Urinary Tract Infection (Catheter-Associated Urinary Tract Infection [CAUTI] and Non-Catheter-Associated Urinary Tract Infection [UTI]) Events

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Introduction: Urinary tract infections (UTIs) are the fifth most common type of healthcare-associated infection, with an estimated 62,700 UTIs in acute care hospitals in 2015. UTIs additionally account for more than 9.5% of infections reported by acute care hospitals[1]. Virtually all healthcare-associated UTIs are caused by instrumentation of the urinary tract.

Approximately 12%-16% of adult hospital inpatients will have an indwelling urinary catheter (IUC) at some time during their hospitalization, and each day the indwelling urinary catheter remains, a patient has a 3%-7% increased risk of acquiring a catheter-associated urinary tract infection (CAUTI).[2-3]

CAUTI can lead to such complications as prostatitis, epididymitis, and orchitis in males, and cystitis, pyelonephritis, gram-negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis in patients. Complications associated with CAUTI cause discomfort to the patient, prolonged hospital stay, and increased cost and mortality[4]. It has been estimated that each year, more than 13,000 deaths are associated with UTIs.[5]

Prevention of CAUTI is discussed in the CDC/HICPAC document, *Guideline for Prevention of Catheter-associated Urinary Tract Infection*.[6]

Settings: Surveillance may occur in any inpatient location(s) where denominator data can be collected, such as critical intensive care units (ICU), specialty care areas (SCA), step- down units, wards, inpatient rehabilitation locations, and long term acute care locations. Neonatal ICUs may participate, but only off plan (not as a part of their monthly reporting plan). A complete listing of inpatient locations and instructions for mapping are located in the CDC Locations and Descriptions chapter.

Note: Surveillance for CAUTI after the patient is discharged from the facility is not required. However, if discovered, any CAUTI with a date of event (DOE) on the day of discharge or the next day is attributable to the discharging location and should be included in any CAUTIs reported to NHSN for that location (see Transfer Rule Chapter 2). No additional indwelling urinary catheter days are reported.

Refer to the NHSN Patient Safety Manual, Chapter *2 Identifying Healthcare Associated Infections in NHSN* and Chapter 16 *NHSN Key Terms* for definitions of the following universal concepts for conducting HAI surveillance.

I. Date of event (DOE)
II. Healthcare associated infection (HAI)
III. Infection window period (IWP)
IV. Present on admission (POA)
V. Repeat infection timeframe (RIT)
VI. Secondary BSI attribution period (SBAP)
VII. Location of Attribution (LOA)
VIII. Transfer rule

Definitions:

Urinary tract infections (UTI) are defined using Symptomatic Urinary Tract Infection (SUTI) criteria, and Asymptomatic Bacteremic UTI (ABUTI). (See Table 1)

Note: UTI cannot be considered secondary to another site of infection.

Indwelling catheter: A drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a drainage bag (including leg bags). These devices are also called Foley catheters. Indwelling urinary catheters that are used for intermittent or continuous irrigation are also included in CAUTI surveillance. Condom or straight in-and-out catheters are not included nor are nephrostomy tubes, ileoconduits, or suprapubic catheters unless an indwelling urinary catheter (IUC) is also present.

Catheter-associated UTI (CAUTI): A UTI where an indwelling urinary catheter was in place for more than two consecutive days in an inpatient location on the **date of event**, with day of device placement being Day 1*,

AND

an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for more than two consecutive days in an inpatient location and then removed, the date of event for the UTI must be the day of device discontinuation or the next day for the UTI to be catheter-associated.

*If the IUC was in place prior to inpatient admission, the catheter day count that determines device – association begins with the admission date to the first inpatient location. This allows for consistency with device denominator count (see Table 2 Denominator Data Collection Methods)

Example of Associating Catheter Use to UTI:

A patient in an inpatient unit has an IUC inserted and the following day is the date of event for a UTI. Because the IUC has not been in place for more than two consecutive days in an inpatient location on the date of event, this is not a CAUTI. However, depending on the date of admission, this may be a healthcare-associated UTI and sets an RIT. Please refer to SUTI 1b: Non-CAUTI.

