Advanced Analysis in National Healthcare Safety Network (NHSN) Surgical Site Infection (SSI)

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The data used in the examples in this presentation are fictitious. They are for illustration purposes only.

Objectives

- Describe risk adjustment used in the surgical site infections (SSI) standardized infection ratio (SIR) calculations and the uses of the SIR measure
- Explain how to interpret and use SIRs under the current 2015 risk-adjustment
- Discuss techniques for ensuring SIR data quality and troubleshooting analysis reports

Describe risk adjustment used in the SSI SIR calculations

Background

- The SIR is a risk-adjusted summary measure that is scalable from facility level to state and the nation
- Compares **observed** number of infections to **predicted** number of infections

$$SIR = \frac{Observed\ (O)\ HAIs}{Predicted\ (P)\ HAIs}$$

- Predicted HAIs
  - Calculated by summing the procedure risk for all procedures included in the summarized calculation
  - The procedure risk is calculated from improved risk models*
  - Based on NHSN aggregate data (2006-2008 and 2015)
  - This presentation will focus on the 2015 data

*2006-2008 baseline: Mu Y et al. Infect Control Hosp Epidemiol 2011;32(10):970-986

*2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

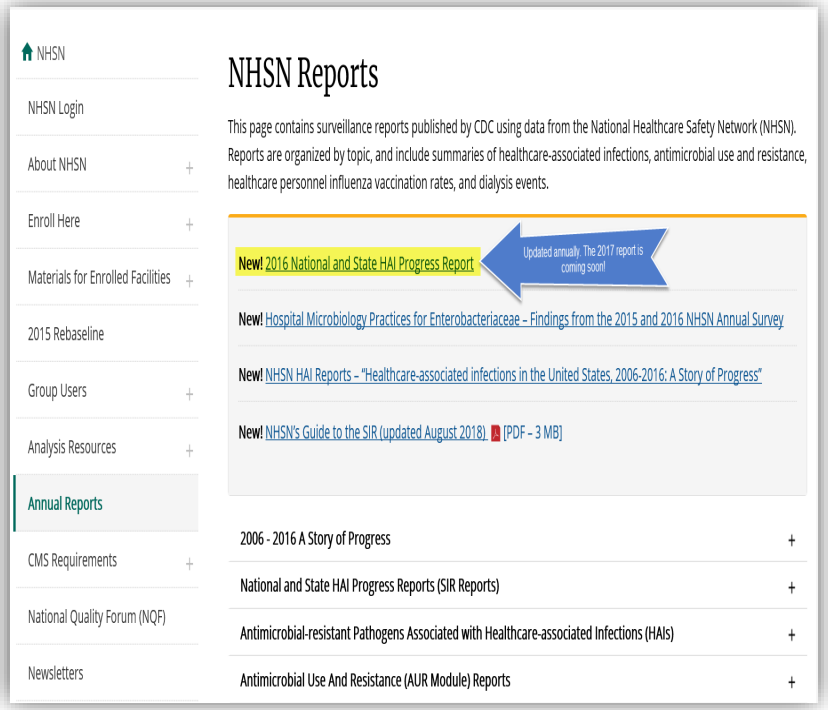
Background

- The 2015 risk-adjusted models for procedures/SSI
  - Separated by patient population: adult and pediatric models
  - Separated by inpatient procedures and hospital outpatient department (HOPD) procedures
- Number of predicted infections, (denominator of SIR) calculated using Logistic Regression Models
  - Risk adjusted with patient level data as well as facility level data
  - In a later slide, we will review how to calculate the number of predicted infections
- Several factors were reviewed and analyzed to determine significance to the relationship between the exposure (surgery) and the outcome (infection)
  - Factors that were found to be statistically significant to this relationship were included in the final validated model

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pscanalysis-resources/nhsn-sir-guide.pdf

Who Uses SIR Data?

- The SIR value provides information about the number of HAIs reported in your facility
- This summary statistic is used by various organizations:
  - CMS: public reporting on Hospital Compare
  - State health department may publish SIRs
  - Corporation
  - Non-profit or research group
  - CDC: national and state-level SIRs
  - Your facility!



Hospital Compare: https://www.medicare.gov/hospitalcompare/search.html
Annual Reports: https://www.cdc.gov/nhsn/datastat/index.html

How is SIR Data Used?

- **National and State Healthcare Associated Infections Progress Report!**
  - The most recent published report is the 2017 report
  - The report is published on the NHSN HAI Data website https://www.cdc.gov/hai/data/portal/progress-report.html and the patient safety atlas: https://gis.cdc.gov/grasp/PSA/HAIreport.html
  - Details about the analysis methods for each HAI are included in the technical appendix of the report

How is SIR Data Used?

- For SSIs
  - The report uses the Complex Admission/Readmission SSI SIR model (separated by adults and pediatrics)
  - It includes SIR and supporting data for the nation for all 39 NHSN operative procedures,
  - For states, the report includes 15 NHSN operative procedures (which are the 10 SCIP procedures plus the 5 top voluminous procedures. The 5 top procedures by volume is based on national data)
  - The report measures progress in the elimination SSIs by comparing the current years report data to the previous years data

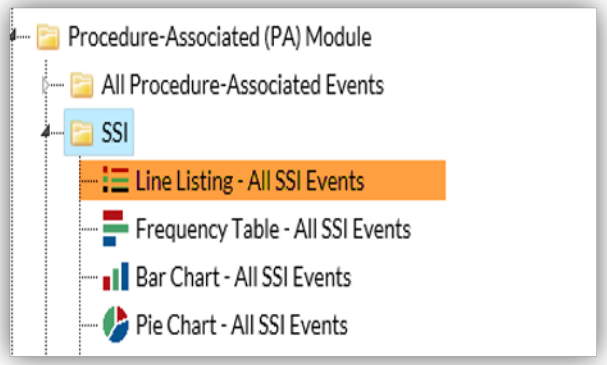
HAI Progress Report: https://www.cdc.gov/hai/data/portal/progressreport.html

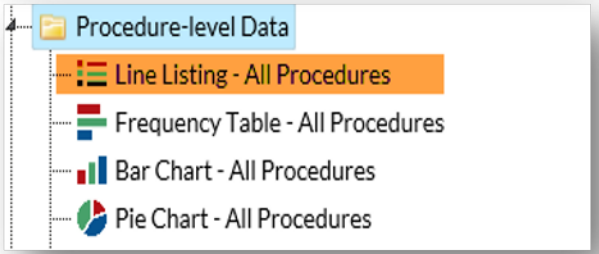
How is SIR Data Used?

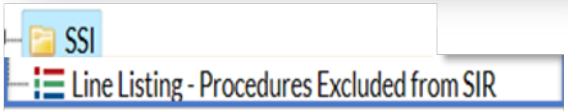
- **Nationally, among acute care hospitals, the highlights in this report**
  - About 1% decrease in SSI related to the 10 select procedures tracked in the report between 2016 and 2017.
  - The 10 select procedures are Surgical Care Improvement Project (SCIP) procedures. For a list of the SCIP procedures, please see: https://health.gov/hcq/pdfs/ssi2012.pdf
  - About 2% increase in abdominal hysterectomy SSIs **(not statistically significant)**
  - About 3% decrease in colon surgery SSIs **(not statistically significant)**

Surgical Site Infection Reports Types

- There various analysis reports available for SSIs and Procedure data
- Line List
  - You can review details of the Procedures/SSI events reported to NHSN by running the line listing reports
  - Determine which SSI events are included in the SIR by model
    - See variables (Bs2_SSIAll, Bs2_SSIPedAll, Bs2_SSIComplex, Bs2_SSIPedComplex, Bs2_SSIComplex30ds)
  - Determine which procedures are excluded from the SIR
    - See the “excl” variables

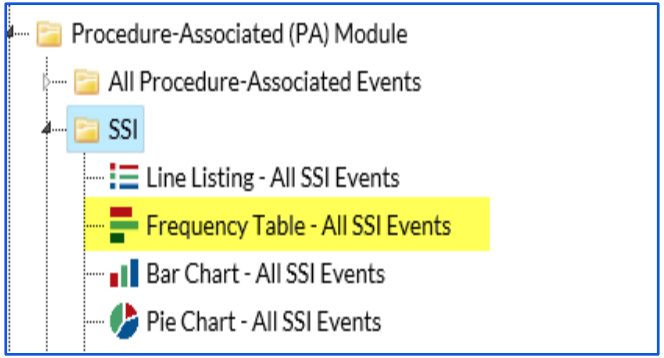


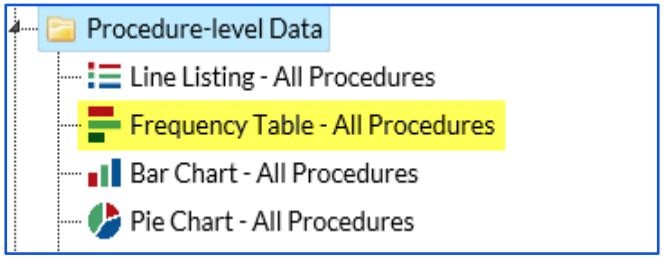




Surgical Site Infection Reports Types

- Frequency Tables
  - You can summarize your counts of Procedures/SSI events by using Frequency table reports





National Healthcare Safety Network
Frequency Table for All Surgical Site Infection Events
As of: February 25, 2019 at 3:28 PM
Date Range: SSI_EVENTS procDateYr 2018 to 2018

Frequency
Percent
Row Pct
Col Pct

Table of procCode by spcEvent

procCode	spcEvent DIP	GIT	IAB	OREP	Total
COLO	1	3	2	1	7
	12.50	37.50	25.00	12.50	87.50
	14.29	42.86	28.57	14.29	
	50.00	100.00	100.00	100.00	
HYST	1	0	0	0	1
	12.50	0.00	0.00	0.00	12.50
	100.00	0.00	0.00	0.00	
	50.00	0.00	0.00	0.00	
Total	2	3	2	1	8
	25.00	37.50	25.00	12.50	100.00

Frequency Missing = 1

By default, the column and row percent will show, but you can remove from your report on the Display Options tab when you modify your report

Data contained in this report were last generated on February 25, 2019 at 8:48 AM.

