21–4.67)	.0116	
			Gender, M vs F	0.84	2.31 (1.22–4.38)	.0099	
			Bed size, >500 vs ≤500	0.94	2.56 (1.44–4.54)	.0013	
			Wound class, CO/D vs C/CC	1.07	2.90 (1.64–5.15)	.0003	

Mu Y et al. Infect Control Hosp Epidemiol 2011;32(10):970-986.

SSI SIR Models – at the Procedure Level

- Can be obtained from Advanced > Procedure-level Data
- Add the following variables:
  - modelRiskAll
  - modelRiskComplex
  - modelRiskComplex30d



SSI SIR Models – at the Procedure level

National Healthcare Safety Network
Line Listing for All Procedures

As of: February 27, 2014 at 10:13 AM
Date Range: PROCEDURES procDateYr After and Including 2013

orgID	procID	procDate	procCode	modelRiskAll	modelRiskComplex	modelRiskComplex30d
10018	319281	01/15/2013	COLO	0.0641	0.0284	0.0181
10018	319282	01/16/2013	COLO	0.0739	0.0338	0.0181
10018	319283	01/17/2013	COLO	0.0481	0.0201	0.0181
10018	319284	01/18/2013	COLO	0.0650	0.0262	0.0277
10018	319285	01/19/2013	COLO	0.0544	0.0214	0.0185
10018	319286	01/20/2013	COLO	0.0797	0.0332	0.0286
10018	319287	01/21/2013	COLO	0.0618	0.0244	0.0286
10018	319288	01/22/2013	COLO	0.0522	0.0220	0.0189
10018	319289	01/23/2013	COLO	0.0523	0.0203	0.0189
10018	319290	01/24/2013	COLO	0.0598	0.0238	0.0191

10

Countdown

Question #4

The table below includes select significant risk factors for a selection of patients undergoing the same NHSN procedure category.

Patient	Age	ASA	Procedure Duration (mins)	Wound Class	Risk: All SSI Model	Risk: Complex A/R Model	Risk: Complex 30-day Model
1	88	1	194	CO	0.0643	0.0284	0.0183
2	28	2	248	CO	0.0827	0.0386	0.0347
3	46	2	202	CC	0.0654	0.0279	0.0287
4	65	2	161	D	0.0618	0.0296	0.0234

Using the information in the above table, which patient do you think is at highest probability of SSI?

0%

1. Patient #1
2. Patient #2
3. Patient #3
4. Patient #4
5. It depends on which SIR you're measuring.

1 2 3 4 5

Question #4
ANSWER

Patient	Age	ASA	Procedure Duration (mins)	Wound Class	Risk: All SSI Model	Risk: Complex A/R Model	Risk: Complex 30-day Model
1	88	1	194	CO	0.0643	0.0284	0.0183
2	28	2	248	CO	0.0827	0.0386	0.0347
3	46	2	202	CC	0.0654	0.0279	0.0287
4	65	2	161	D	0.0618	0.0296	0.0234

- **Patient #2 is at highest risk according to all three risk models.**

Which SIR Model to Use?

- Depends on the intended use(s) of the data
- If interested in incidence of all SSIs identified in your facility, regardless of type or detection method – best to choose the "All SSI" SIRs
- If interested in incidence of only more complex infections (i.e., deep incision, organ/space), as well as only those identified upon an admission to your hospital, - best to choose the "Complex A/R" SIRs
- If interested in verifying COLO and HYST data submitted to CMS, - choose the "Complex 30-day" SIR

All SSI SIR for Select Procedures – 2013 Overall

National Healthcare Safety Network

SIR for All SSI Data by Procedure - By OrgID

As of: February 27, 2014 at 10:11 AM

Date Range: SIR_ALLSSIPROC summaryYr 2013 to 2013

Org ID=10018 CMS Certification Number=N/A

Org ID	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	2013	1749	35	50.672	0.691	0.0214	0.489, 0.950

If infCount in this table is less than you reported, aggregate data are not available to calculate numExp.

Excludes Superficial Incisional Secondary (SIS) and Deep Incisional Secondary (DIS) SSIs.