Notes:

- SUTI 1b cannot be catheter-associated.

Indwelling urinary catheters that are removed and reinserted: If, after an IUC removal, the patient is without an IUC for at least 1 full calendar day (NOT to be read as 24 hours), then the IUC day count will start anew. If instead, a new IUC is inserted before a full calendar day has passed, the indwelling urinary catheter device day count, to determine eligibility for a CAUTI, will continue uninterrupted.

Figure 1: Associating Catheter Use to UTI

	March 31 (Hospital day 3)	April 1	April 2	April 3	April 4	April 5	April 6
Patient A	IUC **Day 3**	IUC **Day 4**	IUC removed **(Foley Day 5)**	IUC replaced **(Foley Day 6)**	IUC **Day 7**	IUC removed **Day 8**	No IUC
Patient B	IUC **Day 3**	IUC **Day 4**	IUC removed **(IUC Day 5)**	No IUC	IUC replaced (**IUC Day 1)**	IUC **Day 2**	IUC **Day 3**

Rationale: NHSN surveillance for infection is not aimed at a specific device. Instead surveillance is aimed at identifying risk to the patient that is the result of device use in general.

Notes:

- In the examples above, Patient A is eligible for a CAUTI beginning on March 31, through April 6th, since an IUC was in place for some portion of each calendar day until April 6th. A UTI with date of event on April 6th would be a CAUTI since the IUC had been in place greater than two days and was removed the day before the date of event.
- Patient B is eligible for a CAUTI on March 31 (IUC Day 3) through April 3. The IUC had been in place for greater than two days and a HAI occurring on the day of device discontinuation or the following calendar day is considered a device-associated infection.
- If the patient did not have a CAUTI by April 3, the patient is not eligible for a CAUTI until April 6, when the second IUC had been in place for greater than two days.

Table 1. Urinary Tract Infection Criteria

Criterion	Urinary Tract Infection (UTI)
	Symptomatic UTI (SUTI) Must meet at least ***one*** of the following criteria:
SUTI 1a **Catheter-associated Urinary Tract Infection (CAUTI) in any age patient**	Patient must meet 1, 2, and 3 below: 1. Patient had an indwelling urinary catheter that had been in place for more than 2 consecutive days in an inpatient location on the date of event AND was either: • Present for any portion of the calendar day on the date of event†, **OR** • Removed the day before the date of event‡ 2. Patient has at least ***one*** of the following signs or symptoms: • fever (>38.0°C • suprapubic tenderness* • costovertebral angle pain or tenderness* • urinary urgency ^ • urinary frequency ^ • dysuria ^ 3. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium of ≥10^5 CFU/ml (See Comments). All elements of the SUTI criterion must occur during the IWP (See IWP Definition Chapter 2 Identifying HAIs in NHSN). † When entering event into NHSN choose "INPLACE" for Risk Factor for IUC ‡ When entering event into NHSN choose "REMOVE" for Risk Factor for IUC ***With no other recognized cause (see Comments) **^** These symptoms cannot be used when catheter is in place. An IUC in place could cause patient complaints of "frequency" "urgency" or "dysuria". **Note:** • Fever is a non-specific symptom of infection and cannot be excluded from UTI determination because it is clinically deemed due to another recognized cause.