National Healthcare Safety Network
Frequency Table for All Procedures
As of: February 25, 2019 at 3:35 PM
Date Range: PROCEDURES procDateYr 2016 to 2018

Frequency

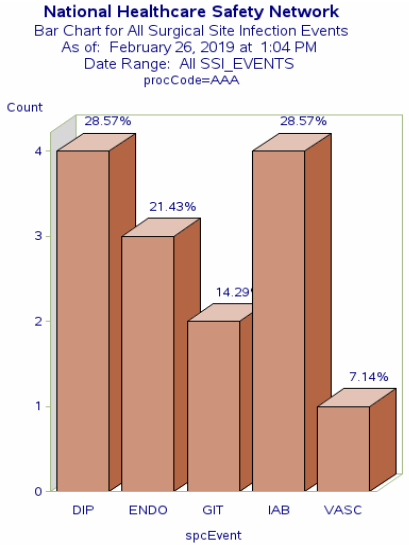
Table of procDateYr by procCode

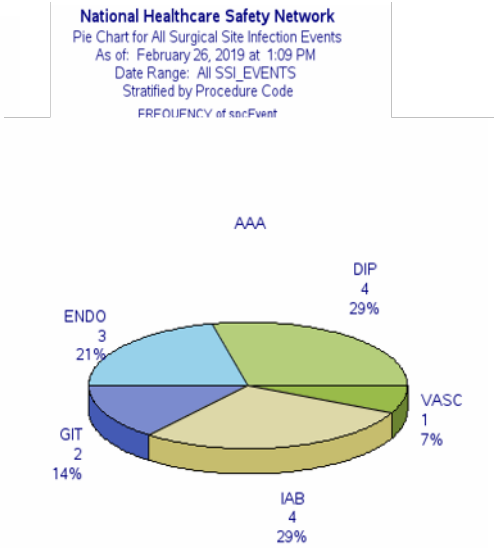
procDateYr	procCode COLO	HYST	Total
2016	482	27	509
2017	521	75	596
2018	7	2	9
Total	1010	104	1114

Data contained in this report were last generated on February 25, 2019 at 8:48 AM.

Surgical Site Infection Reports Types

- Bar and Pie Charts
  - You can visually present counts of Procedures/SSI events with a Bar Chart or Pie Chart





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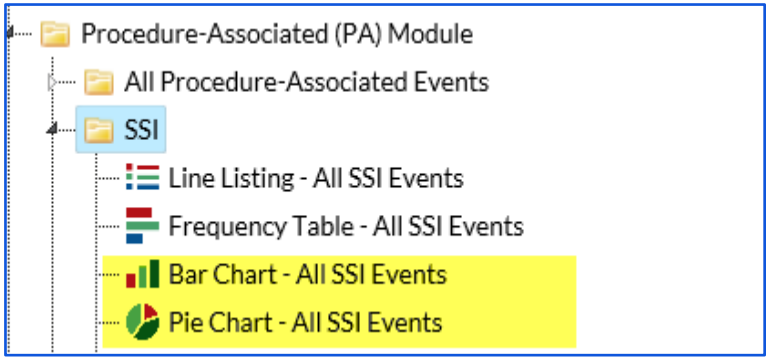
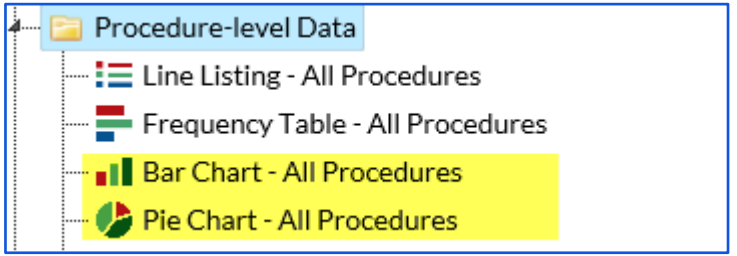
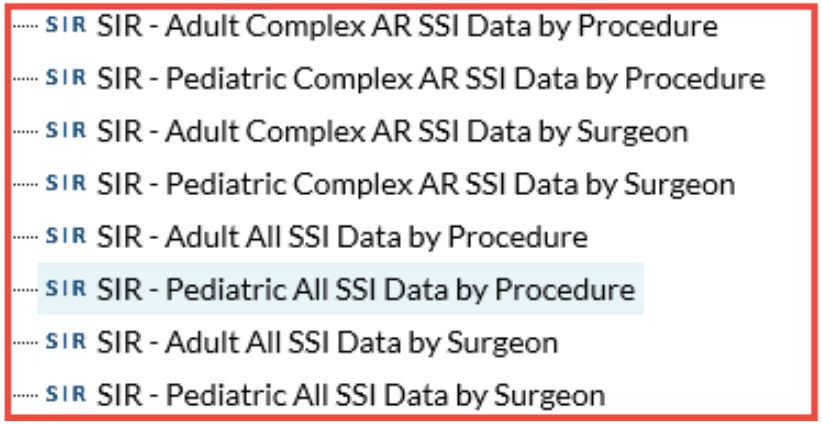




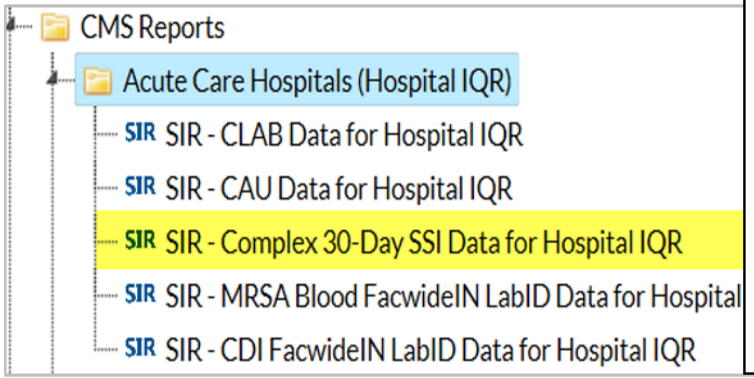
Surgical Site Infection (SSI) Models and Reports

- There are different SSI Models, each has 2 separate reports, by procedure and by surgeon
- **Under the 2015 baseline (BS2)**
  - All SSI Adult Data SIR
  - All SSI Pediatric Data SIR
  - Complex admission/readmission (A/R) Adult SSI SIR
  - Complex A/R Pediatric SSI SIR
  - Complex 30day SSI SIR

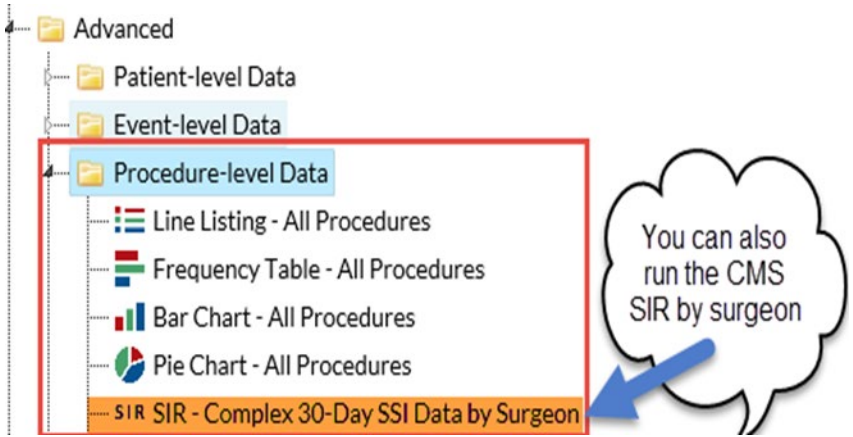


Surgical Site Infection (SSI) Models and Reports

- The Complex 30 day SSI SIR is located in the Acute Care Hospitals (Hospitals IQR) sub folder of the CMS Folder
  - In-plan
  - Inpatient
  - Adults 18 years and older
- If you are an acute care hospital, this is the report you use to verify your CMS data for COLO and HYST
- If you are a critical access hospital, this is still the report you use to verify you CMS COLO and HYST data



Use this report to run Complex 30-day SSI SIR Report for acute care hospitals or critical access hospitals

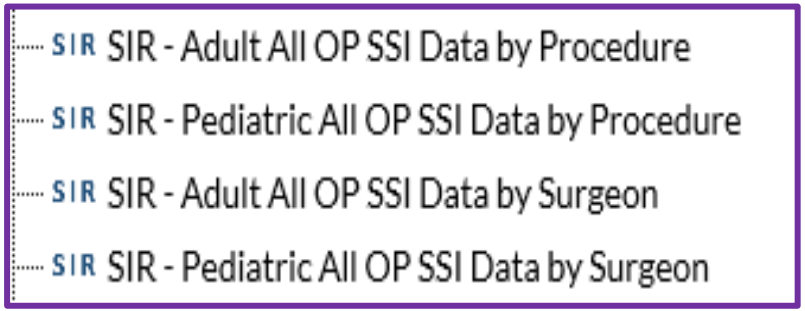


Surgical Site Infection (SSI) Models and Reports:

The Hospital Outpatient Procedure Department (HOPD) SIR Reports!!!

