Epidemiology, Surveillance and an Introduction to the National Healthcare Safety Network (NHSN)

ACH IP Course, 2022

Infection Prevention Training for ACH
Healthcare-Associated Infections Program
Center for Health Care Quality California
Department of Public Health

Objectives

- Discuss basic principles of epidemiology and how they apply to healthcare-associated infection (HAI) surveillance
- Review recommended surveillance practices
- Describe surveillance outcome and process measures for infection prevention
- List reasons to use SIR and TAP reports when giving feedback

Epidemiology and Surveillance

Epidemiology

- Definition: Study of disease factors affecting populations
  - Epi = upon or around
  - Demos = people
  - Logos = study of

Clinical care: focus on the individual

vs

Epidemiology: focus on the group

CDC Principles of Epidemiology in Public Health Practice, Third Edition
(cdc.gov/csels/dsepd/ss1978/lesson1/section1.html)

Healthcare Epidemiology

- Healthcare epidemiology answers questions such as:
  - What factors contribute to increased HAI rates?
  - What populations are at higher risk for developing HAI?
  - How have HAI changed over time?
- Assessment of trends over time

Infection Prevention and Healthcare Epidemiology

- Epidemiologic research and surveillance underlie HAI prevention
  - Use data for action!

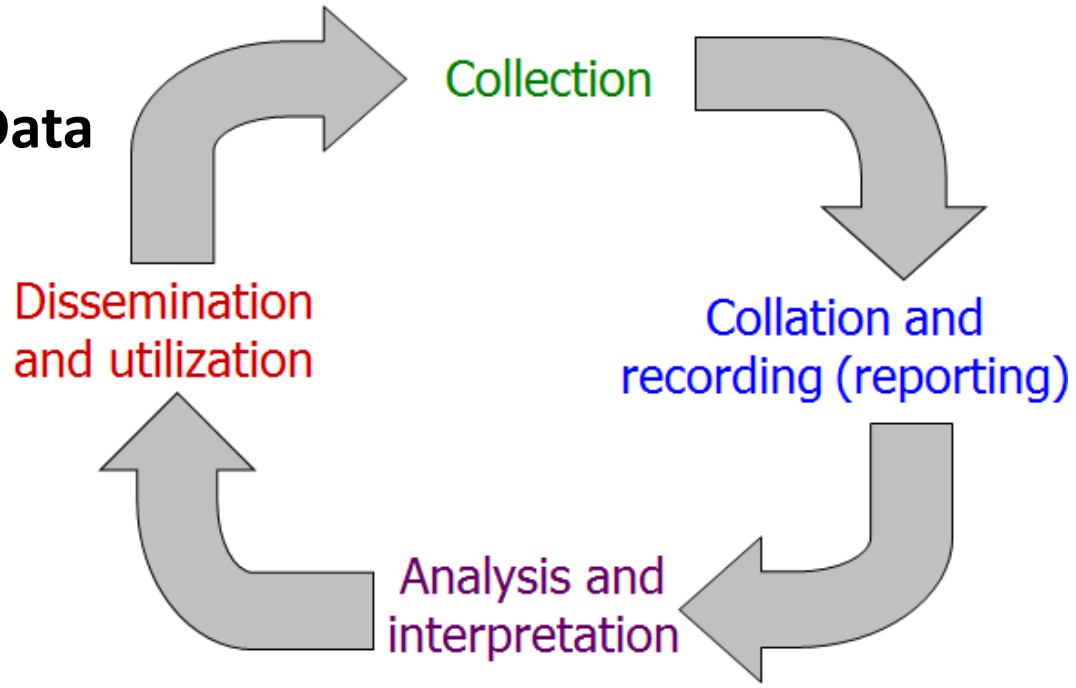
Goal is HAI prevention

Surveillance

Sur = over Veille = watch or watching watching over

A surveillance system is an information loop that starts and ends with communication and action

Flow of Surveillance Data



Epidemiologic Surveillance

- The ongoing, systematic collection, recording, analysis, interpretation, and dissemination of data
- Reflects rate of disease onset or current health/disease status of a community or population (e.g., healthcare patients)
- Aims to identify risk factors for disease
- Used for public health action to reduce morbidity and mortality, and to improve health

Key Tenets of HAI Surveillance

- A written plan serves as the foundation
  - What HAI am I tracking? Why?
  - How will data be used?
  - Where are opportunities to prevent HAI in my facility?
- The intensity of surveillance efforts need to be maintained over time
- Stay consistent over time; always apply same surveillance definitions

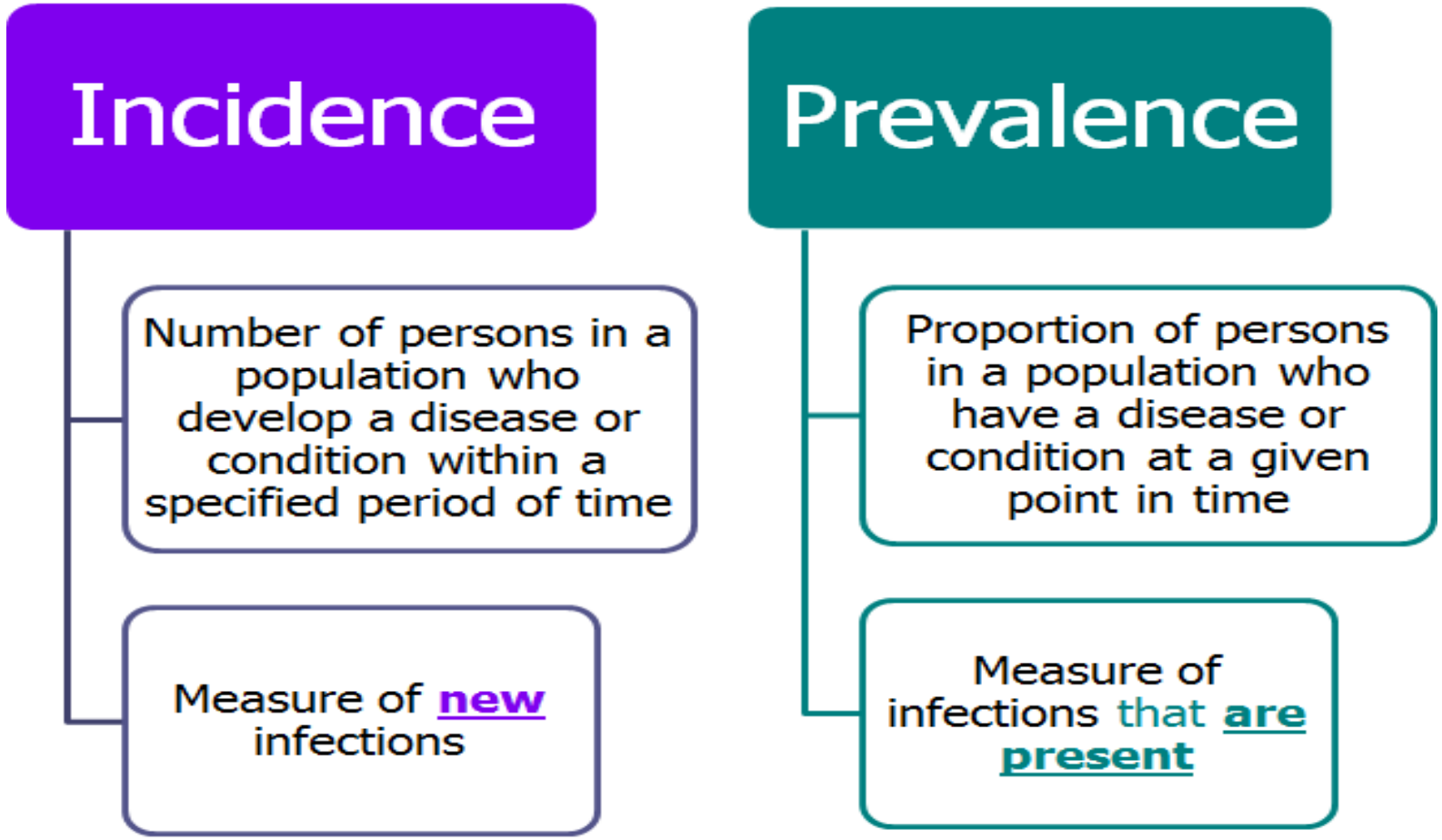
Process Measure Examples

- CAUTI prevention: percent urinary catheters with appropriate indication
- CLABSI prevention: percent adherence to CLIP bundle (all or none)
- CDI prevention: thoroughness of environmental cleaning
- HAI prevention: percent adherence to hand hygiene

Outcome Measure Examples

- CLABSI, CDI, and SSI Standardized Infection Ratio (SIR)
- MRSA and VRE BSI rate per 10,000 patient days
- CAUTI per 1,000 catheter days
- SUR of devices decrease after daily assessment for line necessity is implemented

Measuring Infections



Incidence

Incidence measures the frequency of **disease onset** (i.e., rate). Answers: 'What is the risk of X occurring?'

$$\text{Incidence} = \frac{\text{(\# of new cases) during a specified time period}}{\text{(size of a specific population)}}$$

Example: $\frac{\text{5 SSI}}{\text{97 Kidney Surgeries}}$ = 0.05 new infections per 97 kidney surgeries, During the time period of Jan-Dec 2021

Prevalence

Prevalence measures disease status in a population at a particular time.
Answers: 'How common is X?'

$$\text{Prevalence} = \frac{\text{\# of existing cases during a specified time period}}{\text{size of a specific population}}$$

Examples:

$$\frac{\text{160 employees vaccinated}}{\text{200 employees total}} = 0.8 \times 100 = \mathbf{80\%}$$

$$\frac{\text{2 patients colonized with MRSA}}{\text{100 patients in ICU per month}} = 0.02 \times 100 = \mathbf{2\%}$$

Incidence Density Rate

Incidence density accounts for variation in the time each person is at risk for an event

Incidence density rate =

$$\frac{\text{\# of new cases during a specified time period}}{\text{person-time at risk}}$$

Example:

$$\frac{\text{\# hospital onset CDI}}{\text{\# of patient days}}$$

HAI Surveillance Definitions

- Case definition (surveillance definition)
  - Clinical and laboratory characteristics that a patient must have to be counted as an event or case for surveillance purposes
  - **Time, place, & person** (e.g., age, sex)
  - Universal case reporting
  - A surveillance system in which all cases of a disease are to be reported

Laboratory-based surveillance

A surveillance method in which the reports of cases come from clinical laboratory data only (forgoing case review/symptomatology)

Applying Surveillance Definitions

- Always refer to written definitions to ensure accuracy of applying case definitions
  - Use standardized, published, validated definitions where available
- For accurate and valid comparisons, use the same definitions
  - If definitions change, the comparability of rates over time will be compromised

"…align criteria and definitions and decrease subjectivity while maintaining epidemiologic standardization and clinical relevance."