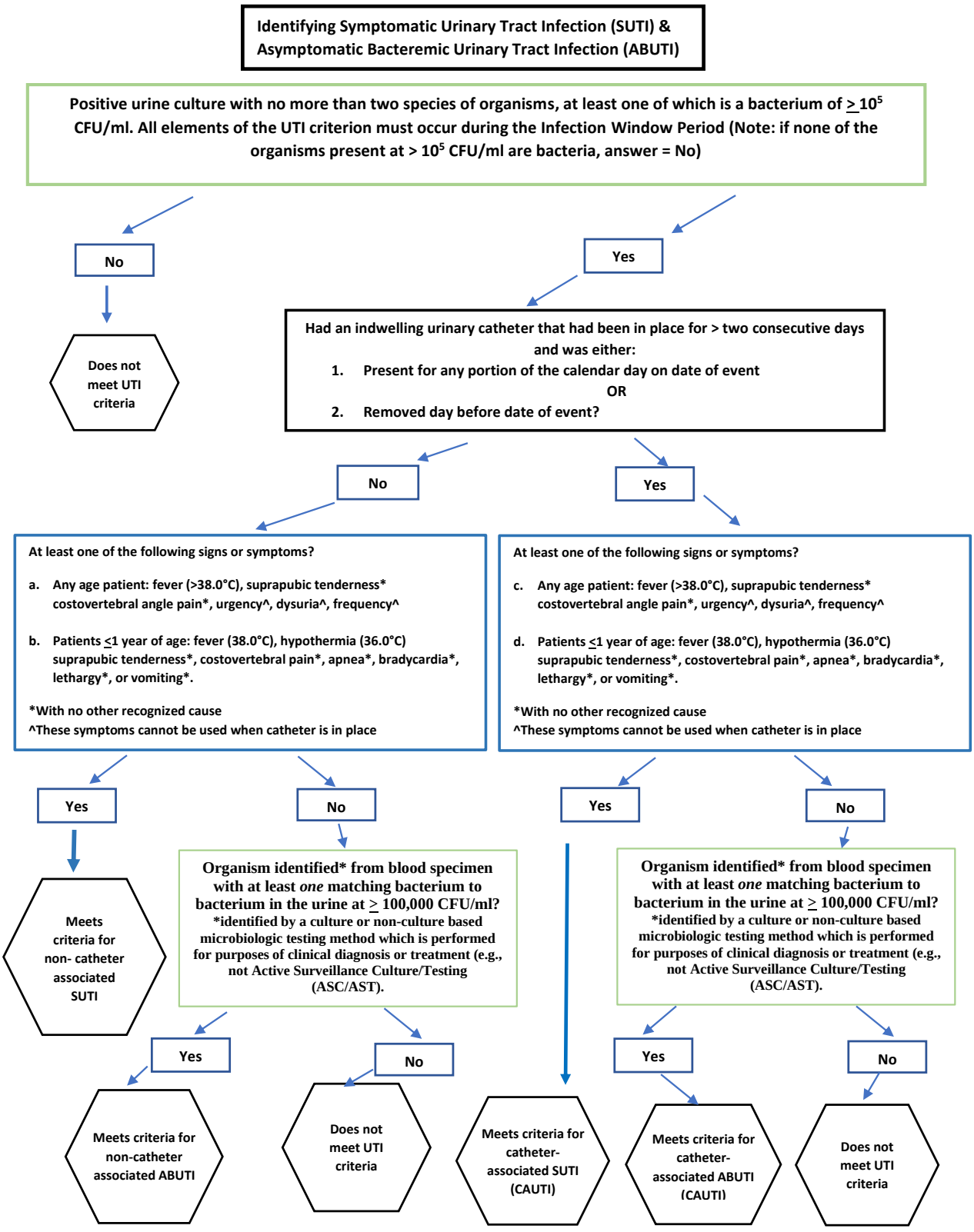
SUTI 1b **Non-Catheter-associated Urinary Tract Infection (Non-CAUTI) in any age patient**	Patient must meet 1, 2, and 3 below: 1. One of the following is true: • Patient has/had an indwelling urinary catheter but it has/had not been in place for more than two consecutive days in an inpatient location on the date of event† **OR** • Patient did not have an indwelling urinary catheter in place on the date of event nor the day before the date of event † 2. Patient has at least ***one*** of the following signs or symptoms: • fever (>38°C) • suprapubic tenderness***** • costovertebral angle pain or tenderness***** • urinary frequency ^ • urinary urgency ^ • dysuria ^ 3. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium of ≥10^5 CFU/ml. (See Comments) All elements of the SUTI criterion must occur during the IWP (See IWP Definition Chapter 2 Identifying HAIs in NHSN). † When entering event into NHSN choose "NEITHER" for Risk Factor for IUC *****With no other recognized cause (see Comments) ^These symptoms cannot be used when IUC is in place. An IUC in place could cause patient complaints of "frequency" "urgency" or "dysuria". **Note:** • Fever is a non-specific symptom of infection and cannot be excluded from UTI determination because it is clinically deemed due to another recognized cause.