Under the 2015 baseline (BS2)

- The SSI SIR reports for outpatient procedures performed in acute care hospitals are available!
- The only model available for outpatient procedures is the All SSI Data SIR.
- There are 2 sets of reports for adults and for pediatrics, by procedure and by surgeon
  - All SSI Adult Data SIR
  - All SSI Pediatric Data SIR



Surgical Site Infection (SSI) Models-Inclusion Criteria

INCLUSION CRITERIA: Under 2015 Baseline INPATIENT PROCEDURES ONLY MODELS	All SSI Model-Adult	All SSI Model-Pediatric	Complex AR SSI Model- Adult	Complex AR SSI Model-Pediatric	Complex 30-Day
All NHSN procedure categories	☑	☑	☑	☑	COLO and HYST
Procedures in patients <18 years		☑		☑	
Procedures in patients >=18 years	☑		☑		☑
Superficial incisional primary (SIP) SSIs	☑	☑			
Deep incisional primary (DIP) SSIs	☑	☑	☑	☑	☑
Organ/space (O/S) SSIs	☑	☑	☑	☑	☑
DIP and O/S SSIs identified within 30 days after procedure (per protocol)	☑	☑	☑	☑	☑
DIP and O/S SSIs identified > 30 days after procedure (per protocol)	☑	☑	☑	☑	
SSIs detected on current admission (A)	☑	☑	☑	☑	☑
SSIs detected on follow-up admission to the same facility (RF)	☑	☑	☑	☑	☑
SSI detected on follow-up admission to different facility (RO)	☑	☑			☑
SSIs detected through post-discharge surveillance efforts (P)	☑	☑			☑

Knowledge Check Question 1: Procedures with either primary closure technique and other than primary closure techniques are included in the SIR under the 2015 baseline

- Rationale: Under the 2015 baseline, procedures with primary or other than primary closure techniques are included in the SSI SIR reports

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

Universal Exclusion Criteria–SIR Calculation

- General exclusions criteria- applicable to procedures (and related SSI events)
  - Patient's Sex is missing (or not reported)
  - Outpatient procedures and resulting SSIs (from the inpatient procedures reports)
    - *NOTE: NHSN has separate models for outpatient procedures*
  - Present at time of surgery (PATOS) is 'Yes' (excluded from numerator and denominator)
  - SSIs that are reported as superficial incisional secondary (SIS) or deep incisional secondary (DIS)

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pscanalysis-resources/nhsn-sir-guide.pdf

Universal Exclusion Criteria–SIR Calculation

- Exclusion due to potential data quality issues or data outliers (out of range data)
  - Age at the time of procedure is greater than 109 years
  - Missing variables required for risk adjustment of the SIR denominator. Variables including closure, ASA score, sex etc.
  - Adult patients ≥ 18 years: if BMI is less than 12 or greater than 60*
  - Pediatric patients < 18 years: if BMI less than 10.49 or greater than 65.79**
  - Procedure duration less than 5 minutes
  - Procedure duration greater than IQR5
    - The IQR5 is calculated as five times the interquartile range (Q1-Q3) above the 75th percentile, using the national aggregate data.
    - For example, if the interquartile range is 30 minutes, and the 75th percentile is 100 minutes, the IQR5 would be calculated as: 100 + (30*5) = 250 minutes

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pscanalysisresources/nhsn-sir-guide.pdf

Universal Exclusion Criteria–SIR Calculation

- Facility-level exclusions
  - Data from ambulatory surgery centers (ASCs) and long-term acute care hospitals (LTACHs)
  - Medical affiliation is missing or medical affiliation is ‘Y’ and medical type is missing (from Annual Facility Survey)
  - Number of beds is missing (from Annual Facility Survey)
- *NOTE: It is often rare that a facility data will be missing the above listed information, but it is important that you are aware of the status of this information.*

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pscanalysis-resources/nhsn-sir-guide.pdf

Knowledge Check Question 2. Are procedures with Dirty wound class automatically excluded from the SSI SIR?

- Rationale: Procedures are not excluded from the SSI SIR because of wound class classifications. Procedures, regardless of the wound class categorization are included in the SIR if they do not meet the universal exclusion criteria

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

2015 Baseline Risk Models: COLO Complex 30-day SSI SIR

Risk Factor		Parameter Estimate
Intercept		*-3.66601*
Risk Factor	Status	
Diabetes	**Yes**	**0.0821**
Diabetes	No	Referent Population
ASA Score: 1, 2, 3/4/5	**Ordinal**	**0.3028**
Sex	**Male**	**0.1036**
Sex	Female	Referent Population
Age (Patient's age/10)	**Continuous**	**-0.1396**
BMI	**≥30**	**0.1259**
BMI	<30	Referent Population
Closure technique	**Other than Primary**	**0.2383**
Closure technique	Primary	Referent Population
Oncology Hospital	**Yes**	**0.5437**
Oncology Hospital	No	Referent Population

2015 Baseline: SIR Guide https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

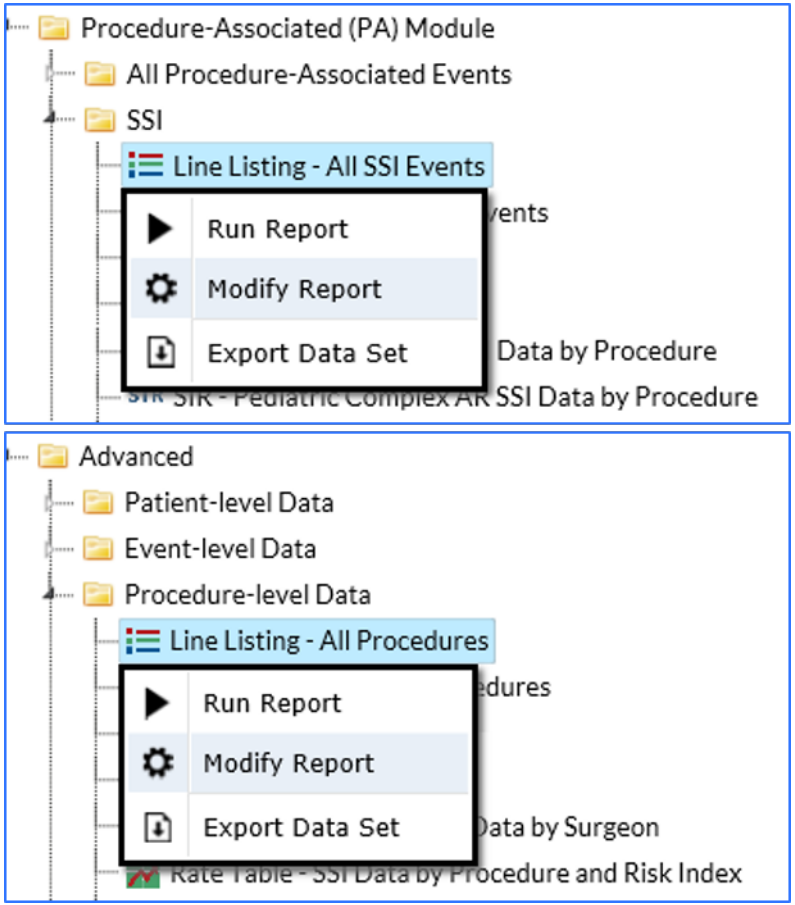
2015 Baseline Risk Models: HYST Complex 30-day SSI SIR

Risk Factor		Parameter Estimate
Intercept		*-5.1801*
Risk Factor	Status	
Diabetes	**Yes**	**0.3247**
Diabetes	No	Referent Population
ASA Score: 1, 2, 3, 4/5	**Ordinal**	**0.4414**
Age (Patient's age/10)	**Continuous**	**-0.1501**
BMI	**≥30**	**0.1106**
BMI	<30	Referent Population
Oncology Hospital	**Yes**	**0.5474**
Oncology Hospital	No	Referent Population

2015 Baseline: SIR Guide https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

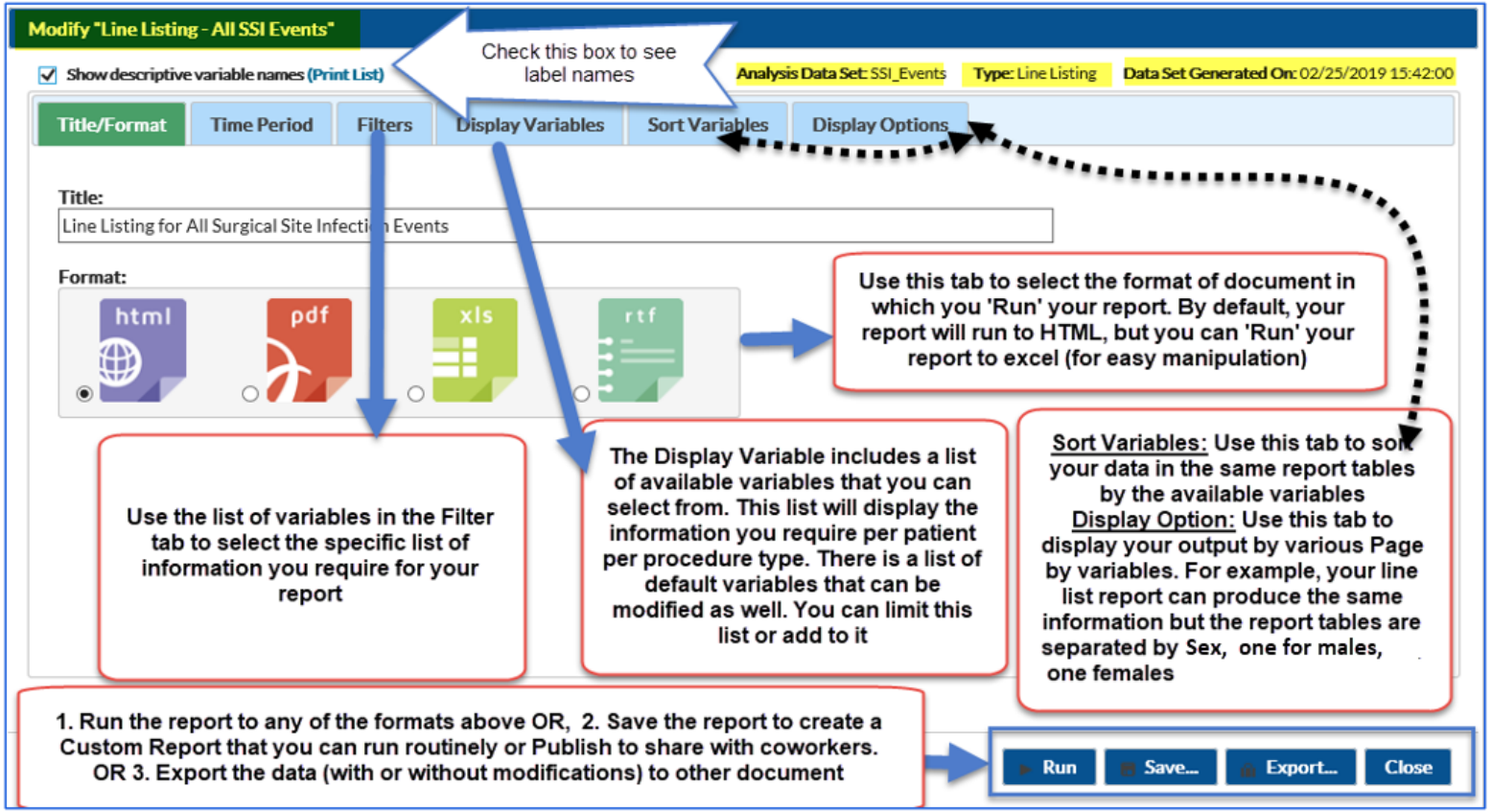
Checking Risk Factors in NHSN-Procedures/SSI

- Checking SSI Data included in SIR
  - For numerator data, run the SSI event line list
    - Analysis→Reports→Procedure-associated (PA) Module→ SSI→ Line Listing - All SSI Events
  - For denominator data, run the All Procedure line list
    - Analysis→Reports→Advanced →Procedure-level Data→Line Listing - All Procedures



Checking Risk Factors in NHSN-The Modify Report Screen!