(NHSN Patient Safety Module, Chapter 2, January 2022)

Clinical vs Surveillance Definitions

- Clinical
  - Patient centered
  - Used for therapeutic decisions

- Surveillance
  - Population based
  - Applied exactly the same way each time

Collect Surveillance Data

- Include IP, clinical staff, and others share the responsibility
- Limit collection to only what is needed
- Be involved in efforts when creating or revising the electronic health records to enable HAI data collection

Prospective Surveillance

- Initiated when patient is still under care
- Advantages
  - Ability to capture information in real time
  - Can interview caregivers
  - Can gather findings not recorded in patient record
  - Easier to demonstrate temporality (e.g., before and after observations) and therefore make causal inferences

Retrospective Surveillance

- Closed record review after patient has been discharged
- Advantages:
  - Allows for comprehensive review of sequential events
  - Efficient
- Disadvantage:
  - Does not allow for prompt intervention
  - Important/relevant information my be missing
- Administrative (billing, coding) data alone **cannot accurately identify HAI**
  - May be useful for identifying **possible HAI**

Numerator Data

- Numerator = number of instances of the “event” being measured
- Examples:
  - HAI identified through **active** surveillance: CLABSI, CAUTI, SSI, VAP
  - HAIs identified by **laboratory** finding alone: CDI, MRSA BSI, VRE BSI
  - Care **practices, processes**, observations: hand hygiene compliance
- Record point in time or time period

Denominator Data

- Denominator = number of patients or procedures being followed, the population size, or person-time at risk (patient or line days)
- Examples:
  - Procedures
  - Patient days
  - Patient visits

Calculate and Analyze Infection Rates

Calculate rates and ratios by denominator type

- Total population at risk, or time at risk
- Used to calculate raw rate or incidence density rate:

Examples:

$$\frac{\text{5 SSI}}{\text{300 cardiac procedures}} \times 100 = 1.67$$

$$\frac{\text{2 CLABSI}}{\text{1500 line days}} \times 1000 = 1.33$$

$$\frac{\text{218 patient days with central line}}{\text{360 total patient days}} = 0.61$$

Risk Factor Data

- Factors that increase a patient's risk for HAI include:
  - Patient characteristics and co-morbidities
  - Facility characteristics
    - Level I trauma
    - Level III NICU
    - Critical access hospital
  - Unit / ward type
    - Med/surg
    - Telemetry
    - ICU
  - Community disease prevalence
  - Invasive device use and duration
    - Central lines
    - Indwelling urinary catheters
    - Ventilator use
  - Surgical procedure types, duration, approach
    - Use of robotics
    - Use of laparoscope versus open procedure

Data collection includes risk factor data necessary for risk adjustment

Applying Risk Adjustment Methodology

- **CLABSI and CAUTI:** Infection risk takes into account patient location
  - ICU has a 1:1 to 1:4 nurse/patient ratio and is for critically ill
  - Telemetry has a 1:6 nurse/patient ratio and is for critical but stable patients
  - Med/surg has 1:8 to 1:12 nurse/patient ratio and is for stable patients
- **SSI:** Probability of infection calculated for each surgical patient
  - Varies by surgery
    - Appendectomy should not be the same risk as colon surgery
    - Tonsillectomy/adenoidectomy should not be the same risk as a liver transplant
- **CDI & MDRO (LabID):** Infection type risk accounts for facility characteristics, disease burden (community prevalence), and testing method (for CDI)

Standardized Infection Ratio (SIR)

- Summary measure used to track HAI incidence
- Allows for tracking over time
- Compares the actual number of HAI reported to what would be predicted using 2015 baseline data
- Adjusted for risk factors significantly associated with HAI

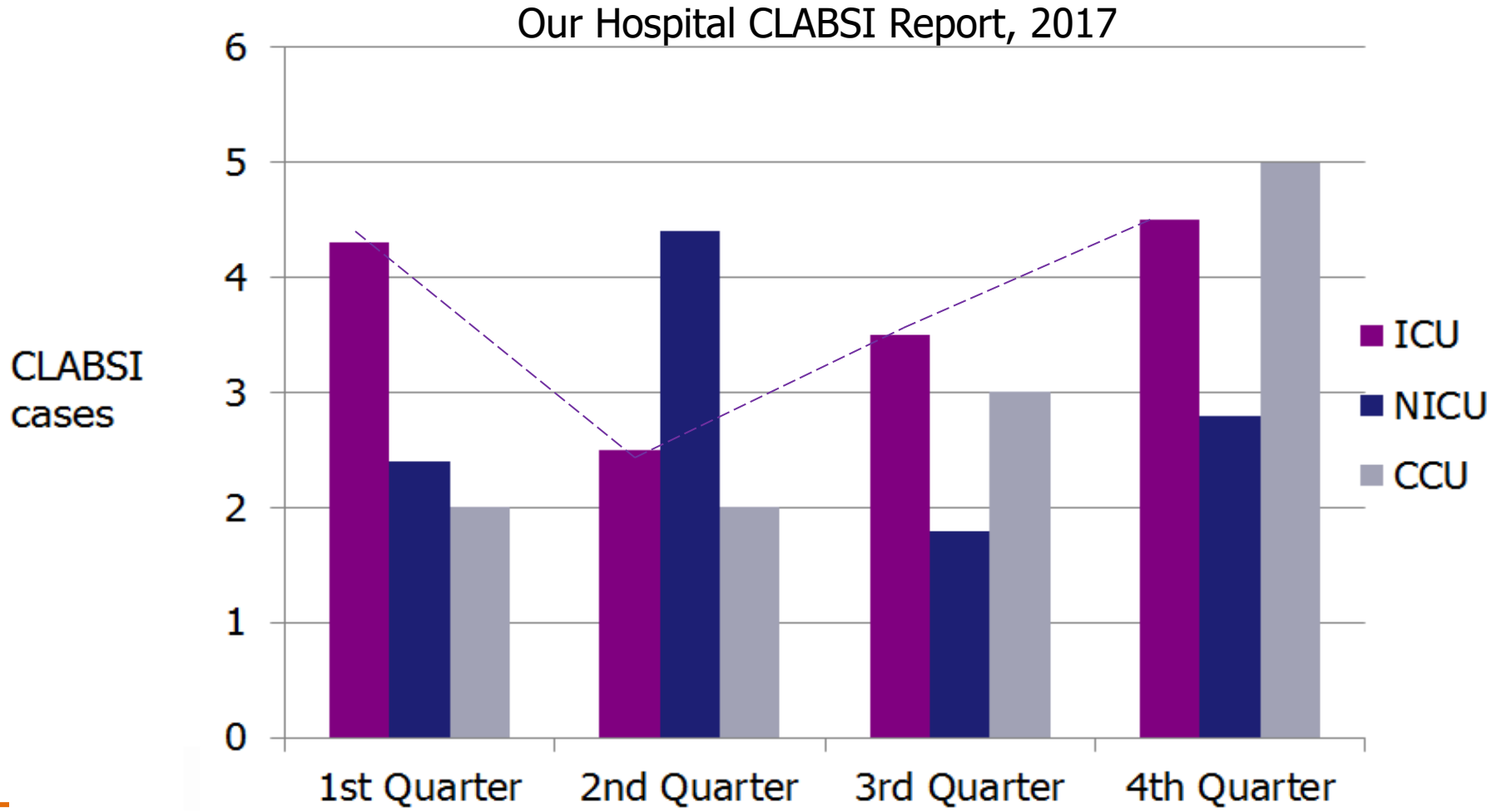
Report and Use Surveillance Data

"Infection surveillance, once the primary task of infection preventionists (IPs), has transitioned over time to assume a more limited place in a massively expanded scope of IP responsibilities. Infection surveillance data is used to measure success of infection prevention and control programs, to identify areas for improvement, and to meet public reporting mandates and pay for performance goals."

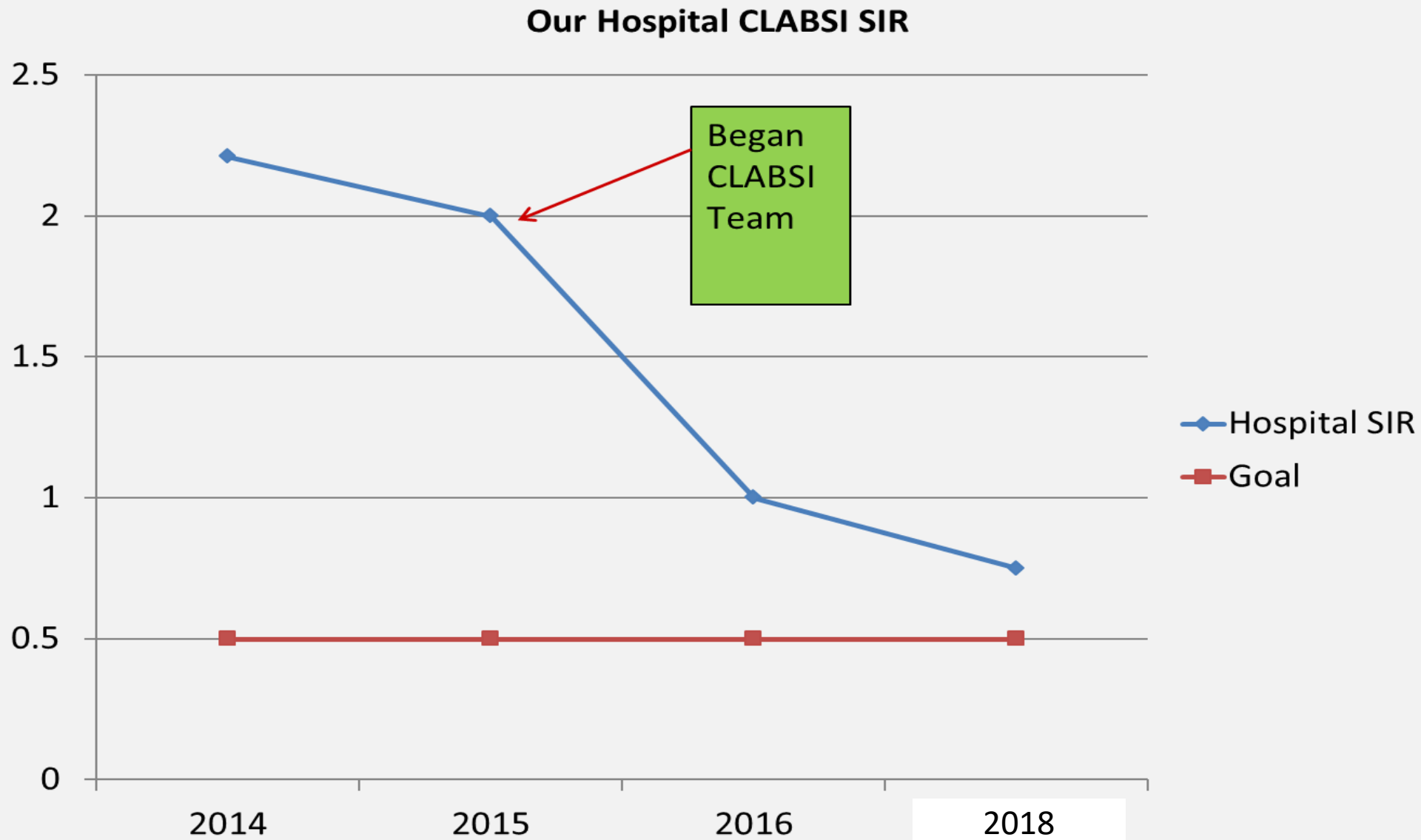
– Sue Barnes, 2017, Infection Control Today

- Plan for distribution of findings
- Report to health care providers most able to impact patient care
- Report in a manner to stimulate process improvement
- Use visual displays of data (e.g., charts, graphs, tables)

Sample Bar Charts



Sample Line Graphs and Histograms - 3



Professional societies

- Association for Professionals in Infection Control and Epidemiology (APIC)
- Society for Healthcare Epidemiology of America (SHEA)
- Infectious Diseases Society of America (IDSA)
  - Guidance documents for definitions, white papers, and evidence-based protocols

Summary

- The IP must understand the basic principles of epidemiology and apply them to HAI surveillance
- Accurate and consistent data collection, recording, analysis, interpretation, and communication of findings is an essential part of the infection prevention and surveillance plan
- Surveillance of process measures helps focus prevention activities to improve outcomes

References

Ebbing Lautenbach, K. F. Woeltje, and P.N. Malani., Practical Healthcare Epidemiology, 3rd Edition, 2010.

Horan, T.C., Andrus, M., and Dudeck, M.A. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. Am J Infection Control 36: 309-332, 2008.

Lee, T.B., Marx, J., Olmsted, R.N., and Scheckler, W.E., Recommended practices for surveillance: Association for Professionals in Infection Control and Epidemiology (APIC), Inc. Am J Infect Control 35:427-440, 2007.

Yi, M., Edwards, M., Horan, T., Berrios-Torres, S., Fridkin, S., *Improving risk-adjusted measures of surgical site infection for the National Health Safety Network.* Infect Control and Hospital Epidemiology. 32(10), 2011.