SUTI 2 **CAUTI or Non-CAUTI in patients 1 year of age or less**	Patient must meet 1, 2, and 3 below: 1. Patient is ⩽1 year of age (with‡ or without an indwelling urinary catheter) 2. Patient has at least ***one*** of the following signs or symptoms: • fever (>38.0°C) • hypothermia (<36.0°C) • apnea***** • bradycardia***** • lethargy***** • vomiting* • suprapubic tenderness* 3. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium of ≥10^5 CFU/ml. (See Comments) All elements of the SUTI criterion must occur during the IWP (See IWP Definition Chapter 2 Identifying HAIs in NHSN). ‡ If patient had an IUC in place for more than two consecutive days in an inpatient location and the IUC was in place on the date of event or the previous day the CAUTI criterion is met. If no such IUC was in place, UTI (non-catheter associated) criterion is met. *****With no other recognized cause (See Comments) **Note:** Fever and hypothermia are non-specific symptoms of infection and cannot be excluded from UTI determination because they are clinically deemed due to another recognized cause.

Comments	"Mixed flora" is not available in the pathogen list within NSHN. Therefore, it cannot be reported as a pathogen to meet the NHSN UTI criteria. Additionally, "mixed flora" represent at least two species of organisms. Therefore, an additional organism recovered from the same culture would represent more than two species of microorganisms. Such a specimen also cannot be used to meet the UTI criteria. The following excluded organisms cannot be used to meet the UTI definition: ➢ Any *Candida* species as well as a report of "yeast" that is not otherwise specified ➢ mold ➢ dimorphic fungi or ➢ parasites An acceptable urine specimen may include these organisms as long as one bacterium of ≥ 100,000 CFU/ml is also present. Additionally, these non-bacterial organisms identified from blood cannot be deemed secondary to a UTI since they are excluded as organisms in the UTI definition. ➢ Suprapubic tenderness whether elicited by palpation (tenderness-sign) or provided as a subjective complaint of suprapubic pain (pain-symptom), documentation of either found in the medical record is acceptable as a part of SUTI criterion if documented in the medical record during the Infection Window Period. ➢ Lower abdominal pain or bladder or pelvic discomfort are examples of symptoms that can be used as suprapubic tenderness. Generalized "abdominal pain" in the medical record is not to be interpreted as suprapubic tenderness as there are many causes of abdominal pain and this symptom is too general. ➢ Left or right lower back or flank pain are examples of symptoms that can be used as costovertebral angle pain or tenderness. Generalized "low back pain" is not to be interpreted as costovertebral angle pain or tenderness.

	Asymptomatic Bacteremic Urinary Tract Infection (ABUTI) **(in any age patient)**
	Patient must meet 1, 2, and 3 below: 1. Patient with***** or without an indwelling urinary catheter has no signs or symptoms of SUTI 1 or 2 according to age 2. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium of ≥10^5 CFU/ml (see Comment section below) 3. Patient has organism identified** from blood specimen with at least ***one*** matching bacterium to the bacterium at ≥ 100,000 CFU/ml identified in the urine specimen, or is eligible LCBI criterion 2 (without fever) and matching common commensal(s) in the urine. All elements of the ABUTI criterion must occur during the Infection Window Period (See Definition Chapter 2 Identifying HAIs in NHSN). *****Patient had an IUC in place for more than two consecutive days in an inpatient location on the date of event, and IUC was in place on the date of event or the day before. *Catheter - associated ABUTI is reportable if CAUTI is in the facility's reporting plan for the location.* ** Organisms identified by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST).
Comments	A urine specimen with "Mixed flora" cannot be used to meet the urine criterion. Additionally, the following excluded organisms cannot be used to meet the UTI definition: • Any *Candida* species as well as a report of "yeast" that is not otherwise specified • mold • dimorphic fungi or • parasites An acceptable urine specimen may include these excluded organisms as long as one bacterium of ≥100,000 CFU/ml is also present. Additionally, these non-bacterial organisms identified from blood cannot be deemed secondary to a UTI since they are excluded as organisms in the UTI definition

