CBE ID

0138

Title

Catheter-Associated Urinary Tract Infection (CAUTI) Standardized Infection Ratio

Project

Management of Acute Events, Chronic Disease, Surgery, and Behavioral Health

Endorsement Status

Endorsed with Conditions

E&M Committee Rationale/Justification

When the measure returns for maintenance (3 years), the measure developer should have explored the possibility of using other all-payer data sources to expand the use of patient-level factors in the risk adjustment model and reduce reliance on facility-level factors.

Is Under Review

No

Next Maintenance Cycle

Fall 2028

Previous Endorsement Cycle

Spring 2025

Steward

Centers for Disease Control and Prevention, National Healthcare Safety Network

1.0 New or Maintenance

Maintenance

1.1 Measure Structure

Single Measure

1.3 Electronic Clinical Quality Measure (eCQM)

No

1.6 Measure Description

Annual risk-adjusted standardized infection ratio (SIR) of catheter-associated urinary tract infections (CAUTI) among adults and children hospitalized as inpatients at acute care hospitals, oncology hospitals, long-term acute care hospitals, and acute care rehabilitation hospitals. SIR is reported annually and is calculated by dividing the number of observed CAUTIs into the number of predicted CAUTIs.

1.7 Composite Measure

No

1.7 Measure Type

Outcome

1.8 Level of Analysis

Facility

1.9 Care Setting

Hospital: Acute Care Facility, Hospital: Critical Access, Hospital: Inpatient, Inpatient Rehabilitation Facility, Long-Term Acute Care Facility

1.10 Measure Rationale

The use of this measure will promote catheter associated urinary tract infection (CAUTI) prevention activities that will lead to improved patient outcomes including reduction of CAUTIs, avoidable medical costs, and patient morbidity and mortality through reduced need for antimicrobials and reduced length of stay.

1.11 Measure Webpage

https://www.cdc.gov/nhsn/psc/uti/index.html

1.13 Data Dictionary

Not attached. I attest that all information will be provided where codes and/or value sets are needed (1.14a - 1.15c).

1.14 Numerator

Number of annually observed catheter-associated urinary tract infections (CAUTI) in hospital inpatients.

1.14a Numerator Details

Symptomatic Urinary Tract Infection (SUTI)
Must meet at least one of the two criteria below. All elements of the SUTI criterion must occur during the infection window period (IWP) (see IWP Definition NHSN Chapter 2 - Identifying HAIs).

- ^ These symptoms cannot be used when catheter is in place.
- *With no other recognized cause.

- ***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:
    1. Present for any portion of the calendar day on the date of event,

       OR

    2. Removed the day before the date of event
2. Patient has at least one of the following signs or symptoms:
    1. fever (>38.0°C)
    2. suprapubic tenderness *
    3. costovertebral angle pain or tenderness *
    4. urinary urgency ^
    5. urinary frequency ^
    6. 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 ≥100,000 CFU/ml.

- ***SUTI 2: Catheter-associated Urinary Tract Infection (CAUTI) in patients 1 year of age or less***

  Patient must meet 1, 2, and 3 below:

1. Patient is < 1 year of age, and 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:
    1. Present for any portion of the calendar day on the date of event,

       OR

    2. Removed the day before the date of event
2. Patient has at least one of the following signs or symptoms:
    1. fever (>38.0°C)
    2. hypothermia (<36.0°C)
    3. apnea*
    4. bradycardia*
    5. lethargy*
    6. vomiting*
    7. 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 ≥100,000 CFU/ml.

Asymptomatic Bacteremic Urinary Tract Infection (ABUTI)

Must meet the single criterion below. All elements of the ABUTI criterion must occur during the IWP (see IWP Definition NHSN Chapter 2 - Identifying HAIs).

- ** Organisms identified by a culture or non-culture based microbiologic testing method that is performed for purposes of clinical diagnosis or treatment.

- ***ABUTI: Catheter-associated Asymptomatic Bacteremic Urinary Tract Infection (CA-ABUTI) in any age patient***

  Patient must meet 1, 2, and 3 below:

1. Patient has no signs or symptoms of SUTI 1 or 2 regardless of age, and 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:
   1. Present for any portion of the calendar day on the date of event,

      OR

   2. Removed the day before the date of event
2. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium of ≥100,000 CFU/ml.
3. Patient has organism identified** from blood specimen with at least one matching bacterium to the ≥100,000 CFU/ml bacterium identified in the urine specimen or is eligible for laboratory confirmed bloodstream infection (LCBI) criterion 2 (without fever) and the common commensal(s) in the blood and urine match.

Key Components for Conducting UTI Surveillance

1. **Assess eligibility of a positive urine culture**
   1. Is this an eligible urine culture (*at least one eligible organism ≥ 100K CFU/ml and no more than two organisms*)?
   2. If yes, continue reviewing the potential event.
   3. If no, **STOP** (*cannot have a UTI event without an eligible urine culture*).

2. **Set the 7-day infection window period (IWP)**
   1. A positive urine culture **always** sets the IWP for the UTI module. The IWP includes 3 days before the urine culture, the day of the urine culture, and 3 days after the urine culture for a total of 7 days.

3. **Locate the first element used to meet site-specific infection criterion within the 7-day IWP.**
    1. Are all the UTI criteria met during the IWP?
        1. If yes, there is a UTI event.
        2. If no, there is no event.

4. **Identify the date of event (DOE)**
    1. The **DOE is** date that the **first element** occurs for the **first time** within the IWP.

5. **Establish if present on admission (POA) or a healthcare-associated infection (HAI)**
    1. **POA:** DOE is the date of admission to an inpatient location, the 2 days before admission, or the calendar day after admission.
    2. **HAI**: DOE occurred on or after hospital day 3.

6. **Identify location of attribution (LOA)**
    1. The LOA is the inpatient location where the patient was assigned on the DOE. This must be assigned to a location where denominator data (i.e. patient days and device days) can be collected.
        1. **Transfer Rule**: Exception to LOA. If the DOE is on the date of transfer or discharge, or the next day, the infection is attributed to the transferring/discharging location.

7. **Associate urinary catheter use to UTI event.**
    1. Indwelling Urinary Catheter (IUC) is defined as: 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).
        1. **CAUTI**: IUC in place for > 2 consecutive days in an inpatient location on the DOE or removed the before the DOE.
        2. **Non-CAUTI**: IUC present, but not in place for > 2 consecutive days in an inpatient location or the patient did not have an IUC in place on the DOE nor the day before the DOE.

8. **Set a repeat infection timeframe (RIT)**
    1. 14-day timeframe where no 'new' UTI events are reported (SUTI or ABUTI). The DOE is Day 1 of the RIT.

https://www.cdc.gov/nhsn/pdfs/pscmanual/2psc_identifyinghais_nhsncurren...

1.15 Denominator

Number of annually predicted catheter-associated urinary tract infections (CAUTI) in hospital inpatients.

1.15a Denominator Details

Numbers of indwelling urinary catheter days attributed to each location are counted for each data period using the following definitions and guidelines. All indwelling urinary catheter days for each location and data period are summed.

Device days and patient days are used for denominator reporting.

1. Determine the hospital inpatient location where the data is being collected.
2. Count the number of patients on the unit (patient days).
3. Count the number of patients with an indwelling urinary catheter in place (device days).
4. The number of predicted infections in NHSN is calculated based on the 2022 national hospital acquired infection (HAI) aggregate data and is adjusted for each facility using variables found to be significant predictors of HAI incidence. The number of predicted CAUTIs is calculated using a negative binomial regression model.

The general formula for the negative binomial regression model is

$\log(\lambda) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i$, where:

α = Intercept

β_i = Parameter estimate

X_i = Value of risk factor (categorical variables: 1 if present, 0 if not present)

i = Number of predictors

The tables below represent the variables found to be statistically significant predictors of catheter associated urinary tract infections (CAUTI) and are used in the negative binomial regression model to calculate the number of predicted healthcare facility-onset catheter associated urinary tract infections (CAUTI) in hospital inpatients under the 2022 baseline data.

See attachment 7.1 Supplemental Attachment for risk models.

1.15b Denominator Exclusions

The following are not considered indwelling urinary catheters by NHSN definitions and are excluded from the device days denominator counts:

- Suprapubic catheters
- Condom catheters
- Straight “in and out” catheterizations
- Nephrostomy tubes
- Ileoconduits

1.15c Denominator Exclusions Details

An indwelling urinary catheter is defined as 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). Any other catheters that do not meet this definition are excluded.

1.15d Age Group

Children (0-17 years), Adults (18-64 years), Older Adults (65 years and older)

1.16 Type of Score

Ratio

1.17 Measure Score Interpretation

Better performance = Lower score

1.18 Calculation of Measure Score

The National Healthcare Safety Network (NHSN) is a system for tracking healthcare-associated infections (HAIs) using data from US healthcare facilities. NHSN provides facility leaders, state health departments, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate HAIs.

NHSN began tracking HAIs in around 300 hospitals, and now serves over approximately 38,000 medical facilities. Current participants include acute care hospitals, long-term acute care hospitals, psychiatric hospitals, rehabilitation hospitals, outpatient dialysis centers, ambulatory surgery centers, and nursing homes, with hospitals (over 6,000) and dialysis facilities representing most of the facilities reporting data.

Establishing this system for tracking and preventing HAIs across the county required NHSN to understand key baseline data about facilities and healthcare. Information that allows NHSN to measure the incidence rates of HAIs represented in these baseline data includes:

- Facility demographics (like number of beds and medical school affiliation)
- Units within facilities (like the type of medical services or care provided on a unit)
- Surveillance data about infections (if, when, and where they occur)

The standardized infection ratio (SIR) is a summary metric used by healthcare facilities, CDC, and other public health organizations to track the incidence of healthcare-associated infections (HAIs) over time. The SIR compares the number of HAIs reported (numerator) to the number that would be predicted (denominator), given the standard population (i.e., national baseline), adjusting for various facility and/or patient-level risk factors that have been found to be significantly associated with differences in HAI incidence. When interpreting the SIR, a value 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.

The catheter associated urinary tract infection (CAUTI) standardized infection ratio (SIR) compares the actual number of CAUTIs reported to the number of CAUTIs that would be predicted. The number of predicted infections is calculated using multivariable regression models generated from nationally aggregated data during a baseline time period. These models are applied to a facility’s denominator and risk factor data to generate a predicted number of infections. To enforce a minimum precision criterion, facility SIRs are only calculated when the number of predicted infections is at least 1.0. This rule was instituted to avoid the calculation and interpretation of statistically imprecise SIRs, which typically have extreme values.

SIR =Observed (O) HAIs / Predicted (P) HAIs

1. Total the number of annually observed (numerator) CAUTIs across the facility.

2. Calculate the number of predicted (denominator) CAUTIs for the facility.

The number of predicted infections is the estimated number of events (i.e. CAUTIs) for the facility considering several facility factors reported to NHSN. The model is based on aggregated national data reported to NHSN during a specific timeframe (i.e. baseline year 2022). The negative binomial generalized linear model is utilized for CAUTI. As a national surveillance HAI tracking system, that US healthcare facilities must report data to, NHSN must characterize risk of infection in the most efficient way. To minimize burden of data collection on facilities, NHSN risk models utilize patient location and facility characteristics that are already reported by all facilities. Collecting additional patient characteristics for inclusion in the risk model, creates additional burden, and are thus not submitted in NHSN.

Negative binomial regression models are used to estimate incidence from a summarized population. The general negative binomial regression formula is:

log (λ) = α + □□1□□1 + □□2□□2 + ⋯ + □□i□□i, where:

α = Intercept

βi = Parameter estimate

Xi = Value of risk factor (categorical variables: 1 if present, 0 if not present)

i = Number of predictors

3. Divide the number of observed CAUTIs by the number of predicted CAUTIs to obtain the standardized infection ratio (SIR).

•If the SIR is greater than 1.0, then more HAIs were observed than predicted based on the 2022 national aggregate data.

• If the SIR is less than 1.0, then fewer HAIs were observed than predicted based on the 2022 national aggregate data.

• If the SIR equals 1.0, then the same number of HAIs were observed as predicted based on the 2022 national aggregate data.

The tables below represent the variables found to be statistically significant predictors of CAUTI and are used in the negative binomial regression model to calculate the number of predicted healthcare facility-onset CAUTIs in hospital inpatients under the 2022 baseline data.

See attachment 7.1 Supplemental Attachment for risk models.

1.19 Measure Stratification Details

The measure is not stratified.

1.20 Types of Data Sources

Electronic Health Records, Paper Patient Medical Records

1.25 Data Source Details

Data is submitted by facilities using the National Healthcare Safety Network (NHSN), web-based application (accessed securely via the Secure Access Management Service).