Introduction to the National Healthcare Safety Network (NHSN)

Objectives

- Review mandatory HAI surveillance and reporting requirements
- Describe National Healthcare Safety Network (NHSN) and key terms
- Demonstrate how to use NHSN
- Review how to interpret NHSN reports

California HAI Reporting Requirements for Hospitals

- Central line associated bloodstream infections **(CLABSI)**
- MRSA bloodstream infections **(MRSA BSI)**
- VRE bloodstream infections (**VRE BSI)**
- *C. difficile* infections (**CDI)**
- Surgical site infections for 28 procedures **(SSI)**
- Influenza vaccination of healthcare practitioners (HCP)

Report data monthly per NHSN protocol

CDPH reporting deadline: 30 days after end of each quarter

Central Line Insertion Practices (CLIP) and preoperative antimicrobial administration reporting are no longer required

CDPH AFL 21-18
(www.cdph.ca.gov/Programs/CHCQ/LCP/Pages/AFL-21-18.aspx)

California Department of PublicHealth

Additional HAI Reporting Requirements for Hospitals Participating in CMS Quality Improvement Programs

- Catheter-associated urinary tract infections (CAUTI)
- Ventilator-associated events (VAE) - **LTAC hospitals only**

Healthcare Facility HAI Reporting Requirements to CMS via NHSN (PDF)
(www.cdc.gov/nhsn/PDFs/CMS/CMS-Reporting-Requirements.pdf)

National Healthcare Safety Network

- Centers for Disease Control and Prevention (CDC) surveillance system for HAI reporting from hospitals, long term care facilities, outpatient settings, inpatient rehabilitation, inpatient psychiatric, and hemodialysis facilities
  - Provides standardization
  - Data used for HAI public reporting and pay for performance programs
- **Required by CDPH to receive mandated HAI data from hospitals**
- Accessed through a secure, web-based interface; open to all U.S. healthcare facilities at no charge

National Healthcare Safety Network (NHSN)

CDC's domestic tracking and response system to identify emerging and enduring threats across healthcare, such as COVID-19, healthcare-associated infections (HAIs), and antibiotic-resistant (AR) infections

147,000+
HAI cases were reported by acute care hospitals to NHSN in 2019 for six common HAI types[1,2]

2020
preliminary data indicate an increase in certain HAIs during the COVID-19 pandemic

$28 billion
in direct medical costs from HAIs each year[3]

37,000+ facilities use NHSN to track and stop infections.

In 2020, CDC quickly adapted NHSN to track information for the U.S. COVID-19 pandemic response.

NHSN data contributes to CMS saving at least $350 million in payments every year.[4]

Precise and actionable data to identify and respond to emerging and enduring threats and save lives

- **The nation's most comprehensive and established system to capture and analyze infection data,** drive improvement in healthcare quality, and stop the spread of deadly pathogens.
- Used by **37,000 U.S. healthcare facilities** - nearly all hospitals, nursing homes, dialysis facilities, and ambulatory surgery centers.
- Saving lives by **driving action to prevent tens of thousands of infections** through reliable data.
- **Highly adaptable for emerging threats** and used for federal, state, local, and healthcare facility emergency response decision-making.
- **Backed by CDC experts in public health,** healthcare, data science, epidemiology, and infection prevention and control.

NHSN is a best buy for public health, healthcare improvement, and emergency response

- Since 2005, NHSN enrollment has increased from 300 hospitals to more than **37,000 facilities in 2020.**
- Flat **annual appropriations of $21 million, and $11 million in one-time COVID-19 supplemental funding in FY20.**
- **The need for surveillance, further modernization, and data driven decision-making is ongoing.**

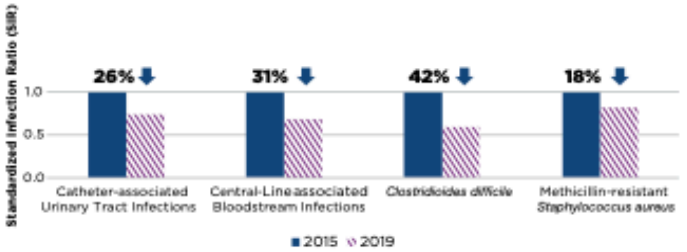
CS 321692-A January 12, 2021

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

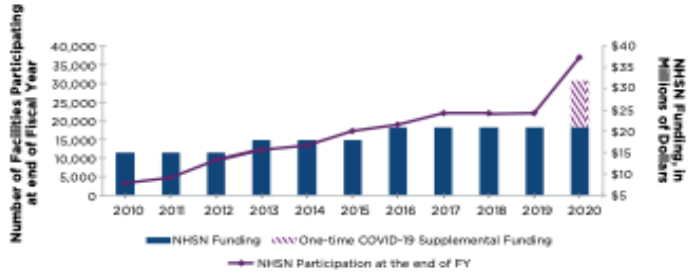
Comprehensive, transparent, publicly available data for federal agencies, health departments, healthcare facilities, and the public to take action

- The Centers for Medicare and Medicaid Services (CMS) relies on NHSN for regulatory functions, public reporting, and incentive payment programs, **including mandatory COVID-19 reporting from all 15,400 U.S. nursing homes.**
- **Healthcare facilities, health departments, and federal agencies rely on NHSN** to inform targeted, tailored infection prevention, to monitor healthcare system capacity, and to stop the spread of emerging and enduring threats, such as COVID-19, HAIs, and AR infections.
- **These targeted prevention and response activities—based on NHSN data and expert analysis—save lives and money at the local, state, and national levels.**

HAI Data, NHSN, 2015–2019



CDC NHSN Expansion, FY 2010–2020



Looking ahead: Faster data and reduced reporting burden

CDC continues to improve NHSN through concrete actions:

- Increasing NHSN reporting automation and decreasing burden for healthcare facilities.
- Expanding use of electronic health records and rapidly emerging health data standards by NHSN.
- Including more nursing homes and outpatient facilities for HAI and emerging threat tracking and prevention.
- Investing in NHSN data modernization efforts to get faster, actionable data.

For more information

visit: https://www.cdc.gov/nhsn
email: CDC-INFO
call: 800-CDC-INFO
Follow us on Twitter: @CDC_NCEZID

NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

References:

[1] CDC. 2019 National and State Healthcare-Associated Infections Progress Report. https://www.cdc.gov/hai/data/portal/progress-report.html

[2] Central line-associated bloodstream infections (CLABSI), Catheter-associated urinary tract infections (CAUTI), *Clostridioides difficile* (CDI), Methicillin resistant *Staphylococcus aureus* (MRSA), Surgical site infections (SSI), and Ventilator-associated events (VAE).

[3] Scott RD II, et. al. The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention. https://www.cdc.gov/hai/pdfs/hai/scott_costpaper.pdf

[4] Through CMS HAC Reduction Program: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Value-Based-Programs/HAC/Hospital-Acquired-Conditions.html

Figure 1: NHSN Components

NHSN Patient Safety Component Manual (PDF)
(www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf)

NHSN Patient Safety Component

[NHSN Patient Safety Component Manual](www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf) (PDF)
(www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf)

NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

January 2022

National Healthcare Safety Network (NHSN)

Patient Safety Component Manual

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Chapter 3: Patient Safety Monthly Reporting Plan and Annual Surveys

Chapter 4: Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and non- central line-associated Bloodstream Infection)

Chapter 5: Central Line Insertion Practices (CLIP) Adherence Monitoring

Chapter 6: Pneumonia (Ventilator-associated [VAP] and non-ventilator-associated Pneumonia [PNEU]) Event

Chapter 7: Urinary Tract Infection (Catheter-Associated Urinary Tract Infection [CAUTI] and non- catheter-associated Urinary Tract Infection [UTI]) and Other Urinary System Infection (USI) Events

Chapter 9: Surgical Site Infection (SSI) Event

Chapter 10: Ventilator-Associated Event (VAE)

Chapter 11: Pediatric Ventilator-Associated Event (pedVAE)

Chapter 12: Multidrug-Resistant Organism & *Clostridium difficile* Infection (MDRO/CDI) Module

Chapter 14: Antimicrobial Use and Resistance (AUR)

NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

January 2022

Dialysis Event Surveillance Protocol

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NHSN Dialysis Event Surveillance Protocol (PDF)
(www.cdc.gov/nhsn/pdfs/pscmanual/8pscdialysiseventcurrent.pdf)

California Department of PublicHealth

Outpatient Procedure Component Includes Ambulatory Surgery Centers (ASCs)

January 2022

National Healthcare Safety Network (NHSN)

Outpatient Procedure Component Manual

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Chapter 5: Key Terms

NHSN Outpt Procedure Component Manual (PDF)
(www.cdc.gov/nhsn/pdfs/opc/opc-manual-508.pdf)

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NHSN Antimicrobial Use and Resistance Module (PDF) (www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf)

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NATIONAL HEALTHCARE SAFETY NETWORK

March 2022

Antimicrobial Use and Resistance (AUR) Module

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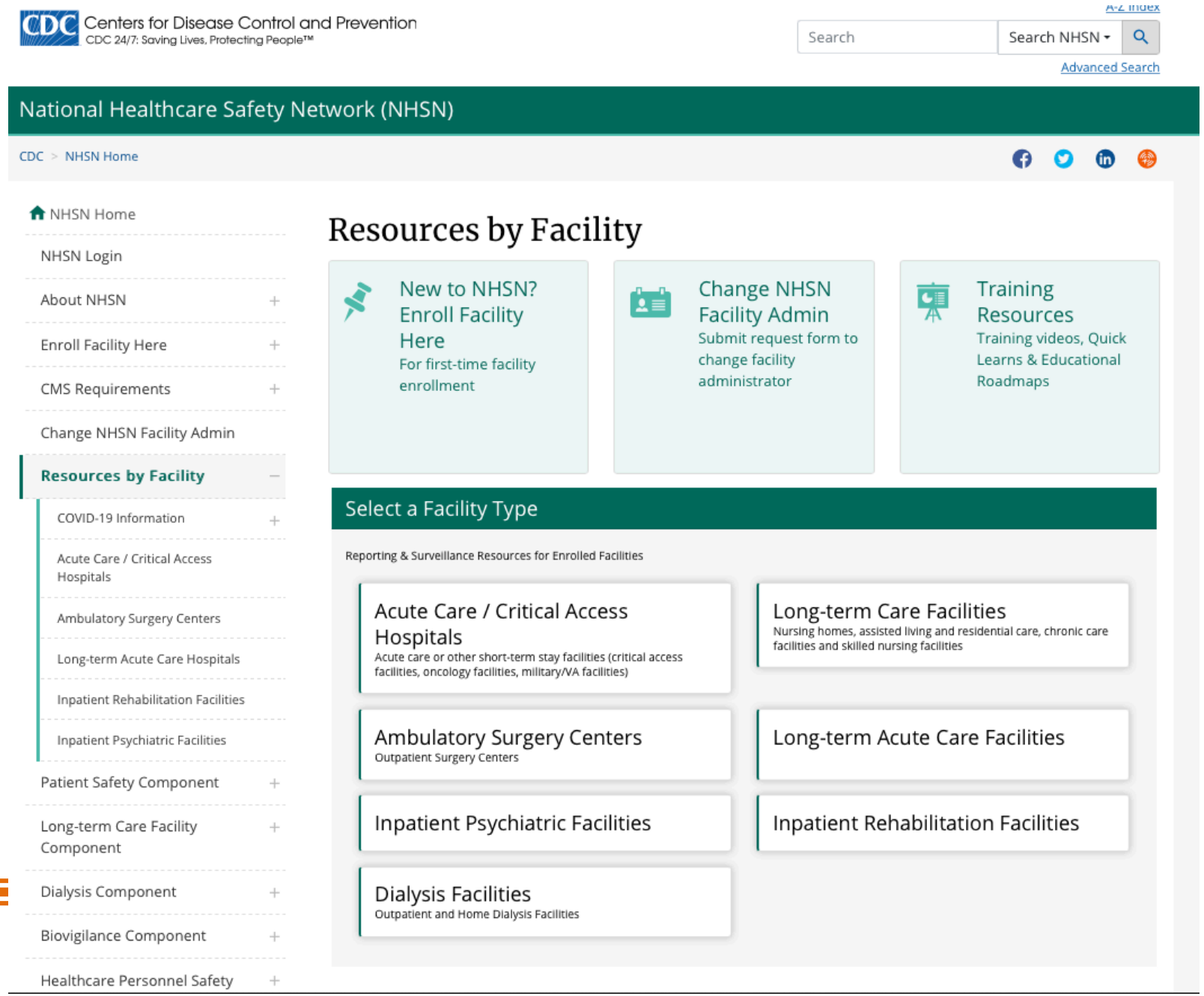
NHSN Strengths