- Using modifications to limit the amount of data on your output is optional



Checking Risk Factors in NHSN-Procedures

National Healthcare Safety Network
Line Listing for All Procedures
As of: March 1, 2019 at 3:15 PM
Date Range: PROCEDURES procDateYM After and Including 2018M01

orgID	sex	procID	procDate	procCode	ageAtProc	BMI_val	outpatient	excluded	bs2_modelRiskComplex30d
10000	M	30394813	01/12/2018	COLO	72	26.54603	N	N	0.0204
10000	M	30855363	01/02/2018	COLO	55	36.964994	N	Y	.
10000	F	30990979	01/01/2018	COLO	62	21.867056	Y	Y	.
10000	F	31386879	03/27/2018	COLO	62	42.986226	N	N	0.0177
10000	F	32071182	02/14/2018	COLO	25	36.160714	N	N	0.0363
10000	F	32484900	07/01/2018	COLO	19	41.464711	N	Y	.
10000	M	32630939	07/01/2018	COLO	26	30.069575	N	N	0.0572

- The procedures Line Listing output will show details of all the risk factors that you select
- In the screenshot above is a list of procedures details of COLOs performed in 2018, including the age, BMI and whether procedures are excluded from the SSI SIR
  - Note: The model risk is not calculated if the procedure is excluded from SIR

Checking Risk Factors in NHSN-SSI Events

National Healthcare Safety Network
Line Listing for All Surgical Site Infection Events
As of: March 1, 2019 at 1:21 PM
Date Range: SSI_EVENTS procDateYM After and Including 2018M01

orgID	patID	spcEvent	procDate	procCode	dob	ageAtProc	sex	procDurationHr	procDurationMin	outpatient	closure	whenDetected	bs2_SSIComplex30d
10000	COLO2018	IAB	03/27/2018	COLO	08/18/1955	62	F	3	5	N	PRI	P	1
10000	J1L2W3	IAB	07/01/2018	COLO	07/01/1999	19	F	3	23	N	PRI	P	0
10000	JJJ333	IAB	07/01/2018	COLO	07/02/1991	26	M	4	5	N	PRI	A	0
10000	MRGREEN	IAB	08/01/2018	COLO	08/01/1976	42	M	4	5	N	PRI	A	0
10000	JLW1357	IAB	02/02/2018	COLO	08/02/1989	28	F	3	3	N	OTH	A	1
10000	MR1234	DIP	11/01/2018	COLO	01/02/1950	68	M	4	4	Y	PRI	RO	0

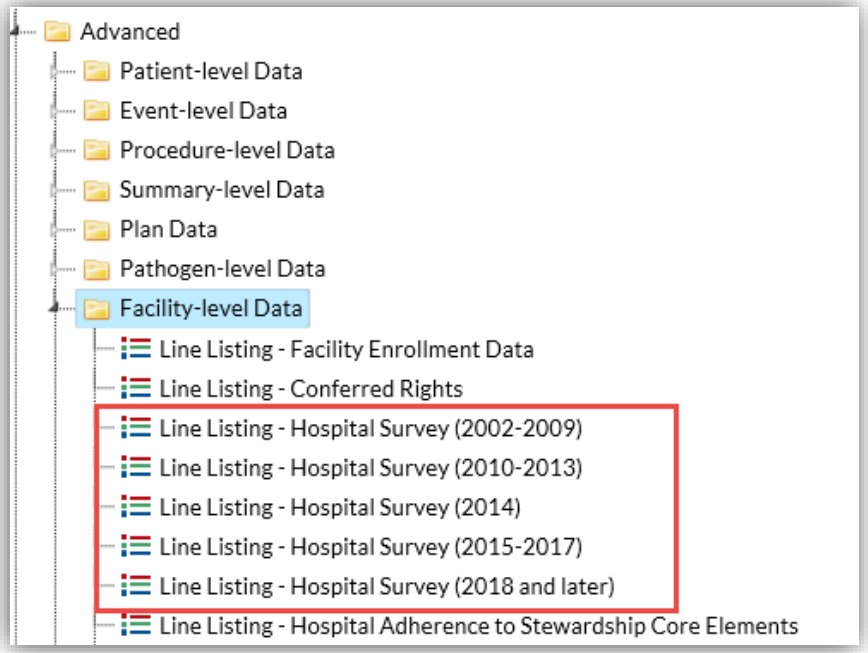
1. Please review the Quick Reference Guide related to the new SSI Indicator Variables (https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/ssi-events-line-list-qrg.pdf) for more information on determining which SSIs are included in the SIRs.

Data contained in this report were last generated on February 25, 2019 at 3:42 PM.

- Just like the procedures Line Listing report, the SSI Events Line Listing output will show details of all the risk factors that you select
- Please see the quick reference guide referenced in the footnote on how to run and determine which model or models SSI events are included

Checking Risk Factors in NHSN- Facility Level Data

- Checking for facility level data including the number of beds, of medical school affiliation or enrollment information
- Analysis→Advanced→Facility-level Data→ Line Listing –Hospital Survey (2015 and later)
- Analysis→Advanced→Facility-level Data→ Line Listing –Facility Enrollment Data

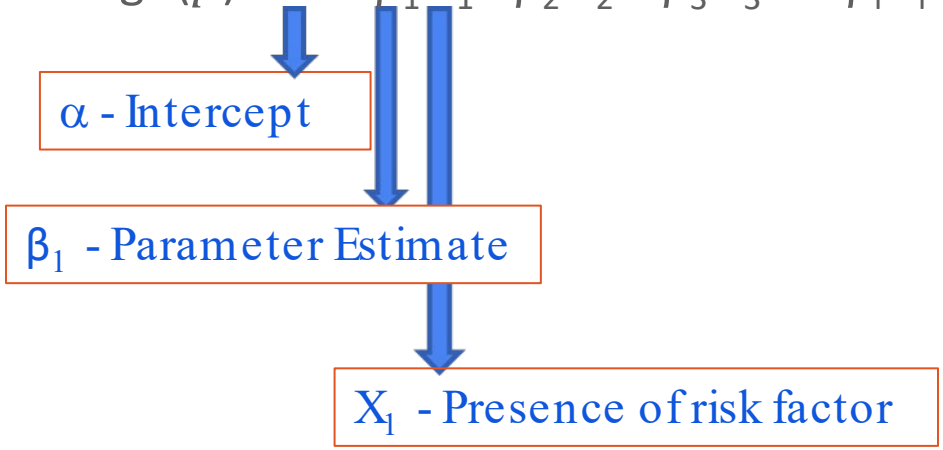


Now that we are familiar with the risk-adjusted models and checking the factors included in them

How to Calculate the Procedure Risk: Number of Predicted Infections

Calculating the Procedure Risk: Number of Predicted Infections

- Calculated using Logistic Regression model*
- $\text{logit}(\hat{p}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta_i X_i$



Where α = intercept
β_i = parameter estimate
X_i = presence of risk factor
(For these risk factors, if present = 1; if not = 0)

- Let's review an example of how this is calculated…

*2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

Calculating the Procedure Risk: Number of Predicted Infections

Age10= Age at procedure /10. In our e.g, **56/10=5.6**

- Logit($\widehat{P}$)=**-3.6601**+ (5.6*-0.1396)(1) + 0.1036(0) + 0.0821(1) + (3*0.3028)(1)+ 0.1259(1) + 0.2383(1) + 0.5437(0)
- Logit($\widehat{P}$)=**- 3.6601** + -0.7818 + 0.0821+ 0.9084+0.1259+0.2383 = **- 3.0872**
- Solve for $\hat{p}$: $\hat{p} = e^{\text{logit}(\hat{p})} / (1 + e^{\text{logit}(\hat{p})})$
  $\hat{p} = e^{-3.0872} / (1 + e^{-3.0872}) = 0.0397$
- Conclusion:
  - Procedure risk for this patient is 0.04364 or 4% risk for a deep incisional or organ/space infection following colon surgery

COLO Surgery: Complex 30-day Risk Model to Predict SSI*		
Risk Factor	Parameter Estimate	Patient 1
Intercept	**-3.6601**	
Age10	-0.1396	56
Sex (M)	0.1036	F
Diabetes (Y)	0.0821	Y
ASA (1,2, 3/4/5)	0.3028	3
BMI ≥ 30	0.1259	31
Closure (OTH)	0.2383	OTH
Oncology Hospital	0.5437	N

*2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pa-analysis-resources/nhsn-sir-guide.pdf

Calculating the Procedure Risk: Number of Predicted Infections

- The NHSN SSI events are included in the numerator based on the date of procedure and not the date of event because the **procedure carries the risk for infection** and since the event is linked to the procedure, we are able to determine the relationship between surgery (exposure) and infection (outcome) that way
- Procedures must be linked to its resulting SSI events in NHSN, if applicable. Please refer to the protocol for more information on how to link SSI event to the appropriate procedure

*2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pscanalysis-resources/nhsn-sir-guide.pdf

