

# Central Line-associated Bloodstream Infection and Surgical Site Infection Surveillance Using the National Healthcare Safety Network

**Kathy Allen-Bridson RN, BSN, CIC**

*Nurse Consultant*

*Centers for Disease Control and Prevention*

*Division of Healthcare Quality Promotion*

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National Center for Emerging and Zoonotic Infectious Diseases



# Objectives

1. *State the Centers for Disease Control and Prevention's definitions and criteria of Central Line-associated Bloodstream Infection (CLABSI)*
2. *State the Centers for Disease Control and Prevention's definitions and criteria of Surgical Site Infection (SSI)*
3. *State the correct method to identify denominators for data analysis of both event types*

# *Background*



# NHSN Website

The National Healthcare Safety Network (NHSN) is a voluntary, secure, internet-based surveillance system that integrates and expands legacy patient and healthcare personnel safety surveillance systems managed by the Division of Healthcare Quality Promotion (DHQP) at CDC. NHSN also includes a new component for hospitals to monitor adverse reactions and incidents associated with receipt of blood and blood products. Enrollment is open to all types of healthcare facilities in the United States, including acute care hospitals, long term acute care hospitals, psychiatric hospitals, rehabilitation hospitals, outpatient dialysis centers, ambulatory surgery centers, and long term care facilities. For more information, click on the topics below.



Replay

## Biovigilance Component

NHSN Biovigilance Component

GO

MDRO HAI: Recovery Act Biovigilance

Text size: [S](#) [M](#) [L](#) [XL](#)

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## Topics

### About NHSN

Overview, Purposes, Confidentiality statement, How data are used, External Peer Review report...

### Forms

Component-specific manuals containing data collection protocols, instructions for completing forms...

### NHSN Manuals

Component-specific manuals containing data collection protocols, instructions for completing forms...

### Resource Library

Guides, Manuals, NHSN Codes & Variables, FAQs, HIPAA

### Enrollment Requirements

Eligibility, Required Training, Reporting & System Requirements, Security, Begin Enrollment...

### Training

Self-study slide sets and corresponding materials for NHSN modules...

### Patient Safety Component

Overview of the Modules: Device-associated, Procedure-associated, MDRO/CDAD, Vaccination...

### Biovigilance Component

Hemovigilance Module Overview

## Data & Statistics

### States with Facilities Using NHSN

(total-2646)



CDC currently supports more than 2600 hospitals that are using NHSN and 21 states require hospitals to report HAI's using NHSN.

[More Data & Statistics >>](#)

 [Get email updates](#)

To receive email updates about NHSN, enter your email address:

[What's this?](#)

Contact NHSN:

 Centers for Disease Control and Prevention

<http://www.cdc.gov/nhsn/index.html>

# CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting

Teresa C. Horan, MPH, Mary Andrus, RN, BA, CIC, and Margaret A. Dudeck, MPH  
Atlanta, Georgia

## BACKGROUND

Since 1988, the Centers for Disease Control and Prevention (CDC) has published 2 articles in which nos-

population for which clinical sepsis is used has been restricted to patients  $\leq 1$  year old. Another example is that incisional SSI descriptions have been expanded to specify whether an SSI affects the primary or a secondary in-

*Horan TC, Andrus ML, Dudeck MA. CDC/NHSN surveillance definition of healthcare-associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control 2008;36:309-32.*

<http://www.cdc.gov/ncidod/dhqp/pdf/NNIS/NosInfDefinitions.pdf>

# *Surveillance vs. clinical definitions*



- Different purposes*
- May not agree*
- Comments section useful to note important factors*

*Can submit questions to NHSN mailbox [NHSN@cdc.gov](mailto:NHSN@cdc.gov)*

# *Healthcare-associated Infection (HAI)*

- *A localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) that
  - *Occurs in a patient in a healthcare setting and*
  - *Was not present or incubating at the time of admission, unless the infection was related to a previous admission**
- *When the setting is a hospital, meets the criteria for a specific infection (body) site as defined by CDC (Chapter 17 of NHSN manual)*
- *When the setting is a hospital, may also be called a nosocomial infection*

A microscopic view of several red blood cells, appearing as biconcave discs with a reddish-pink hue, set against a dark red background. The cells are arranged in a cluster, with some in the foreground and others receding into the background.

# *CLABSI Criteria and Application*

# Central Line-associated Bloodstream Infections (CLABSI) Module

- *Estimated 92,011 CLABSIs occur in the United States each year<sup>1</sup>*
- *Most bloodstream infections are associated with the presence of a central line or umbilical catheter (in neonates) at the time of or before the onset of the infection*
- *Estimated mortality is 12-25% for each CLABSI<sup>2</sup>*

*Attributable cost estimated \$29,156/CLABSI*

**→** *\$2.7 billion in US/year<sup>1</sup>*



# *Central Line-associated Bloodstream Infection (CLABSI)*

- *CLABSI surveillance utilizes the Major Event Type: BSI*
- *Specific Event Type: Laboratory Confirmed Bloodstream Infection (LCBI)*

# *Major and Specific Event Types*



# *Central Line-associated Bloodstream Infection (CLABSI)*

- *CLABSI= Primary BSI that develops in a patient that had a central line within the 48 hours prior to the infection onset.*
- *Primary BSI= BSI that is not secondary to an infection at another site*

**NOTE: There is no minimum time period that the central line must be in place in order for the BSI to be considered central line-associated.**

# 48-Hour Transfer Rule

- *CLABSIs are attributed to the patient location at the onset of the BSI.*
- *Exception: If the BSI develops within 48 hours of discharge from a location, indicate the discharging location on the infection report.*

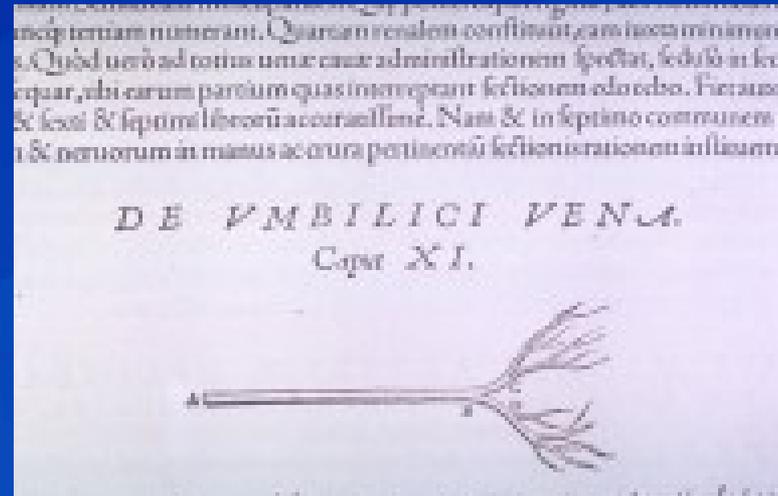
## *Definition: Central Line*

**A vascular infusion device that terminates at or close to the heart or in one of the great vessels and is used for infusion, withdrawal of blood, or hemodynamic monitoring.**