Figure 2: Identifying SUTI and ABUTI Flowchart



Monthly Summary Data

Numerator Data: The *Urinary Tract Infection (UTI)* form (CDC 57.114) is used to collect and report each CAUTI that is identified during the month selected for surveillance. The Instructions for Completion of Urinary Tract Infection form include brief instructions for collection and entry of each data element on the form. The UTI form includes patient demographic information and information on whether an indwelling urinary catheter was present. Additional data include the specific criteria met for identifying the UTI, whether the patient developed a secondary bloodstream infection, whether the patient died, and the organisms isolated from cultures and their antimicrobial susceptibilities.

Reporting Instructions:
If no CAUTIs are identified during the month of surveillance, the "Report No Events" box must be checked on the appropriate denominator summary screen, (for example, *Denominators for Intensive Care Unit (ICU)/Other Locations (Not NICU or SCA/ONC).*

Denominator Data: Device days and patient days are used for denominators (See Key Terms chapter).The method of collecting device-day denominator data may differ depending on the location of patients being monitored. The following methods may be used:

Table 2: Denominator Data Collection Methods

Denominator Data Collection Method	Details
Manual, Daily (specifically, collected at the same time **every day** of the month)	Denominator data (patient days and device days) should be collected at the same time, every day, for each location performing surveillance to ensure that differing collection methods don't inadvertently result in device days being greater than patient days. The Instructions for Completion of Denominators for Intensive Care Unit (ICU)/Other Locations (Not NICU and SCA/ONC) and Instructions for Completion of Denominators for Specialty Care Areas (SCA)/Oncology (ONC) contain brief instructions for collection and entry of each data element on the form. Indwelling urinary catheter days, which are the number of patients with an indwelling urinary catheter device, are collected daily, at the same time each day, according to the chosen location using the appropriate form (CDC 57.117 and 57.118). These daily counts are summed and only the total for the month is entered into NHSN. Indwelling urinary catheter days and patient days are collected separately for each of the locations monitored.

Denominator Data Collection Method	Details
Manual, sampled once/week (collected at the same time on the same designated day, **once per week**)	To reduce staff time spent collecting surveillance data, once weekly sampling of denominator data to generate estimated urinary catheter days may be used as an alternative to daily collection in non-oncology ICUs and wards (see Notes below). Sampling may not be used in SCA/ONC locations or NICUs. During the month, the number of patients in the location (patient-days) and the number of patients with an indwelling urinary catheter (urinary catheter-days) is collected on a designated day each week (for example, every Tuesday), at the same time during the month. Evaluations of this method have repeatedly shown that use of Saturday or Sunday generate the least accurate estimates of denominator data, and, therefore, these days should not be selected as the designated day.[7-9] If the day designated for the collection of sampled data is missed, collect the data on the next available day instead. The following must be collected and entered NHSN: 1. The monthly total for patient-days, based on collection daily 2. The sampled total for patient-days 3. The sampled total urinary catheter-days When these data are entered, the NHSN application will calculate an estimate of urinary catheter-days. **Notes:** • To ensure the accuracy of estimated denominator data obtained by sampling, only ICU and ward location types with an average of 75 or more urinary catheter-days per month are eligible to use this method. A review of each location's urinary catheter denominator data for the past 12 months in NHSN will help determine which locations are eligible. • The accuracy of estimated denominator data generated by sampling can be heavily influenced by incorrect or missing data. Careful implementation of data collection following the guidance in this protocol is essential to avoid erroneous fluctuations in rates or Standardized Infection Ratios (SIRs).