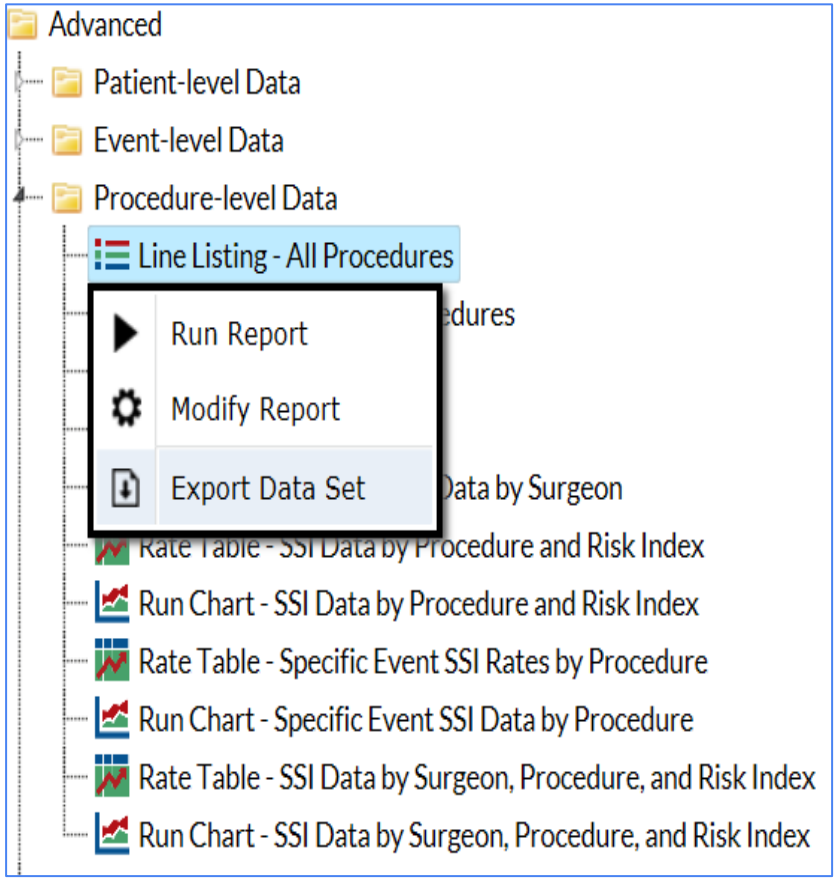
Calculating the Procedure Risk: Number of Predicted Infections

- When you calculate the procedure risk for each patient within your summary time period and sum them, you get your number of predicted infections for that period

Patient	Age	Diabetes	ASA	BMI	Oncology Hospital	Sex	Closure	SSI	Probability of SSI ($\hat{p}$)
1	56	Y	3	31	N	F	OTH	0	0.0397
2	45	N	2	28	N	M	PRI	0	0.0410
.									
.									
200	52	N	2	32	N	M	PRI	1	0.010
Total								**Observed = 1**	**Number Predicted = 3.789**
SIR = Number of observed infections/Number of Predicted infections = 1/3.789 =0.264									

*2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pscanalysis-resources/nhsn-sir-guide.pdf

Calculating the Procedure Risk in NHSN



The procedure risk calculated for each patient for the Complex -30-day (CMS) model

The procedure risk calculated for each patient for the All SSI Adult model

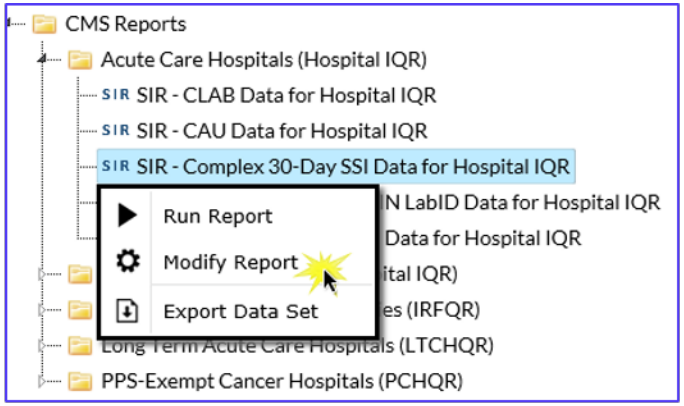
The procedure risk calculated for each patient for the Complex AR Adult model

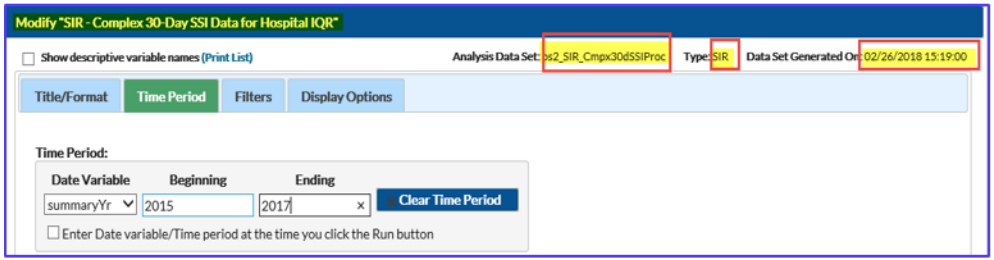
bs2_modelRiskComplex30d	bs2_modelRiskAdultAll	bs2_modelRiskAdultCmpx
0.015	0.0285	0.017
0.0241	0.0385	0.0252
0.007	0.0031	0.0027
0.089	0.0075	0.0016
0.0241	0.0385	0.0134
0.0241	0.0385	0.115

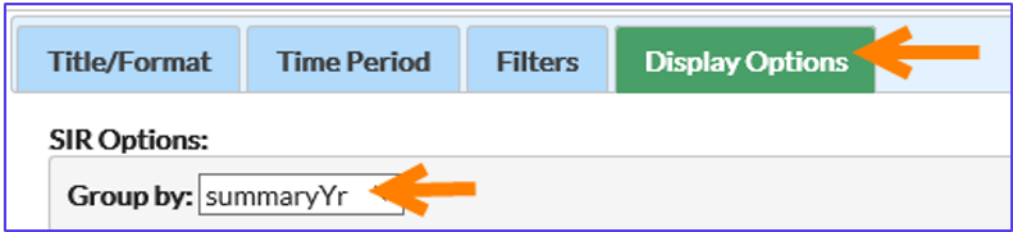
Explain how to interpret and use SIRs under the current risk adjustment

Lets Use an Example

- Your small facility wants to examine how your SIRs have changed from 2015 to 2017 (under the current 2015 baseline)
- You are primarily interested in COLO
- So you decide to use the CMS report
- What do you do? Where do you start
  - Begin by generating the SIR reports for each year
  - Then identify and explain the differences between the SIR data elements for the 3 years
- How can NHSN support your process?







Generating 2015 Baseline SIR in NHSN- Quick Notes!

- By now, we are all familiar with the process of running reports in NHSN
- Expanded modification page
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/howtomodifyreport.pdf
- SIR report titles include baseline year in the title
- Multiple SIR tables on your report, including list of procedures excluded from SIR (where applicable)
- Footnotes (changes in content and format)
  - The 2015 baseline report footnotes are ordered chronologically, numbered and colored. The footnotes mimic the same pattern, across HAIs

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

Generating 2015 Baseline SIR in NHSN

orgid	ccn	proccode	procCount	summaryYr	infCountComplex30d	numPredComplex30d	SIRComplex30d	SIRComplex30d_pval	SIRComplex30d95CI
10541	N/A	COLO	34	2015	1	1.698	0.589	0.677	0.029, 2.904
10541	N/A	COLO	43	2016	1	2.313	0.432	0.427	0.022, 2.132
10541	N/A	COLO	23	2017	0	0.991	.	.	

- In the example, the main difference between the 3 years is
  - the number of procedures included in the SIR calculation
- 34 of COLO procedures performed in 2015 are included in the SIR, with 1 SSI event. For the time period, and the procedures specified, we predicted that this facility will have nearly 2 infections
  - Predictive model based on facility level data and patient level data

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

Generating 2015 Baseline SIR in NHSN

orgid	ccn	proccode	procCount	summaryYr	infCountComplex30d	numPredComplex30d	SIRComplex30d	SIRComplex30d_pval	SIRComplex30d95CI
10541	N/A	COLO	34	2015	1	1.698	0.589	0.677	0.029, 2.904
10541	N/A	COLO	43	2016	1	2.313	0.432	0.427	0.022, 2.132
10541	N/A	COLO	23	2017	0	0.991	.	.	

- 43 of COLO procedures performed in 2016 are included in the SIR, with 1 SSI events. For the time period, and the procedures specified, we predicted that this facility will have about 2 infections
- In 2017, this small facility performed nearly half of the procedures performed in 2016 with no infections
- Based on statistical evidence, we can conclude that our COLO SIRs for both 2015 and 2016 (with a p-value of 0.677 and 0.427) are not different from 1.
- A 2017 SIR is not calculated for COLO because the minimum precision criterion (MPC) is not met (i.e., the predicted number of infections is <1)

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

Generating 2015 Baseline SIR in NHSN

- As a small facility, running SIR reports over multiple years might provide enough data for an overall facility SIR

orgid	ccn	proccode	procCount	infCountComplex30d	numPredComplex30d	SIRComplex30d	SIRComplex30d_pval	SIRComplex30d95CI
10541	N/A	COLO	100	2	5.002	0.4	0.165	0.067, 1.321

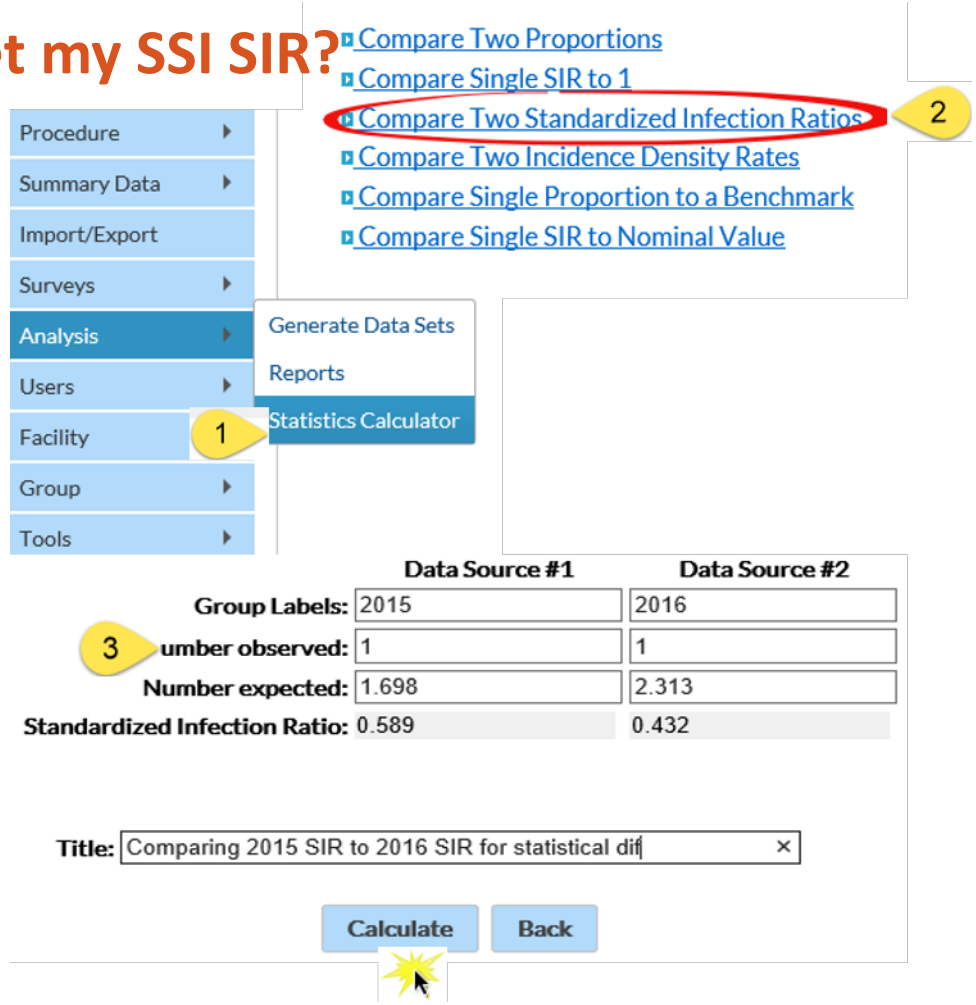
2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

How do I Present and Interpret my SSI SIR?