Includes only procedures and associated SSIs that are reported with primary closure technique.

Lower bound of 95% Confidence Interval only calculated if infCount > 0. SIR values only calculated if numExp >= 1.

Source of aggregate data: 2006-2008 NHSN SSI Data

Data contained in this report were last generated on February 27, 2014 at 8:08 AM.

Question #5

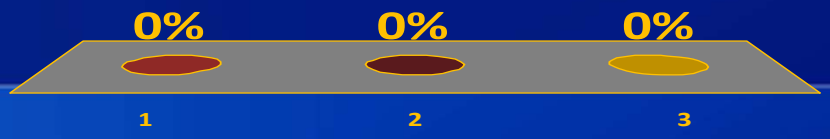
Org ID	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	2013	1749	35	50.672	0.691	0.0214	0.489, 0.950

Based on the p-value and the 95% CI, is the number of observed infections statistically significantly different from the number expected?

1. Yes
2. No
3. Not sure

10

Countdown



Question #5
ANSWER

Org ID	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	2013	1749	35	50.672	0.691	0.0214	0.489, 0.950

Based on the p-value and the 95% CI, is the number of observed infections statistically significantly different from the number expected?

A. Yes

The p-value is <0.05 and the 95% CI does not cross 1.

Overall SIR Interpretation

Org ID	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	2013	1749	35	50.672	0.691	0.0214	0.489, 0.950

- During 2013, our facility identified 35 SSIs, attributed to 1,749 procedures performed.
- The number of expected SSIs during this timeframe, based on national data, was 50.672.
- This yields an SIR of 0.691, indicating that we observed approx. 31% fewer infections than expected
- Based on statistical evidence, we can conclude that our SIR is different from 1.

Overall SIR Interpretation

- GREAT! Our SSI SIR is far below 1! That means we can stop here, right???
- Not so fast…

Elements of an interpretation

- **Cover the basics**
  - How many HAIs?
  - SIRs
  - Over what period of time?
- **Interpret the statistical results**
  - P-value
  - 95% CI
- **Highlight successes or pitfalls**
  - For which procedure types were there 0 SSIs?
  - Trends – have SIRs gone up, or down, for any procedure and/or surgeon compared to previous time period?
  - If a goal is set that is different from an SIR of 1, how is the progress towards that goal?

Elements of an interpretation (cont'd)

- **Supplement the data**
  - What were the organisms identified? Any trends?
  - What special prevention efforts/education have started during this time period?
  - Have there been any significant changes in staff or type of patients undergoing these surgeries
  - Has surveillance been part of any special initiatives?
  - Have there been any internal, or external validation programs that have taken place during this time period?
  - Has education of NHSN definitions enhanced surveillance and understanding of definitions?
- **Look ahead**
  - What are the plans to lower SIRs or maintain low SIRs?

All SSI SIR – 2013
By Procedure

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
CBGB	2013	61	4	1.825	2.192	0.1510	0.696, 5.287
CHOL	2013	174	1	1.270	0.787	0.9183	0.039, 3.883
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041
FUSN	2013	184	3	3.656	0.821	0.7963	0.209, 2.233
HPRO	2013	231	1	4.398	0.227	0.0787	0.011, 1.121
HYST	2013	307	2	4.190	0.477	0.2902	0.080, 1.577
KPRO	2013	300	3	5.020	0.598	0.3852	0.152, 1.626

- **SIRs are provided for each procedure category and time period.**
  - Includes p-value and 95% CI for each category
  - Allows you to see each procedure category's contribution to the overall SIR, including the number of expected infections.
  - Can view changes in SIR for each procedure category over time

Translation from Procedure-specific SIRs to Overall SIR

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
CBGB	2013	61	4	1.825	2.192	0.1510	0.696, 5.287
CHOL	2013	174	1	1.270	0.787	0.9183	0.039, 3.883
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041
FUSN	2013	184	3	3.656	0.821	0.7963	0.209, 2.233
HPRO	2013	231	1	4.398	0.227	0.0787	0.011, 1.121
HYST	2013	307	2	4.190	0.477	0.2902	0.080, 1.577
KPRO	2013	300	3	5.020	0.598	0.3852	0.152, 1.626

The "number expected" is calculated by summing the estimated risk for each procedure in that category and time period.