Instructions and protocol for completing CAUTI event reporting are available at the following website:

https://www.cdc.gov/nhsn/psc/uti/index.html

Instructions and Data Collection
Forms: https://www.cdc.gov/nhsn/pdfs/pscmanual/7psccauticurrent.pdf

https://www.cdc.gov/nhsn/pdfs/pscmanual/2psc_identifyinghais_nhsncurren...

https://www.cdc.gov/nhsn/forms/57.114_UTI_BLANK.pdf

https://www.cdc.gov/nhsn/forms/57.117_DenominatorSCA_BLANK.pdf

https://www.cdc.gov/nhsn/forms/57.118_DenominatorICU_BLANK.pdf

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NHSN Standard Infection Ratio (SIR) Guide NHSN SIR Guide

1.26 Minimum Sample Size

The measure is not based on a sample.

2.1 Attach Logic Model

2.1 Logic Model.pdf

2.2 Evidence of Measure Importance

Approximately 75% of UTIs that occur in the hospital are associated with a urinary catheter, and approximately 15-25% of patients in the hospital have a urinary catheter (Centers for Disease Control and Prevention, 2015). Prolonged urinary catheter use can increase the risk of developing a CAUTI (Centers for Disease Control and Prevention, 2015). In 2023, 3,774 general acute care hospitals reported a total of 17,370 CAUTIs to CDC's National Healthcare Safety Network (NHSN), which signified a 38% decrease in the CAUTI Standardized Infection Ratio (SIR) from national baseline in 2015 (Centers for Disease Control and Prevention 2023 HAI Progress Report). Multiple studies provide strong empirical support for the association between CAUTI prevention practices, including appropriate catheter use and proper techniques for catheter insertion and maintenance, and the reduction of CAUTIs. A large study performed at Mayo Clinic-Rochester, a large academic medical center with 1,300 beds, piloted a CAUTI prevention bundle in the medical ICU. This bundle focused on appropriate catheter use, catheter maintenance techniques (e.g., securing the catheter, proper catheter care), and appropriate practices for ordering urine cultures when there is a clear indication. Along with these prevention items, the EHR was updated to support documentation of compliance with the bundle. During the pilot study, the CAUTI rates in the MICU decreased from 6.0 to 0.0 CAUTIs/1,000 urinary catheter days; this decrease was sustained for a year (Sampathkumar et al.,2016). In May 2015, the bundle was implemented throughout the hospital, leading to a 70% reduction in CAUTI rates, from 2.0 to 0.6/1,000 catheter days (Sampathkumar et al.,2016). Another large urban teaching hospital implemented a study to reduce CAUTI rates that focused on appropriate catheter use and included a nurse-driven protocol for the removal of urinary catheters that were no longer medically necessary. Implementation of this protocol reduced catheter days by 11.79% and CAUTI rates by 38% in 2019 (Baker et al., 2022). Finally, a large study of 128 children's hospitals analyzed the implementation of CAUTI insertion and maintenance bundles to reduce CAUTI rates in the pediatric population. To track CAUTIs, the study utilized NHSN's CAUTI definition and tracked all patients admitted as an inpatient who had an indwelling urinary catheter from 2011-2017. CAUTI rates across these hospitals decreased 61.6% from 2.55 to 0.98 infections/1,000 urinary catheter-line days (Foster et al., 2020). This evidence supports a link between processes included in CAUTI prevention practices, such as proper techniques for catheter maintenance, and the reduction of CAUTIs.

References:

- Baker S, Shiner D, Stupak J, Cohen V, Stoner A. Reduction of Catheter-Associated Urinary Tract Infections: A Multidisciplinary Approach to Driving Change. Crit Care Nurs Q. 2022 Oct-Dec 01;45(4):290-299.
- Centers for Disease Control and Prevention. (2022). *Catheter-associated urinary tract infections*. *https://arpsp.cdc.gov/profile/nhsn/cauti*.
- Foster, C. B., Ackerman, K., Hupertz, V., Mustin, L., Sanders, J., Sisson, P., & Wenthe, R. E. (2020). Catheter-associated urinary tract infection reduction in a pediatric safety engagement network. *Pediatrics*, *146*(4).
- Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA; Healthcare Infection Control Practices Advisory Committee. Guideline for prevention of catheter-associated urinary tract infections 2009. Infect Control Hosp Epidemiol. 2010 Apr;31(4):319-26.
- Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

The following guideline supports the measure and is evidence based-Guideline for prevention of catheter-associated urinary tract infections 2009.

The guideline recommendations include specific interventions and practices to reduce urinary catheter use and catheter related urinary tract infections. Evidence supports a link between processes included in CAUTI prevention practices, such as appropriate catheter use, proper techniques for catheter insertion and maintenance, and the reduction of CAUTIs.

Source: Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA; Healthcare Infection Control Practices Advisory Committee. Guideline for prevention of catheter-associated urinary tract

infections 2009. Infect Control Hosp Epidemiol. 2010 Apr;31(4):319-26. Last updated February 2017.

https://www.cdc.gov/infectioncontrol/guidelines/cauti/index.html

The guideline uses the GRADE method to describe the statement's strength of recommendation.

HICPAC system for categorizing recommendations in this guideline is as follows:

Category IA. Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.

Category IB. Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale; or an accepted practice (e.g., aseptic technique) supported by limited evidence.

Category IC. Required by state or federal regulations, rules, or standards.

Category II. Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.

Unresolved issue. Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.

The guideline uses the following categories and definitions for the evidence grading system used to describe the level of evidence or level of certainty in the evidence.

Aggregate Level of Confidence in Effect Estimate

- High: Highly confident that the true effect lies close to that of the estimated size and direction of the effect. For example, confidence in the evidence is rated as "High" when there are multiple studies with no major limitations, there are consistent findings, and the summary estimate has a narrow confidence interval.
- Moderate: The true effect is likely to be close to the estimated size and direction of the effect, but there is a possibility that it is substantially different. For example, confidence in the evidence is rated as "Moderate" when there are only a few studies and some have limitations but not major flaws, there is some variation between study results, or the confidence interval of the summary estimate is wide.
- Low: The true effect may be substantially different from the estimated size and direction of the effect. For example, confidence in the evidence is rated as "Low" when supporting studies have major flaws, there is important variation between study results, the confidence interval of the summary estimate is very wide, or there are no rigorous studies.

These specific interventions include practices to reduce catheter related infections:

Healthcare intervention #1

Ensuring appropriate catheter use includes inserting catheters only for appropriate indications and leaving in place if needed.

The recommendation was based on a targeted systematic review of the best available evidence, with explicit links between the evidence and recommendations. The literature review includes 1 systematic review study, 9 randomized controlled trials and 12 observational studies.

1. Minimize urinary catheter use and duration of use in all patients, particularly those at higher risk for CAUTI or mortality from catheterization such as women, the elderly, and patients with impaired immunity (Category IB)
2. Avoid use of urinary catheters in patients and nursing home residents for management of incontinence (Category IB).
3. Use urinary catheters in operative patients only as necessary, rather than routinely (Category IB).
4. For operative patients who have an indication for an indwelling catheter, remove the catheter as soon as possible postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use (Category IB).

Healthcare intervention #2

Implement proper techniques for urinary catheter insertion

The recommendation was based on a targeted systematic review of the best available evidence, with explicit links between the evidence and recommendations. The literature review includes 6 systematic review study, 16 randomized controlled trials and 18 observational studies.

1. Perform hand hygiene immediately before and after insertion or any manipulation of the catheter device or site. (Category IB)
2. Ensure that only properly trained persons (e.g., hospital personnel, family members, or patients themselves) who know the correct technique of aseptic catheter insertion and maintenance are given this responsibility. (Category IB)

3. In the acute care hospital setting, insert urinary catheters using aseptic technique and sterile equipment. (Category IB)
4. In the non-acute care setting, clean (i.e., non-sterile) technique for intermittent catheterization is an acceptable and more practical alternative to sterile technique for patients requiring chronic intermittent catheterization. (Category IA)
5. Properly secure indwelling catheters after insertion to prevent movement and urethral traction. (Category IB)
6. Unless otherwise clinically indicated, consider using the smallest bore catheter possible, consistent with good drainage, to minimize bladder neck and urethral trauma. (Category II)
7. If intermittent catheterization is used, perform it at regular intervals to prevent bladder over distension. (Category IB)
8. Consider using a portable ultrasound device to assess urine volume in patients undergoing intermittent catheterization to assess urine volume and reduce unnecessary catheter insertions. (Category II)

Healthcare intervention #3

Implement proper techniques for urinary catheter maintenance.

The recommendation was based on a targeted systematic review of the best available evidence, with explicit links between the evidence and recommendations. The literature review includes 6 systematic review study, 56 randomized controlled trials, 34 observational studies and 1 economic analysis.

1. Following aseptic insertion of the urinary catheter, maintain a closed drainage system (Category IB)
2. Maintain unobstructed urine flow. (Category IB)
3. Use Standard Precautions, including the use of gloves and gown as appropriate, during any manipulation of the catheter or collecting system. (Category IB)
4. Complex urinary drainage systems (utilizing mechanisms for reducing bacterial entry such as antiseptic-release cartridges in the drain port) are not necessary for routine use. (Category II)
5. Changing indwelling catheters or drainage bags at routine, fixed intervals is not recommended. Rather, it is suggested to change catheters and drainage bags based on clinical indications such as infection, obstruction, or when the closed system is compromised. (Category II)
6. Unless clinical indications exist (e.g., in patients with bacteriuria upon catheter removal post urologic surgery), do not use systemic antimicrobials routinely to prevent CAUTI in patients requiring either short or long-term catheterization. (Category IB)
7. Do not clean the periurethral area with antiseptics to prevent CAUTI while the catheter is in place. Routine hygiene (e.g., cleansing of the meatal surface during daily bathing or showering) is appropriate. (Category IB)

8. Unless obstruction is anticipated (e.g., as might occur with bleeding after prostatic or bladder surgery) bladder irrigation is not recommended. (Category II)
9. Routine irrigation of the bladder with antimicrobials is not recommended. (Category II)
10. Routine instillation of antiseptic or antimicrobial solutions into urinary drainage bags is not recommended. (Category II)
11. Clamping indwelling catheters prior to removal is not necessary. (Category II)

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent catheter-associated urinary tract infections in acute-care hospitals: 2022 Update

Summary of Recommendations to Prevent CAUTI

Reference: Patel PK, Advani SD, Kofman AD, Lo E, Maragakis LL, Pegues DA, Pettis AM, Saint S, Trautner B, Yokoe DS, Meddings J. Strategies to prevent catheter-associated urinary tract infections in acute-care hospitals: 2022 Update. Infect Control Hosp Epidemiol. 2023 Aug;44(8):1209-1231.

Quality of Evidence

HIGH: Highly confident that the true effect lies close to that of the estimated size and direction of the effect. Evidence is rated as “high” quality when there are a wide range of studies with no major limitations, there is little variation between studies, and the summary estimate has a narrow

confidence interval.

MODERATE: The true effect is likely to be close to the estimated size and direction of the effect, but there is a possibility that it is substantially different. Evidence is rated as “moderate” quality when there are only a few studies and some have limitations but not major flaws, there is some variation between studies, or the confidence interval of the summary estimate is wide.

LOW: The true effect may be substantially different from the estimated size and direction of the effect. Evidence is rated as “low” quality when supporting studies have major flaws, there is important variation between studies, the confidence interval of the summary estimate is very wide, or there are no rigorous studies.

Essential practices

Infrastructure and resources

1. Perform a CAUTI risk assessment and implement an organization-wide program to identify and remove catheters that are no longer necessary using 1 or more methods documented to be effective. (Quality of evidence: MODERATE)

a. Develop and implement institutional policy requiring periodic, usually daily, review of the necessity of continued catheterization.

b. Consider utilizing electronic or other types of reminders (see Supplementary Content, Appendices 2 and 3 online) of the presence of a catheter and required criteria for continued use.

c. Conduct daily review during rounds of all patients with urinary catheters by nursing and physician staff to ascertain necessity of continuing catheter use.

2. Provide appropriate infrastructure for preventing CAUTI. (Quality of evidence: LOW)

a. Ensure that the supplies for following best practices for managing urinary issues are readily available to staff in each unit, including bladder scanners, non-catheter incontinence management supplies (urinals, garments, bed pads, skin products), male and female external urinary catheters, straight urinary catheters, and indwelling catheters including the option of catheters with coude tips.

b. Ensure that non-catheter urinary management supplies are as easy to obtain for bedside use as indwelling urinary catheters.

c. Ensure the physical capability for urinary catheters with tubes attached to patients (eg, indwelling urinary catheters, some external urinary catheters[EUCs]) to be positioned on beds, wheelchairs, at an appropriate height and without kinking for patients in their rooms and during transport.

3. Provide and implement evidence-based protocols to address multiple steps of the urinary catheter life cycle (Fig. 1): catheter appropriateness (step 0), insertion technique (step 1), maintenance care (step 2), and prompt removal (step 3) when no longer appropriate. (Quality of evidence: LOW)

a. Adapt and implement evidence-based criteria for acceptable indications for indwelling urethral catheter use, which may be embedded as standardized clinical-decision support tools within electronic medical record (EMR) ordering systems. Expert-consensus–derived indications for indwelling catheter use have been developed, although there is limited research that assesses the appropriateness of these uses.