Denominator Data Collection Method	Details
Electronic	For ***any*** location, denominator data from electronic sources (for example, urinary catheter days from electronic charting), may be used after validation of a minimum three consecutive months proves the data to be within 5% (+/-) of the manually-collected, once a day counts. When converting from one electronic counting system to another electronic counting system, the new electronic system should be validated against manual counts as above. If electronic counts for the new electronic system are not within 5% of manual counts, resume manual counting and continue working with IT staff to improve design of electronic denominator data extraction (while reporting manual counts) until concurrent counts are within 5% for 3 consecutive months. Note: This guideline is important because validating a new electronic counting system against an existing electronic system can magnify errors and result in inaccurate denominator counts. Perform the validation of electronic counts separately for each location conducting CAUTI surveillance.

Data Analyses:

All data that is entered into NHSN can be analyzed at event or summary level. The data in NHSN can be visualized and analyzed in various ways, for example, descriptive analysis reports for both the denominator and numerator data.

Types of CAUTI Analysis Reports

Standardized Infection Ratio

The Standardized Infection Ratio (SIR) is a summary measure used to track HAIs at a national, state, or local level over time. The SIR adjusts for various facility and/or patient-level factors that contribute to HAI risk within each facility. In HAI data analysis, the SIR compares the actual number of HAIs reported to the number that would be predicted, given the standard population (i.e., NHSN baseline), adjusting for several risk factors that have been found to be significantly associated with differences in infection incidence. The number of predicted infections is calculated using probabilities from negative binomial regression models constructed from 2015 NHSN data.

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

An SIR greater than 1.0 indicates that more HAIs were observed than predicted; conversely, an SIR less than 1.0 indicates that fewer HAIs were observed than predicted.

More information regarding the CAUTI SIR model and the parameter estimates can be found in the SIR Guide.

SIR Guide: https: //www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf
Keys to Success: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/keys-to-success-h.pdf

Note: The SIR will be calculated only if the number of predicted CAUTIs (numPred) is ≥1 to help enforce a minimum precision criterion.

While the CAUTI SIR can be calculated for single locations, the measure also allows you to summarize your data by multiple locations, adjusting for differences in the incidence of infection among the location types. For example, you will be able to obtain one CAUTI SIR adjusting for all locations reported. Similarly, you can obtain one CAUTI SIR for all ICUs in your facility.

The Standardized Utilization Ratio

The SUR, or Standardized Utilization Ratio is a summary measure used to track device use at a national, state, or local, or facility level over time. The SUR adjusts for various facility and/or location-level factors that contribute to device use. The method of calculating an SUR is similar to the method used to calculate

the Standardized Infection Ratio (SIR), a summary statistic used in NHSN to track healthcare-associated infections (HAIs). In device-associated HAI data analysis, the SUR compares the actual number of device days reported to what would be predicted, given the standard population (specifically, the NHSN baseline), adjusting for several factors that have been found to be significantly associated with differences in device utilization.

$$\text{SUR} = \frac{Observed\ (O)\ Catheter\ Days}{Predicted\ (P)\ Catheter\ Days}$$

In other words, an SUR greater than 1.0 indicates that more device days were observed than predicted; conversely, an SUR less than 1.0 indicates that fewer device days were observed than predicted. SURs are currently calculated in NHSN for the following device types: central lines, urinary catheters, and ventilators.

More information regarding the CAUTI SUR model and the parameter estimates can be found in the SUR Guide.