- Provides standards for surveillance to allow comparisons over time
- Data are risk-adjusted using national referent (baseline) data
- Web-based; data housed remotely
- Automated data quality checks
- Built-in data analysis tools allows electronic reporting using national electronic health record standards (e.g., HL7, CDA)
- Expandable to many health care setting types

NHSN Data

Facilities own their NHSN surveillance data

- May edit data at any time to improve accuracy and completeness
- May join NHSN groups to confer rights for data access
  - Allow healthcare organizations to analyze data from member facilities
  - Facilities within a group cannot see each other's data
  - California hospitals mandated to join the **CDPH group** in NHSN
- Data use agreement with NHSN describes data sharing with CMS and state/local public health departments



[NHSN Surveillance protocols, forms, analysis resources, FAQ, training, CMS requirements, newsletters] (**www.cdc.gov/NHSN**)

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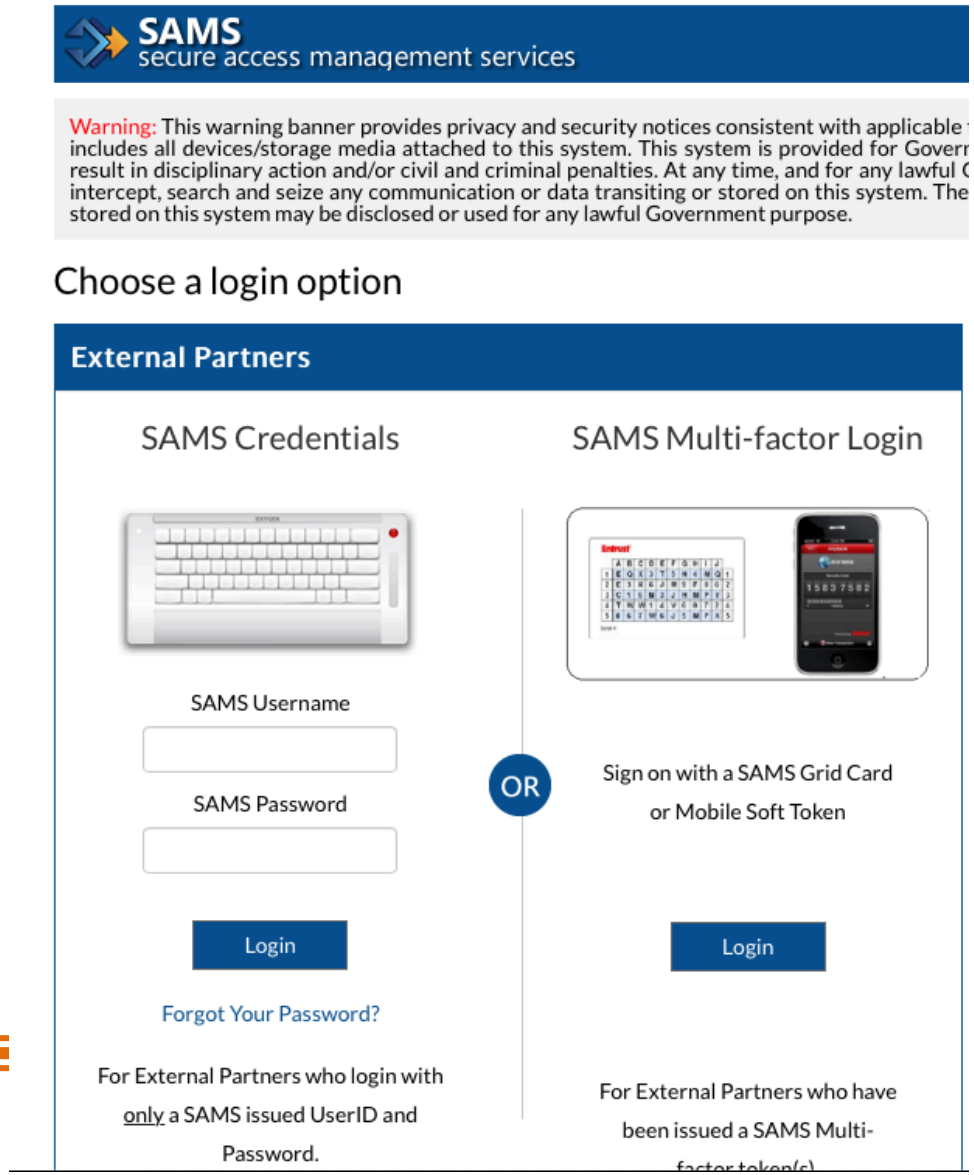
Accessing NHSN

- Each hospital must assign a NHSN facility administrator (FA)
  - Receives all NHSN communications
  - Assigns new users
  - Has full rights and can assign user rights as needed
  - Can create user groups
- To become an NHSN user
  - FA sends new user requests (e-mail) to NHSN
  - NHSN invites (email) the new user
- All NHSN users must apply for a Security Access Management Services (SAMS) card to access NHSN

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Logging on to NHSN

[NHSN SAMS Login page](auth.cdc.gov/siteminderagent/forms/login)



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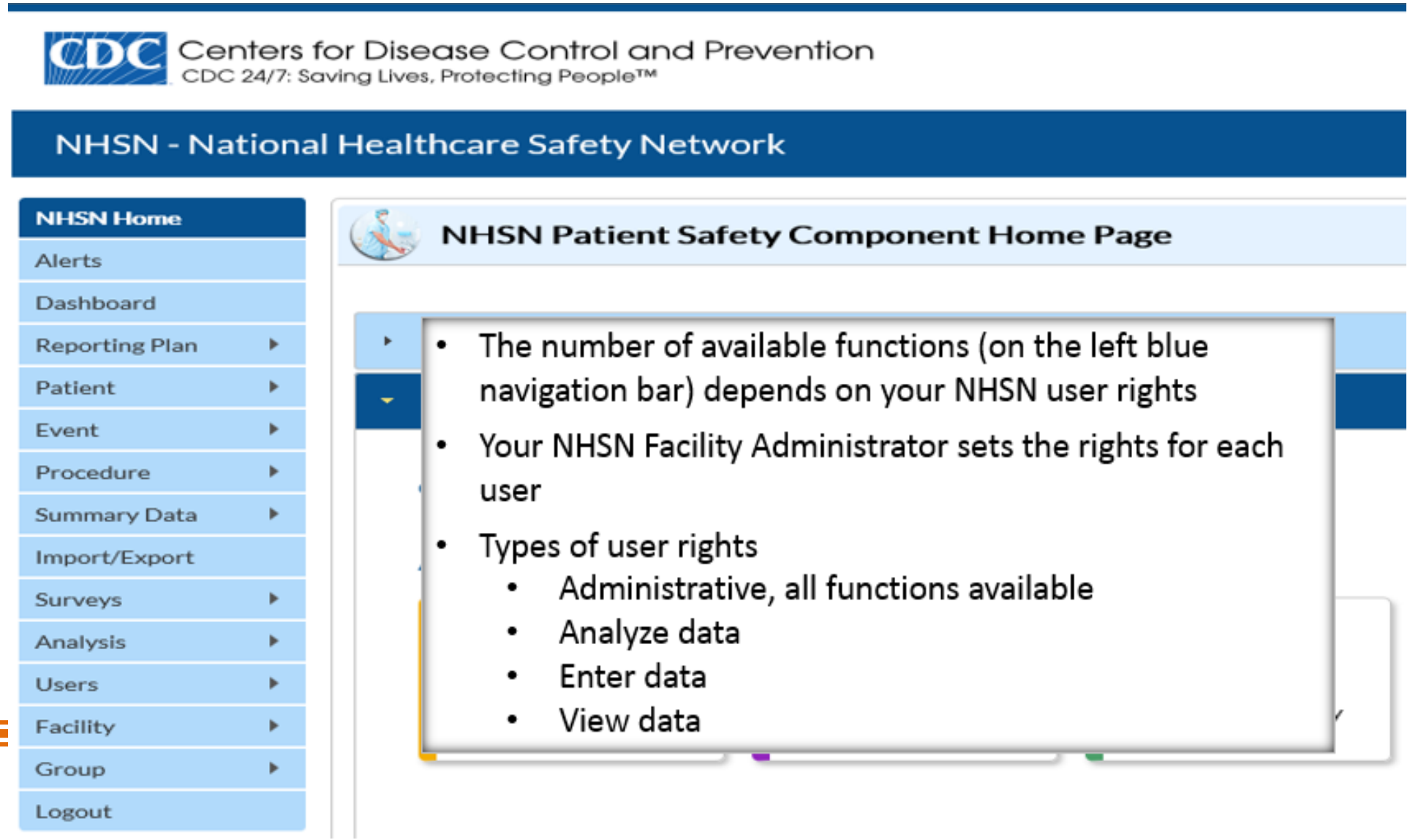
Access NHSN via Secure Web Portal Using SAMS Card



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Map NHSN Locations

- Each NHSN patient care area is defined by the type of patients receiving care in that location
- Define (or redefine) a patient care location:
  - Step 1: Determine the acuity level (e.g., critical care, ward)
  - Step 2: Determine the type of service (e.g., burn, surgical, cardiac)
- Hospital designates each location type
- Important to review location mapping **yearly** to ensure correct risk adjustments applied for each location

NHSN Patient Safety Manual: Chapter 15

Determine NHSN Location Types

- Apply 80% Rule to designate patient type in **most locations**
  - Patient care area is comprised of at least 80% patients of the same acuity level
- Apply **60%** Rule for **medical/surgical mixed** units
  - If more than 60% are medical patients, define as a medical location
  - If more than 60% are surgical patients, define as a surgical location

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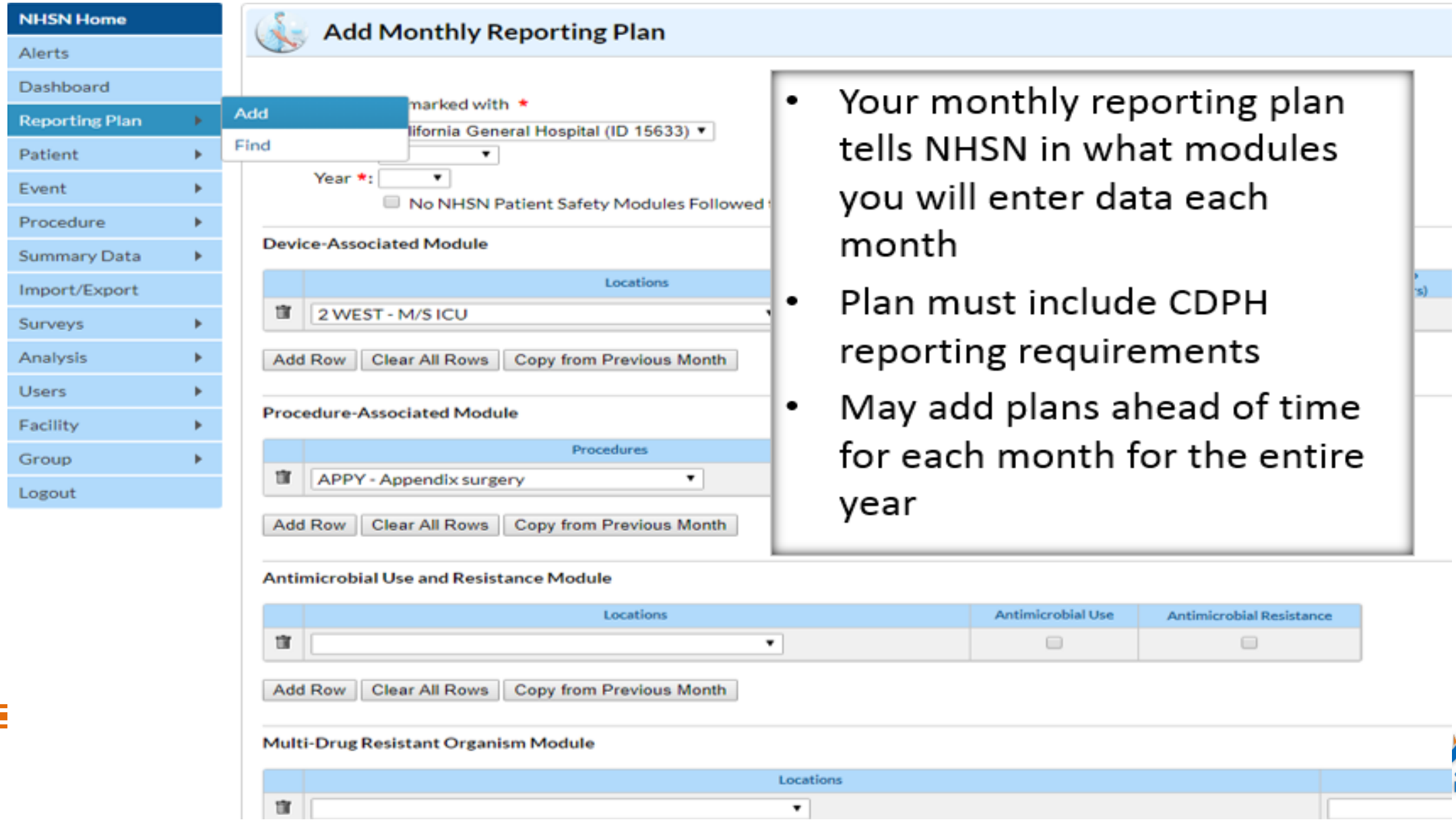
NHSN Inpatient vs Outpatient