4. Ensure that only trained HCP insert urinary catheters and that competency is assessed regularly. (Quality of evidence: LOW)

a. Require supervision by experienced HCP when trainees insert and remove catheters to reduce the risk of infectious and traumatic complications related to urinary catheter placement.

5. Ensure that supplies necessary for aseptic technique for catheter insertion are available and conveniently located. (Quality of evidence: LOW)

6. Implement a system for documenting the following in the patient record: physician order for catheter placement, indications for catheter insertion, date and time of catheter insertion, name of individual who inserted catheter, nursing documentation of placement, daily presence of a catheter and

maintenance care tasks, and date and time of catheter removal. Record criteria for removal and justification for continued use. (Quality of evidence: LOW)

a. Record in a standard format for data collection and quality improvement purposes and keep accessible documentation of catheter placement (including indication) and removal.

b. If available, utilize electronic documentation that is searchable.

c. Consider nurse-driven urinary catheter removal protocols for first trial of void without an indwelling catheter when the indication for placement has resolved (see Essential Practices, 3).

7. Ensure that sufficiently trained HCP and technology resources are available to support surveillance for catheter use and outcomes. (Quality of evidence: LOW)

8. Perform surveillance for CAUTI if indicated based on facility risk assessment or regulatory requirements. (Quality of evidence: LOW)

9. Standardize urine culturing by adapting an institutional protocol for appropriate indications for urine cultures in patients with and without indwelling catheters. Consider incorporating these indications into the EMR, and review indications for ordering urine cultures in CAUTI risk assessment. (Quality of evidence: LOW)

Education and training

1. Educate HCP involved in the insertion, care, and maintenance of urinary catheters about CAUTI prevention, including alternatives to indwelling catheters, and procedures for catheter insertion, management, and removal. (Quality of evidence: LOW)

2. Assess healthcare professional competency in catheter use, catheter care, and maintenance. (Quality of evidence: LOW)

3. Educate HCP about the importance of urine-culture stewardship and provide indications for urine cultures. (Quality of evidence: LOW)

a. Consider requiring clinicians to identify an appropriate indication for urine culturing when placing an order for a urine culture.

4. Provide training on appropriate collection of urine. Specimens should be collected and arrive at the microbiology lab as soon as possible, preferably within an hour. If delay in transport to the laboratory is expected, samples should be refrigerated (no more than 24 hours) or collected in preservative urine transport tubes. (Quality of evidence: LOW)

5. Train clinicians to consider other methods for bladder management such as intermittent catheterization, or external male or female collection devices, when appropriate before placing an indwelling urethral catheter. (Quality of evidence: LOW)

6. Share data in a timely fashion and report results to appropriate stakeholders. (Quality of evidence: LOW)

Insertion of indwelling catheters

1. Insert urinary catheters only when necessary for patient care and leave in place only as long as indications remain. (Quality of evidence: MODERATE)

2. Consider other methods for bladder management such as intermittent catheterization, or external male or female collection devices, when appropriate. (Quality of evidence: LOW)

3. Use appropriate technique for catheter insertion. (Quality of evidence: MODERATE)

4. Consider working in pairs to help perform patient positioning and monitor for potential contamination during placement. (Quality of evidence: LOW)

5. Practice hand hygiene (based on CDC or WHO guidelines) immediately before insertion of the catheter and before and after any manipulation of the catheter site or apparatus. (Quality of evidence: LOW)

6. Insert catheters following aseptic technique and using sterile equipment. (Quality of evidence: LOW)

7. Use sterile gloves, drape, and sponges, a sterile antiseptic solution for cleaning the urethral meatus, and a sterile single-use packet of lubricant jelly for insertion. (Quality of evidence: LOW)

8. Use a catheter with the smallest feasible diameter consistent with proper drainage to minimize urethral trauma but consider other catheter types and sizes when warranted for patients with anticipated difficult catheterization to reduce the likelihood that a patient will experience multiple, sometimes traumatic, catheterization attempts. (Quality of evidence: LOW)

Management of indwelling catheters

1. Properly secure indwelling catheters after insertion to prevent movement and urethral traction. (Quality of evidence: LOW)

2. Maintain a sterile, continuously closed drainage system. (Quality of evidence: LOW)

3. Replace the catheter and the collecting system using aseptic technique when breaks in aseptic technique, disconnection, or leakage occur. (Quality of evidence: LOW)

4. For examination of fresh urine, collect a small sample by aspirating urine from the needleless

sampling port with a sterile syringe/cannula adaptor after cleansing the port with disinfectant. (Quality of evidence: LOW)

5. Facilitate timely transport of urine samples to laboratory. If timely transport is not feasible, consider refrigerating urine samples or using sample collection cups with preservatives. Obtain larger volumes of urine for special analyses (eg, 24-hour urine) aseptically from the drainage bag. (Quality of evidence: LOW)

6. Maintain unobstructed urine flow. (Quality of evidence: LOW)

a. Remind bedside caregivers, patients, and transport personnel to always keep the collecting bag below the level of the bladder.

b. Do not place the bag on floor.

c. Keep the catheter and collecting tube free from kinking, which can impair urinary flow and increase stasis within the bladder, increasing infection risk.

d. Empty the collecting bag regularly using a separate collecting container for each patient. Avoid touching the draining spigot to the collecting container.

7. Employ routine hygiene. Cleaning the meatal area with antiseptic solutions is an unresolved issue, though emerging literature supports chlorhexidine use prior to catheter insertion. Alcohol-based products should be avoided given concerns about the alcohol causing drying of the mucosal tissues.

(Quality of evidence: LOW)

Additional approaches

1. Develop a protocol for standardizing diagnosis and management of postoperative urinary retention, including nurse-directed use of intermittent catheterization and use of bladder scanners when appropriate as alternatives to indwelling urethral catheterization. (Quality of evidence: MODERATE)

a. If bladder scanners are used, clearly state indications, train nursing staff in their use, and disinfect between patients according to the manufacturer’s instructions.

2. Establish a system for analyzing and reporting data on catheter use and adverse events from catheter use. (Quality of evidence: LOW)

a. Use cumulative attributable difference to identify high-risk units or hospitals as described in Section 5.

b. Measure process and outcomes measures (eg, standardized utilization ratio and standardized infection ratio) as described in Section 5.

c. Define and monitor catheter harm in addition to CAUTI, including catheter obstruction, unintended removal, catheter trauma, or reinsertion within 24 hours of removal.

3. Establish a system for defining, analyzing, and reporting data on non–catheter-associated UTIs, particularly UTIs associated with the use of devices being used as alternatives to indwelling urethral catheters. (Quality of evidence: LOW)

a. Non–catheter-associated UTIs are defined as UTIs that occur in hospitalized patients without an indwelling urethral catheter. These include but are not limited to patients that have had no urinary device at all, as well as those with EUCs, urinary stents, or urostomies, or who undergo

intermittent catheterization, that are not captured by the NHSN CAUTI definition.

b. As the incidence of CAUTI continues to decline, the proportion of non–catheter-associated UTIs is increasing in some hospitals. However, the national incidence of non–catheter-associated UTIs is not known, as surveillance and reporting of these UTIs are not required by US federal agencies.

c. As non–catheter-associated UTIs are a common indication for antibiotics in hospitalized patients, this metric could provide important information as healthcare facilities consider the risks and benefits of newer alternatives to urinary catheters with currently limited published data on adverse events (eg, EUCs for women) to help inform when the benefit outweighs the potential risk for specific patient populations.

2.4 Performance Gap

Using data submitted in 2023, there were 2,496 hospitals with 22,342,219 catheter days that qualified for the acute care metric. Their mean performance score was 0.855. The 351 long-term acute care hospitals with 1,134,836 catheter days had a mean performance score of 0.957 . The 506 IRF hospitals with 551,742 catheter days had a mean performance score of 1.065. The 16 CAH hospitals with 19992 catheter days that qualified for the metric had a mean performance score of 1.215.

2.4a Attach Performance Gap Results

2.4 Performance Gap.pdf

2.6 Meaningfulness to Target Population

“Please accept these comments from the Patient Safety Action Network regarding the following HAI measures; we are commenting on all of them together:

- Catheter-Associated Urinary Tract Infections (CAUTI)
- Central Line Associated Blood Stream Infections (CLABSI)
- 30-Day Post-Operative Colon Surgery (COLO) and Abdominal Hysterectomy (HYST) Surgical Site Infection (SSI)
- Methicillin-resistant *Staphylococcus aureus* (MRSA) Bacteremia LabID Event
- *Clostridioides difficile* (CDI) LabID Event
- Antimicrobial Use Measure

Fundamentally, each of these measures is important and essential to preventing infections. If we do not measure and publicly report these events in a continuous, standardized way, we cannot truly know or understand when actual progress is made.

There are several target populations for these measures. First, members of the public who may need to use the services of a local hospital at any given point without warning or who have an interest in seeing how their hospital compares to others on hospital acquired infections. The published HAI measures provide that public service. Second, patients being treated at a hospital who are infected might not benefit from the past published HAI measures, but they probably are interested in accountability. One of the first questions many ask is "will my infection be counted?" The next question typically is, "how can we prevent it from happening again to someone else?" To them, these measurements are very important.

The value and meaningfulness of these outcome measures lie in tracking reduction of patient harm over time using individual hospitals' HAI measures. Progress means fewer infections at each point of measurement with a goal toward no infections. Unfortunately, these measures are rarely presented on a continuum demonstrating whether each hospital has reduced this harm over the years. And they are no longer presented with the actual numbers of infections, which reflect actual infections reported and not an estimate.

We also believe the value of these measures is lowered because of the way they are reported to the public. It appears that the standardization using an SIR of 1.0 as the baseline has established that as the status quo, even though the baseline has been adjusted over time. We wonder how often hospitals accept SIRs of around 1.0 as acceptable. Further, the use of risk adjustment skews the real results in each of these measures, i.e., the patients who got infected. We would rather see a stratified presentation that compares similar hospitals together – without risk adjustments. We believe that would be more meaningful to the public.

Also, the terms used to present the data lead to confusion, such as predicted number of infections and better than/no different/worse than the national benchmark. Many hospitals' data is "not available," without context (the hospital failed to report, the hospital does not have enough cases to rate, etc).

Even with these limitations, the measures are important to retain because of their value to patients who expect to be free from preventable harm when hospitalized. You ask about the full meaning of these measures to patients, but that requires some understanding of what happens to them following a hospital acquired infection. These events affect each person in a different way. It can mean a round of antibiotics; a longer stay in the hospital or the need to seek further treatment; continued chronic conditions, including recurrences of the infection; significant medical debt; losing a job due to missing work as a consequence of an infection; losing one's home due to mounting medical bills and other debts; permanent disability; sepsis that is only survived after intense medical care; and death. This should clearly explain why all these measures are meaningful to patients.

Frankly, we need more infection measures so that all hospital acquired infections are accounted for, like what is done in California. It seems to us that every time federal agencies ask for feedback about these measures, the result is less information to the public."

Catheter-Associated Urinary Tract Infection (CAUTI) Standardized Infection Ratio serves as a broad, objective measure of healthcare-associated infection (HAI) burden within many patient care locations. HAI reduction has been a national priority set by U.S. Government going back to 2008 with the U.S. Health and Human Services (HHS) National Action Plan to Prevent Health Care-associated Infections: Roadmap to Elimination.[1] While there has been overall progress in reducing these specific HAIs, there is room for improvement in both the surveillance and prevention of CAUTIs.

Measuring CAUTIs has also been a priority for CMS as indicated by the use of the measure in six CMS Programs including Hospital Acquired Condition Reduction Program, Hospital Value-Based Purchasing, IRF Quality Reporting, LTCH Quality Reporting, Hospital Inpatient Quality Reporting, and Exempt Cancer Hospital Quality Reporting.

1. U.S. Health and Human Services (HHS) National Action Plan to Prevent Health Care-associated Infections: Roadmap to Elimination. Accessed April 28, 2025 at https://www.hhs.gov/oidp/topics/health-care-associated-infections/hai-a…

3.1 Contributions Towards Closing Care Gaps

This domain is optional for Spring 2025.

4.1a Data Structure and Availability

This is a maintenance measure, and the measure specifications have not changed. Facilities have not notified NHSN of any feasibility issues within the last year.

All required data elements are routinely generated, in structured fields, and used during care delivery. Facilities can choose to submit this data manually via a web form or via submission of CDA electronic files. NHSN has built-in business rules for mandatory data elements and does not allow for the submission of incomplete records.
Addressing NHSN data quality issues is integral to NHSN's ability to help facilities collect the data needed to identify areas needing prevention efforts, measure progress of prevention efforts, and push toward elimination of HAIs. The NHSN team routinely reviews the data reported to NHSN and contacts facilities to resolve confirmed and suspected data quality flags. Data quality checks conducted to help confirm the accuracy of the data being reported include checking CAUTI data, implementing business rules within the application, verifying alerts, and confirming that flags are triggered by incomplete data.