Translation from Procedure-specific SIRs to Overall SIR

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
CBGB	2013	61	4	1.825	2.192	0.1510	0.696, 5.287
CHOL	2013	174	1	1.270	0.787	0.9183	0.039, 3.883
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041
FUSN	2013	184	3	3.656	0.821	0.7963	0.209, 2.233
HPRO	2013	231	1	4.398	0.227	0.0787	0.011, 1.121
HYST	2013	307	2	4.190	0.477	0.2902	0.080, 1.577
KPRO	2013	300	3	5.020	0.598	0.3852	0.152, 1.626
TOTAL	**2013**	**1749**	**35**	**50.672**			

The infection count, procedure count, and number of expected infections are summed.

Org ID	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	2013	1749	35	50.672	0.691	0.0214	0.489, 0.950

Translation from Procedure-specific SIRs to Overall SIR

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
CBGB	2013	61	4	1.825	2.192	0.1510	0.696, 5.287
CHOL	2013	174	1	1.270	0.787	0.9183	0.039, 3.883
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041
FUSN	2013	184	3	3.656	0.821	0.7963	0.209, 2.233
HPRO	2013	231	1	4.398	0.227	0.0787	0.011, 1.121
HYST	2013	307	2	4.190	0.477	0.2902	0.080, 1.577
KPRO	2013	300	3	5.020	0.598	0.3852	0.152, 1.626
TOTAL	**2013**	**1749**	**35**	**50.672**	**0.691**		

The overall SIR is <u>not</u> a sum of the individual SIRs, but rather is calculated by:

Total infection count/ total expected count

Org ID	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
10018	2013	1749	35	50.672	0.691	0.0214	0.489, 0.950

10

Countdown

Question #6

Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
CBGB	2013	61	4	1.825	2.192	0.1510	0.696, 5.287
CHOL	2013	174	1	1.270	0.787	0.9183	0.039, 3.883
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041
FUSN	2013	184	3	3.656	0.821	0.7963	0.209, 2.233
HPRO	2013	231	1	4.398	0.227	0.0787	0.011, 1.121
HYST	2013	307	2	4.190	0.477	0.2902	0.080, 1.577
KPRO	2013	300	3	5.020	0.598	0.3852	0.152, 1.626

Based on the table above, which procedure category has the highest contribution to the overall SIR?

1. FUSN
2. CBGB
3. KPRO
4. COLO

0%

Question 6 - ANSWER

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
CBGB	2013	61	4	1.825	2.192	0.1510	0.696, 5.287
CHOL	2013	174	1	1.270	0.787	0.9183	0.039, 3.883
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041
FUSN	2013	184	3	3.656	0.821	0.7963	0.209, 2.233
HPRO	2013	231	1	4.398	0.227	0.0787	0.011, 1.121
HYST	2013	307	2	4.190	0.477	0.2902	0.080, 1.577
KPRO	2013	300	3	5.020	0.598	0.3852	0.152, 1.626

- **Based on the table above, which procedure category has the highest contribution to the overall SIR?**

4. COLO

COLO contributes the highest number of SIRs for a single procedure category as well as the highest amount of risk to the overall SIR, as seen by the "number expected".

Example #3

- Due to the high number of COLO procedures performed in 2013, and the high incidence of SSI following these procedures, you have been asked to provide more specifics regarding these data to the Chief Surgeon.
- You begin your analysis by looking at both the ALL SSI SIR and the Complex A/R SSI SIR.

COLO – All SSI SIR

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041

COLO – Complex A/R SSI SIR

Procedure Code	Summary Yr	Procedure Count	Complex AR Model Infection Count	Complex AR Model Number Expected	Complex AR Model SIR	Complex AR Model SIR p-value	Complex AR Model 95% Confidence Interval
COLO	2013	491	9	13.392	0.672	0.2246	0.328, 1.233

Question #7

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041

Procedure Code	Summary Yr	Procedure Count	Complex AR Model Infection Count	Complex AR Model Number Expected	Complex AR Model SIR	Complex AR Model SIR p-value	Complex AR Model 95% Confidence Interval
COLO	2013	491	9	13.392	0.672	0.2246	0.328, 1.233

Given the results of these two SIRs, what conclusions can you begin to make?