# Definition: Great Vessel

*The following are considered great vessels for the purpose of reporting central line infections and counting central line days*

- *Aorta*
- *Pulmonary artery*
- *Superior vena cava*
- *Inferior vena cava*
- *Brachiocephalic veins*
- *Internal jugular veins*
- *Subclavian veins*
- *Common Iliac veins*
- *External iliac veins*
- *Femoral veins*



# Definition: Infusion

- *Introduction of a solution through a blood vessel via a catheter lumen*
- *Includes:*
  - *Continuous infusions such as nutritious fluids or medications,*
  - *Intermittent infusions such as flushes or IV antimicrobial administration,*
  - *Administration of blood or blood products in the case of transfusion or hemodialysis*



# LCBI – Criterion 1

*Patient has a recognized pathogen cultured from one or more blood cultures*

And

*Organism cultured from blood is not related to an infection at another site.*



**Example: Jon Smith had a PICC line inserted on admission (June 1). On hospital day 4, he became confused and experienced chills. Blood cultures were drawn which grew *E. faecalis*.**

**Mr. Smith meets the criteria for LCBI Criterion 1.**

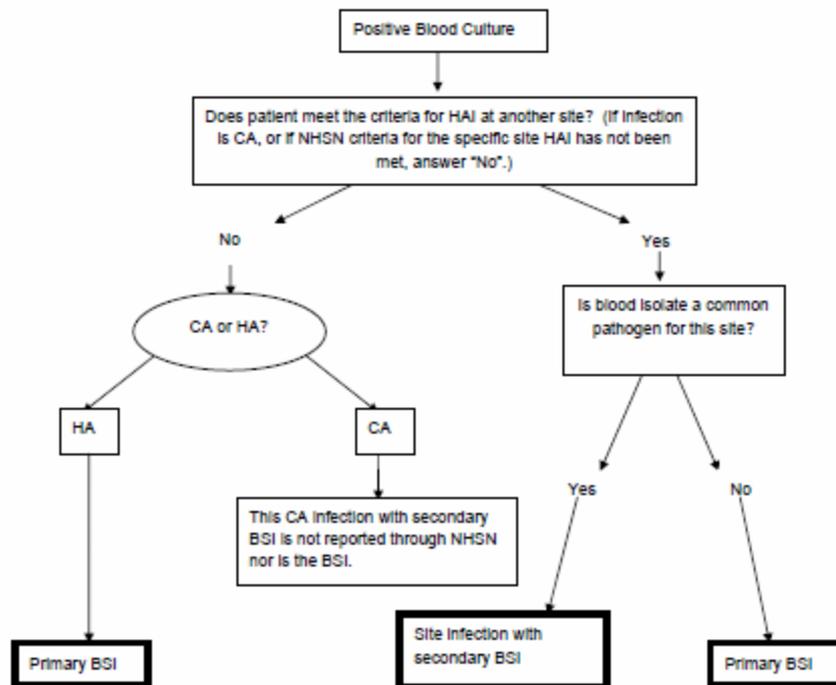
# *BSI Secondary to Infection at Another Site*

- *Requires an infection by CDC/NHSN definitions (Chapter 17) at another site*
- *They must be related*
  - *Same organism*
  - *Logical organism if no culture required for the definition*
- *See:*  
<http://www.cdc.gov/nhsn/PDFs/Newsletters/May09.pdf>

**What is the meaning of the statement “not related to infection at another site” in relation to a positive blood culture?**

The goal of NHSN (CDC) infection site criteria is to identify and consistently categorize infections that are healthcare-associated into major and specific infection sites or types. Several of the criteria include the caveat that signs, symptoms, and laboratory findings may not be related to infection at another site. When assessing positive blood cultures in particular, one must be sure that there is no other CDC-defined primary source of HAI that may have seeded the bloodstream secondarily, otherwise the infection may be misclassified as a primary BSI or erroneously associated with the use of a central line.

If the CDC criteria for the remote infection require a culture, then the organism(s) cultured from that site must match the organism(s) in the blood culture. In instances where a culture of the involved site is not required for NHSN criteria, and no such culture is collected, it may be necessary to use clinical judgment regarding the likelihood of it causing a secondary blood stream infection (BSI). In these instances, the following guidance may be used to help determine the relatedness of remote sources of infection to a positive blood culture:



*BSI= bloodstream infection  
HAI= healthcare-associated infection  
CA= community acquired*

## LCBI- Criterion 2

- *Patient has at least one of the following signs or symptoms: fever ( $>38^{\circ}\text{C}$ ), chills or hypotension*

And

- *Signs and symptoms and positive laboratory results are not related to an infection at another site*

And

- Common skin contaminant (i.e. diphtheroids [*Corynebacterium* spp.], *Bacillus* [not *B. anthracis*] spp., *Propionibacterium* spp., coagulase-negative staphylococci [including *S. epidermidis*], viridans group streptococci, *Aerococcus* spp., *Micrococcus* spp.) is cultured from two or more blood cultures drawn on separate occasions.

# LCBI Criterion 3

- Patient  $\leq$  1 yr of age has at least one of the following signs or symptoms: fever ( $>38$  °C core), hypothermia ( $<36$  °C core), apnea, or bradycardia

And

- Signs and symptoms and positive laboratory results are not related to an infection at another site

And

- Common skin contaminant (i.e. diphtheroids [*Corynebacterium* spp.], *Bacillus* [not *B. anthracis*] spp., *Propionibacterium* spp., coagulase-negative staphylococci [including *S. epidermidis*], viridans group streptococci, *Aerococcus* spp., *Micrococcus* spp.) is cultured from two or more blood cultures drawn on separate occasions.

## Note

*While LCBI Criterion 3 only applies to patients 1 year of age or less, Criteria 1 and 2 may be used for patients of ANY age, including children 1 year-old or younger.*



**One or more blood cultures means that at least one bottle from a blood draw is reported by the laboratory as having grown organisms (i.e., is a positive blood culture).**

*Let's look at the criteria in more detail...Criterion 1:*

**Recognized pathogen does not include organisms considered common skin contaminants. A few of the recognized pathogens are Staph aureus, Enterococcus spp., E. coli, Pseudomonas spp., Klebsiella spp., Candida spp., etc.**



## *Criteria 2 and 3:*

**The phrase “two or more blood cultures (BC) drawn on separate occasions” means:**

- 1. That blood from at least two blood draws were collected within two days of each other, and**
- 2. That at least one bottle from each blood draw is reported by the laboratory as having grown the same common skin contaminant organism (i.e., is a positive BC)**

## Criteria 2 & 3 **Determining “sameness” of two organisms**

If the organism from one culture is identified to both genus and species level (e.g., *S. epidermidis*) and the companion culture identifies only the genus with or without other attributes (in this example, coagulase-negative staphylococci), then it is assumed that the organisms are the same.