- When you interpret the SIR,
  - Consider the SSI model you are using (the inclusion criteria) and the purpose
  - How many SSIs?
  - Over what period of time?
- Interpret the statistical results
  - What is the p-value and what does it mean?
  - What is the 95% CI and how is it applied?

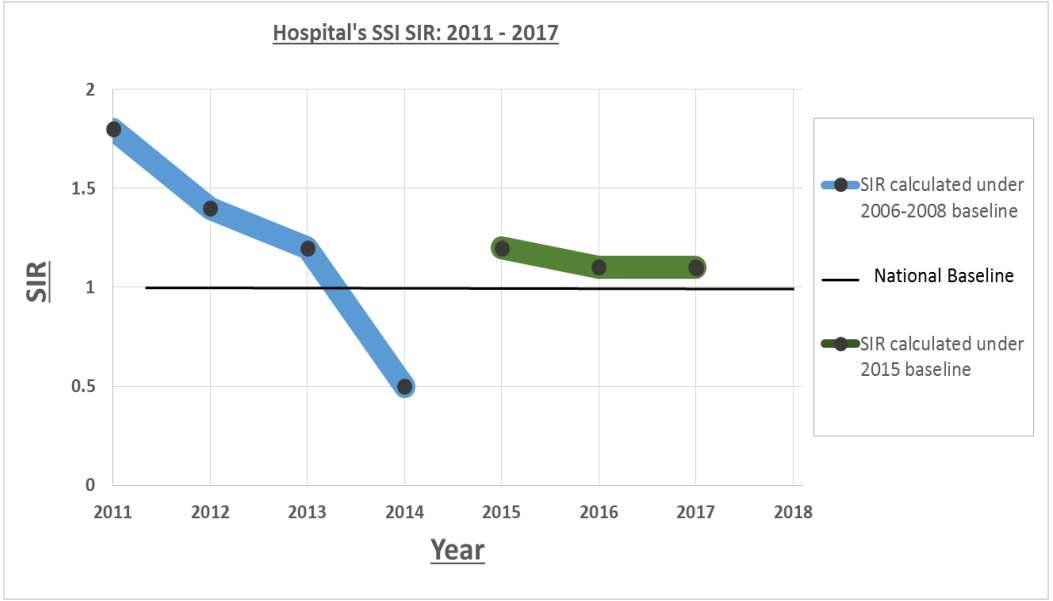
How do I Present and Interpret my SSI SIR?

- Use the statistical calculator to tell more of your story!
  - Consider calculating the statistical difference between 1 year's SIR vs. the other. Perhaps the prevention program is accounting for changes made from one year to the other
  - In my example, I compared 2015 to 2016 using the process displayed in the screen shot to the right. When I click Calculate, a p-value and 95% CI is produced to determine if the 2 SIRs are statistically different
  - In my example, the 2 SIRs are not different



How do I Present and Interpret my SIR?

- Data can be presented graphically
  - Bar charts
  - *Run charts
  - *When you present multiple time periods of SIR data in a continuous line graph, please make sure you are using the same baseline for each time period. Otherwise, please separate the data points on the graph by baseline year*



*Charts are not available in NHSN. Data should be exported and graphical output created in excel

Knowledge Check Question 3: What does the procedure count field represent? This is the column called procCount located in SSI SIR tables

- Rationale: The procedure count field is a subset of all procedures reported by the facility. This is the number of procedures that contribute to the number of predicted infections. This number could be different for each model due model-specific inclusion criteria

2015 Baseline: SIR Guide: https://www.cdc.gov/nhsn/pdfs/pscanalysis-resources/nhsn-sir-guide.pdf

What is the Difference in Procedure Count in NHSN vs. QNET?

- In the NHSN SIR reports, including the CMS report, the procedure count refers to the number of procedures contributing to the calculation of the number of predicted infections. Meaning, the procedure count in NHSN SIR reports already has the universal exclusion criteria applied
- The procedure count in QNET (Hospital Compare) is the total number of in-plan, inpatient procedures in adults 18 years and older –with no consideration to universal exclusion criteria
  - The number of predicted infections, however, is calculated with the procedures that meet inclusion criteria

Discuss techniques for ensuring SIR data quality and troubleshooting analysis reports

Ensuring SSI SIR Data Quality

- Follow NHSN protocol closely for SSIs
- Check your annual surveys
  - Be aware of changes you have reported from year to year
- Check your Monthly reporting plans
  - Make sure procedure categories are included
  - “Off Plan” data have fewer requirements for completion – could lead to missing data fields/variables
- Enter and check denominator and numerator data
- Resolve alerts
- Generate datasets
- Running analysis reports to check data
  - Line list and frequency reports

How Data Quality Impacts SSI SIR

orgID	procID	procCode	procDate	exclMissingVarInd	exclMissingVarList	exclDurThresholdInd
10018	48291	COLO	05/01/2015	Y	medaff	N
10018	58772	COLO	01/02/2015	Y	medaff	N
10018	58777	HPRO	08/23/2015	Y	medaff	N
10018	58779	COLO	11/13/2015	Y	medaff	N
10018	58783	COLO	04/20/2015	Y	medaff	N
10018	58784	HYST	02/05/2015	Y	medaff	N
10018	58789	HYST	05/22/2015	Y	medaff	N
10018	58791	HYST	06/20/2015	Y	medaff	N
10018	58792	HYST	07/14/2015	Y	medaff	N

orgID	procID	procCode	exclMissingVarInd	exclMissingVarList	exclDurThresholdInd
10018	58854	CSEC	Y	labor	N
10018	58855	CSEC	Y	labor	N
10018	58856	CSEC	Y	labor	N
10018	58857	CSEC	Y	labor	N
10018	58858	CSEC	Y	labor	N
10018	58859	CSEC	Y	labor	N
10018	58860	CSEC	Y	labor	N

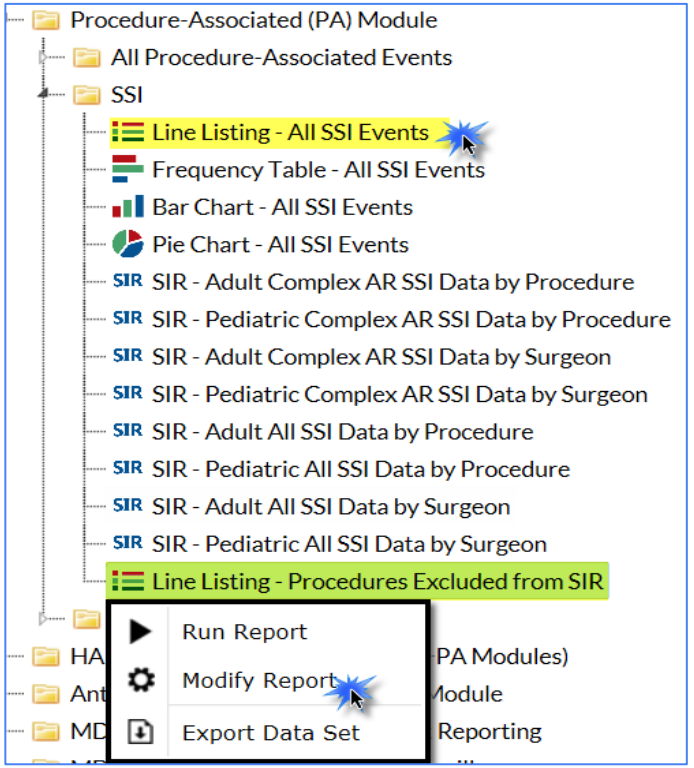
- Your SSI SIR is impacted if data is collected and entered incorrectly
  - Facility-level data (e.g., facility bed size, medical school affiliation, facility type)
  - Patient-level data (e.g., procedure duration, patient height, weight, setting in which procedure is performed)

How Data Quality Impacts SSI SIR

- Because these data are used in the predictive model, any inaccuracy could be reflected in the predictive model
- The inaccuracy may be subtle
- Others may be more pronounced
  - Adding/editing/deleting events
  - Addressing alerts or failing to do so
  - Monthly reporting plan or the lack there of