NHSN Inpatient: a patient whose date of admission to the healthcare facility and the date of discharge are different calendar days

NHSN Outpatient: patient whose date of admission to the healthcare facility and the date of discharge are the same day

- SSI and surgical procedure data reported for hospital inpatient, outpatient, and ambulatory surgery centers enrolled in NHSN
- Outpatient data such as LabID and CDI from locations such as ED and 24-observation units required per surveillance protocols

Enter Your Monthly Reporting Plan



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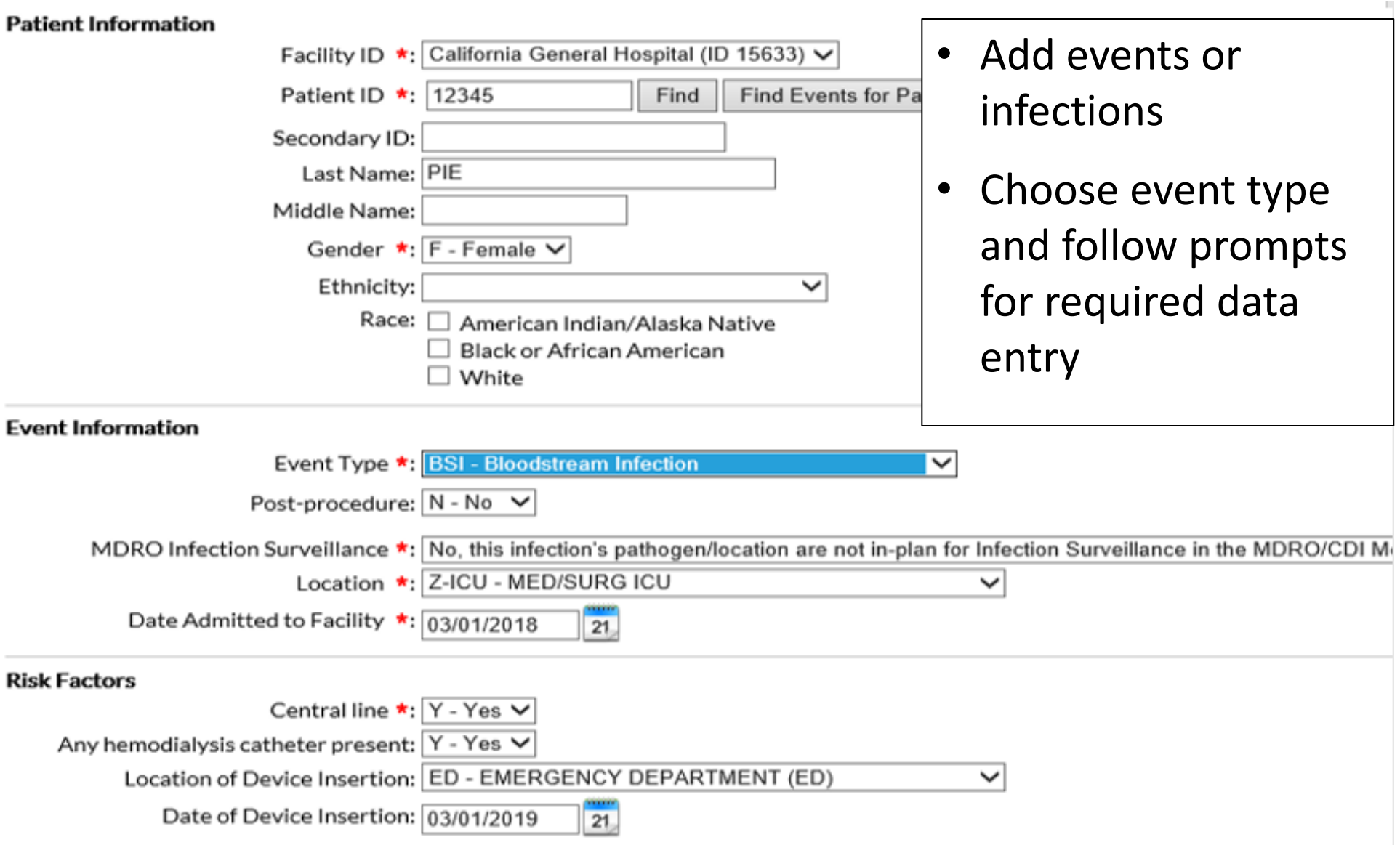
Report Events (CLABSI, MRSA/VRE BSI, CDI, SSI)



- Add events or infections
- Choose event type and follow prompts for required data entry

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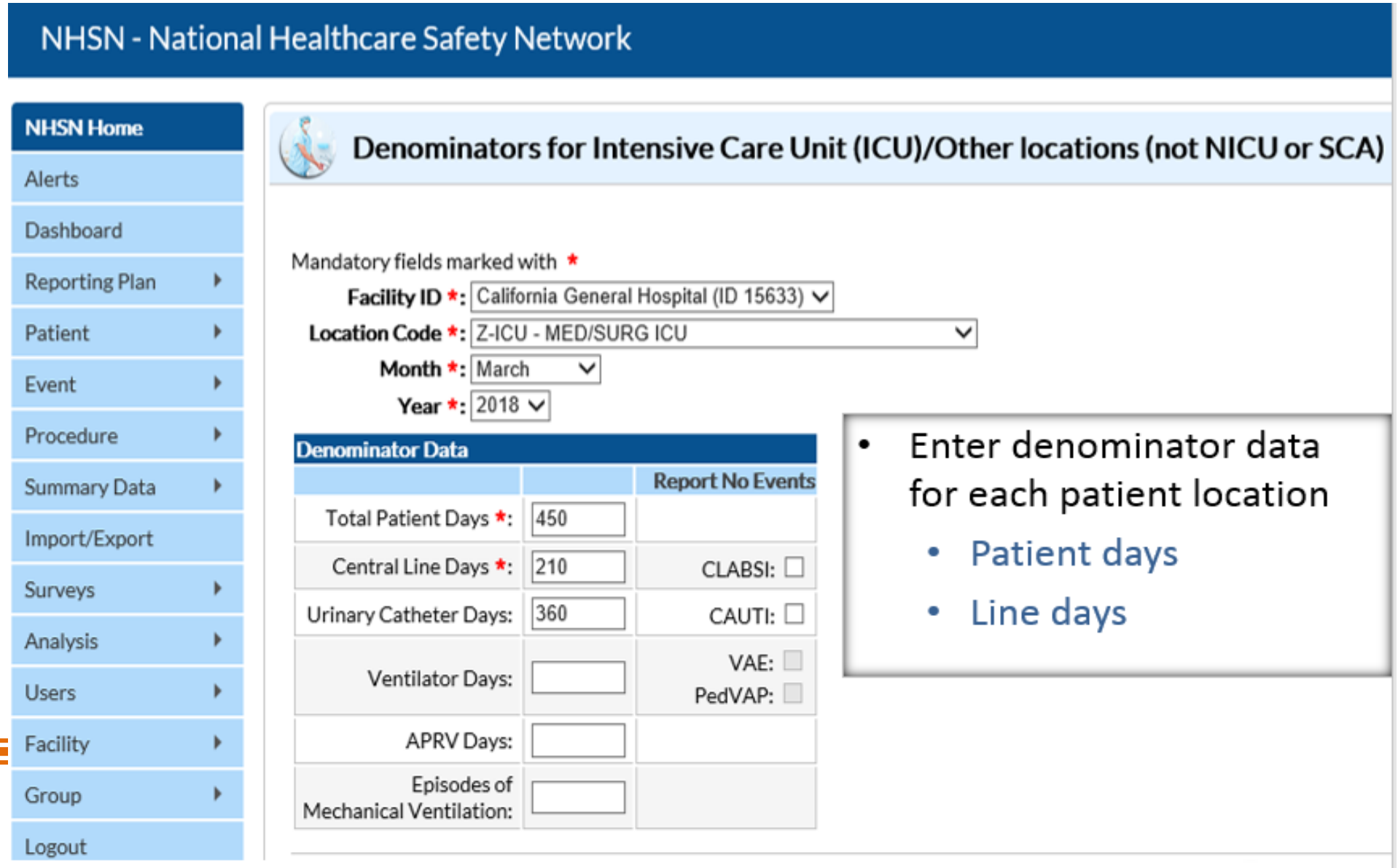
Colonization and Inflammation

Colonization – presence of microorganisms on skin, mucous membranes, in open wounds, or in excretions or secretions but are not causing adverse clinical signs or symptoms

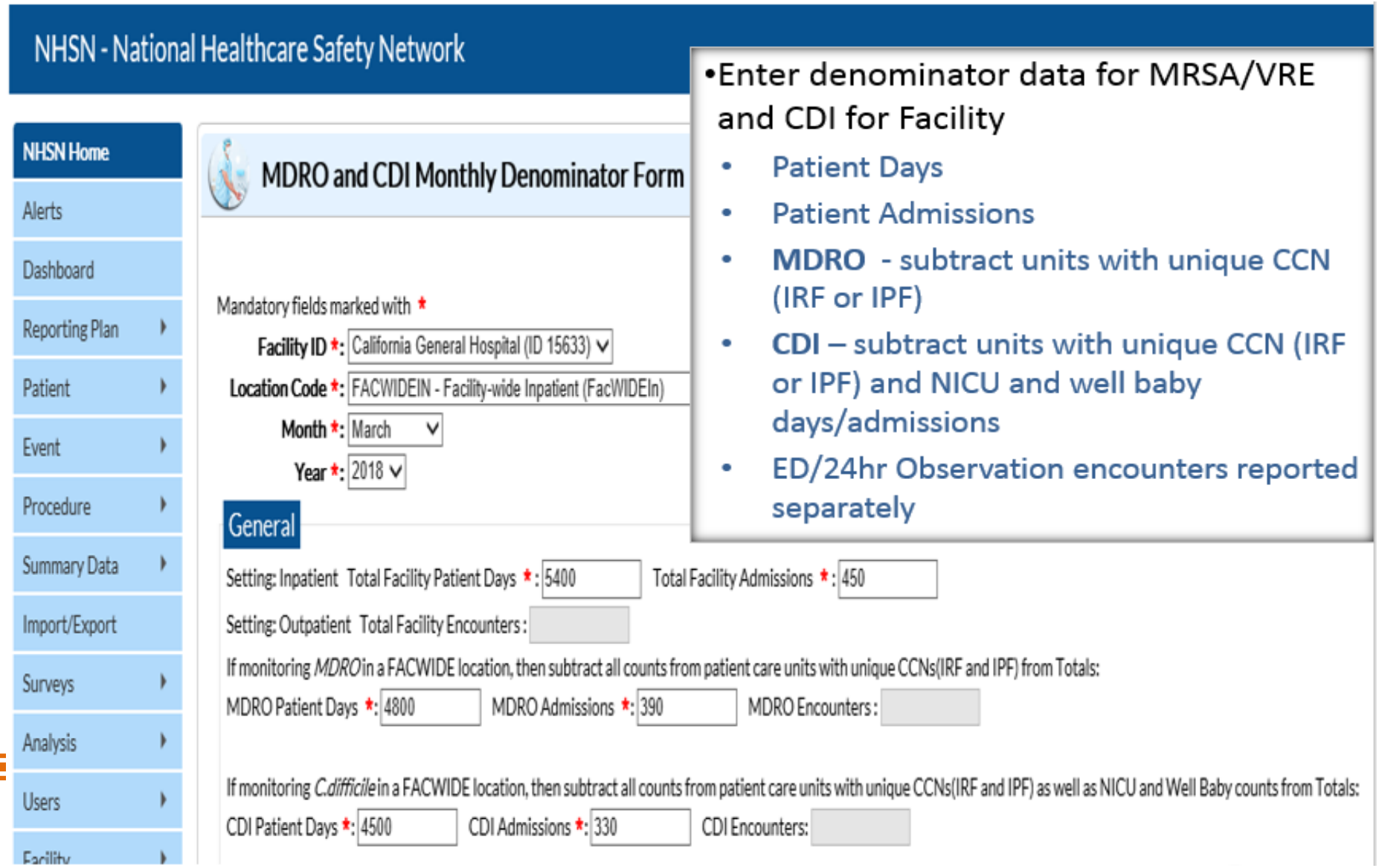
Inflammation – results from tissue response to injury or stimulation by noninfectious agents, such as chemicals