Report the genus/species to NHSN, i.e., in this example, report *S. epidermidis*. See other examples below:

Culture	Companion Culture	Report as...
<i>Bacillus</i> spp. (not <i>anthracis</i> )	<i>B. cereus</i>	<i>B. cereus</i>
<i>S. salivarius</i>	<i>Strep viridans</i>	<i>S. salivarius</i>

Criteria 2  
& 3

## Determining “sameness” of two organisms

*If organisms are speciated (e.g., both are *B. cereus*), but no antibiograms are done, or they are done for only one of the isolates, it is assumed that the organisms are the same.*



# Criteria 2 & 3 *Determining "sameness" of two organisms (cont.)*

*If the organisms from the cultures have antibiograms that are different for two or more antimicrobial agents, it is assumed that the organisms are not the same.*

## **Examples:**

Organism Name	Isolate A	Isolate B	Interpret as...
<i>S. epidermidis</i>	All drugs <b>S</b>	All drugs <b>S</b>	Same
<i>S. epidermidis</i>	OX <b>R</b> GENT <b>R</b>	OX <b>S</b> GENT <b>S</b>	Different
<i>Corynebacterium</i> spp.	PENG <b>R</b> CIPRO <b>S</b>	PENG <b>S</b> CIPRO <b>R</b>	Different
<i>Strep viridans</i>	All drugs <b>S</b>	All drugs <b>S</b> except ERYTH ( <b>R</b> )	Same

# Collecting Blood Culture Specimens

*Ideally, blood specimens for culture should be obtained from two to four blood draws from separate venipuncture sites (e.g., right and left antecubital veins), not through a vascular catheter.*

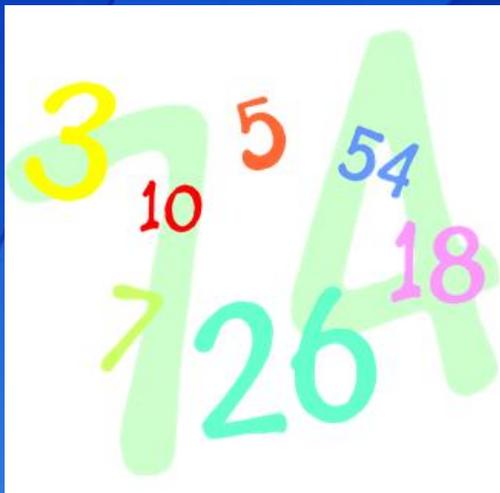


*These blood draws should be performed simultaneously or over a short period of time (i.e., within a few hours).*

*If your facility does not currently obtain specimens using this technique, you may still report BSIs using the NHSN criteria, but you should work with appropriate personnel to facilitate better specimen collection practices for blood cultures.*

# CLABSI Summary Data

*Data used to calculate HAI rates and related measures*



1. *Patient days*
2. *Central Line days*

# Collecting Summary Data

Patient Days: at the same time every day count the number of patients on the unit

Device Days: data collected differs according to surveillance location. However the constants are:

- count at the same time every day
- count the number of patients with one or more devices (pt with  $\geq 2$  gets counted as 1)

# Collecting Summary Data

- *ICUs/Other locations: no changes*
- *Specialty Care Areas (SCA)s:*
  - *# pts.with permanent central lines*
  - *# pts with temp central lines*
  - *Pts with both count only temp line\**

*SCAs= Adult and pediatric locations: Long Term Acute Care, Bone Marrow Transplant, Acute Dialysis, Hematology/Oncology, Solid Organ Transplant*

# Collecting Summary Data

- *Neonatal Intensive Care Units (NICUs): stratified by birthweight:*
  - *# pts with central line*
  - *# pts with umbilical line*
  - *Pts with both count only umbilical line\**

*Patient days must be stratified by birthweight also.*

*\*Temporary and umbilical lines have the highest risk of infection*

# Collecting ICU/Other Summary Data

NHSN Home

Reporting Plan

Patient

Event

Procedure

Summary Data

▢ Add

▢ Find

▢ Incomplete

Import/Export

Analysis

Surveys

Users

Facility

Group

Log Out

Logged into DHQP Memorial Hospital (ID 10000) as KATHY.  
Facility DHQP Memorial Hospital (ID 10000) is following the PS component.

## Denominators for Intensive Care Unit (ICU)/ Other locations (not NICU or SCA)

HELP

Mandatory fields marked with \*

Facility ID\*: 10000 (DHQP Memorial Hospital )

Location Code\*: BICU3 - BURN ICU 3

Month\*: January

Year\*: 2010

Total Patient Days\*: 505

Central Line Days\*: 100

Urinary Catheter Days:

Ventilator Days:



Edit

Delete

Back

# Collecting SCA Summary Data

NHSN - National Healthcare Safety Network

 NHSN Home

Logged into DHQP Memorial Hospital (ID 10000) as KATHY.  
Facility DHQP Memorial Hospital (ID 10000) is following the PS component.

Reporting Plan

Patient

Event

Procedure

Summary Data

 Add

 Find

 Incomplete

Import/Export

Analysis

Surveys

Users

Facility

Group

Log Out

## Denominators for Specialty Care Area (SCA)

Save of Summary Data successful.

 HELP

Mandatory fields marked with \*

Facility ID\*: 10000 (DHQP Memorial Hospital )

Location Code\*: SCA - SPECIALTY CARE AREA

Month\*: January

Year\*: 2010

Total Patient Days\*: 100

Temporary Central Line Days\*: 20

Permanent Central Line Days\*: 60

Urinary Catheter Days\*: 100

Ventilator Days:



Edit

Delete

Back

# Collecting NICU Summary Data

NHSN - National Healthcare Safety Network

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 NHSN Home

Logged into DHQP Memorial Hospital (ID 10000) as KATHY.  
Facility DHQP Memorial Hospital (ID 10000) is following the PS component.

Reporting Plan

Patient

Event

Procedure

Summary Data

 Add

 Find

 Incomplete

Import/Export

Analysis

Surveys

Users

Facility

Group

Log Out

## Neonatal Intensive Care Unit

 HELP

Mandatory fields marked with \*

Facility ID\*: 10000 (DHQP Memorial Hospital )

Location Code\*: NICU 3 - LEVEL 3 NICU

Month\*: January

Year\*: 2010

**Umbilical  
Catheters**

[Print PDF Form](#)

Birth Wt.	Patient Days*	U/C Days*	CL Days*	Vent Days*
<=750	10	5	5	10
751-1000	10	5	5	10
1001-1500	10	5	5	10
1501-2500	101	5	5	10
>2500	10	5	5	10

Edit

Delete

Back

# CLABSI Analysis:

## The Standardized Infection Ratio (SIR)

# USING THE STANDARDIZED INFECTION RATIO FOR HAI ANALYSIS

- ❑ *Based on Standardized Mortality Ratio (SMR)*
  - *Used extensively in public health research*
- ❑ *Compares the experience in one facility to that in a standard population (referent population)*