NHSN provides facilities with internal validation toolkits, which facilities can use to audit their

internal data to identify any potential inaccuracies or problems. The internal validation toolkit also provides recommendations to facilities for implementing quality control processes to ensure data is accurate and complete.
Additionally, NHSN offers external validation toolkits, which can be used by state or local health departments, or other auditors, to perform checks on the data that facilities submit to NHSN. External validation allows for the auditors to identify gaps in understanding of surveillance definitions or other errors and provide education to ensure data reported to NHSN follows the standardized specifications.

4.1b Implementation Costs and Burden

Per the Paperwork Reduction Act (PRA) of 1995, federal agencies cannot conduct or sponsor the collection of information unless the Office of Management and Budget (OMB) has reviewed and approved the proposed data collection. Federal agencies must submit a set of documents known as an Information Collection Request (ICR), to request OMB approval of an information collections. The ICR documents describe what information is needed, why it is needed, how it will be collected, and how much time, money, and effort it will cost the respondents to collect the information.

Multiple data collection forms are utilized to provide surveillance data on CAUTIs. Below are the OMB-approved estimated total annual burden hours and annual cost for all facilities that complete this data collection.

See attachment 7.1 Supplemental Attachment for burden and cost table.

4.1c Confidentiality

While CDC can retrieve data by personal identifier, CDC does not, as a matter of practice or policy, retrieve data in this way. Specifically, the primary practice and policy of CDC regarding NHSN data is to retrieve data by the name of the hospital or another non-personal identifier, not an individual patient, for surveillance and public health purposes. Furthermore, patient identifiers are not necessary for NHSN to operate.

An Assurance of Confidentiality is granted for all data collected under NHSN. NHSN’s Assurance of Confidentiality, states the following:

“the voluntarily provided information obtained in this surveillance system that would permit identification of any individual or institution is collected with a guarantee that it will be held in strict confidence, will be used only for the purposes stated, and will not otherwise be disclosed or released without the consent of the individual, or the institution in accordance with Sections 304, 306 and 308(d) of the Public Health Service Act (42 USC 242b, 242k, and 242m(d)).”

4.3 Feasibility Informed Final Measure

This is a maintenance measure and the measure specifications have not changed.

4.4 Proprietary Information

Not a proprietary measure and no proprietary components

5.1.1 Data Used for Testing

Reliability Testing: The dataset used for testing is the Center for Disease Control's (CDC) National Healthcare Safety Network (NHSN), which collects healthcare infection data from facilities throughout the United States. Data is from 1/1/2023 to 12/31/2023.

Validity Testing: The dataset used for testing is the 2023 Center for Disease Control's (CDC) National Healthcare Safety Network (NHSN), which collects healthcare infection data from facilities throughout the United States.

Validation Studies:

1. Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

- Dates of data used in testing: January 2013-December 2015

1. Luu A, Dominguez F, Yeshoua B, Vo C, Nallapa S, Chung D, Wald-Dickler N, Butler-Wu SM, Khaleel H, Chang K, Canamar CP, Holtom P, Spellberg B. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship. Clin Infect Dis. 2021 Jun 1;72(11):e883-e886.

- Dates of data used in testing: April 1, 2018-February 1, 2020

1. Potugari BR, Umukoro PE, Vedre JG. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center. Clin Med Res. 2020 Dec;18(4):140-144.

- Dates of data used in testing: January 2016 to December 2017

1. Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JL Jr. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023 Mar;51(3):319-323.

- Dates of data used in testing: January 2019 to December 2021

1. McVey C, von Wenckstern T, Mills C, Yager L, McCauley C, Rivera Y, Reed E. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections. J Nurs Care Qual. 2022 Oct-Dec 01;37(4):295-299.

- Date of data used in testing: January 2020 to July 2021

1. Wright, M., Xiong, M. S., Fendler, J., Jones, J., & Dolim, M. (2022, March). Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients. In *Oncology Nursing Forum* (Vol. 49, No. 2).

- Date of data used in testing: January 2020 to July 2021

1. Kaminski MA, Episcopia B, Malik S, Fornek M, Landman D, Xavier G, Quale J. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City, 2016-2019. Infect Control Hosp Epidemiol. 2021 Jul;42(7):842-846.
    1. Date of data used in testing: January 1, 2016- December 2019
2. Rebecca Bartles, Sara Reese, Alexandr Gumbar, Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator, American Journal of Infection Control, Volume 52, Issue 12, 2024, Pages 1345-1350.
    1. Date of data used in testing: December 2023 to June 2024.

Risk Adjustment:

The dataset used for the risk adjustment was derived from the 2022 Center for Disease Control's (CDC) National Healthcare Safety Network (NHSN), which includes healthcare infection data from facilities throughout the United States. The data includes in-plan CAUTI data and risk factors derived from facility enrollment information and the annual facility survey.

5.1.1a Dates of Testing Data

Field not required for Spring 2025

5.1.2 Differences in Data

Reliability Testing: The dataset used for testing is the 2023 Center for Disease Control's (CDC) National Healthcare Safety Network (NHSN), which collects healthcare infection data from facilities throughout the United States.

Validity Testing: The dataset used for testing is the Center for Disease Control's (CDC) National

Healthcare Safety Network (NHSN) 2023 dataset, which collects healthcare infection data from facilities throughout the United States. Only facilities with both a CAUTI and CLABSI SIR were included in the analysis. Facilities must have had at least 1 or more predicted event to be included.

Validation Studies:

1. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach: CAUTI SIR data was reported by the facility to NHSN between January 2013 to December 2015.

Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

1. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship: CAUTI SIR data reported by the facility to NHSN between April 2018 and February 2020.

Luu A, Dominguez F, Yeshoua B, Vo C, Nallapa S, Chung D, Wald-Dickler N, Butler-Wu SM, Khaleel H, Chang K, Canamar CP, Holtom P, Spellberg B. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship. Clin Infect Dis. 2021 Jun 1;72(11):e883-e886.

1. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center: CAUTI SIR data was reported by the facility to NHSN between January 2016 to December 2017.

Potugari BR, Umukoro PE, Vedre JG. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center. Clin Med Res. 2020 Dec;18(4):140-144.

1. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic: CAUTI SIR data was reported by the facility to NHSN between January 2019 to December 2021.

Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JL Jr. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023 Mar;51(3):319-323.

1. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections: CAUTI SIR data was reported by the facility to NHSN between January 2020 to July 2021.

McVey C, von Wenckstern T, Mills C, Yager L, McCauley C, Rivera Y, Reed E. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections. J Nurs Care Qual. 2022 Oct-Dec 01;37(4):295-299.

1. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients: CAUTI SIR data was reported by the facility to NHSN between January 2020 to December 2021.

Wright, M., Xiong, M. S., Fendler, J., Jones, J., & Dolim, M. (2022, March). Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients. In *Oncology Nursing Forum* (Vol. 49, No. 2).

1. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City: Data from the National Healthcare Safety Network (NHSN) looked at trends involving 11 hospitals in New York City.

Kaminski MA, Episcopia B, Malik S, Fornek M, Landman D, Xavier G, Quale J. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City, 2016-2019. Infect Control Hosp Epidemiol. 2021 Jul;42(7):842-846.

1. Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator: For each facility, the standardized infection ratios (SIR) were entered from Centers for Medicaid and Medicare Services (CMS) Hospital Compare Web site6for central line-associated bloodstream infection (CLABSI), catheter-associated urinary tract infection (CAUTI), *Clostridiodes difficile* infection and colon surgical site infection (SSI).

Rebecca Bartles, Sara Reese, Alexandr Gumbar, Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator, American Journal of Infection Control, Volume 52, Issue 12, 2024, Pages 1345-1350.

Risk Adjustment:

The 2022 and 2023 national aggregate data were reviewed for all potential data quality issues including outlier values prior to performing the risk-adjusted modeling of the SIR denominator for the CAUTI risk model. Based on the surveillance protocol for CAUTI, data were excluded from modeling consideration if it met the criteria. Data from patients who were not assigned to inpatient beds were excluded from the denominator counts, including data from all patients at outpatient clinics, 24-hour observation units, emergency department visits, and other specialty locations that did not have enough data to be included in the 2022 CAUTI risk model creation.

Inpatient rehabilitation locations and inpatient psychiatric locations that have their own Centers for Medicare and Medicaid Services (CMS) Certification Number (CCN) were excluded.

5.1.3 Characteristics of Measured Entities

Reliability Testing: See attachment 7.1 Supplemental Attachment for response and data table.

Validity Testing: See attachment 7.1 Supplemental Attachment for response and data table.

Validation Studies:
I. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach: The bundle interventions were piloted in a 24-bed adult medical ICU at large academic medical center. After pilot testing, the bundle was then rolled out to the remaining 8 adult and pediatric ICUs and 38 general care units at the facility.
Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

II. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship: The intervention was implemented in a large academic medical center in Los Angeles County with 676 beds.
Luu A, Dominguez F, Yeshoua B, Vo C, Nallapa S, Chung D, Wald-Dickler N, Butler-Wu SM, Khaleel H, Chang K, Canamar CP, Holtom P, Spellberg B. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship. Clin Infect Dis. 2021 Jun 1;72(11):e883-e886.

III. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center: An adult acute care rural 504-bed community academic hospital.
Potugari BR, Umukoro PE, Vedre JG. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center. Clin Med Res. 2020 Dec;18(4):140-144.

IV. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic: University hospital in the Midwest with 247 beds.
Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JL Jr. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023 Mar;51(3):319-323.

V. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections: A Magnet-designated, large, academic, level 1 trauma center in Houston, Texas.
McVey C, von Wenckstern T, Mills C, Yager L, McCauley C, Rivera Y, Reed E. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections. J Nurs Care Qual. 2022 Oct-Dec 01;37(4):295-299.

VI. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients: A 25-bed hematology/oncology unit and a total of 528 patients.
Wright, M., Xiong, M. S., Fendler, J., Jones, J., & Dolim, M. (2022, March). Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients. In Oncology Nursing Forum (Vol. 49, No. 2).

VII. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City: Data from the National Healthcare Safety Network (NHSN) were extracted for 11 acute care hospitals belonging to the NYC Health + Hospital system from 2016 through 2019. Trends in device infections per 1,000 patient days, device utilization ratios, and standardized infection ratios (SIRs) were examined for the 11 hospitals and for the entire system.
Kaminski MA, Episcopia B, Malik S, Fornek M, Landman D, Xavier G, Quale J. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City, 2016-2019. Infect Control Hosp Epidemiol. 2021 Jul;42(7):842-846.

VIII. Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator: There were 390 total acute care hospitals that participated in version 1.0 of the staffing calculator.
Rebecca Bartles, Sara Reese, Alexandr Gumbar, Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator, American Journal of Infection Control, Volume 52, Issue 12, 2024, Pages 1345-1350.

Risk Adjustment:
The risk adjustment model is based on data from Acute Care Hospitals (ACHs), Critical Access Hospitals (CAH), Inpatient Rehabilitation Facilities (IRF), and Long-Term Acute Care hospitals (LTAC) and are modeled separately based on risk factors significantly associated with those settings. Facilities that met reporting criteria within NHSN for 2023 were included in the final risk model(s). Facilities varied in key characteristics relevant to the risk model, including bed size and teaching status. The diverse sample used for risk-adjusted modeling reflects variation across U.S. hospitals and supports comparisons in CAUTI performance measure in each care setting.

5.1.4 Characteristics of Units of the Eligible Population

Reliability Testing:

The CAUTI risk models used to calculate the predicted number of events were developed using patient care location- and facility-level factors. Since the data collection design did not allow for the capture of patient-level factors such as age or sex, these models are informed by surrogates of patient acuity (e.g., patient care location type, etc.). Studies have shown that significant differences in CAUTI incidence exist among different adult and pediatric ICUs and wards (see references below). We have provided hospital level information in section 5.1.3 above.

- Burton DC, Edwards JR, Srinivasan A, Fridkin SK, Gould, CV. Trends In Catheter-Associated Urinary Tract Infections in Adult Intensive Care Units—United States,1990-2007. Infect Control Hosp Epidemiol 2011;32(8):748-756.
- Klevens, RM, Edwards, JR, Richards, CL Jr, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Rep 2007;122(2):160–166.
- Wise, M, Scott, R, Ellingson, K, et al. Burden of major hospital-onset device-associated infection types among adults and children in the United States, 2007. Paper presented at: 21st Annual Scientific Meeting of the Society for Healthcare Epidemiology of America; April 2, 2011; Dallas, Texas. Abstract 3703.
- Scott, R, Wise, M, Ellingson, K, Baggs, J, Jernigan, J. Economic burden of major device-associated, acute-care hospital-onset infections among adults and children in the United States, 2007. Paper presented at: 21st Annual Scientific Meeting of the Society for Healthcare Epidemiology of America; April 3, 2011; Dallas, Texas. Abstract 4552.

Validity Testing:

The CAUTI risk models used to calculate the predicted number of events were developed using patient care location- and facility-level factors. Since the data collection design did not allow for the capture of patient-level factors such as age or sex, these models are informed by surrogates of patient acuity (e.g., patient care location type, etc.). Studies have shown that significant differences in CAUTI incidence exist among different adult and pediatric ICUs and wards (see references below). We have provided hospital level information in section 5.1.3 above.