0% 1. **Regardless of SIR risk model, our SSI experience remains the same.**

0% 2. **Based on the risk adjustment, fewer COLO patients are at risk for a deep incisional or organ/space SSI.**

0% 3. **More than half of the SSIs identified are superficial incisional SSIs.**

0% **We need to do more digging…**

10

Countdown

COLO – All SSI SIR

Procedure Code	Summary Yr	Procedure Count	All SSI Model Infection Count	All SSI Model Number Expected	All SSI Model SIR	All SSI Model SIR p-value	All SSI Model 95% Confidence Interval
COLO	2013	492	21	30.313	0.693	0.0800	0.440, 1.041

COLO – Complex A/R SSI SIR

Procedure Code	Summary Yr	Procedure Count	Complex AR Model Infection Count	Complex AR Model Number Expected	Complex AR Model SIR	Complex AR Model SIR p-value	Complex AR Model 95% Confidence Interval
COLO	2013	491	9	13.392	0.672	0.2246	0.328, 1.233

- **Notice that the procedure count is practically the same, but the rest of the calculations differ between the two models. Why?**

ALL SSI Model vs. Complex A/R Model

Includes:	ALL SSI Model	Complex A/R
Outpatient procedures	✓	
Superficial incisional primary SSIs	✓	
Deep incisional primary SSIs	✓	✓
Organ/space SSIs	✓	✓
SSIs detected on current admission	✓	✓
SSIs detected on follow-up admission to same facility	✓	✓
SSIs detected on follow-up admission to <u>different</u> facility	✓	
SSIs detected through post-discharge surveillance efforts	✓	

COLO SSIs by Detection Method and Type

Frequency

Table of spcEvent by whenDetected					
spcEvent(Specific Event)	whenDetected(When Detected)				
	A	P	RF	RO	Total
DIP	7	0	0	0	7
GIT	1	1	0	0	2
IAB	0	0	1	0	1
OUTI	0	0	0	1	1
SIP	4	3	0	4	11
Total	12	4	1	5	22

- Cells highlighted above are counts of SSIs <u>excluded</u> from the Complex A/R SSI SIR.

- A = During the admission at which the procedure was performed
- RF = During readmission to <u>this</u> hospital
- RO = During readmission to another hospital
- P = Post-discharge surveillance

COLO SSIs by Detection Method and Type

Frequency	Table of spcEvent by whenDetected				
	spcEvent(Specific Event)	whenDetected(When Detected)			
		A	P	RF	RO	Total
	DIP	7	0	0	0	7
	GIT	1	1	0	0	2
	IAB	0	0	1	0	1
	OUTI	0	0	0	1	1
	SIP	4	3	0	4	11
	Total	12	4	1	5	22

- **WAIT! This table shows 22 SSIs…but the All SSI SIR showed only 21!**

Universal Exclusion Criteria

National Healthcare Safety Network

Incomplete and Custom Procedures not Included in SIR

As of: February 27, 2014 at 10:11 AM

Date Range: SIR_ALLSSIPROC summaryYH 2012H1 to 2012H1

if (((procCode NOT IN ("CBGC", "CSEC"))))

Org ID=10018 CMS Certification Number=N/A

Summary Yr/Half	Org ID	Procedure Code	Outpatient?	Procedure Count	All SSI Model Infection Count
2012H1	10018	COLO	N	4	1
2012H1	10018	HPRO	N	1	0
2012H1	10018	HYST	N	2	1

COLO Summary

- **During 2013, there were 22 total SSIs identified following COLO procedures**
- **The COLO SIR for all SSIs was 0.693, however the statistical evidence does not indicate that there were significantly fewer infections than predicted**
- **Of the 22 SSIs identified:**
  - 1 was excluded from the SIRs, as it was attributed to a procedure with an extremely long procedure duration.
  - 9 were identified as deep incisional or organ/space infections
  - 13 were identified during a stay at our facility

COLO Summary

- When we focus our SIR measurement on those SSIs that were deep incisional or organ/space, and/or detected during an admission to this facility, our SIR is about the same, at 0.672.