## **Number observed/number expected**

*Quick and Dirty:*

*If the expected # of infections = # observed, the ratio will be: **1***

*>1 = more infections than expected*

*< 1 = fewer infections than expected*

# ADVANTAGES OF STANDARDIZED INFECTION RATIO FOR HAI ANALYSIS

- ❑ **Adjusts for risk factors most often affecting infection risk**
  - *Device-associated events:*
    - *Location type*
    - *Facility type (in some locations)*
    - *In some events, birthweight*
  - *Procedure-associated events:*
    - *Procedure-specific variables*
  
- ❑ **Presents in single metric how the number of infections experienced relates to the expected number:**  
**Number observed/number expected**

# COMPUTING THE SIR FOR DEVICE-ASSOCIATED DATA

## □ Determine numerator:

- *Simply the number of infections at that facility during time period*

## □ Determine denominator:

- *Multiply the referent stratum-specific rates by the number of patients in each stratum*
- *Sum all of these*
- *Equals the “expected denominator”*



## COMPUTING THE SIR: Example\*

Type of ICU Location	# CLABSI	# Central line-days	CLABSI Rate	NHSN Rate	p-value	Expected # of CLABSI <sup>a</sup>
Medical cardiac	2	380	5.26	2.0	0.09	0.76
Medical	1	257	3.89	Medical	0.15	0.67
Med/Surgical	3	627	4.78	1.5	0.11	0.94
Neurosurgical	2	712	2.81	2.5	0.32	1.78
<i>Total</i>	<i>8</i>	<i>1976</i>	<i>4.05</i>	<i>---</i>	<i>---</i>	<i>4.15</i>

$$\text{SIR} = 1.98^b$$

<sup>a</sup>Calculated as the NHSN # of central line days X the expected infection rate 1000  ;  $(380 \times 2.0) / 1000 = 0.76$

<sup>b</sup>Calculated as the total # of CLABSI observed by the total # CLABSI expected;  $8 / 4.15 = 1.98$  (i.e., 98% higher than expected)

# Analysis of CLABSI data

Event

Procedure

Summary Data

Import/Export

Analysis

- Generate Data Sets
- Output Options**
- Statistics Calculator

Surveys

Users

Facility

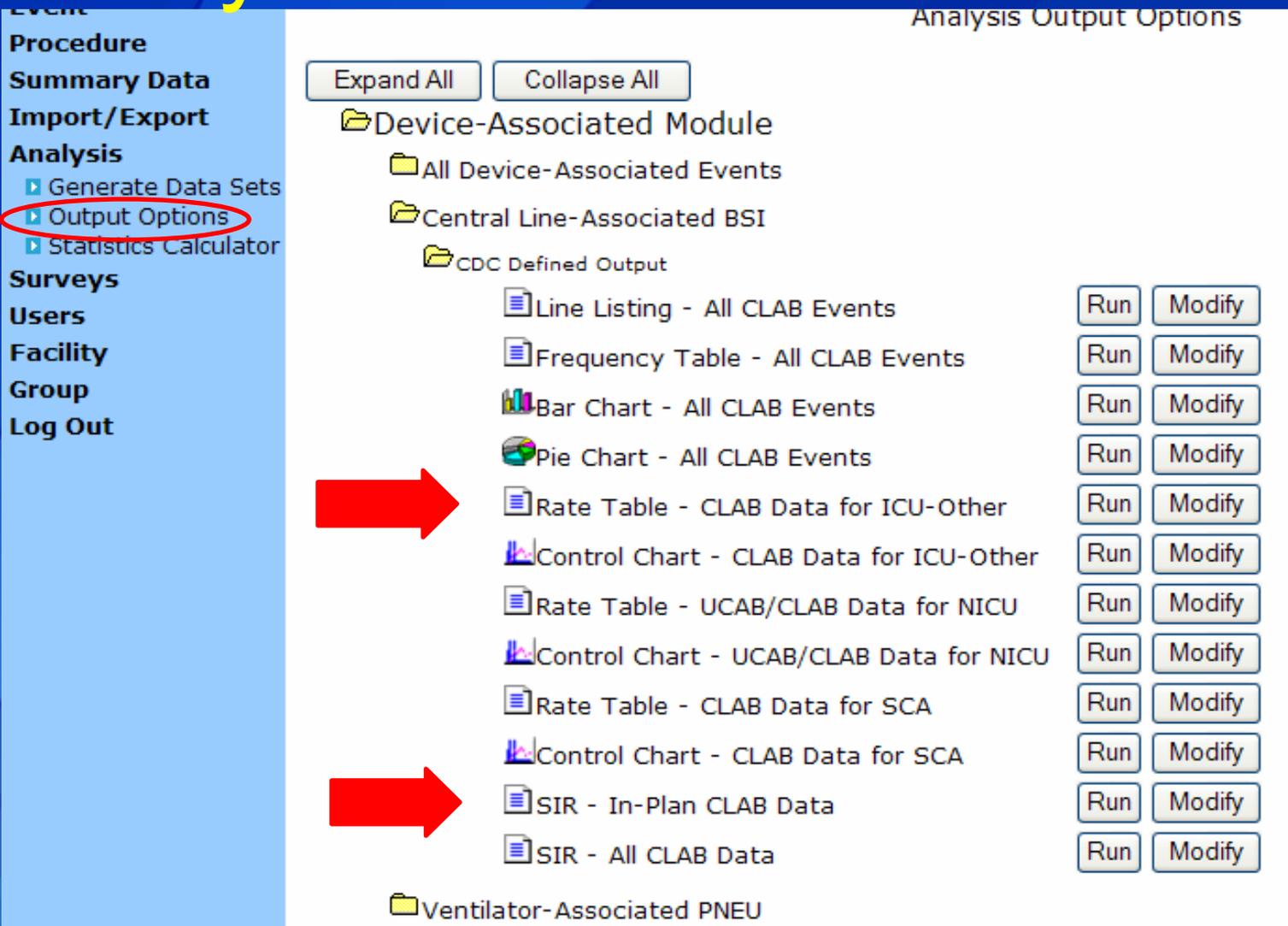
Group

Log Out

Analysis Output Options

Expand All Collapse All

- Device-Associated Module
  - All Device-Associated Events
  - Central Line-Associated BSI
    - CDC Defined Output
      - Line Listing - All CLAB Events [Run] [Modify]
      - Frequency Table - All CLAB Events [Run] [Modify]
      - Bar Chart - All CLAB Events [Run] [Modify]
      - Pie Chart - All CLAB Events [Run] [Modify]
      - Rate Table - CLAB Data for ICU-Other [Run] [Modify]
      - Control Chart - CLAB Data for ICU-Other [Run] [Modify]
      - Rate Table - UCAB/CLAB Data for NICU [Run] [Modify]
      - Control Chart - UCAB/CLAB Data for NICU [Run] [Modify]
      - Rate Table - CLAB Data for SCA [Run] [Modify]
      - Control Chart - CLAB Data for SCA [Run] [Modify]
      - SIR - In-Plan CLAB Data [Run] [Modify]
      - SIR - All CLAB Data [Run] [Modify]
  - Ventilator-Associated PNEU



# Analysis of CLABSI data

National Healthcare Safety Network

SIR for In-Plan Central Line-Associated BSI Data - By OrgID

As of: October 4, 2010 at 1:03 PM

Date Range: All CLAB\_RATESICU

if (((bsiPlan = "Y" ) ) )

orgid=10018

orgid	summaryYH	infCount	numExp	numCLDays	SIR	SIR_pval	SIR95CI
10018	2009H1	9	5.640	3213	1.60	0.1179	0.832, 2.784
10018	2010H1	0	1.095	464	0.00	0.1179	

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

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

Source of aggregate data: NHSN Report, Am J Infect Control 2009;37:783-805

Data contained in this report were last generated on September 29, 2010 at 11:20 AM.