- Burton DC, Edwards JR, Srinivasan A, Fridkin SK, Gould, CV. Trends In Catheter-Associated Urinary Tract Infections in Adult Intensive Care Units—United States,1990-2007. Infect Control Hosp Epidemiol 2011;32(8):748-756.
- Klevens, RM, Edwards, JR, Richards, CL Jr, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Rep 2007;122(2):160–166.
- Wise, M, Scott, R, Ellingson, K, et al.Burden of major hospital-onset device-associated infection types among adults and children in the United States, 2007. Paper presented at: 21st Annual Scientific Meeting of the Society for Healthcare Epidemiology of America; April 2, 2011; Dallas, Texas. Abstract 3703.
- Scott, R, Wise, M, Ellingson, K, Baggs, J, Jernigan, J. Economic burden of major device-associated, acute-care hospital-onset infections among adults and children in the United States, 2007. Paper presented at: 21st Annual Scientific Meeting of the Society for Healthcare Epidemiology of America; April 3, 2011; Dallas, Texas. Abstract 4552.

Validation Studies:

I. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach: Adult and pediatric ICU and general care unit patients at the facility were included in the study. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

II. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship: A total of 509 inpatient urine cultures were ordered. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Luu A, Dominguez F, Yeshoua B, Vo C, Nallapa S, Chung D, Wald-Dickler N, Butler-Wu SM, Khaleel H, Chang K, Canamar CP, Holtom P, Spellberg B. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship. Clin Infect Dis. 2021 Jun 1;72(11):e883-e886.

III. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center: All inpatient departments of an acute care rural 504 bed community academic hospital. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Potugari BR, Umukoro PE, Vedre JG. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center. Clin Med Res. 2020 Dec;18(4):140-144.

IV. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic: All adult units at the facility were included in the study. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JL Jr. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023 Mar;51(3):319-323.

V. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections: All inpatient departments hospital wide. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
McVey C, von Wenckstern T, Mills C, Yager L, McCauley C, Rivera Y, Reed E. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections. J Nurs Care Qual. 2022 Oct-Dec 01;37(4):295-299.

VI. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients: Inpatients on a 25-bed hematology/oncology unit with a Foley catheter, who were age 60 or above. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Wright, M., Xiong, M. S., Fendler, J., Jones, J., & Dolim, M. (2022, March). Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients. In Oncology Nursing Forum (Vol. 49, No. 2).

VII. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City: All inpatient departments hospital wide. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Kaminski MA, Episcopia B, Malik S, Fornek M, Landman D, Xavier G, Quale J. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City, 2016-2019. Infect Control Hosp Epidemiol. 2021 Jul;42(7):842-846

VIII. Results from the beta version of the APIC staffing calculator: Most of the hospitals have an intensive care unit (ICU) (n = 355, 91.0%) and an emergency department (ED) (n = 386, 99.0%), perform surgery (n = 385, 98.7%), and are a part of a system (n = 329, 84.4%) (Table 1). Almost 90% of hospitals with > 500 beds have a burn unit, stem cell transplant unit (SCTU) or an inpatient rehabilitation unit (IRF) (n = 64, 87.7%), compared to about 50% of hospitals with < 200 beds. The case mix index (CMI) increased by hospital size; hospitals with 101 to 200 beds had a lower CMI (median: 1.54, IQR: 0.25) compared to hospitals with > 750 beds (2.27, 0.39).
Rebecca Bartles, Sara Reese, Alexandr Gumbar, Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator, American Journal of Infection Control, Volume 52, Issue 12, 2024, Pages 1345-1350.

Risk Adjustment:

The CAUTI risk models used to calculate the predicted number of events were developed using patient care location- and facility-level factors. Since the data collection design did not allow for the capture of patient-level factors such as age or sex, these models are informed by surrogates of patient acuity (e.g., patient care location type, etc.). Studies have shown that significant differences in CAUTI incidence exist among different adult and pediatric ICUs and wards (see references below). We have provided hospital level information in section 5.1.3 above.

- Burton DC, Edwards JR, Srinivasan A, Fridkin SK, Gould, CV. Trends In Catheter-Associated Urinary Tract Infections in Adult Intensive Care Units—United States,1990-2007. Infect Control Hosp Epidemiol 2011;32(8):748-756.
- Klevens, RM, Edwards, JR, Richards, CL Jr, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Rep 2007;122(2):160–166.
- Wise, M, Scott, R, Ellingson, K, et al.Burden of major hospital-onset device-associated infection types among adults and children in the United States, 2007. Paper presented at: 21st Annual Scientific Meeting of the Society for Healthcare Epidemiology of America; April 2, 2011; Dallas, Texas. Abstract 3703.

• Scott, R, Wise, M, Ellingson, K, Baggs, J, Jernigan, J. Economic burden of major device-associated, acute-care hospital-onset infections among adults and children in the United States, 2007. Paper presented at: 21st Annual Scientific Meeting of the Society for Healthcare Epidemiology of America; April 3, 2011; Dallas, Texas. Abstract 4552.

5.2.1 Level(s) of Reliability Testing Conducted

Accountable entity level (i.e., measure score) (e.g., signal-to-noise analysis)

5.2.2 Method(s) of Reliability Testing

To measure facility-level reliability, we computed signal-to-noise ratio.

Signal-to-noise reliability testing was performed to distinguish measure scores between facilities (Adams J.L. 2009). The annual standardized infection ratio (SIR) is defined as the sum of observed (O) events at the facility divided by the sum of predicted (P) events calculated from the risk-adjustment model. Signal-to-noise reliability testing denotes between-facility variance and within-facility variance (Adams J.L. 2009). Each facility SIR represents the between-facility variance; total variance of the data across eligible facilities with predicted number ≥1. The within-facility variance of the SIR for each facility was then calculated as Var(O/P) where P is a constant, a nuisance factor with no random variation. O was assumed to follow a Poisson distribution with rate parameter approximated by P. The result is Var(O/P) = Var(O)/P2 = P/P2 = 1/P. Signal to noise reliability scores can range from 0 to 1. A reliability of zero implies that all the variability in a measure is attributable to measurement error. A reliability of one implies that all the variability is attributable to real difference in performance.
References:

• Adams, J. L. (2009). The reliability of provider profiling: a tutorial. RAND.

5.2.3 Reliability Testing Results

See attachment

5.2.3a Attach Additional Reliability Testing Results

5.2.3 Reliability Testing Results.pdf

5.2.4 Interpretation of Reliability Results

We calculated the signal-to-noise reliability score for each facility that had at least one predicted CAUTI event. Reliability testing was performed on data from 2023, for all care settings that report the measure.

The percentage of facilities with an estimated reliability of >=0.6 was as follows: 65% of acute care hospitals, 83% of LTAC, and 86% of IRF. Only 16 CAH qualified for the metric; these hospitals had a median reliability of 0.451. The decile distribution of reliability measurements is in section 5.2.3a above.

Signal-to-Noise reliability scores vary across facilities from zero to one, with a score of zero indicating that all variation is attributable to noise (variation across patients within facilities) and a score of one indicating that all variation is caused by real differences in performance across facilities.

The median reliability score for ACH was 0.668, for LTACH was 0.72, for IRF was 0.689, and for CAH was 0.45. The median signal-to-noise reliability scores for ACH, LTACH, and IRF demonstrate substantial agreement, while the score for CAH demonstrates moderate agreement. Our interpretation of the results is based on the standards established by Landis and Koch (1977):

< 0 – Less than chance agreement
0 – 0.2 Slight agreement
0.21 – 0.39 Fair agreement
0.4 – 0.59 Moderate agreement
0.6 – 0.79 Substantial agreement
0.8 – 0.99 Almost Perfect agreement
1 Perfect agreement

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. biometrics, 159-174.

5.3.1 Level(s) of Validity Testing Conducted

Accountable entity level (i.e., measure score) (e.g., criterion validity)

5.3.2 Type of Accountable Entity Level Validity Testing Conducted

Empirical validity testing at the accountable entity-level (e.g., criterion validity, construct validity, known groups analysis)

5.3.3 Method(s) of Validity Testing

A Pearson correlation coefficient was calculated to assess a hypothesized linear relationship in the positive direction between annual Standardized Infection Ratios (SIR) for catheter associated urinary tract infections (CAUTI) and central line associated blood stream infections (CLABSI). The annual SIR is defined as the sum of observed (O) events at the facility divided by the sum of predicted (P) events calculated from the risk-adjustment model. Each facility that reported both CAUTI and CLABSI data for 2023 with at least 1 predicted event for each was included. If a facility reported only CAUTI or only CLABSI or did not have at least 1 predicted event for both HAIs, they were excluded from the analysis. Correlation coefficients range from -1 to +1, where a coefficient of -1 implies a perfect negative correlation, 0 implies no correlation, and +1 implies a perfect positive correlation. A significance threshold of 0.05 was used to test the result.

We hypothesized that there would be a positive correlation between CAUTI and CLABSI SIRs because there is overlap in the infection prevention practices preventing both types of infections (for example, hand hygiene, using sterile insertion techniques; performing routine surveillance, catheter assessments, and healthcare personnel education; assessing for signs or symptoms of infection, and adhering to clinical guidelines such as care and maintenance bundles.) Thus, we predicted that while the correlation would be positive, it would be a weak correlation.

Validation Studies:

These studies assess a hypothesized relationship between a reduction in the CAUTI SIR and implementation of CAUTI prevention techniques. A SIR > 1.0 represents that more CAUTIs were observed than predicted, a SIR <1.0 represents that fewer CAUTIs were observed than predicted, and a SIR =1.0 represents the same number of CAUTIs were observed as predicted. A literature review did not identify any published literature examining both prevention activities and NHSN CAUTI SIR in long term acute care hospitals or inpatient acute rehabilitation hospitals. After consultations with experts in the field, we determined that articles focusing on CAUTIs in patients at acute care hospitals could serve as a proxy for CAUTIs at all healthcare facilities because the same strategies to prevent CAUTI are used regardless of facility type. The studies support the hypothesis that the measure score (CAUTI SIR) correctly reflects the quality of care provided and adequately identifies differences in quality. Each study was performed at a single institution.

I. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach:

Researchers at Mayo Clinic Rochester, a large academic medical center with 1,300 beds, hypothesized that there would be a decrease in their NHSN CAUTI SIR after implementation of a CAUTI prevention bundle. This bundle consisted of six elements: consider alternatives to indwelling Foley catheters each day, connect the catheter with a securement device to minimize movement and urethral irritation, perform appropriate perineal and catheter care, only access the catheter when medically necessary and use aseptic technique, call for a bladder scan before irrigating, and order a urine culture only when the indication is clear. The bundle was piloted between August 2014 and January 2015 in the facility’s 24-bed medical ICU, which had the highest CAUTI rates in the medical center. After successful implementation of the pilot study, the bundle was rolled out to the remaining eight adult and pediatric ICUs and to the 38 general care units in May 2015.

Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

II. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship:

Researchers at a large, public, tertiary-care, academic hospital with 767 beds hypothesized that implementation of a diagnostic stewardship program using education, audit, and feedback would reduce their facility’s NHSN CAUTI standardized infection ratio (SIR) by reducing the number of inpatient urine cultures. The researchers hypothesized that their increased CAUTI SIR was due to positive urine cultures that were sent for fever work-up, rather than for signs and symptoms of

UTI, and that the positive cultures were catheter contaminants, rather than true infections. In April 2019, a hospital-wide educational program on urine culture testing began. A grand rounds lecture was given to the department of surgery and department of medicine to educate clinicians on the appropriate criteria for inpatient urine cultures. The nursing staff was also educated to not offer urine cultures for routine fever workup. Following the education, a retrospective review of de-identified medical records of patients at the facility who had an order for a urine culture from March 2019 through January 2020 was conducted to determine appropriateness of the orders. Cultures were considered to be appropriate if patients met at least 1 of the following criteria: 1. Symptoms of a UTI (dysuria, frequency, burning, suprapubic pain/tenderness, flank pain/tenderness); 2. If unable to describe symptoms (intubated, altered, etc), must have all 3 of: ▫ Temperature ≥38°C ▫ No other obvious cause of fever ▫ Positive urinalysis (defined by 5 white blood cells per high-power field); 3. Periurologic procedure. Patients who were pregnant and patients who had urine cultures that were sent within 24 hours of admission were excluded. CAUTIs were defined using the NHSN criteria. Change in SIR compared to the baseline period was assessed using a single-tailed Mann-Whitney U test, with P value ≤ .05 considered significant. Luu A, Dominguez F, Yeshoua B, Vo C, Nallapa S, Chung D, Wald-Dickler N, Butler-Wu SM, Khaleel H, Chang K, Canamar CP, Holtom P, Spellberg B. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship. Clin Infect Dis. 2021 Jun 1;72(11):e883-e886.

III. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center:

Researchers at a rural acute care hospital hypothesized that a multimodal intervention to prevent CAUTI would reduce the hospital's NHSN CAUTI SIR. The intervention, which consisted of provider education, daily reminders for patient assessment of clinical necessity for catheter use, establishment of best practices, advocating for alternative toileting options, and promotion of aseptic technique for catheter insertion and removal, was implemented in all inpatient departments from 2016 to 2017. Standardized technical protocols implemented included aseptic techniques for insertion and removal of catheters, maintaining closed drainage system, prevention of backflow, sterile technique for collecting urine for culture, and minimal duration of catheter placement. The primary outcome for analysis was the NHSN CAUTI SIR with a secondary outcome of urinary catheter days and predicted CAUTIs. Urinary catheter days are the number of days during which a patient had an indwelling catheter per year. CAUTI SIRs were calculated one year prior to the implementation of the intervention in 2015 and one year after the implementation of the intervention in 2017. Observed CAUTIs, predicted CAUTIs, calculated SIRs, and urinary catheter days were compared between pre- and post-intervention among units using the Mann-Whitney U test with two-sided hypothesis testing at a threshold level of significance at 0.05.

Potugari BR, Umukoro PE, Vedre JG. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center. Clin Med Res. 2020 Dec;18(4):140-144.

IV. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a Community Academic Medical Center using a Multidisciplinary Team Employing a Multi-pronged Approach during the COVID-19 Pandemic:

Researchers at a community academic medical center implemented a bundle of CAUTI prevention strategies including appropriate catheter use, aseptic insertion technique, catheter maintenance, prompt removal when the catheter was no longer needed, and daily meetings between hospital leadership and nursing. In addition, urinary catheters were tracked and discussed daily during morning nursing huddles and infection prevention nurses met in person with patients who were resistant to catheter removal to educate them on the importance of removal to decrease infection risk. The researchers hypothesized these bundled interventions would decrease the facility's NHSN CAUTI SIR.

Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JL Jr. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023 Mar;51(3):319-323.

V. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections:

Researchers implemented a nurse-sensitive indicator quality improvement (NSIQI) toolkit, which allowed an assigned nurse to visually audit one patient per shift on the following CAUTI prevention bundle elements: observations for Foley tubing with dependent loops, completed Foley catheter and perineum hygiene care, and the evaluation of Foley catheter necessity. Researchers hypothesized that use of the NSIQI toolkit would reduce the facility's NHSN CAUTI SIR. The bundle elements were monitored during each nursing shift and a score of each bundle element was summed to create a letter grade (A-F) for that shift. Report cards were then posted on each unit based on the audit results. A total of 60 audits per month were collected, 30 on day shift and 30 on night shift, from October 2020 through July 2021.

McVey C, von Wenckstern T, Mills C, Yager L, McCauley C, Rivera Y, Reed E. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections. J Nurs Care Qual. 2022 Oct-Dec 01;37(4):295-299.

VI. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients:

After a cluster of 2 CAUTIs in a 25-bed hematology/oncology unit, researchers hypothesized that implementation of daily chlorhexidine baths would decrease the unit's NHSN CAUTI SIR. The unit implemented the bathing protocol for all patients aged 60 and older who had Foley catheters. Daily chlorhexidine bathing was piloted for three months beginning in January 2020. After a successful pilot, the protocol was adopted as a unit standard.

Wright, M., Xiong, M. S., Fendler, J., Jones, J., & Dolim, M. (2022, March). Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients. In Oncology Nursing Forum (Vol. 49, No. 2).

VII. Trends in Central-Line-Associated Bloodstream Infections and Catheter-Associated Urinary Tract Infections in a Large Acute-care Hospital System in New York City:

Data from the National Healthcare Safety Network (NHSN) were extracted for 11 acute-care hospitals belonging to the NYC Health + Hospital system from 2016 through 2019. Trends in device infections per 1,000 patient days, device utilization ratios, and standardized infection ratios (SIRs) were examined for the 11 hospitals and for the entire system.

Kaminski MA, Episcopia B, Malik S, Fornek M, Landman D, Xavier G, Quale J. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City, 2016-2019. Infect Control Hosp Epidemiol. 2021

Jul;42(7):842-846
VIII. Closing the Gap on Infection Prevention Staffing Recommendations: Results from the Beta Version of the APIC Staffing Calculator:
In this study, a staffing calculator was developed and piloted to provide facilities with customized infection prevention staffing recommendations. The study hypothesized that facilities with lower staffing levels would have higher standardized infection ratios (SIR) for central line-associated bloodstream infection (CLABSI), catheter-associated urinary tract infection (CAUTI), Clostridiodes difficile infection and colon surgical site infection (SSI).
Rebecca Bartles, Sara Reese, Alexandr Gumbar, Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator, American Journal of Infection Control, Volume 52, Issue 12, 2024, Pages 1345-1350.

5.3.4 Validity Testing Results

Validity Testing:
The 2,260 acute care hospitals had a weak but significant positive correlation (rho= 0.26785, p<0.0001). The 313 long-term acute care facilities had a weak but significant positive correlation (rho= 0.26222, p<0.0001).

Validation Studies:
I. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach:
In 2013-2014, prior to implementation of the CAUTI prevention bundle, the ICU SIR CAUTI was 1.0. After implementation of the CAUTI prevention bundle, in 2015, the ICU SIR CAUTI rate decreased to 0.24. In addition, CAUTI rates decreased by 70% from the 2013 baseline of 2.0/1,000 catheter-days to 0.6/1,000 catheter-days in 2015.

Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

II. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship:
Prior to the intervention, the facility's CAUTI SIR was >2. The facility saw a statistically significant improvement in their NHSN CAUTI SIR, with SIRS in April, June, September, and December 2019 that were 0 (P<0.5). By the end of the study in February 2020, the facility's CAUTI SIR was 1.
Luu A, Dominguez F, Yeshoua B, Vo C, Nallapa S, Chung D, Wald-Dickler N, Butler-Wu SM, Khaleel H, Chang K, Canamar CP, Holtom P, Spellberg B. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship. Clin Infect Dis. 2021 Jun 1;72(11):e883-e886.

III. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center:
Prior to implementation of the multimodal intervention, the center had 16,195 urinary catheter days, 27 cases of confirmed CAUTI with a corresponding number of predicted infections of 17.717, and an estimated calculated SIR of 1.524. Post intervention in 2017, the number of CAUTIs was nine, urinary catheter days were 13,348, the predicted infection number was 14.821, and the estimated SIR was 0.607. CAUTI SIR decreased from 1.524 to 0.607 for a 60.2% reduction over a 2-year period, the CAUTI event rate was reduced from 27 in 2015 to 9 in 2017, a 66.6% reduction post-intervention and there was a 17.6% reduction in urinary catheter days from 16,195 in 2015 to 13,348 in 2017. All results were statistically significant reductions with $P<0.05$.

Potugari BR, Umukoro PE, Vedre JG. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center. Clin Med Res. 2020 Dec;18(4):140-144.

IV. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic:
Prior to implementation of the prevention bundle, the facility's NHSN CAUTI SIR was 0.37 in 2019. After implementation of the bundle the facilities NHSN CAUTI SIR decreased to 0.23 in 2020; this decrease was sustained in 2021 with a 0.00 NHSN CAUTI SIR.

Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JL Jr. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023 Mar;51(3):319-323.

V. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections:
The facility's CAUTI SIR decreased by 19.4% in the 10-months post-intervention. In addition to reduction in their CAUTI SIR, the facility reported increased nursing awareness around nurse-sensitive infection prevention bundle elements.
McVey C, von Wenckstern T, Mills C, Yager L, McCauley C, Rivera Y, Reed E. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections. J Nurs Care Qual. 2022 Oct-Dec 01;37(4):295-299.
VI. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients:
In 2020, the CAUTI SIR was 2.324; after implementation of the daily chlorhexidine baths, the SIR decreased to 0.00.
Wright, M., Xiong, M. S., Fendler, J., Jones, J., & Dolim, M. (2022, March). Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients. In Oncology Nursing Forum (Vol. 49, No. 2).
VII. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City:
Over the 4-year period, there were progressive declines in central-line days, infections per 1,000 central-line days, and device utilization ratios for the system. The average annual SIRs for the system also declined: 1.40 in 2016, 1.09 in 2017, 1.04 in 2018, and 0.82 in 2019. Case-mix indices correlated with SIRs for CLABSIs. Level 1 trauma centers had higher SIRs and a

disproportionately greater number of CLABSIs in patients located in NHSN-defined surgical intensive care units.

Kaminski MA, Episcopia B, Malik S, Fornek M, Landman D, Xavier G, Quale J. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City, 2016-2019. Infect Control Hosp Epidemiol. 2021 Jul;42(7):842-846

VIII. Closing the Gap on Infection Prevention Staffing Recommendations: Results from the beta Version of the APIC Staffing Calculator

This study showed a significant association between higher SIR ranges and staffing status for central line-associated bloodstream infections (P = .02), catheter-associated urinary tract infections (P = .001), Clostridioides difficile infections (P = .003), and colon surgical site infections (P = .0001).

Rebecca Bartles, Sara Reese, Alexandr Gumbar, Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator, American Journal of Infection Control, Volume 52, Issue 12, 2024, Pages 1345-1350.

5.3.4a Attach Additional Validity Testing Results

The system is advising that this field is required.docx

5.3.5 Interpretation of Validity Results

Validity Testing:

The CAUTI standardized infection ratio (SIR) and CLABSI SIR are both device-associated healthcare associated infection outcome measures. Implementation of infection prevention strategies, such as prevention bundles or checklists for infection prevention, have been shown to decrease both CLABSI and CAUTI SIRs. Nursing staff generally provide maintenance care for both types of catheters, and many of the components of the prevention bundles or checklists are similar/the same between the two catheter types. For example, prevention bundles/checklists for both types of catheters include sterile insertion techniques, performing routine surveillance and catheter assessments in both the ICU and non-ICU setting, healthcare personnel education, assessing for signs or symptoms of infection, and adherence to clinical guidelines. However, other factors or prevention strategies may differ between the catheter types. For example, facilities may implement CLABSI-specific prevention practices such as chlorhexidine-containing dressings for central lines, use of antiseptic-containing caps, or use of antimicrobial-impregnated central lines. Alternatively, facilities may choose to implement CAUTI-specific prevention practices such as processes for bladder management alternatives and nurse-driven urinary catheter removal protocols. Additionally, some facilities have specialized vascular access teams that provide expertise for central line insertion and care practices.

We hypothesized that there would be a weak positive correlation between the CAUTI SIR and CLABSI SIR. We predicted only a weak correlation between the two measures because some facilities may choose to focus quality improvement on the prevention of a single HAI (CAUTI or

CLABSI) due to resource limitations or other factors.

The significant positive correlations in acute care hospitals as well as long-term acute care facilities (rho=0.26785, p<0.0001 and rho= 0.26222, p<0.0001, respectively) of the relationship between CAUTI and CLABSI SIR demonstrate that the SIRs are valid measures of healthcare quality, as they are both driven by clinically relevant patient care practices and evidence-based infection prevention strategies implemented by the healthcare facilities.

Validation Studies:
Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach:
In 2013-2014, prior to implementation of the CAUTI prevention bundle, the ICU SIR CAUTI rate was 1.0. After implementation of the CAUTI prevention bundle, in 2015, the ICU SIR CAUTI rate decreased to 0.24. In addition, CAUTI rates decreased by 70% from the 2013 baseline of 2.0/1,000 catheter-days to 0.6/1,000 catheter-days in 2015.
This study demonstrates that implementation of a CAUTI prevention bundle led to a significant reduction in the reported CAUTI SIR. A SIR > 1.0 represents that more CAUTIs were observed than predicted, a SIR < 1.0 represents that fewer CAUTIs were observed than predicted, and a SIR= 1.0 represents the same number of CAUTIs were observed as predicted. Thus, this study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.

Sampathkumar P, Barth JW, Johnson M, Marosek N, Johnson M, Worden W, Lembke J, Twing H, Buechler T, Dhanorker S, Keigley D, Thompson R. Mayo Clinic Reduces Catheter-Associated Urinary Tract Infections Through a Bundled 6-C Approach. Jt Comm J Qual Patient Saf. 2016 Jun;42(6):254-61.

Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship:
Prior to the intervention, the facility's CAUTI SIR was >2. The facility saw a statistically significant improvement in their NHSN CAUTI SIR, with SIRs in April, June, September, and December 2019 that were 0 (P<0.5). By the end of the study in February 2020, the facility's SIR was 1. This study demonstrates that improvements in quality of care led to significant and sustained improvements in the reported CAUTI SIR. A SIR > 1.0 represents that more CAUTIs were observed than predicted, a SIR < 1.0 represents that fewer CAUTIs were observed than predicted, and a SIR= 1.0 represents the same number of CAUTIs were observed as predicted. Thus, this study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.

Luu A, Dominguez F, Yeshoua B, Vo C, Nallapa S, Chung D, Wald-Dickler N, Butler-Wu SM, Khaleel H, Chang K, Canamar CP, Holtom P, Spellberg B. Reducing Catheter-associated Urinary Tract Infections via Cost-saving Diagnostic Stewardship. Clin Infect Dis. 2021 Jun 1;72(11):e883-e886.

Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center:
Prior to implementation of the multimodal intervention, the care center had 16,195 urinary catheter days, 27 cases of confirmed CAUTI with a corresponding number of predicted infections of 17.717 and an estimated calculated SIR of 1.524. Post-intervention in 2017, the care center had 13,348 urinary catheter days, nine CAUTIs with 14.821 predicted infections, , and an estimated SIR of 0.607. CAUTI SIR decreased 60.2% from 1.524 to 0.607 over a 2-year period, the CAUTI event rate decreased 66.6% from 27 in 2015 to 9 in 2017, and there was a 17.6% reduction in urinary catheter days from 16,195 in 2015 to 13,348 in 2017. All results were statistically significant reductions with $P<0.05$ (Table 1). This study demonstrates that implementation of a CAUTI prevention bundle led to a significant reduction in the reported CAUTI SIR. A SIR > 1.0 represents that more CAUTIs were observed than predicted, a SIR < 1.0 represents that fewer CAUTIs were observed than predicted, and a SIR= 1.0 represents the same number of CAUTIs were observed as predicted. The study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.

Potugari BR, Umukoro PE, Vedre JG. Multimodal Intervention Approach Reduces Catheter-associated Urinary Tract Infections in a Rural Tertiary Care Center. Clin Med Res. 2020 Dec;18(4):140-144.

Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic:
Prior to implementation of the prevention bundle, the facility's NHSN CAUTI SIR was 0.37 in 2019. After implementation of the bundle, the facility's NHSN CAUTI SIR decreased to 0.23 in 2020; this decrease was sustained in 2021 with a 0.00 CAUTI NHSN SIR. This study demonstrates that implementing a CAUTI prevention bundle led to significant and sustained improvements in the reported CAUTI SIR. A SIR > 1.0 represents that more CAUTIs were observed than predicted, a SIR < 1.0 represents that fewer CAUTIs were observed than predicted, and a SIR= 1.0 represents the same number of CAUTIs were observed as predicted. This study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.

Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JL Jr. Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023 Mar;51(3):319-323.

Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections:
The facility's CAUTI SIR decreased by 19.4% in the 10-months post-intervention. In addition to reduction in their CAUTI SIR, researchers reported increased nursing awareness around nurse-sensitive infection prevention bundle elements post-intervention. This study demonstrates that implementing a nursing sensitive CAUTI prevention bundle can significantly reduce a facilities

CAUTI SIR. A SIR > 1.0 represents that more CAUTIs were observed than predicted, a SIR < 1.0 represents that fewer CAUTIs were observed than predicted, and a SIR= 1.0 represents the same number of CAUTIs were observed as predicted. The study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.
McVey C, von Wenckstern T, Mills C, Yager L, McCauley C, Rivera Y, Reed E. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections. J Nurs Care Qual. 2022 Oct-Dec 01;37(4):295-299.

Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients:
In 2020, the facility's CAUTI SIR was 2.324; after implementation of the daily chlorhexidine baths, the SIR decreased to 0.00. The study found that implementing a CHG bathing protocol in high-risk hematology and oncology patients led to a significant reduction in the reported CAUTI SIR. A SIR > 1.0 represents that more CAUTIs were observed than predicted, a SIR < 1.0 represents that fewer CAUTIs were observed than predicted, and a SIR= 1.0 represents the same number of CAUTIs were observed as predicted. Thus, this study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.
Wright, M., Xiong, M. S., Fendler, J., Jones, J., & Dolim, M. (2022, March). Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients. In Oncology Nursing Forum (Vol. 49, No. 2).

Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections
in a large acute-care hospital system in New York City:
Across an 11-hospital system, continuing efforts to reduce device utilization and infection rates resulted in declining SIRs for CLABSIs. Hospitals with
higher case-mix indices, and particularly level 1 trauma centers, had significantly higher central-line
infection rates and SIRs .
A SIR > 1.0 represents that more CLABSIs were observed than predicted, a SIR < 1.0 represents that fewer CLABSI were observed than predicted, and a SIR= 1.0 represents the same number of CLABSIs were observed as predicted. The study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.
Kaminski MA, Episcopia B, Malik S, Fornek M, Landman D, Xavier G, Quale J. Trends in central-line-associated bloodstream infections and catheter-associated urinary tract infections in a large acute-care hospital system in New York City, 2016-2019. Infect Control Hosp Epidemiol. 2021 Jul;42(7):842-846

The study showed a correlation between staffing levels and infection outcomes (CAUTI, CLABSI, C difficile, and colon SSI). Programs with below-expected staffing levels according to the calculator were more likely to have higher SIRs. This finding reinforces the value of well-staffed infection prevention programs in maintaining lower SIRs.

Rebecca Bartles, Sara Reese, Alexandr Gumbar, Closing the gap on infection prevention staffing recommendations: Results from the beta version of the APIC staffing calculator, American Journal of Infection Control, Volume 52, Issue 12, 2024, Pages 1345-1350.

5.4.1 Methods Used to Address Risk Factors

Statistical risk adjustment model with risk factors

5.4.2 Conceptual Model Rationale

NHSN follows a highly rigorous process while developing risk adjustment models for its measures. The process begins with a thorough clinical and epidemiological review of all eligible potential risk factors that are currently collected in NHSN. The data available in NHSN are a combination facility-level, unit/ward-level, and limited patient-level risk factors. Those experts then recommend risk factors to be evaluated statistically. CDC obtains the risk factors considered for the model predicted events (i.e., denominator) by estimating the parameters, or probability of risk occurrence. The final model is chosen by finding the optimal parameterizations of all covariates (i.e., risk factors) in linear regression procedures. In other words, risk factors are included in a model if they are determined to significantly impact healthcare associated infection (HAI) incidence. The model is then double-tested by a reverse process that removes non-significant factors. Each best model is fit-tested, calibrated, and validated using industry standard techniques.

References:

- NHSN's Guide to the 2022 Baseline Standardized Infection Ratios. Centers for Disease Control and Prevention website. https://www.cdc.gov/nhsn/2022rebaseline/sir-guide.pdf. Updated November 2024.
- Obtaining the Number of Predicted Events for the Standardized Infection Ratio (SIR)

5.4.2a Attach Conceptual Model

5.4 Conceptual Model.pdf

5.4.3 Variable Distribution Across Measured Entities

See attachment 7.1 Supplemental Attachment for response and data tables.

5.4.4 Risk/Case-Mix Adjustment Modeling and/or Stratification Results

Each potential risk factor was tested for association with the outcome using Wald, Likelihood

Ratio and Type III Chi-square tests at significant level for entry ≤ 0.25. This initial analysis was repeated by adding successive model parameters that assess model fit using AIC, BIC, and Deviance; where possible, we evaluated the model's prediction using the pseudo-adjusted R-squared. Model diagnostics were used to assess potential multicollinearity by variance decomposition and the conditional index. Data points were assessed for high influence and leverage. Linearization and monotonicity were assessed using splines or other regularization methods. Each resulting model from this process was fit using backward elimination (or selection) to detect any possible associations not identified in the former forward stagewise selection process and to seek additional confirmation of any factor associations. Variables were retained in the final model if $p<0.05$ and confirmed by both forward stagewise and backward selection approaches. Next, the best model was validated via bootstrap sampling that relied on 1,000 replications selected randomly with replacement. If the confidence interval of the beta estimate for a variable contained 0 using the 2.5 and 97.5 percentiles, that variable would be removed from the final model. For the acute-care hospital model, only 2 variables did not meet statistical significance for the final model: number of ICU beds and facility type; the rest of the variables noted in section 1.1.5a were retained. For the CAH model, 4 variables did not meet statistical significance: medical type, location type, bed size, and ICU bed size. The other 2 variables (LOS and ICU bed proportion) were retained. For the IRF model, 14 variables did not meet statistical significance: census count, location type, CDC location, bed size, rehab setting, LOS, proportion vent, proportion ped, proportion traSCDys, proportion ortho, proportion other, proportion strok, and proportion brain dys. For the LTAC model, 19 variables did not meet statistical significance: daily census, location to ACH, provide acute care services, location type, CDC location, LTAC setting, bed size, high acuity beds, ICU beds, share housing neuro, share housing none, share housing rehab, share housing residential, share housing SNF, proportion ventilator, proportion hemodialysis, proportion high observation, proportion single occupancy. Finally, the model discrimination was computed with the pseudo-adjusted R-squared.

See attachment 7.1 Supplemental Attachment for risk models.

5.4.4a Attach Risk/Case-mix Adjustment Modeling and/or Stratification Specifications

5.4.4 Risk Case-Mix Adjustment Modeling.pdf

5.4.5 Calibration and Discrimination

Discrimination of risk models were assessed using the Dispersion-based pseudo R-squared, and calibration was visually investigated by dividing predicted number of events into deciles and plotting the observed number of events. Additionally, the Root Mean Square Error (RMSE) was calculated between observed and predicted events.

For the acute care hospital model, the dispersion-based pseudo r-square was 29.8%, for CAH 16.4%, for LTAC 16.7%, and IRF 40.9%. For each of the 4 CAUTI models, there was no obvious deviation from the y=x line in the decile calibration plot. The RMSE for each of the models was low: acute care hospital 1.09, CAH 0.52, LTAC 3.9, IRF 1.2.

5.4.5a Attach Calibration and Discrimination Testing Results

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5.4.6 Interpretation of Risk/Case-mix Factor Findings

The final risk adjustment models demonstrated that differences in patient characteristics and facility-level factors were adequately accounted for. Variables were retained based on both statistical significance ($p < 0.05$) and validation through forward stagewise and backward elimination techniques. Several variables tested did not meet criteria for inclusion, which supports the strength of the selection process. For instance, in the acute care hospital model, number of ICU beds and facility type were excluded because they did not show a meaningful association with CAUTI risk. On the other hand, variables like length of stay (LOS) and ICU bed proportion were retained across multiple models, reinforcing their relevance as important predictors. The models were validated using bootstrap sampling, which helped identify and remove any variables with unstable beta estimates, ensuring that the model maintained generalizability. Overall, the modeling approach demonstrated that the retained risk factors sufficiently captured variation in patient case-mix across facility types. The use of model diagnostics such pseudo-R-squared confirmed good model fit and predictive utility. This indicates that outcome comparisons using the risk-adjusted results are fair and not confounded by underlying differences in population or facility. The retained variables meaningfully explain differences in outcome risk, and the exclusion of non-significant variables and variables that were limited in the model helps to avoid unnecessary model complexity.

5.4.7 Final Approach to Address Risk Factors

Statistical risk adjustment model with risk factors

6.1.1 Current Status

In use

6.1.3 Current Use(s)

Public Reporting, Public Health/Disease Surveillance, Payment Program, Regulatory and Accreditation Programs, Quality Improvement with Benchmarking (external benchmarking to multiple organizations), Quality Improvement (Internal to the specific organization)

6.1.3 Program Details

Name of the program and sponsor
National Healthcare Safety Network (NHSN) Sponsor: Center for Disease Control and Prevention (CDC)
URL of the program
https://www.cdc.gov/nhsn/index.html
Purpose of the program
The CDC NHSN healthcare-associated infection tracking system provides facilities, states, regions, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate healthcare-associated infections
Geographic area and percentage of accountable entities and patients included
Enrollment in NHSN has continuously increased, with over 37,000 actively reporting healthcare

facilities across the U.S. Of the total enrolled healthcare facilities, there are over 6,000 acute care facilities; 8,400 dialysis facilities; 600 long-term acut
Applicable level of analysis and care setting

Facility, inpatients at acute care hospitals, oncology hospitals, long-term acute care hospitals, and acute care rehabilitation hospitals

,
Name of the program and sponsor
Care Compare Sponsor: U.S. Centers for Medicare and Medicaid Services
URL of the program
https://www.medicare.gov/care-compare/
Purpose of the program
For people with Medicare or their caregivers who want to choose a Medicare provider, such as a physician, hospital, nursing home, and others, this tool provides a single source search.
Geographic area and percentage of accountable entities and patients included
Over 4,000 Medicare-certified acute-care hospitals, long-term acute care hospitals and over 1,100 acute rehabilitation hospitals across the nation.
Applicable level of analysis and care setting

Facility, Inpatient/Hospital

,
Name of the program and sponsor
Hospital-Acquired Condition Reduction Program (HACRP) Sponsor: U.S. Centers for Medicare and Medicaid Services
URL of the program
https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments...
Purpose of the program
The Hospital-Acquired Condition Reduction Program encourages hospitals to improve patients' safety and reduce the number of conditions people experience from their time in a hospital.
Geographic area and percentage of accountable entities and patients included
General acute-care hospitals across the nation.
Applicable level of analysis and care setting

Facility, Inpatient/Hospital

,
Name of the program and sponsor
Hospital Inpatient Quality Reporting Program (HIQR) Sponsor: U.S. Centers for Medicare and Medicaid Services
URL of the program
https://www.cms.gov/medicare/quality/initiatives/hospital-quality-initiative/in...
Purpose of the program
Under the Hospital Inpatient Quality Reporting Program, CMS collects quality data from hospitals paid under the Inpatient Prospective Payment System, with the goal of driving quality improvement through measurement.
Geographic area and percentage of accountable entities and patients included