There's more to the story…

- **SIRs are a *summary* measure**
- **Additional details and information can be obtained from NHSN**
  - Age of patients
  - Types of SSIs
  - Time from procedure to event
  - Method of detection (e.g., during readmission, via post-discharge surveillance)
  - Surveillance criteria used to define each SSI
  - Pathogen information (if applicable)
  - Individual risk for each procedure/patient , by surgeon (per the NHSN risk models)

More on Frequency Tables and Line Lists…

- **Both can aide in internal validation activities:**
  - Over-classification of higher ASA scores?
  - Are there any surgeons with consistently higher procedure durations compared to the other surgeons?
  - Is there any surgeon that performs more surgeries as a result of trauma?
  - Is wound class being appropriately assigned?
  - Any difference in the distribution of SSI types among surgeons?
- **TIP! When running SSI frequency tables and line lists, be sure to limit by the <u>procedure date</u> in order to align with the SIR.**

Example #4
Understanding Precision

- **Both Hospital A and Hospital B have been performing SSI surveillance in 2013.**
  - Hospital A is a 150-bed, academic facility
  - Hospital B is a smaller, 50-bed hospital with no medical school affiliation

Hospital	# obs SSI	# exp SSI	SIR	P-value	95% CI
A	24	14.196	1.691	0.011	1.083, 2.516
B	4	2.387	1.676	0.219	0.457, 4.291

Example #4
Understanding Precision

Hospital	# obs SSI	# exp SSI	SIR	P-value	95% CI
A	24	14.196	1.691	0.011	1.083, 2.516
B	4	2.387	1.676	0.219	0.457, 4.291

- The SIRs are similar – around 1.6
- Statistical results differ – only Hospital A's SIR is significantly different from 1
- Notice that Hospital A's SIR is based on a higher volume of data, and therefore, the SIR is more precise

Example #4
More about precision…

- Hospital B also reported CAUTI and CDI LabID data:

HAI	# obs	# exp	SIR	P-value	95% CI
CAUTI	2	0.763	--	--	--
CDI	1	0.962	--	--	--

- There are not enough data in order to "expect" even 1 infection of each type – therefore SIRs are not calculated

Example #4
More about precision…

- **Even though SIRs are not calculated, there are still options for Hospital B to interpret the data**

HAI	# obs	# exp	SIR	P-value	95% CI
CAUTI	2	0.763	--	--	--
CDI	1	0.962	--	--	--

- **Hospital B can:**
  - Look at monthly or quarterly CAUTI rates to assess device use, as well as to determine when the CAUTIs occurred
  - Generate SIRs for a longer time period (e.g., year, 18-months)
  - Focus on the practical significance of the data

Example #4
Practical Significance

- **While helpful, sophisticated statistics are not always required when interpreting internal data.**
- **Using CAUTI as the example…**
  - 2 infections were identified, but not even 1 was predicted to occur – this alone could be cause for concern within the hospital
  - Were there changes in staff during this time period?
  - Were there changes in the devices used or how they were maintained?
  - Has this been a trend over previous time periods of this length?

HAI	# obs	# exp	SIR	P-value	95% CI
CAUTI	2	0.763	--	--	--

Example #4
Practical Significance

- **Going back to Hospital B's SSI data…**

Hospital	# obs SSI	# exp SSI	SIR	P-value	95% CI
B	4	2.387	1.676	0.219	0.457, 4.291

- **Depending on what is being assessed and the prevention and reduction goals, Hospital B may wish to make decisions regardless of the statistical results.**
  - Continue or increase prevention efforts for SSIs
  - Additional information may help – e.g., are these SSIs attributed to a specific procedure category or surgeon(s)? When are these SSIs identified? What type of SSIs were identified?