National Healthcare Safety Network

SIR for In-Plan Central Line-Associated BSI Data - By OrgID/Location Type

As of: October 4, 2010 at 1:03 PM

Date Range: All CLAB\_RATESICU

if (((bsiPlan = "Y" ) ) )

Date Range: CLAB\_RATESICU summaryYr 2010 to 2010

orgID=10000 loccdc=IN:ACUTE:CC:M

location	summaryYM	CLABCount	numCLDays	CLABRate	CLAB_Mean	IDR_pval	IDR_pctl	numPatDays	LineDU	LineDU_Mean	P_pval	P_pctl
AUNIT	2010M01	0	25	0.0	2.6	0.9378	0	100	0.25	0.61	0.0000	7

Source of aggregate data: NHSN Report, Am J Infect Control 2009;37:783-805

Data contained in this report were last generated on July 29, 2010 at 2:38 PM.

## Rate Table for CLABSI ICU/OTHER

National Healthcare Safety Network

Rate Table for Central Line-Associated BSI Data for ICU-Other

As of: July 29, 2010 at 3:08 PM

Date Range: CLAB\_RATESICU summaryYr 2010 to 2010

orgID=10000 loccdc=IN:ACUTE:CC:MS

location	summaryYM	CLABCount	numCLDays	CLABRate	CLAB_Mean	IDR_pval	IDR_pctl	numPatDays	LineDU	LineDU_Mean	P_pval	P_pctl
3 MS	2010M01	0	200	0.0	2.1	0.6560	10	584	0.34	0.59	0.0000	9
3 MS	2010M02	1	403	2.5	2.1	0.5724	67	591	0.68	0.59	0.0000	73

Source of aggregate data: NHSN Report, Am J Infect Control 2009;37:783-805

Data contained in this report were last generated on July 29, 2010 at 2:38 PM.

National Healthcare Safety Network

Rate Table for Central Line-Associated BSI Data for ICU-Other

As of: July 29, 2010 at 3:08 PM

Date Range: CLAB\_RATESICU summaryYr 2010 to 2010

orgID=10000 loccdc=IN:ACUTE:WARD:BHV

location	summaryYM	CLABCount	numCLDays	CLABRate	CLAB_Mean	IDR_pval	IDR_pctl	numPatDays	LineDU	LineDU_Mean	P_pval	P_pctl
BHV	2010M04	0	100	0.0	0.0					0.02		

## Rate Table for Umb Cath/Central Line-Associated BSI Data for NICU

## CLAB Rate Data

As of: July 29, 2010 at 3:13 PM

Date Range: All CLAB\_RATESNICU

orgID=10000 loccdc=IN:ACUTE:CC:NURS

location	birthwtcode	summaryYM	CLABCount	numCLDays	CLABRate	CLAB_Mean	IDR1_pval	IDR1_pctl	numPatDays	LineDU	LineDU_Mean	P1_pval	P1_pctl
856800	A	2009M08	0	2	0.0	3.9	0.9922	25	6	0.33	0.35	0.5000	32
856800	A	2009M12	0	8	0.0	3.9	0.9690	25	13	0.62	0.35	0.0467	91
856800	B	2009M08	0	2	0.0	3.4	0.9933	25	6	0.33	0.32	0.5000	50
856800	B	2009M12	0	5	0.0	3.4	0.9834	25	10	0.50	0.32	0.1869	85
856800	C	2009M08	0	2	0.0	2.4	0.9951	25	6	0.33	0.24	0.4747	68
856800	C	2009M12	0	0	.	2.4	.	.	4	0.00	0.24	0.3354	0
856800	D	2009M08	0	2	0.0	2.4	0.9952	25	6	0.33	0.16	0.2591	83
856800	D	2009M12	0	0	.	2.4	.	.	8	0.00	0.16	0.2174	0
856800	E	2009M08	0	2	0.0	1.9	0.9962	50	6	0.33	0.20	0.3715	85
856800	E	2009M12	0	5	0.0	1.9	0.9906	50	15	0.33	0.20	0.1574	85
NICU 3	A	2005M01	0	13	0.0	3.9	0.9501	25	28	0.46	0.35	0.1541	81
NICU 3	A	2005M04	0	7	0.0	3.9	0.9728	25	28	0.25	0.35	0.1694	32
NICU 3	A	2005M06	0	3	0.0	3.9	0.9883	25	21	0.14	0.35	0.0361	5
NICU 3	A	2005M07	0	8	0.0	3.9	0.9690	25	16	0.50	0.35	0.1693	81
NICU 3	A	2005M09	0	13	0.0	3.9	0.9501	25	113	0.12	0.35	0.0000	5
NICU 3	A	2005M12	0	3	0.0	3.9	0.9883	25	14	0.21	0.35	0.2072	12
NICU 3	A	2006M01	0	17	0.0	3.9	0.9353	25	45	0.38	0.35	0.4313	61
NICU 3	A	2006M02	0	3	0.0	3.9	0.9883	25	10	0.30	0.35	0.4886	32
NICU 3	A	2006M04	0	2	0.0	3.9	0.9922	25	12	0.17	0.35	0.1452	12
NICU 3	A	2006M05	0	14	0.0	3.9	0.9464	25	45	0.31	0.35	0.3263	32
NICU 3	A	2006M06	0	35	0.0	3.9	0.8714	25	56	0.63	0.35	0.0000	91
NICU 3	A	2007M05	0	55	0.0	3.9	0.8054	25	76	0.72	0.35	0.0000	95
NICU 3	A	2007M06	0	75	0.0	3.9	0.7445	25	88	0.85	0.35	0.0000	100
NICU 3	A	2007M12	0	10	0.0	3.9	0.9614	25	11	0.91	0.35	0.0002	100
NICU 3	A	2009M04	0	0	.	3.9	.	.	0	.	0.35	.	.
NICU 3	A	2010M01	0	5	0.0	3.9	0.9805	25	10	0.50	0.35	0.2635	81