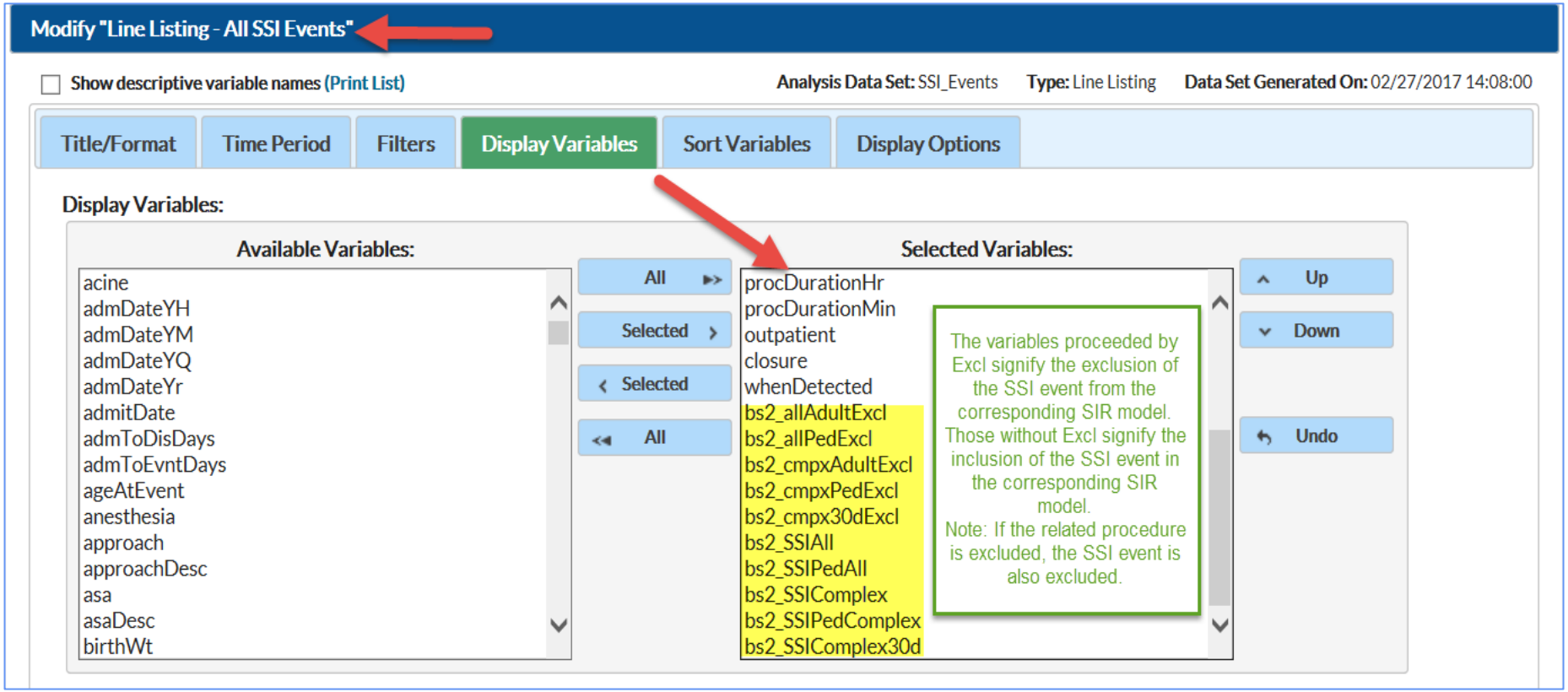
Running Analysis Reports in NHSN

- The process followed to troubleshoot your SSI SIR remains the same
- Existing reports improved to facilitate the troubleshooting process
  - Line Listing- Procedures Excluded from SIR
  - Line Listing- All SSI Events
  - Line Listing- All Procedures
- New variables
  - Indicator variables for SSI events
  - Exclusion variables for procedures



https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/line-list-procedures-excluded-sir.pdf

SSI Event Line Listing (BS2 Baseline)



https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/ssi-events-line-list-qrg.pdf

Line Listing for SSI Events Indicator (BS2 Baseline)

National Healthcare Safety Network
Line Listing for All Surgical Site Infection Events
As of: March 11, 2019 at 8:58 PM
Date Range: SSI_EVENTS procDateYQ 2018Q3 to 2018Q3

orgID	patID	spcEvent	procDate	procCode	ageAtProc	outpatient	closure	whenDetected	bs2_SSIAll	bs2_SSIpedAll	bs2_SSIComplex	bs2_SSIPedComplex	bs2_SSIComplex30d
10000	J1L2W3	IAB	7/1/2018	COLO	19	N	PRI	P	0	0	0	0	0
10000	JJJ333	IAB	7/1/2018	COLO	26	N	PRI	A	1	0	1	0	0
10000	MRGRE	IAB	8/1/2018	COLO	42	N	PRI	A	1	0	1	0	0
10000	HYST12	SIP	9/1/2018	HYST	24	N	PRI	P	1	0	0	0	0
10000	MR123	MED	9/25/2018	CBGB	68	N	PRI	RF	1	0	1	0	0

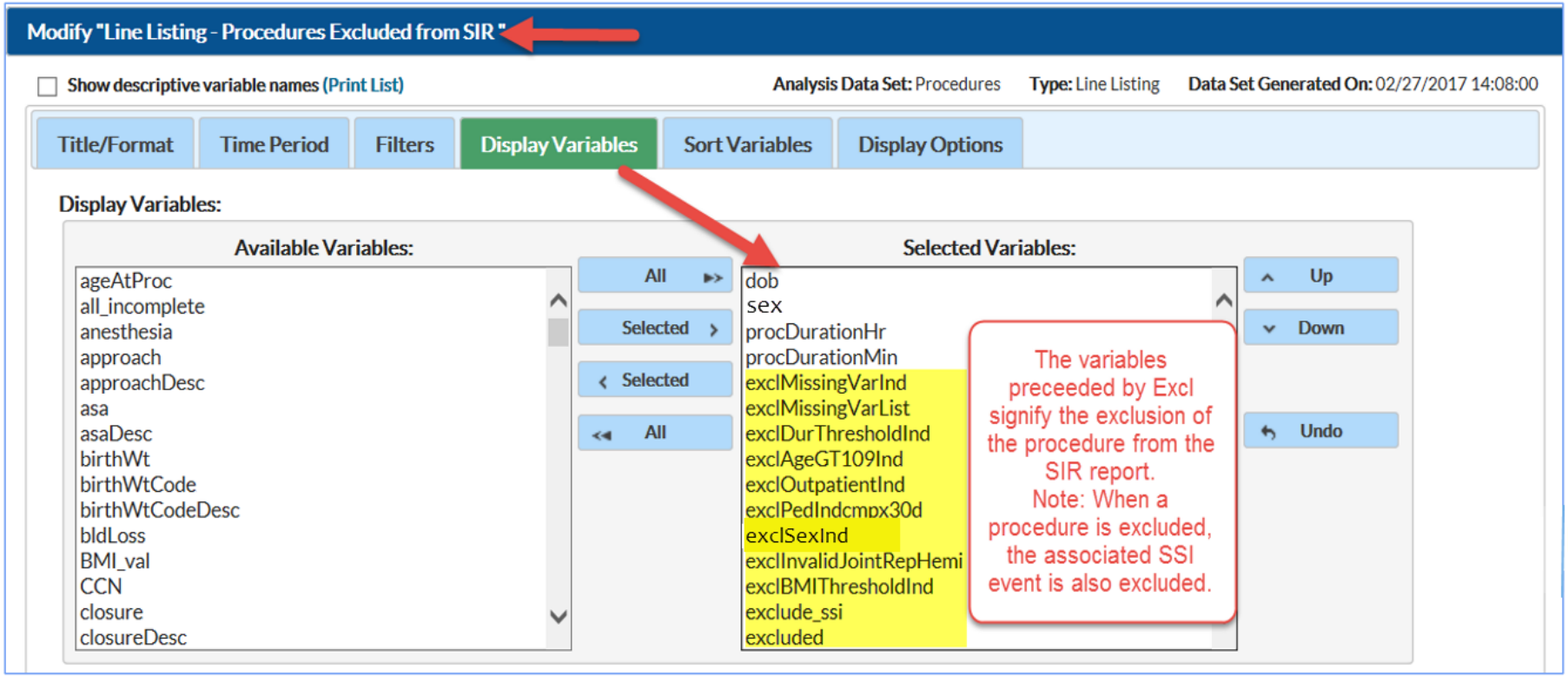
1. Please review the Quick Reference Guide related to the new SSI Indicator Variables (https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/ssi-events-line-list-qrg.pdf) for more information on determining which SSIs are included in the SIRs.
Data contained in this report were last generated on March 10, 2019 at 2:02 PM.

https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/ssi-events-line-list-qrg.pdf

Defining SSI Event Indicator Variables

Variable Name	Definition Procedure is included in the specified model (if value is set to 1)
bs2_AllSSI	Included in All Adult SSI SIR model
bs2_SSIPedAll	Included in All Pediatric SSI SIR model
bs2_SSIComplex	Included in Complex AR Adult SSI SIR model
bs2_SSIPedComplex	Included in Complex AR Pediatric SSI SIR model
bs2_SSIComplex30d	Included in Complex 30-daySSI SIR model

Line Listing for Procedures Excluded from SSI SIR (BS2 Baseline)



https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/line-list-procedures-excluded-sir.pdf

Line Listing for Procedures Excluded from SSI SIR (BS2 Baseline)

National Healthcare Safety Network
Line Listing for Procedures Excluded from SSI SIR (2015 Baseline)
As of: March 11, 2019 at 8:29 PM
Date Range: PROCEDURES procDateYQ 2018Q3 to 2018Q3

orgID	procID	procCode	procDate	bs2_allAdult Excl	bs2_allPed Excl	bs2_cmpxAdult Excl	bs2_cmpxPed Excl	bs2_cmpx30d Excl
10000	35678445	AMP	9/1/2018	1	1	1	1	1
10000	35678446	AMP	9/1/2018	1	1	1	1	1
10000	35678448	BILI	9/1/2018	1	1	1	1	1

The following footnotes apply to the 2015 Baseline only.
1. The "Line Listing for Procedures Excluded from SSI SIR (2015 Baseline)" report contains procedures excluded from one or more SIRs.
2. Variables preceded by excl indicate the reason for exclusion. If excl criterion is set to Y, then the procedure is excluded from the denominator of the related SIR.
3. Please review the Quick Reference Guide on Procedure Exclusion Criteria (https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/line-list-procedures-excluded-sir.pdf) for more information on how to determine which records are included in the SIRs.
4. The variable indicating procedures excluded from the CMS IQR program SIR is bs2_compx30dExcl; it applies to COLO and HYST only.