- Colonization and inflammation are not infections and not reported to NHSN
- May need to report colonization to public health per communicable disease reporting requirements (for example, CRE, *C. auris)*

Report Monthly Summary Data - CLABSI



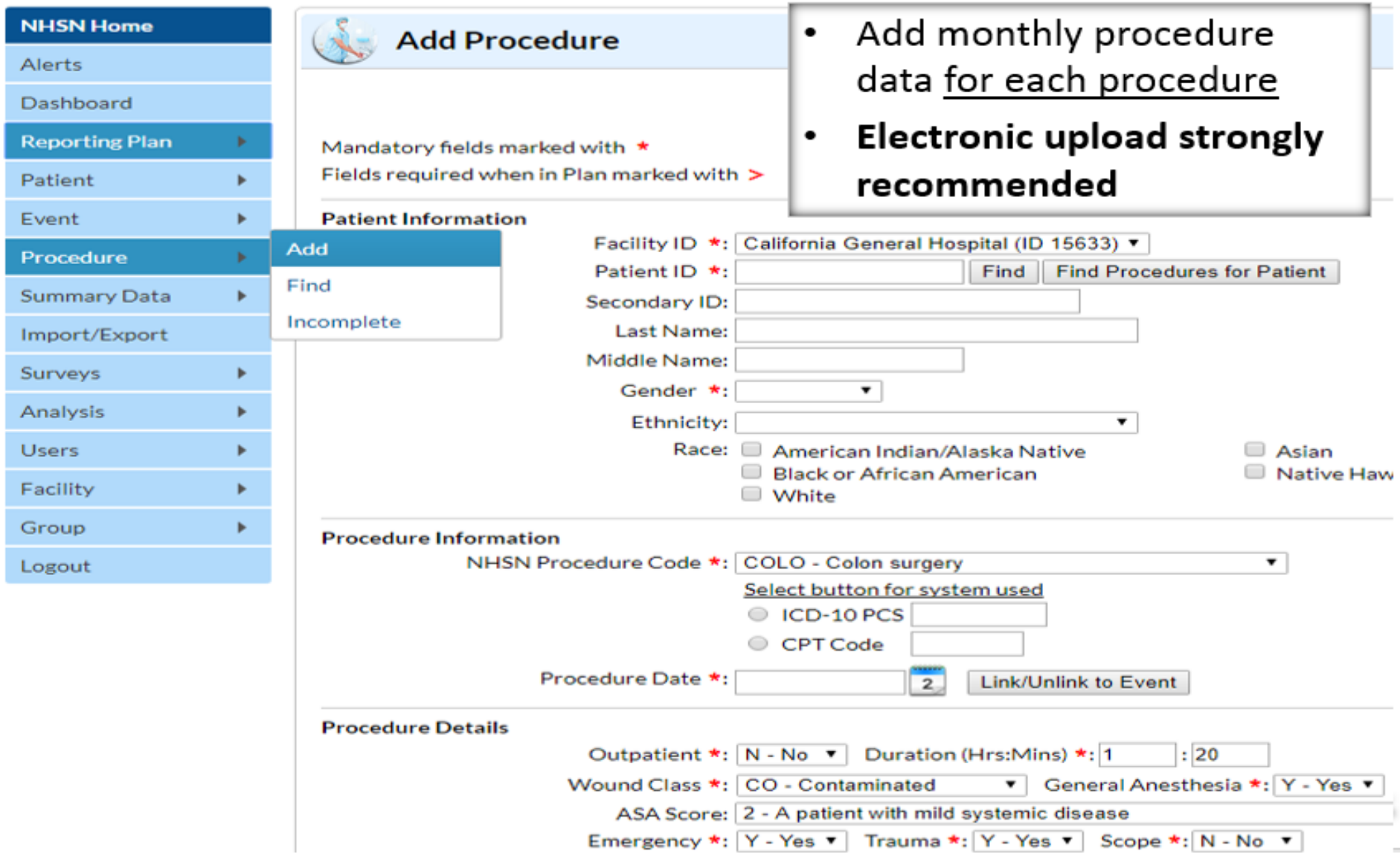
Report Monthly Summary Data – MDRO / CDI



- Enter denominator data for MRSA/VRE and CDI for Facility
  - Patient Days
  - Patient Admissions
  - **MDRO** - subtract units with unique CCN (IRF or IPF)
  - **CDI** – subtract units with unique CCN (IRF or IPF) and NICU and well baby days/admissions
  - ED/24hr Observation encounters reported separately

California Department of PublicHealth

Report Monthly Surgical Procedure Data



- Add monthly procedure data for each procedure
- **Electronic upload strongly recommended**

California Department of PublicHealth

NHSN Standardized Infection Ratio (SIR)

- Used by NHSN to report infection incidence
  - SIR instead of infection rate
- Driven by need for a single summary measure of infection incidence that adjusts for differences in infection risk
- SIR compares the number of HAI reported by your hospital with a predicted number of HAI calculated by NHSN

NHSN Risk Adjustment

NHSN applies risk adjustment to determine the predicted number of HAI for your hospital based on 2015 referent data

HAI	Factors in Risk Adjustment
CDI	Test type, community onset prevalence, facility bed size*,facility medical school affiliation*, number of ICU beds*, facility type*,reporting from ED or 24-hr observation unit
CLABSI	ICU vs ward, medical school affiliation*, facility bed size*, facility type* average length of stay* (LTACH), birth weight (NICU)
MBI-LCBI	Acute care hospitals only; ICU vs ward, facility bed size*, medical school affiliation*
MRSA BSI	Community onset prevalence, average length of stay*, medical school affiliation*, facility type*, number of ICU beds*
SSI	Age, ASA score, wound class (contaminated or dirty), procedure duration, general anesthesia, emergency procedure, gender, BMI, diabetes, trauma, endoscope, procedure type (primary, revision), approach, spine level, closure, duration of labor, oncology, facility bed size*, medical school affiliation*
	* Data from NHSN Annual Survey

SSI Risk Adjustment

- Risk models developed for each NHSN operative procedure
  - Includes only those risk factors found to increase SSI risk for that procedure
- Every patient undergoing a procedure in your hospital has SSI risk probability calculated by NHSN
- Your hospital's predicted number of SSI is the sum of your surgical patients' risk probabilities

Interpreting SIR

Presenting the Standardized Infection Ratio (SIR)!

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

If the **SIR > 1.0**, then **more** HAIs were observed than predicted, based on the 2015 national aggregate data.

If the **SIR < 1.0**, then **fewer** HAIs were observed than predicted, based on the 2015 national aggregate data.

If the **SIR= 1.0**, then the **same** number of HAIs were observed as predicted, based on the 2015 national aggregate data.

What is *p* Value?

As far as the SIR goes…

The **p-value** is a statistical measure that tells us whether the number of observed infections is statistically significantly different than the number of predicted infections (i.e., whether the SIR is significantly different from 1.0).

If the **p-value ≤ 0.05**, we can conclude that the number of observed infections is statistically significantly different than the number of predicted infections.

If the **p-value > 0.05**, we conclude that the number of observed infections is **not** statistically significantly different than the number of predicted infections.

What is *Confidence Interval*?

And how about that 95% Confidence Interval (CI)?

The 95% CI is a statistical range of values for which we have a high degree of confidence that the true SIR lies within that range.

If the **CI does not include 1**, then the SIR is significantly different than 1.0 (i.e., the number of observed infections is significantly different than the number predicted).
Example: 95% CI= (0.85, 0.92)

If the **CI includes the value of 1**, then the SIR is **not** significantly different than 1.0 (i.e., the number of observed infections is not significantly different than the number predicted).
Example: 95% CI= (0.85, 1.24)

If the **SIR is 0.000** (i.e., the infection count is 0 and the number of predicted infections is ≥ 1.0), the lower bound of the 95% CI will **not** be calculated.

Calculating SIR

$$SIR = \frac{\text{Observed HAIs}}{\text{Predicted HAIs}}$$

Calculating Standardized Infection Ratio (SIR)

- Standardized infection ratio

$$SIR = \frac{\text{Observed HAI}}{\text{Predicted HAI}}$$

Example:
Hospital A has 4 MRSA BSI over 23,500 patient days. National data predicted 2.5 MRSA BSI.

$$SIR = \frac{4}{2.5} = 1.6$$

Determine if Your SIR is Significantly Higher or Lower than National Comparison Data

National Healthcare Safety Network
SIR for DHQP Memorial Hospital for 2021 - By OrgID
As of: January 13, 2022 at 1:18 PM
Date Range: BS2_CLAB_RATE SALL summaryYr 2021 to 2021
if (((locationType = "CC")))

Facility Org ID=10000 Type of Affiliation=M

Facility Org ID	CMS Certification Number	Events	Number Predicted	Central Line Days	SIR	SIR p-value	95% Confidence Interval	SIR Percentile
10000	31C0001043	3	1.814	1608	1.653	0.3843	0.421, 4.500	93

The observed difference is not statistically significant if

- **p-value >0.05**, or
- **95% confidence interval includes 1.0**

- If the p-value is not significant, the confidence interval won't be significant either and vice versa

- The confidence interval indicates precision as well as significance

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SIR Interpretation

Summary Yr	Infection Count	Number Expected	Central Line Days	SIR	SIR p-value	95% Confidence Interval
2016	9	7.191	3786	1.25	0.2962	0.653, 2.184

1. 9 HAI CLABSI in 2016, only 7.2 were expected. The SIR is 1.25 or 25% higher than what would be predicted from national data
2. The difference is not significantly different than **that predicted by** the national hospital data because our estimate is not very precise
3. The SIR varies from 35% below to more than double the predicted value (.65 – 2.2)
4. Continue to monitor CLABSI rates over time. More data will help us better understand how we compare to other similar hospitals

SIR Interpretation - 2

Summary Yr/Half	InfCount	Number Expected	Central Line Days	SIR	SIR p-value	95% Confidence Interval
2016H1	74	26.606	10065	2.78	0.0000	2.184, 3.492

This report indicates the following:

1. 74 HAI CLABSI per 10,065 line days, 26.6 were predicted
2. The SIR is 2.78, nearly 3 times higher than what would be predicted
3. The precision of this estimate shows that the hospital is between 2 and 3 ½ times higher than predicted (C.I. 2.2 – 3.5)
4. This facility needs to implement a CLABSI prevention program immediately