# *Surgical Site Infections (SSIs)*



# *Epidemiology*

- *SSIs are the third most frequently reported HAI*
- *Account for 14-16% of all HAIs among hospitalized patients*
- *Remains a substantial cause of morbidity and mortality even with recent advances in prevention*

# *Hospital Inpatient Quality Reporting Program (RHQDAPU)*

- *Tentative requirements for SSI reporting:*
- *Procedures occurring after January 1, 2011*
- *The Joint Commission's SCIP (Surgical Care Improvement Project) core measurement set*

CABG (CBGB & CBGC) HPRO  
CARD HYST  
COLO KPRO

VASC  
VHYST

# *NHSN Operative Procedure*

## *Includes:*

- *Surgery completed in a single trip to the OR*
- *Incision closed before leaving OR*
- *Surgery conducted in defined operating room suite*
- *May be an in- or out-patient procedure*
- *Laparoscopic & traditional approaches included*

# *Definition of an Operating Room*

- *A patient care area that meets the American Institute of Architects (AIA) criteria for an operating room<sup>7</sup>. This may include an operating room, C-Section room, interventional radiology room, or a cardiac catheterization lab.*

# *NHSN Operative Procedures\**

- *Each NHSN Operative Procedure category consists of a group of ICD-9-CM codes*  
Example: CBGB (CABG with chest and donor site incisions) = ICD-9 codes 36.10 – 36.14, 36.19
- *When monitoring a specific NHSN Operative Procedure category, all the ICD-9 codes within that category that are done in your facility must be followed*

*\*Table 11 in the NHSN Patient Safety Component Protocol document*

# *Implant*

- *A nonhuman-derived implantable foreign body (e.g., prosthetic heart valve, hip prosthesis) that is permanently placed in a patient during an NHSN operative procedure and is not routinely manipulated for diagnostic or therapeutic purposes*
- *Screws, wires, and mesh that are left in place are considered implants (currently staples are also considered implants). This list is not all inclusive.*

# Non-Autologous Transplant

- *Transplant: Human cells, tissues, organs, or cellular- or tissue-based products that are placed into a human recipient via grafting, infusion, or transfer. Examples include: heart valves, organs, ligaments, bone, blood vessels, skin, corneas, and bone marrow cells.*
- *Autologous or “autograft” transplants are products that originate from the patient’s own body.*
- *Non-autologous or “allograft” transplants are tissues or other products derived from another human body, either a donor cadaver or a live donor.*

# Transplant

- *REPORTING INSTRUCTIONS:*
- *Some products are a combination of human- and nonhuman-derived materials, such as demineralized human bone matrix with porcine gel carrier. When placed in a patient during an operative procedure, indicate "Yes" for both the Implant and Non-autologous Transplant fields.*
- *Some operative procedures involve placement of both autologous and non-autologous products. For these procedures, indicate "Yes" for Non-autologous Transplant field.*

# Superficial Incisional SSI

A superficial incisional SSI must meet one of the following criteria:

Infection occurs within 30 days after the operative procedure  
and  
involves only skin and subcutaneous tissue of the incision  
and

patient has at least one of the following:

- a. purulent drainage from the superficial incision.
- b. organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
- c. at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat, and superficial incision is deliberately opened by surgeon, and is culture-positive or not cultured. A culture-negative finding does not meet this criterion.
- d. diagnosis of superficial incisional SSI by the surgeon or attending physician.

# Superficial Incisional SSI

NOTE: There are two specific types of superficial incisional SSIs:

1. Superficial Incisional Primary (SIP) – a superficial incisional SSI that is identified in the primary incision in a patient that has had an operation with one or more incisions (e.g., C-section incision or chest incision for CBGB)
2. Superficial Incisional Secondary (SIS) – a superficial incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (e.g., donor site [leg] incision for CBGB)

## REPORTING INSTRUCTIONS:

- Do not report a stitch abscess (minimal inflammation and discharge confined to the points of suture penetration) as an infection.
- Do not report a localized stab wound infection as SSI. While it would be considered either a skin (SKIN) or soft tissue (ST) infection, depending on its depth, it is not reportable under this module.
- “Cellulitis”, by itself, does not meet the criteria for Superficial Incisional SSI.
- If the incisional site infection involves or extends into the fascial and muscle layers, report as a deep-incisional SSI.
- Classify infection that involves both superficial and deep incision sites as deep incisional SSI.
- An infected circumcision site in newborns is classified as CIRC. Circumcision is not an NHSN operative procedure. CIRC is not reportable under this module.
- An infected burn wound is classified as BURN and is not reportable under this module

# Deep Incisional SSI

A **deep incisional SSI** must meet <sup>e</sup>one of the following criteria:

Infection occurs within 30 days after the operative procedure if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operative procedure

and

involves deep soft tissues (e.g., fascial and muscle layers) of the incision

and

patient has at least one of the following:

- a. purulent drainage from the deep incision but not from the organ/space component of the surgical site
- b. a deep incision spontaneously dehisces or is deliberately opened by a surgeon and is culture-positive or not cultured when the patient has at least one of the following signs or symptoms: fever ( $>38^{\circ}\text{C}$ ), or localized pain or tenderness. A culture-negative finding does not meet this criterion.
- c. an abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination
- d. diagnosis of a deep incisional SSI by a surgeon or attending physician.

# Organ/Space SSI

An organ/space SSI must meet the following criterion:

Infection occurs within 30 days after the operative procedure if no implant<sup>1</sup> is left in place or within 1 year if implant is in place and the infection appears to be related to the operative procedure

*and*

infection involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure

*and*

patient has at least 1 of the following:

- a. purulent drainage from a drain that is placed through a stab wound into the organ/space
- b. organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space
- c. an abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination
- d. diagnosis of an organ/space SSI by a surgeon or attending physician.

# Specific Sites of Organ/Space SSI

**Table 2. Specific sites of an organ/space SSI.** Criteria for these sites can be found in the NHSN Help Messages (must be logged in to NHSN) or Chapter 17.<sup>8</sup>

Code	Site	Code	Site
BONE	Osteomyelitis	LUNG	Other infections of the respiratory tract
BRST	Breast abscess or mastitis	MED	Mediastinitis
CARD	Myocarditis or pericarditis	MEN	Meningitis or ventriculitis
DISC	Disc space	ORAL	Oral cavity (mouth, tongue, or gums)
EAR	Ear, mastoid	OREP	Other infections of the male or female reproductive tract
EMET	Endometritis	OUTI	Other infections of the urinary tract
ENDO	Endocarditis	SA	Spinal abscess without meningitis
EYE	Eye, other than conjunctivitis	SINU	Sinusitis
GIT	GI tract	UR	Upper respiratory tract
IAB	Intraabdominal, not specified elsewhere	VASC	Arterial or venous infection
IC	Intracranial, brain abscess or dura	VCUF	Vaginal cuff
JNT	Joint or bursa		

# Organ/Space SSI

- ★ • Occasionally an organ/space infection drains through the incision. Such infection generally does not involve reoperation and is considered a complication of the incision. Therefore, classify it as a deep incisional SSI.
- ★ • Report mediastinitis following cardiac surgery that is accompanied by osteomyelitis as SSI-MED rather than SSI-BONE.
- ★ • Report CSF shunt infection as SSI-MEN if it occurs  $\leq 1$  year of placement; if later or after manipulation/access, it is considered CNS-MEN and is not reportable under this manual.
  - Report spinal abscess with meningitis as SSI-MEN following spinal surgery.