CAUTI Rate

The CAUTI rate per 1000 urinary catheter days is calculated by dividing the number of CAUTIs by the number of catheter days and multiplying the result by 1000.

$$\text{CAUTI Rate} = \frac{No.\ of\ CAUTIs}{No.of\ Catheter\ Days} * 1000$$

Device Utilization Ratio

The Urinary Catheter Utilization Ratio is calculated by dividing the number of urinary catheter days by the number of patient days.

$$\text{DUR} = \frac{No.\ of\ Urinary\ Catheter\ Days}{No.\ of\ Patient\ Days}$$

These calculations will be performed separately for the different types of ICUs, specialty care areas, and other locations in the institution, except for neonatal locations. DURs are useful for the purposes of tracking device use over shorter periods of time and for internal trend analyses.

Descriptive Analysis Output Options

Descriptive analysis output options of numerator and denominator data, such as line listings, frequency tables, and bar and pie charts are available in the NHSN application. SIRs, SURs and CAUTI rates and run charts are also available.

Line List: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/linelists.pdf
Frequency Tables: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/frequencytables.pdf
Bar Chart: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/BarCharts.pdf
Pie Chart: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/PieChart.pdf

Guides on using NHSN analysis features are available at: www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html.

A troubleshooting guide for the CAUTI SIR is available at: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sur-guide-508.pdf

NHSN Group Analysis:
NHSN Group Users can perform the same analysis as facility level users in NHSN. A few helpful tools in NHSN for groups are listed in the resources below. These tools are guides on how to start and join a Group; how to create a template to request data from facilities; how to determine the level of access granted by the facility following the previous steps, and how to analyze the facilities data.

Group Analysis Resources:

NHSN Group Users Page: https://www.cdc.gov/nhsn/group-users/index.html

Group User's Guide to the Membership Rights Report: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/GroupAnalysisWebinar.pdf

Group User's Guide to the Line Listing- Participation Alerts: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/group-alerts.pdf

Table 3. CAUTI Measures Available in NHSN

Measure	Calculation	Application
CAUTI SIR	$\frac{\text{Number of Observed CAUTIs}}{\text{Number of Predicted CAUTIs}}$	Both location specific and summarized measure
CAUTI Rates	$\frac{\text{Number of CAUTIs per locaiton}}{\text{Number of Urinary Catheter Days per location}} * 1000$	Location specific measure only
Urinary Catheter SUR	$\frac{\text{Number of Observed Catheter Days}}{\text{Number of Predicted Catheter Days}}$	Both location specific and summarized measure
DUR	$\frac{\text{Number of Catheter Days for a location}}{\text{Number of Patient Days for a location}}$	Location specific measure only

References

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[2]McGuckin M. *The patient survival guide: 8 simple solutions to prevent hospital and healthcare-associated infections.* New York, NY: Demos Medical Publishing; 2012.

[3]Lo E, Nicolle LE, Coffin SE, Gould C, Maragakis LL, Meddings J, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals: 2014 update. *Infection Control and Hospital Epidemiology* 2014; 35:464-79.

[4]Scott R. The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention, 2009. Division of Healthcare Quality Promotion, National Center for Preparedness, Detection, and Control of Infectious Diseases, Coordinating Center for Infectious Diseases, Centers for Disease Control and Prevention, February 2009.

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[6]Gould, CV., Umscheid, CA.,Agarwal, RK., Kuntz, G., Pegues, DA. "Guideline for Prevention of Catheter-associated Urinary Tract Infections". *Infection Control and Hospital Epidemiology*. 2010;31: 319-26.

[7]Klevens, R., et al. Sampling for Collection of Central Line Day Denominators in Surveillance for Healthcare-associated Bloodstream Infections. *Infection Control and Hospital Epidemiology*. 2006;27: 338-42.

[8]Thompson, N., et al. Evaluating the Accuracy of Sampling to Estimate Central Line–Days: Simplification of NHSN Surveillance Methods*. Infection Control and Hospital Epidemiology*. 2013;34(3): 221-228.

[9]See, I., et al. ID Week 2012 (Abstract #1284): Evaluation of Sampling Denominator Data to Estimate Urinary Catheter and Ventilator Days for the NHSN. San Diego, California. October 19, 2012.