SSI Risk Adjustment - 2

Example: Abdominal hysterectomy (HYST)

- Factors in the model that add to SSI risk are
  - Diabetes
  - ASA score
  - Hospital bed size (from the annual survey)
  - Scope
  - Age
  - Duration of procedure
  - BMI

NHSN: A Guide to the SIR (PDF)

(cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf)

SSI Risk Adjustment - 3

This table represents a partial list of 100 hypothetical patients who have undergone a HYST procedure and the risk factors present for each

Table 2. Risk Factors for 100 Patients Undergoing a HYST Procedure (Complex 30-Day model)

Patient	Diabetes	ASA score	BMI	Age	Oncology Hospital	SSI Identified?	Probability of SSI ($\hat{p}$)
1	Y	2	29	32	Y	1	0.020
2	N	3	35	49	Y	0	0.019
3	N	5	20	51	Y	1	0.026
.	.	.	.	.	.		.
.	.	.	.	.	.		.
100	N	4	27	27	Y	0	0.037
TOTAL						8 (observed SSIs)	6.750 (predicted SSIs)

2% risk of SSI for patient 1

Probability of SSI is calculated for each surgical patient

The SSI probabilities are added together to get the predicted number of SSI for this surgical patient population

$$SIR = \frac{\text{Observed (O) HAIs}}{\text{Predicted (P) HAIs}} = \frac{8}{6.750} = 1.190$$

SIR indicates 19% higher than predicted from national data

The SIR Percentile

- A value that gives what percentage of facilities have a similar or lower SIR compared to your facility
  - SIR percentile of 93 means that 93% of facilities in the nation (with at least 1 predicted infection) have an SIR equal to or lower than 1.653

National Healthcare Safety Network
SIR for DHQP Memorial Hospital for 2021 - By OrgID
As of: January 13, 2022 at 1:18 PM
Date Range: BS2_CLAB_RATESALL summaryYr 2021 to 2021
if (((locationType = "CC")))

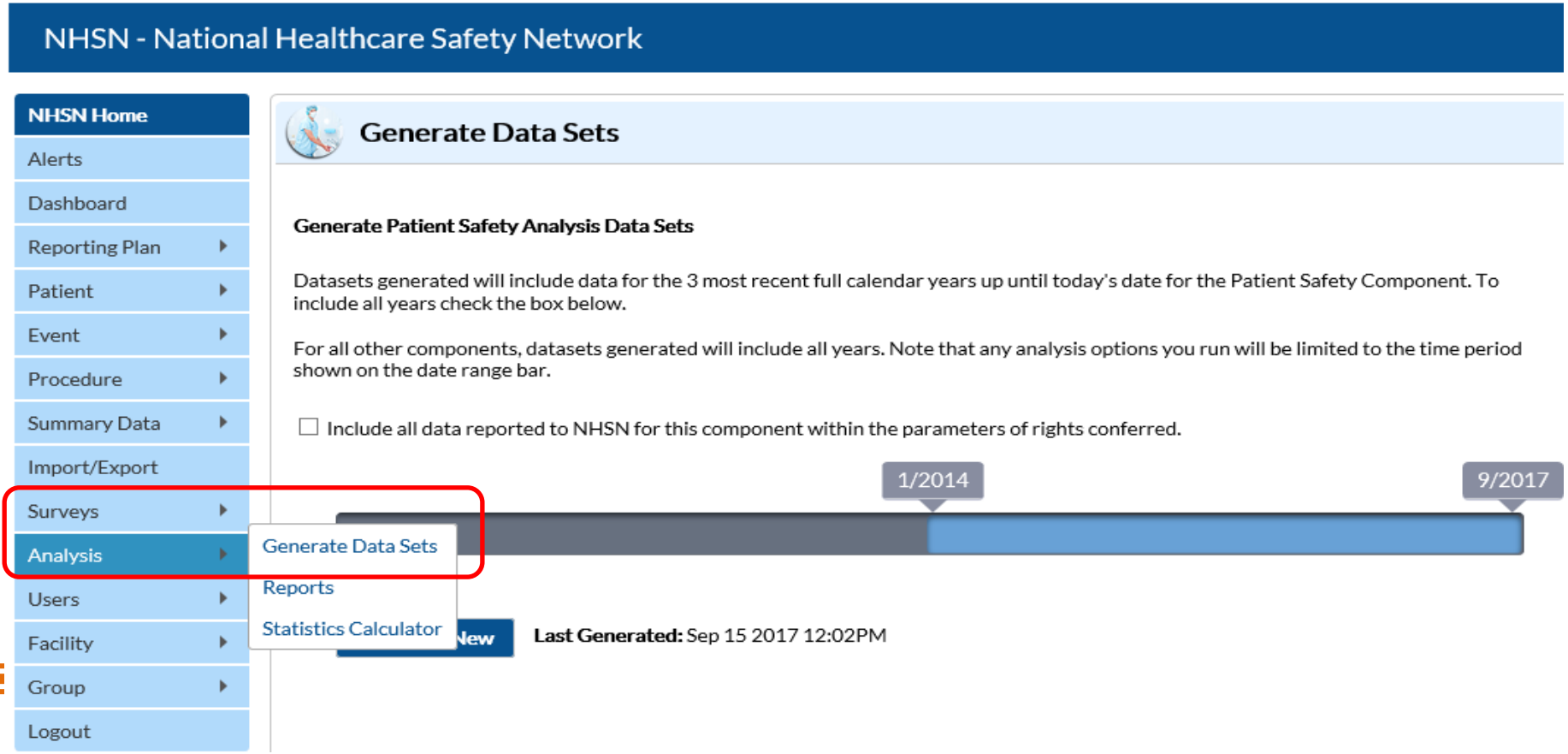
Facility Org ID=10000 Type of Affiliation=M

Facility Org ID	CMS Certification Number	Events	Number Predicted	Central Line Days	SIR	SIR p-value	95% Confidence Interval	SIR Percentile
10000	31C0001043	3	1.814	1608	1.653	0.3843	0.421, 4.500	93

California Department of PublicHealth

Use Your NHSN Data

- Generate a data set after all data are entered before running analysis reports
- Generating a data set retrieves a copy of your hospital data from NHSN
- Data sets are specific to each NHSN user

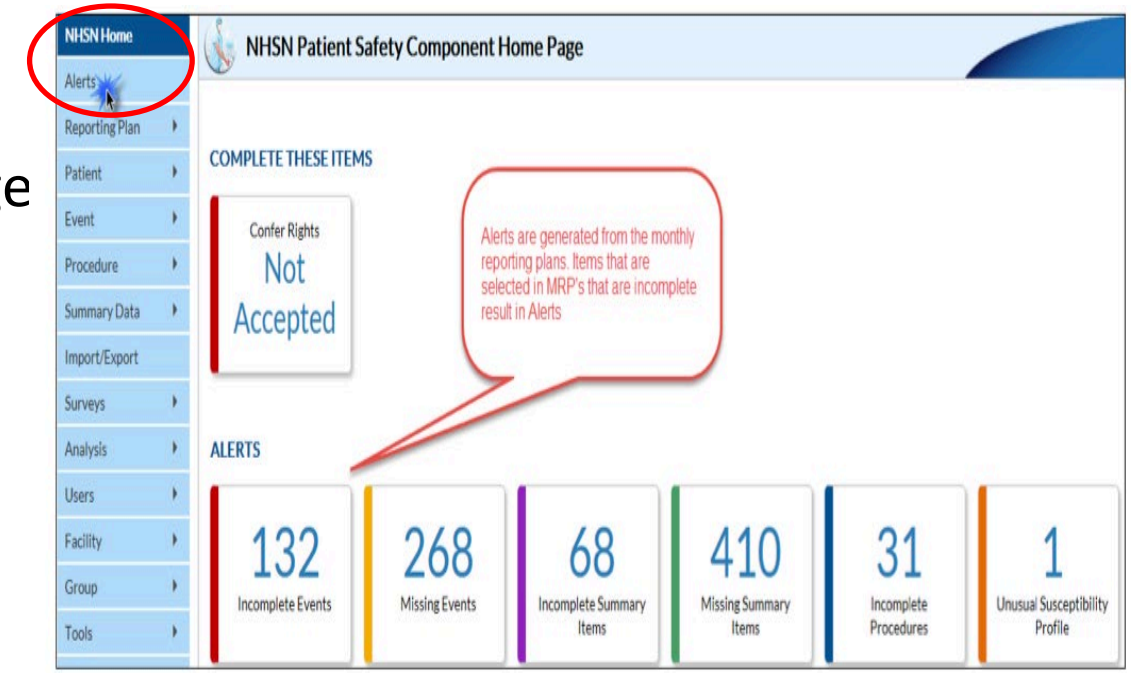


NHSN Analysis Options and Reports

- Analysis Reports are available only if you generate a data set
  - Developed by NHSN
  - Presented in a series of expandable folders
- To view report options
  - Choose a module
  - Choose “Modify Report” to choose a date range, other options
  - If you select “Run Report,” all relevant data for years will be included in the report

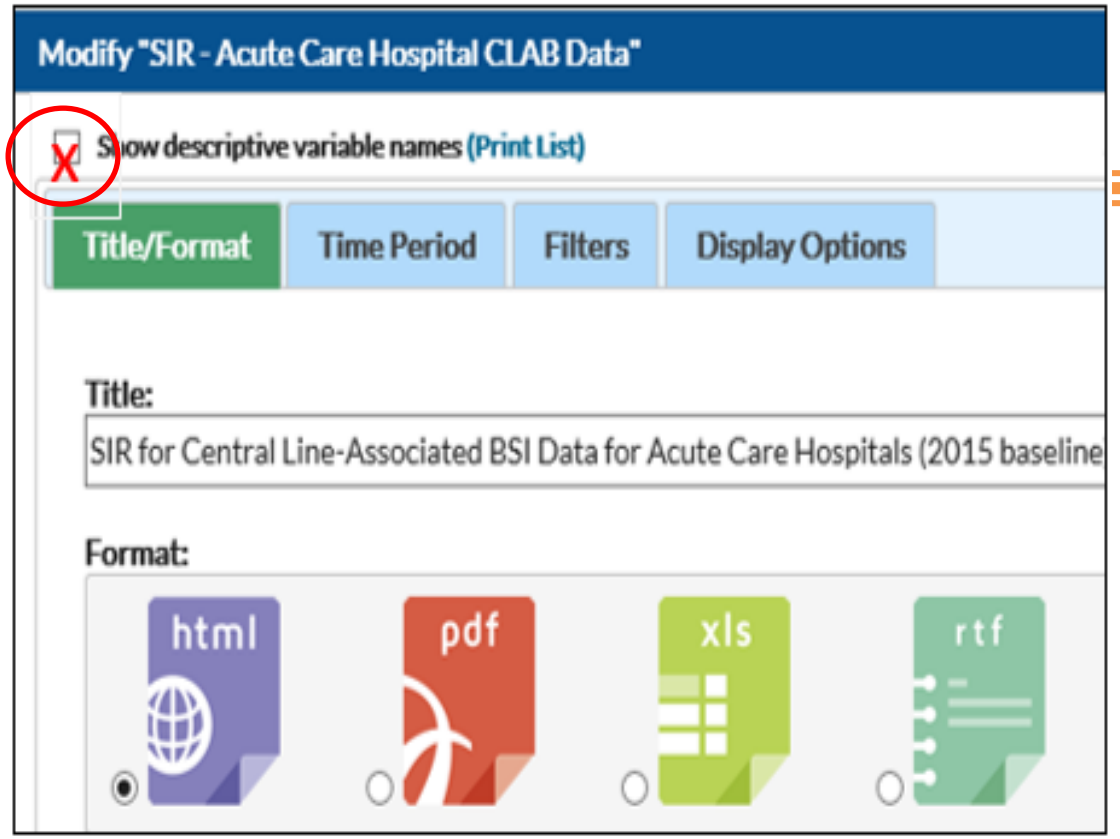
Alerts and Resolving Alerts

- Alerts are automatic checks in NHSN that remind you of incomplete or missing in-plan data
- Before using the analysis function, make sure to clear all (relevant) alerts found on the Home Page or by clicking on the 'Alerts' tab on the sidebar
- If there are no events for a given month, check the Report No Events box
- If not, alerts will appear if you have completed a summary form for a unit listed in your reporting plan but have not entered events