Example #5
Internal Comparisons

- You work at a Long Term Acute Care Hospital (LTACH) that has been performing surveillance for CLABSI and CAUTI. Due to the location type used for reporting, you are unable to obtain an SIR.
- You'd like to measure how your facility is doing compared to National data, as well as how your facility is doing over time, comparing 2 6-month time periods.

Internal Comparisons

- **NOTE! The methods we are about to discuss can be applied to other location types within the acute care setting. For example:**
  - Telemetry wards
  - Mixed Acuity Wards
  - IRFs and IRF units

CAUTI Output Options

Patient Safety Component

Analysis Output Options

HELP

Expand All | Collapse All

- Device-Associated Module
  - All Device-Associated Events
  - Central Line-Associated BSI
  - Ventilator-Associated PNEU
  - Ventilator-Associated Events
  - Urinary Catheter-Associated UTI
    - CDC Defined Output

Line Listing - All CAU Events	Run	Modify
Frequency Table - All CAU Events	Run	Modify
Bar Chart - All CAU Events	Run	Modify
Pie Chart - All CAU Events	Run	Modify
Rate Table - CAU Data for ICU-Other/SCA/ONC	Run	Modify
Run Chart - CAU Data for ICU-Other/SCA/ONC	Run	Modify
Rate Table - CAU Data for NICU	Run	Modify

LTAC ICU CAUTI Rates

Location	Summary Yr/Half	Months	CA UTI Count	Urinary Catheter Days	CA UTI Rate	NHSN CAU Pooled Mean	Incidence Density p-value	Incidence Density Percentile
ICU	2013H1	6	4	678	5.900	2.6	0.1367	85
ICU	2013H2	6	2	685	2.920	2.6	0.7888	65

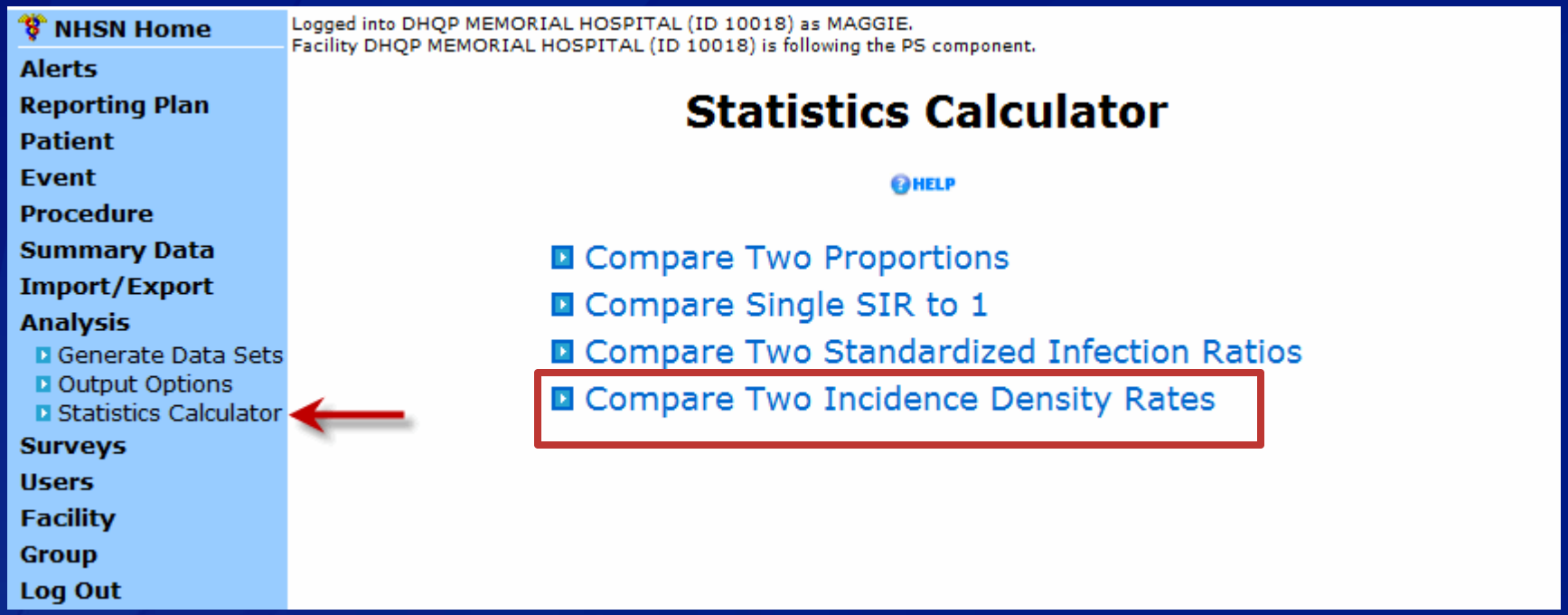
- Here we have the output from NHSN for our LTAC ICU location.
- We have the NHSN pooled mean ("external comparison")
- BUT…have we made significant progress when comparing to ourselves???