# Organ/Space SSI

- *If a patient has several NHSN operative procedures prior to an infection, report the operative procedure code of the operation that was performed most closely in time prior to the infection date, unless there is evidence that the infection is associated with a different operation.*
- *2. If more than one NHSN operative procedure was done through a single incision, attempt to determine the procedure that is thought to be associated with the infection. If it is not clear (as is often the case when the infection is a superficial incisional SSI), or if the infection site being reported is not an SSI, use the NHSN Principal Operative Procedure Selection Lists (Table 3) to select which operative procedure to report.*

**Table 3. NHSN Principal Operative Procedure Selection Lists**

The following lists are derived from Table 1, NHSN Operative Procedure Categories. The operative procedures with the highest risk of surgical site infection are listed before those with a lower risk.

Priority	Code	Abdominal Operations
1	SB	Small bowel surgery
2	KTP	Kidney transplant
3	LTP	Liver transplant
4	BILI	Bile duct, liver or pancreatic surgery
5	REC	Rectal surgery
6	COLO	Colon surgery
7	GAST	Gastric surgery
8	CSEC	Cesarean section
9	SPLE	Spleen surgery
10	APPY	Appendix surgery
11	HYST	Abdominal hysterectomy
12	VHYST	Vaginal Hysterectomy
13	OVRY	Ovarian surgery
14	HER	Herniorrhaphy
15	CHOL	Gall bladder surgery
16	AAA	Abdominal aortic aneurysm repair
17	NEPH	Kidney surgery
18	XLAP	Laparotomy
Priority	Code	Thoracic Operations
1	HTP	Heart transplant
2	CBGB	Coronary artery bypass graft with donor incision(s)
3	CBGC	Coronary artery bypass graft, chest incision only
4	CARD	Cardiac surgery
5	THOP	Thoracic surgery

# Entering Procedure Data (1)

1. Manual
2. Electronic Import

## Importing Patient Safety Procedure Data

The NHSN will allow importation of procedure data in an ASCII comma delimited text file format. You can generate the import files from different external sources, such as databases or hospital information systems. The default import option allows the importation of procedures where the procedure date occurs in a month for which a Monthly Reporting Plan exists and the Plan specifies the procedure code in the import file record. If you wish to import records for procedures not in the Plan, you must specify which procedures to include.

Custom procedures can also be imported if they are first created on the custom options page.

### NOTES:

1. Data in the import file must be in the same order as described in the table below, not as they appear on the Denominator for Procedure form.
2. The comma delimited text file format defined in the below table requires commas between fields even if no data values exist (e.g., optional or empty fields).
3. If a bilateral procedure is performed, two procedure records are required. Refer to the NHSN Procedure Codes table for a list of procedures that can be bilateral.
4. There should be a unique duration for each bilateral procedure. If only one total time is available for both procedures, estimate the duration for each or split the time evenly between them.
5. For procedures, if Outpatient = Y, then the procedure must be one of those listed in the NHSN Procedure Codes table as an Outpatient Procedure.
6. If you are importing Surgeon Code, all surgeon codes must exist in NHSN prior to importing.
7. If the optional Procedure Comment field has text that contains commas you must place a double quote at the beginning and end of the string of text (e.g., with allograft, dowels, plates).
8. When creating comma delimited files, be careful to exclude non-printable characters as they may actually cause the data to be improperly imported and result in errors.
9. You must delete the header line from the CSV file prior to importing the data.
10. Fields marked as "Optional for Import" allow an incomplete record to be imported. Note that these fields are considered required for completion of an in-plan procedure record and can be completed through manual edit of each record in the NHSN reporting application.

# Entering Procedure Data (2)

- *1. If more than one NHSN operative procedure (category) is performed during the same trip to the OR, a Denominator for Procedure (CDC 57.121) record is reported for each operative procedure being monitored. Even if more than one NHSN operative procedure (category) is done through the same incision (e.g., CARD and CBGC), a Denominator for Procedure record is reported for each.*
- **EXCEPTIONS:**
  - *If a patient has both a CBGC and CBGB during the same trip to the OR, report only as a CBGB.*
  - *If patient has a LAM as an approach to FUSN, record only FUSN*

# *Entering Procedure Data (3)*

- If more than one NHSN operative procedure is performed through the same incision, record the combined duration of all procedures, which is the time from skin incision to primary closure*
- For bilateral operative procedures (e.g., KPRO), two separate Denominator for Procedure (CDC 57.121) are completed. To document the duration of the procedure, indicate the incision time to closure time for each procedure separately or, alternatively, take the total time for both procedures and split it evenly between the two*

# *Entering Procedure Data (4)*

- If a patient goes to the OR more than once during the same admission and another procedure is performed through the same incision within 24 hours of the original operative incision, report only one procedure on the Denominator for Procedure (CDC 57.121) combining the durations for both procedures*

# Analysis of SSI data



*(and improved)*

~~NNIS Risk Index~~

*NHSN Risk Modeling*



# Limitations of the 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
- What can be done to improve risk adjustment?

# Improved Risk Adjustment

- Risk index relies on three risk factors only
  - Allow all available factors to be considered
- These same risk factors must differentiate risk for all types of procedures
  - Allow the set of risk factors to be procedure-specific
- The relative contribution of these factors are constrained to be equal
  - Allow each factor's contribution to vary according to its significant association with risk
- What can be done to improve risk adjustment?
  - Build logistic regression models

# Available NHSN Risk Factors

## ***For All Procedures***

*General anesthesia*

*Age*

*Wound class*

*Emergency*

*Gender*

*ASA score*

*Trauma*

*Endoscope*

*Duration of procedure*

*Bed size<sup>Δ</sup>*

*Med School Affiliation<sup>Δ</sup>*

## ***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*

<sup>Δ</sup>Hospital-level factor

# Available NHSN Data

**2006-2008**

Number of procedure types:	40
Number of hospitals:	823
Total SSI:	16,152
Total procedure volume:	823,770
Lowest (spleen surgery):	257
Highest (knee prosthesis):	171,659

# Example Comparison- NNIS Risk vs. Modeling SSI after VHYS

Patient	Age	Duration	ASA Score	Med School Affiliation	SSI	Prob of SSI ( $\hat{p}$ )	
						Risk Index	Model
1	40	117	4	Y	0	0.012	0.050
2	53	95	2	N	0	0.007	0.004
3	30	107	2	Y	1	0.007	0.033
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
100	37	128	4	Y	1	0.012	0.050
<b>Total</b>					<b>O = 3</b>	<b>E = 0.85</b>	<b>E = 2.91</b>

*Standardized Infection Ratio (SIR) = 3 / 0.85 = 3.5*

# SSI Analysis Options

The screenshot shows a software interface for SSI analysis. It features a tree view on the left with folders and files. To the right of each file is a pair of buttons labeled 'Run' and 'Modify'. A red bracket on the left side of the interface groups the following files: SIR - Complex AR SSI Data by Procedure, SIR - Complex AR SSI Data by Surgeon, SIR - In-plan Complex AR SSI data by Procedure, SIR - In-plan Complex AR SSI data by Surgeon, SIR - All SSI Data by Procedure, SIR - All SSI Data by Surgeon, SIR - In-plan All SSI Data by Procedure, and SIR - In-plan All SSI data by Surgeon.