Modifying NHSN Report

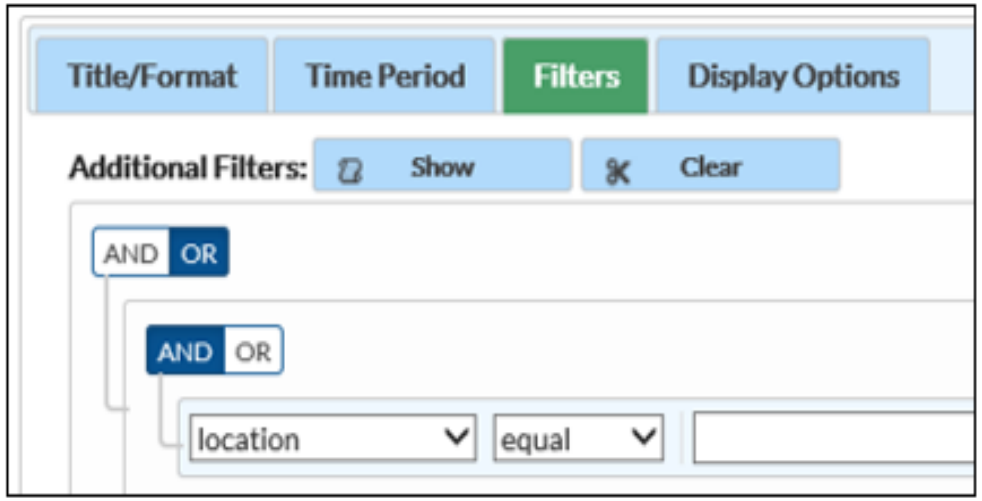
- Check “Show descriptive variable names”
  - Easier to read
- Choose what you want to modify
  - Title or Format
  - Time Period



Modifying NHSN Report - 2

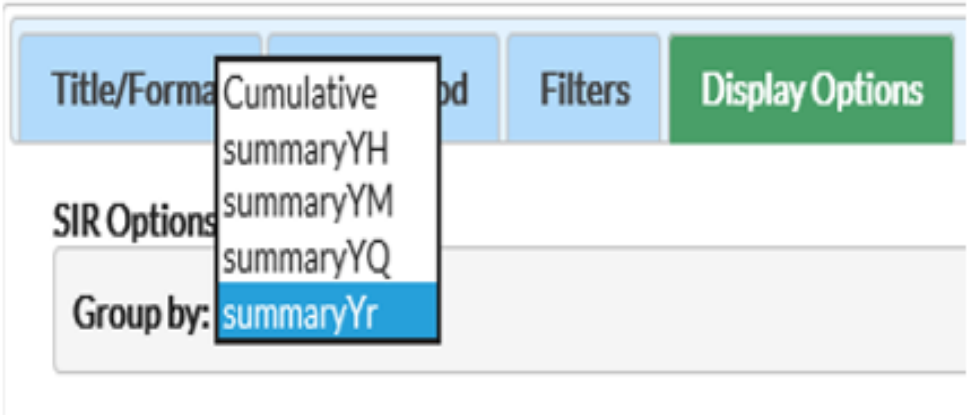
Filters

- Allows more variables to be added to the report



Display Options

- Choose how you want the data displayed in the report



Sample Rate Table

- Review your rate tables routinely to verify that infections and denominator data are reported each month

National Healthcare Safety Network
Rate Table for Central Line-Associated BSI Data for ICU-Ot
As of: September 23, 2017 at 6:20 PM
Date Range: BS2_CLAB_RATESICU summaryYM 2016M01 to 2016M12

loccdc=IN:ACUTE:CC:CT CCN= 99999 facType=HO

location	summaryYM	CLABCount	numCLDays	CLABRate	numPatDays
CCU	2016M01	0	187	0.000	410
CCU	2016M02	1	226	4.425	392
CCU	2016M03	0	242	0.000	383
CCU	2016M04	0	165	0.000	388
CCU	2016M05	0	217	0.000	341
CCU	2016M06	1	197	5.076	353
CCU	2016M07	0	207	0.000	386
CCU	2016M08	0	164	0.000	289
CCU	2016M09	0	180	0.000	342
CCU	2016M10	0	176	0.000	356
CCU	2016M11	0	53	0.000	469
CCU	2016M12	0	197	0.000	398

Sample Standardized Infection Ratio (SIR) Table for One Year – by Location

Shows each location's predicted number of CLABSI

Shows each locations SIR and p-value indicating if the SIR is significantly lower or higher than predicted

location	summaryYr	months	infcount	numPred	numcldays	SIR	SIR_pval	SIR95CI
4 M/S	2016	12	1	2.862	3288	0.349	0.2778	0.017, 1.723
5 MED	2016	12	3	4.237	4867	0.708	0.5940	0.180, 1.927
6E ONC	2016	12	5	4.406	4158	1.135	0.7309	0.416, 2.516
6S 6W	2016	12	1	2.330	2676	0.429	0.4214	0.021, 2.117
CCU	2016	12	2	2.227	2211	0.898	0.9634	0.151, 2.967
CMU NEW	2016	12	1	1.905	2188	0.525	0.5813	0.026, 2.589
ICCU	2016	12	2	1.333	1477	1.501	0.5352	0.252, 4.958
ICU	2016	12	11	4.463	4430	2.465	0.0085	1.296, 4.284

NHSN: A Guide to the SIR

- How to interpret SIR
- How SIR is calculated
- Risk adjustment factors for specific HAI

NHSN Standardized Infection Ratio (SIR) Guide (PDF)
(www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf)

California Department of PublicHealth

Standardized Utilization Ratio (SUR)

National Healthcare Safety Network
SUR for Central Line Device Use for Acute Care Hospitals (2015 baseline) - By OrgID
As of: July 8, 2021 at 10:51 AM
Date Range: All B 82_CLAB_RATE BALL

orgID=10018 medType=G

orgID	ccn	summaryYH	numCLDays	numPatDays	numPredDDays	SUR	SUR_pval	SUR95CI	SUR_pctl
10018	66666	2019H1	2974	3530	776.379	3.831	0.0000	3.696, 3.970	100
10018	66666	2019H2	961	1529	284.308	3.380	0.0000	3.172, 3.599	100

1. This report includes central line utilization data from acute care hospitals for 2015 and forward.
2. The SUR is only calculated if number of predicted device days (numPredDDays) is >= 1. Lower bound of 95% Confidence Interval only calculated when number of observed device days > 0.
3. The predicted device utilization days is calculated based on national aggregate NHSN data from 2015. It is risk adjusted for CDC location, hospital beds, medical school affiliation type, and facility type.

The number of central line days/the number of predicted central line days = SUR*

*Calculated SUR is also available for CAUTI surveillance

THE NHSN STANDARDIZED UTILIZATION RATIO (SUR)

A Guide to the SUR

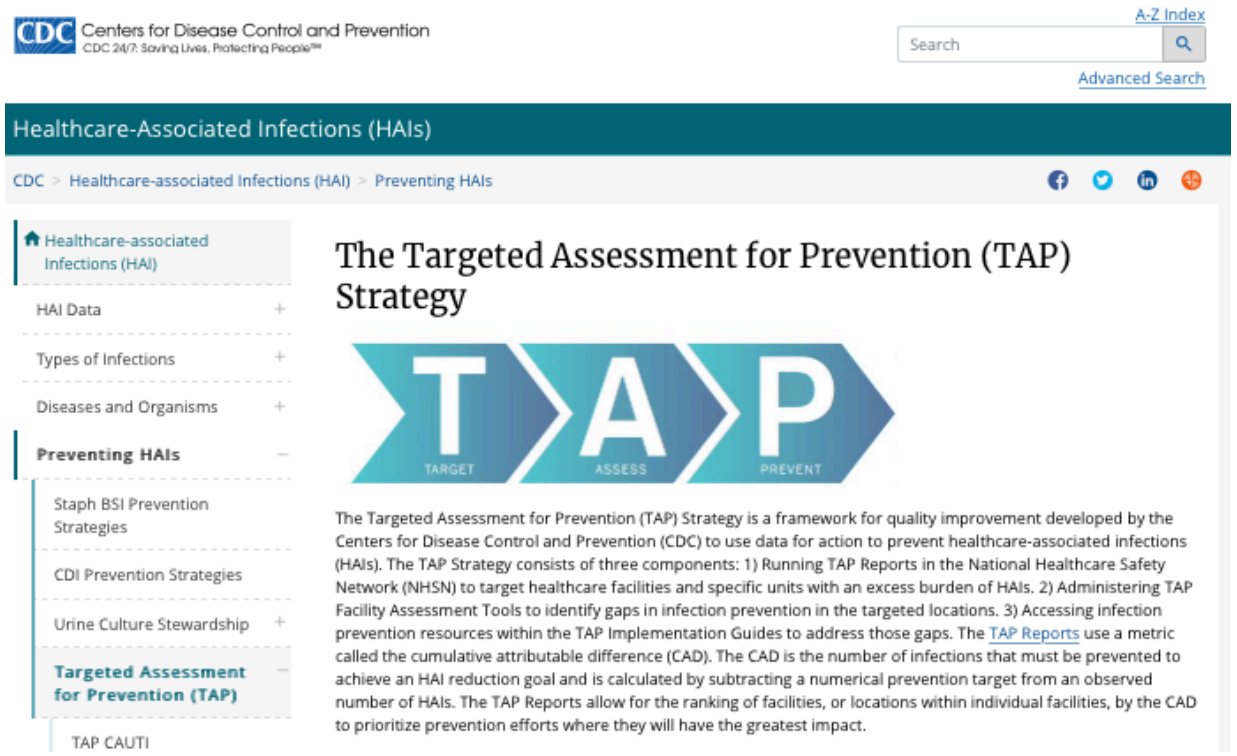
Updated April 2022

[CDC NHSN Standardized Utilization Ration (SUR) Guide](cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sur-guide-508.pdf) (PDF)
(cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sur-guide-508.pdf)

California Department of PublicHealth

Targeted Assessment for Prevention (TAP) Reports

- **Available for CDI, CLABSI, CAUTI**
- Identifies **number of infections that need to be prevented** to reach targeted goal
  - Called the cumulative attributable difference (CAD) in NHSN
  - Lists results by location for CLABSI and CAUTI
- Assists in deciding where to focus infection prevention efforts



Targeted Assessment for Prevention (TAP) Strategy

(www.cdc.gov/hai/prevent/tap.html)

Using the Cumulative Attributable Difference (CDA) to Explain Rates

- Eliminates statistical terms when explaining results
- "If our medical ICU had eliminated _(#) CLABSIs, we would have met our goal"
- In this example, eliminating 23 C. difficile HAI cases out of 61 would have met the facility goal

Number of Beds	Patient Days	COHCFA Prevalence	CDIF Facility Incident HO LabID Event Count	CDIF Facility Incident HO LabID Number Expected	Facility CAD	SIR
354	60059	0.14	61	55.034	22.48	1.108

Targeted Assessment for Prevention (TAP) Strategy
(www.cdc.gov/hai/prevent/tap.html)

NHSN Help

- Use NHSN website (www.cdc.gov/nhsn)
- Email NHSN questions to nhsn@cdc.gov
- For technical questions about CDPH NHSN requirements, email HAI_Data@cdph.ca.gov

Summary

- NHSN is a surveillance system used for recording data which meets the regulatory reporting requirements for CDPH and CMS
- NHSN has many analysis features to assist users in interpreting and presenting their data
- Resources are available for interpretation and analysis of NHSN data from:
  - CDC (www.cdc.gov/nhsn)
  - CDPH (www.cdph.ca.gov/HAI)

Questions?

For more information,

please contact

HAIProgram@cdph.ca.gov

Include “ACH IP Training Course” in the subject line

Post Test

Now that you have completed this module,

Click on the “Post Test” link when it pops up

To Return to

Learning Stream

and take the post test

If the Post Test link does not pop up, you will be sent a link via e-mail