LTAC ICU CAUTI Rates

Location	Summary Yr/Half	Months	CA UTI Count	Urinary Catheter Days	CA UTI Rate	NHSN CAU Pooled Mean	Incidence Density p-value	Incidence Density Percentile
ICU	2013H1	6	4	678	5.900	2.6	0.1367	85
ICU	2013H2	6	2	685	2.920	2.6	0.7888	65

- **What can we say about these data, without running a statistical test?**
  - The CAUTI rate decreased over the two periods.
  - The number of urinary catheter-days was nearly the same.
  - The catheter use is unknown.

Statistics Calculator



Quick Reference Guide: http://www.cdc.gov/nhsn/PS-Analysis-resources/PDF/StatsCalc.pdf

Statistics Calculator

Compare Two Incidence Density Rates

HELP

When comparing two incidence density rates (i.e. person-time), the hypothesis is that the rates are not different from each other. To perform a statistical test and calculate a p-value, enter the number of events as the numerator, the number of person-time units (i.e. exposure) as the denominator, and choose the multiplier you wish for the rate calculation. Press calculate. (See examples below)

	Data Source #1	Data Source #2
Group Labels:	Jan-June	July-Dec
Numerator(Number of events):	4	2
Denominator(Number of person-time units):	678	685

Multiplier: 1000

Title: LTAC ICU CAUTI Rates

Calculate Back

Quick Reference Guide: http://www.cdc.gov/nhsn/PS-Analysis-resources/PDF/StatsCalc.pdf

Statistics Calculator - Results

	Jan-June	July-Dec
Numerator	4	2
Denominator	678	685
Incidence Density Rate	5.900	2.920
IDR p-value	0.4459	

- **Based on statistical evidence, we did not observe a significant change in this location's CAUTI rate**
- **HOWEVER – this decrease is significant in a *practical* sense.**

In Summary…

- SIRs for LabID and SSI data provide a summarized risk adjusted measure of incidence in your hospital.
- Additional reports from NHSN provide detailed information to supplement rates and SIRs.
- Practical significance may be more useful than statistical significance, particularly with small hospitals
- Internal comparisons and trend analysis can help you speak to you facility's experience over time

In Summary…

"The road is short, but the river is long."

Bobby Long, "The River is Long"

Additional Resources

- **Improving Risk-Adjusted Measures of Surgical Site Infection for the National Healthcare Safety Network**
  - Infect Control Hosp Epidemiol 2011;32(10):970-986
  - http://www.cdc.gov/nhsn/PDFs/pscManual/SSI_ModelPaper.pdf

- **SIR Newsletter:**

http://www.cdc.gov/nhsn/PDFs/Newsletters/NHSN_NL_OCT_2010SE_final.pdf

- **Risk adjustment for CDI and MRSA Bacteremia LabID:**

http://www.cdc.gov/nhsn/PDFs/mrsa-cdi/RiskAdjustment-MRSA-CDI.pdf

Additional Resources

- Details for CMS reporting and CMS-related reports within NHSN: http://www.cdc.gov/nhsn/cms/index.html

- NHSN Annual Reports: http://www.cdc.gov/nhsn/dataStat.html

- Ellingson K. Breaking down *P* values and 95% confidence intervals: What infection preventionists should know about statistical certainty. Am J Infect Control 2013;41:1083-4.

Thank you!

nhsn@cdc.gov