Folder/Item	Run	Modify
SSI		
CDC Defined Output		
Line Listing - All SSI Events	Run	Modify
Frequency Table - All SSI Events	Run	Modify
Bar Chart - All SSI Events	Run	Modify
Pie Chart - All SSI Events	Run	Modify
SIR - Complex AR SSI Data by Procedure	Run	Modify
SIR - Complex AR SSI Data by Surgeon	Run	Modify
SIR - In-plan Complex AR SSI data by Procedure	Run	Modify
SIR - In-plan Complex AR SSI data by Surgeon	Run	Modify
SIR - All SSI Data by Procedure	Run	Modify
SIR - All SSI Data by Surgeon	Run	Modify
SIR - In-plan All SSI Data by Procedure	Run	Modify
SIR - In-plan All SSI data by Surgeon	Run	Modify
Line Listing - Incomplete Procedures for SSI SIR	Run	Modify
Post-Procedure PNEU		
MDRO/CDAD Module - Infection Surveillance		
MDRO/CDAD Module - LABID Event Reporting		

# National Healthcare Safety Network

## SSI Sample Analysis

### SIR for All SSI Data by Procedure - By OrgID

As of: October 4, 2010 at 1:22 PM

Date Range: All SIR\_ALLSSIPROC

orgid=10018

orgid	summaryYH	procCount	infCountAll	numExpAll	SIRAll	SIRAll_pval	SIRAll95CI
10018	2009H1	157	11	2.709	4.06	0.0001	2.277, 6.721
10018	2009H2	370	3	4.119	0.73	0.4105	0.198, 1.882
10018	2010H1	38	0	3.367	0.00	.	.

As of: October 4, 2010 at 1:22 PM

Date Range: All SIR\_ALLSSIPROC

orgid=10018

orgid	proccode	summaryYH	procCount	infCountAll	numExpAll	SIRAll	SIRAll_pval	SIRAll95CI
10018	AAA	2009H1	1	0	0.104	.	.	.
10018	AAA	2010H1	1	0	0.104	.	.	.
10018	AMP	2009H1	1	0	0.069	.	.	.
10018	AMP	2010H1	5	0	0.345	.	.	.
10018	APPY	2009H1	2	1	0.020	.	0.0193	2.630, 243.275
10018	CARD	2009H2	3	0	0.039	.	.	.
10018	CARD	2010H1	1	0	0.026	.	.	.
10018	BGB	2009H1	20	3	0.0941	.	1.341	2.630, 243.275

# *SSI Analysis Options*

- SSI rates will still be available using the legacy NNIS risk index
- Advanced output section
- No NHSN pooled means available

# SSI Risk Models

Special Edition: NHSN e-News: SIRs

October 15, 2010

## Appendix D: SSI SIR Risk Factors

NHSN Operative Procedure	Risk Factor(s) – ALL SSIs
AAA	duration
AMP	duration, number of beds*
APPY	emergency, gender, number of beds*, wound class
AVSD	age
BILI	asa, duration, number of beds*
BRST	asa, duration, number of beds*
CBGB/C	age, asa, duration, gender, number of beds*
CARD	age, asa, duration
CHOL	age, asa, duration, endoscope, wound class
COLO	age, anesthesia, asa, duration, endoscope, medical school affiliation*, number of beds*, wound class
CRAN	age, asa, duration, number of beds*, trauma
CSEC	age, anesthesia, asa, BMI, duration, emergency, duration of labor, wound class
FUSN	approach, asa, diabetes, duration, medical school affiliation*, spinal level, trauma, wound class
FX	age, asa, duration, number of beds*, outpatient
GAST	asa, duration, emergency
HER	age, asa, duration, gender, outpatient
HPRC	age, asa, duration, HPRC, number of beds*

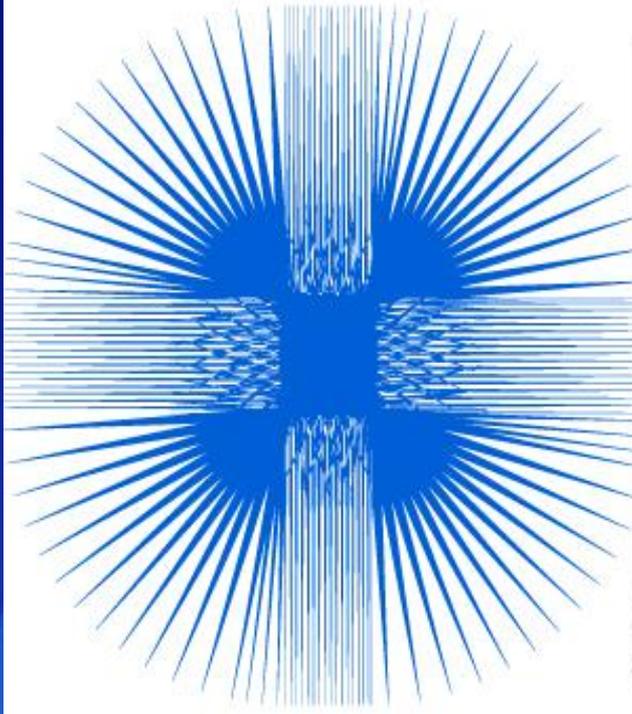
\*These risk factors originate from the Patient Safety Annual Facility Survey

# References

<sup>1</sup> Scott, RD. *The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention.*

[http://www.cdc.gov/ncidod/dhqp/pdf/Scott\\_CostPaper.pdf](http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf) accessed April 12, 2010.

<sup>2</sup> Kluger DM, Maki DG. *The relative risk of intravascular device related bloodstream infections in adults (Abstract).* In: *Abstracts of the 39<sup>th</sup> Interscience Conference on Antimicrobial Agents and Chemotherapy.* San Francisco, CA: American Society for Microbiology. 1999:514



**NHSN**

National Healthcare  
Safety Network

**[nhsn@cdc.gov](mailto:nhsn@cdc.gov)**