Data contained in this report were last generated on March 10, 2019 at 2:02 PM.

https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/line-list-procedures-excluded-sir.pdf

Line Listing for Procedures Excluded from SSI SIR (BS2 Baseline)

National Healthcare Safety Network
Line Listing for Procedures Excluded from SSI SIR (2015 Baseline)
As of: March 11, 2019 at 8:29 PM
Date Range: PROCEDURES procDateYQ 2018Q3 to 2018Q3

orgID	procID	procCode	procDate	exclAgeGT109Ind	exclBMIThresholdInd	exclDurThresholdInd	exclSexInd	exclInvalidJointRepHemi	exclMissingVarInd	exclMissingVarList	exclOutpatientInd	exclPedIndcmpx30d	excluded
10000	35678445	AMP	9/1/2018	N	N	Y	N	N	N		N	N	Y
10000	35678446	AMP	9/1/2018	N	N	N	N	N	N		Y	N	Y
10000	35678448	BILI	9/1/2018	N	N	N	N	N	N		Y	N	Y

- This is the second part of the Line List of Procedures Excluded from the SSI SIR that provides the reason for exclusion.
  - The reasons for exclusions are provided by the "EXCL" variables
- Please see the subsequent slides for the definition of exclusion variables

https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/line-list-procedures-excluded-sir.pdf

Defining Procedure Exclusion Variables

Variable Names	Definition Procedure is excluded because one or more of the following is true: =Y (for Yes)
exclMissingVarInd	Missing a variable required for the risk adjustment of the SIR
exclMissingVarList	If missing variables
exclDurThresholdInd	The procedure duration is less than 5 minutes or greater than the duration cut off point
exclAgeGT109Ind	The patient was older than 109 years old at the time of surgery
exclOutpatientInd	The procedure is an outpatient procedure
exclPedIndcmpx30d	Procedure is a pediatric procedure and excluded from the CMS model
exclSexInd	The patient's sex is missing (or not reported)
exclInvalidJointRepHemi	The value set for 2015 data entered for KPRO and HPRO as JointRepHemi is invalid
exclBMIThresholdInd	The patient's BMI is less than 12 or greater than 60 for adults The patient's BMI is less than 10.49 or greater than 65.79 for peds

Defining Procedure Exclusion Variables-Per SSI Models

Variable Name	Definition Procedure is excluded from the specified model (if value is set to 1)
bs2_allAdultExcl	Procedure is excluded from the All Adult SSI SIR model
bs2_allPedsExcl	Procedure is excluded from the All Pediatric SSI SIR model
bs2_cmpxAdultExcl	Procedure is excluded from the Complex AR Adult SSI SIR model
bs2_cmpxPedExcl	Procedure is excluded from the Complex AR Pediatric SSI SIR model
bs2_cmpx30dExcl	Procedure is excluded from the Complex 30-daySSI SIR model

In Summary…

- The SIR is a summary measure of the SSI events resulting from inpatient surgeries performed in a facility
- While the factors included in the risk-adjusted models have been updated, the predictive model still uses logistic regression to calculate the number of predicted infections.
- The factors included in the calculation have been updated
- The inclusion and exclusion criteria for the SSI SIR numerator and denominator have also been updated
  - Review the document on how to run and interpret the Line listing-Procedures Excluded from SIR
  - Review the document on SSI event indicator variables
- Become familiar with how 2015 baseline changes have impacted your SSI SIR by running the reports and utilizing the resources available on our website

Resources

- SIR Guide
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf
- How to modify report
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/howtomodifyreport.pdf
- Troubleshooting Guides
  - **https://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html**
- Detailed Guides for Specific Analysis Options
  - **https://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html**
  - **https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/line-list-procedures-excluded-sir.pdf**
  - **https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/ssi-events-line-list-qrg.pdf**

Resources

- Reporting Height and Weight for Procedures in NHSN
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/Reporting-Height-and-Weight-for-Procedures-508.pdf
- How do I create a line list of procedures?
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/faq-procedure-line-list.pdf
- How to run the SIR report: Standardized Infection Ratio (SIR) Table *Surgical Site Infections*
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/sirtablesssi.pdf
- Using the Statistics Calculator
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/StatsCalc.pdf

Thank You!

NHSN@cdc.gov

Frequently Asked SSI Questions and Answers for your Reference

Frequently Asked SSI Questions

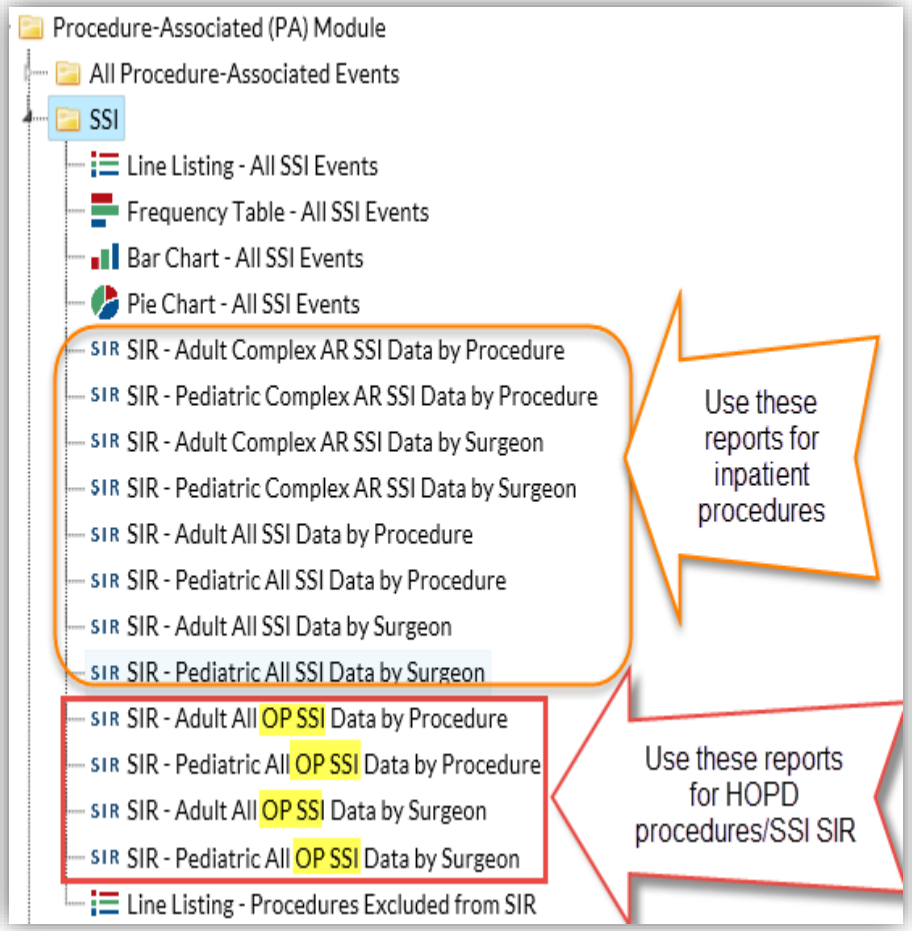
- Question 1: I uploaded my procedures for the month and generated datasets but the are not showing up on my SIR reports. Can you help?
  - Answer: Often the reason for procedures not showing up on an SIR report following an import and dataset generation is that an Alert of Missing Procedure-associated Events exists. Check to make sure the Alert is addressed. If an event occurs from one of the imported procedures, please enter it and link to the appropriate procedure and generate datasets. The Report will be adjusted accordingly
- Question 2:I imported my procedures with surgeon codes but I am unable to see them on the SIR reports when I ran them. How do I fix that?
  - Answer: Before you can use surgeon codes in your procedure import file, you must first import a surgeon code file into NHSN. The SIR reports will only recognize surgeons that have already been entered into the application prior to the import of procedures

Frequently Asked SSI Questions

- Question 3: We were under the impression that Class 3 and Class 4 infections are not factored into the CMS reports. Is that true?
  - Answer: No, Procedures are **not** excluded from SSI SIRs because of the wound class. Meaning, procedures, regardless of the wound class are included in the SSI SIR, including the CMS SIR. The wound class is a factor used in the risk adjustment of the SSI SIR for the Adult All SSI Data and the Complex AR models for certain procedures
    - More information in the SSI section of the SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf
- Question 4 : I ran the Line Listing of Procedures Excluded from the SSI SIR and all the exclusions reasons are set to “N” yet “Excluded” is set to “Y”
  - Answer: When this happens, then the procedure is linked to a PATOS event. As you may already know, PATOS events are excluded from the numerator and the procedures from which they occur are excluded from the denominator of the SIR

Frequently Asked SSI Questions

- Question 5: Why are outpatient procedures excluded from the SSI SIR?
  - Answer: Outpatient procedures are separated from inpatient procedure reports because they each have its own SIR report. In the patient safety component (PSC), outpatient procedures from hospital outpatient department (HOPD) are included in the OP SSI reports. Please refer to the image on the right for information. SIR reports are not available for all the NHSN operative procedures performed in HOPD



Frequently Asked SSI Questions

- Question 6: Are procedures with other than primary closures (non-primary closure technique) included in the SSI SIR?
  - Answer: Procedures with non-primary closure techniques are included in the 2015 baseline SSI SIRs. They are however excluded from the 2006-2008 baseline SSI SIRs.
- Question 7 : Where can I find state and national statistics on SSIs?
  - Answer: The National and State HAI Progress Report provides SIR data for the current and previous year as a way to measure progress. More information here: https://www.cdc.gov/hai/data/portal/progress-report.html

Frequently Asked SSI Questions

- Question 8: Are PATOS events still excluded from the SSI SIR report? If yes, which ones?
  - Answer: PATOS events are excluded from all the 2015 baseline SIR reports. The event is excluded from the numerator of the SIR and the procedure from which it resulted is excluded from the denominator of the SIR. The exclusion of PATOS events (and procedures) are applicable to all the 2015 baseline SSI SIR reports
    - More information in the SSI section of the SIR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf
- Question 9 : What do I do when the patient's height and weight are not available to enter into NHSN?
  - Answer: NHSN recommends that you review the patient charts, check all available resources for the height and weight at the time of the admission for the procedure to gather that information. if the information is still unavailable, NHSN recommends report 1 ft (for height) and 1 lb (for weight). This will result in the procedure being excluded from the SSI SIR due to the calculated BMI value being out of range

Frequently Asked SSI Questions

- Question 10: Can import off-plan procedures into NHSN so that I can use the risk adjusted SIR reports to monitor them?
  - Answer: Off-plan data can be imported into NHSN using CSV. Data import by CDA requires data to be IN-plan. When off plan data are imported into NHSN, there are fewer restrictions on providing data that are required for the risk adjustment of the SIR denominator. This means, there will no alerts for missing or out of range data. There will also be no alert to link events to procedure. One must be careful when importing Off-plan data to ensure the risk factors required for the risk adjustment of the SIR denominator are complete and accurate.