Over 4,000 Medicare-certified acute-care hospitals across the nation.
Applicable level of analysis and care setting

Facility, Inpatient/Hospital

,
Name of the program and sponsor
The Prospective Payment System (PPS)-Exempt Cancer Hospital Quality Reporting (PCHQR) Program Sponsor: U.S. Centers for Medicare and Medicaid Services
URL of the program
https://www.cms.gov/medicare/quality/initiatives/hospital-quality-initiative/pp...
Purpose of the program
The PCHQR program is intended to equip consumers with quality-of-care information to make more informed decisions about healthcare options.
Geographic area and percentage of accountable entities and patients included
Eleven cancer hospitals across the nation.
Applicable level of analysis and care setting

Facility, Inpatient/Hospital

,
Name of the program and sponsor
Inpatient Rehabilitation Facility (IRF) Quality Reporting Program Sponsor: U.S. Centers for Medicare and Medicaid Services
URL of the program
https://www.cms.gov/medicare/quality/inpatient-rehabilitation-facility
Purpose of the program
Under the Inpatient Rehabilitation Facility (IRF) Quality Reporting Program CMS collects data from IRFs with the goal of driving quality improvement through measurement and transparency.
Geographic area and percentage of accountable entities and patients included
Over 1,100 acute rehabilitation hospitals across the nation.
Applicable level of analysis and care setting

Facility, Inpatient/Hospital

,
Name of the program and sponsor
Long-Term Care Hospital (LTCH) Quality Reporting Program Sponsor: U.S. Centers for Medicare and Medicaid Services
URL of the program
https://www.cms.gov/medicare/quality/long-term-care-hospital
Purpose of the program
Under the Long-Term Care Hospital (LTCH) Quality Reporting Program CMS collects data from LTCHs with the goal of driving quality improvement through measurement and transparency
Geographic area and percentage of accountable entities and patients included
Over 350 LTCHs across the nation.
Applicable level of analysis and care setting

Facility, Inpatient/Hospital

,
Name of the program and sponsor
Hospital Value-Based Purchasing Program Sponsor: U.S. Centers for Medicare and Medicaid Services
URL of the program
https://www.cms.gov/medicare/quality/value-based-programs/hospital-purchasing
Purpose of the program
The Hospital Value-Based Purchasing (VBP) Program is part of our ongoing work to structure Medicare’s payment system to reward providers for the quality of care they provide.
Geographic area and percentage of accountable entities and patients included
Over 3,000 hospitals across the country.
Applicable level of analysis and care setting

Facility, Inpatient/Hospital

6.2.1 Actions of Measured Entities to Improve Performance

To improve performance on this measure, facilities should review best practices and available guideline recommendations to determine which prevention strategies they can implement. The capability of a facility to implement CAUTI prevention strategies can vary. Success in reducing CAUTI rates depend on factors such as available resources, leadership support, and staff engagement.

Prevention strategies can include hand washing, sterile insertion techniques, performing routine surveillance, catheter assessments, healthcare personnel education, assessing for signs or symptoms of infection, and adherence to clinical guidelines such as care and maintenance bundles. Conducting root cause analysis of increased healthcare-associated infection rates can help identify weak points in infection control and guide targeted interventions.

CDC's Targeted Assessment for Prevention (TAP) Strategy provides a structured framework to prevent healthcare-associated infections (HAIs) and is available to all measured entities. This strategy involves assessing infection prevention policies and practices through TAP Facility Assessments and implementing tailored interventions to address gaps and reduce HAIs. It is primarily focused on CAUTIs, CLABSIs, and C. difficile infections.

The CAUTI Standardized Infection Ratio (SIR) and urinary catheter Standardized Utilization Ratio (SUR) are important indicators of HAI prevention efforts. If a facility observes an increase in their SUR followed by an increase in their CLAUTI SIR, they can implement a facility wide hand hygiene improvement program in addition to daily assessments of urinary catheter need and prompt removal of unnecessary catheters. Both of these recommendations are based on clinical guidelines for CAUTI prevention.

Patel PK, Advani SD, Kofman AD, et al. Strategies to prevent catheter-associated urinary tract infections in acute-care hospitals: 2022 Update. Infection Control & Hospital Epidemiology. 2023;44(8):1209-1231. doi:10.1017/ice.2023.137

6.2.2 Feedback on Measure Performance

Facilities generate standardized infection ratio (SIR) analysis reports within CDC NHSN monthly and use their SIR to determine if process improvement initiatives should be implemented to reduce CAUTIs.

State health departments have advised that they publicly report facility-level SIRs, which allows patients and families within the state to select high-quality facilities. State health departments also utilize CAUTI SIRs to target specific facilities with higher SIRs for additional support in initiating prevention activities.

Feedback from reporting facilities and state health departments on measure performance and implementation is sent to the CDC NHSN Helpdesk. Additionally, during live training such as ‘Ask the Experts’ webinars and educational sessions, an online survey is provided to attendees to share feedback on the measure.

Users of the NHSN application can solicit and deliver feedback directly to the NHSN team. We have collected feedback from external users regarding the unintended consequences of including spinal cord injury-associated neurogenic bladder (SCI-NB) patients within this module. This feedback was gleaned from case tickets and letters of consideration.

6.2.3 Consideration of Measure Feedback

The CDC NHSN team conducts an annual review of each measure protocol. For any measure revision recommendation received, CDC NHSN follows a standard operational procedure designed to ensure thorough evaluation and implementation if appropriate. The process begins with a preliminary discussion and decision-making by the NHSN Subject Matter Expert (SME) team. User inquiries are then assessed to evaluate the extent of the concern or improvement. A literature review is conducted to determine whether the recommendation aligns with current guidelines. If supporting evidence is identified, the findings are reviewed collaboratively by the NHSN team and then by branch leadership and clinicians. External experts are consulted on an ad hoc basis.

Since 2015, NHSN has released an annual 'Summary of Updates' that outlines changes to the

Patient Safety Component protocol based on the review process. These modifications aim to enhance clarity and address feedback received from measured entities. It's important to note that the actual measures are not changed every year.

6.2.4 Progress on Improvement

Acute Care Hospitals (ACH):
Between 2015 and 2021, the CAUTI SIR for ACH decreased significantly. There was a statistically significant 23.3% (p <0.0001; 95% CI: 21.3%-25.4%) decrease in the 2021 SIR (0.800) as compared to the 2015 SIR (0.986), suggesting improvements in infection prevention and control across facilities. The median percent change in the SIR when comparing year to year was 5.73% (Min: -5.13%, Max: 8.96%), indicating a consistent downward trend. The largest improvement in the SIR occurred between 2018 (0.815) and 2019 (0.748) with an 8.96% (p<0.0001; 95% CI: 6.90%-11.00%) decrease in the SIR. Notably, the steady decrease in the SIR was interrupted by the COVID-19 pandemic; this is consistent with published literature1. The largest increase in the SIR occurred between 2020 (0.759) and 2021 (0.800) with a 5.13% (p<0.0001; 95% CI: 3.20%-6.70%) increase in the SIR. Although there is evidence of an overall improvement in the SIR from 2015 to 2020, the number of facilities with a SIR greater than the national SIR remained stable, ranging between 8% and 12% of the total number of facilities with at least one predicted CAUTI. This suggests a need for targeted interventions to support these facilities in reducing the number observed CAUTIs.

Critical Access Hospitals (CAH):
Between 2015 and 2021, the CAUTI SIR for CAH declined significantly. The SIR decreased 31.3% from 0.944 in 2015 to 0.719 in 2021 (p = 0.004; 95% CI: 9.1%-57.7%). This trend suggests improvements in infection prevention and control measures within these facilities. The most substantial improvement in the SIR occurred between 2018 (0.749) and 2019 (0.566), with a significant decrease of 32.3% (p = 0.004; 95% CI: 9.4%-60.3%). Similar to ACHs, consistent improvement in the SIR was interrupted by the COVID-19 pandemic with a 15.2% increase in the SIR, although this increase was statistically insignificant (p = 0.079; 95% CI: -29.4%-1.9%). Overall, while there is clear evidence of improvement in the SIR for CAHs from 2015 to 2019, the data indicate that continued efforts are essential to regain the progress made prior to the COVID-19 pandemic.

Long-term Acute Care (LTAC) Hospitals:
Between 2015 and 2021, the CAUTI SIR for LTAC exhibited a significant downward trend. The SIR decreased from 0.992 in 2015 to 0.748 in 2021, reflecting a reduction of 32.5% (p < 0.001; 95% CI: 25.4%-40.1%). This trend indicates improvements in infection prevention and control measures within these facilities. The most notable improvement in the SIR occurred between 2018 (0.877) and 2019 (0.801), with a significant decrease of 9.5% (p = 0.003; 95% CI: 3.2%-16.4%). However, similar to CAUTI SIRs in other facility types, the consistent improvement in the CAUTI SIR for LTAC was disrupted during the COVID-19 pandemic: in 2020 and 2021, the SIR remained stable at 0.748, indicating no significant reduction during this period. Overall, while there is clear

evidence of improvement in the SIR for LTAC facilities from 2015 to 2019, the data suggest that ongoing efforts are crucial to maintain and further enhance infection control practices, especially in light of the challenges posed by the COVID-19 pandemic.

Inpatient Rehabilitation Facilities (IRF):
Between 2015 and 2021, the CAUTI SIR for IRF exhibited inconsistencies. The SIR increased 8.8% from 0.990 in 2015 to 1.124 in 2021 ($p = 0.034$; 95% CI: 7.8%-9.8%). This rise in the SIR underscores the urgent need for improvements in infection prevention and control practices within these facilities. While the CAUTI SIR increased between 2015 and 2021, some inconsistent year-to-year improvements were also noted. Unlike other facility types, the most significant improvement in the SIR occurred from 2019 (1.15) to 2020 (0.94), reflecting a statistically significant 22.5% decrease ($p < 0.001$; 95% CI: 8.9%-37.7%). However, despite this decrease in 2020, the SIR rebounded to 1.124 in 2021, indicating ongoing challenges in achieving consistent improvements in infection control measures. Throughout this period, the national SIR consistently remained above 1, indicating that more CAUTI events were observed than predicted. Despite some fluctuations, the overall data suggests that IRFs have not made substantial progress in reducing CAUTI events, highlighting the urgent need for enhanced infection prevention and control strategies in these facilities.

See attachment 7.1 Supplemental Attachment for data tables.

6.2.5 Unexpected Findings

Patient medical records and other sources of patient data must be reviewed to determine if the patient meets the necessary criteria for a healthcare-associated CAUTI. It is possible that reviewers may miss symptoms or fail to identify that patients meet criteria, resulting in an under-reporting of CAUTI events. Data collectors might also intentionally under-report CAUTIs. Both actions would result in an SIR that is calculated to be lower than the actual SIR. Alternatively, patients may be identified as having a CAUTI, when in fact they do not meet CAUTI criteria, resulting in a calculated SIR that is higher than the actual SIR. In addition, it is possible that SIRs may be miscalculated. To reduce the possibility of manual error in SIR calculation, the CDC NHSN reporting tool includes business logic to minimize misclassification of CAUTI and inaccurate reporting of catheter days, and the CDC NHSN system generates SIRs automatically.

Individuals have expressed concerns that use of the CAUTI measure may have the unintended consequence of premature removal of indwelling urinary catheters in spinal cord injury patients, without institution of proper bladder management and with unintended adverse consequences on renal function. However, only anecdotal data have been cited to substantiate these concerns, without compelling evidence of a connection to the measure itself. Safe bladder management in spinal cord injury patients is a priority, and if management is unsafe then interventions should target improvements in clinical practices where they are needed. CAUTI is also a prevention priority in spinal cord injury patients, and efforts to prevent these infections should be driven by quality measure data.

To address this feedback, we have defined Spinal Cord Injury-associated Neurogenic Bladder (SCI-NB) for surveillance purposes and introduced a new risk factor field within the application. The new SCI-NB definition does not currently exclude CAUTI determinations or impact related analytics. Its purpose is to assess the number of spinal cord injury patients with neurogenic bladder, with the goal of evaluating whether current UTI criteria may need modification in the future. The SCI-NB field is optional and in the exploratory phase. However, we are encouraging facilities to use this field now to familiarize themselves with the new definition and applicable ICD-10-CM diagnosis codes. The SCI-NB CAUTI data will be available for the next endorsement cycle.

7.1 Supplemental Attachment

7.1 Supplemental Attachment-CAUTI.pdf

Developer POC email

ujb1@cdc.gov

Measure Developer POC

Paula Farrell
CDC NHSN
Atlanta , GA
United States

Measured/accountable entity (reliability and/or validity) methodology and results (if available)

Measured entity (reliability and validity) methodology and results (if available)

The measure developer is different from the measure steward

No

Steward Address

Andrea Benin
Atlanta, GA
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Steward Organization

Centers for Disease Control and Prevention, National Healthcare Safety Network

Steward Organization URL

https://www.cdc.gov/nhsn/index.html

Steward POC email

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