CBE ID

0139

Title

Central Line-Associated Bloodstream Infection (CLABSI) 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

Initial Endorsement

Sun, 08/09/2009 - 20:00

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 central line-associated bloodstream infections (CLABSI) among adults and children hospitalized as inpatients at acute care hospitals, critical access hospitals, oncology hospitals, and long-term acute care hospitals. SIR is reported annually and is calculated by dividing the number of observed CLABSIs by the number of predicted CLABSIs.

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, Long-Term Acute Care Facility

1.10 Measure Rationale

The use of this measure will promote central line-associated bloodstream infection (CLABSI) prevention activities that will lead to improved patient outcomes including reduction of CLABSI's, 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/bsi/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 central line-associated bloodstream infections (CLABSI) in hospital inpatients.

1.14a Numerator Details

Determine the patients who developed a laboratory confirmed blood stream infection, with a central line that was accessed during the admission, and the date the infection was identified. A central line is defined as an intravascular catheter that terminates at or close to the heart or in one of the great vessels that is used for infusion, withdrawal of blood, or hemodynamic monitoring. A CLABSI is defined by a laboratory confirmed bloodstream infection (LCBI) and must meet one of the following criteria:

i. Patient of any age has a recognized bacterial or fungal pathogen, not included on the NHSN

common commensal list:
Identified from one or more blood specimens obtained by a culture OR Identified to the genus or species level by non-culture based microbiologic testing (NCT)* methods.
ii. Patients of any age have at least one of the following signs or symptoms: Fever (>38.0oC), chills, or hypotension AND Organism(s) identified in blood is not related to an infection at another site AND The same NHSN common commensal is identified by a culture from two or more blood specimens collected on separate occasions.

iii. Patient ≤ 1 year of age has at least one of the following signs or symptoms: Fever (>38.0oC), hypothermia (<36.0oC), apnea, or bradycardia AND Organism(s) identified in blood is not related to an infection at another site AND The same NHSN common commensal is identified by a culture from two or more blood specimens collected on separate occasions.
For common commensal organisms, see the NHSN Terminology Browser (see reference document below).
1. Determine if the patient is in an inpatient location and the location to which the CLABSI is attributed.
2. Determine if the infection was present on admission, defined as the day of admission to an inpatient location (calendar day 1), the 2 days before admission, and the calendar day after admission.
3. Determine if the infection is considered a healthcare-associated Infection (HAI), defined as the infection occurring on or after the 3rd calendar day of admission to an inpatient.
a. Additional infections identified within the day 1 and day 14 are not assigned as new infections.

The following devices are not considered central lines and are excluded from the numerator:
- Arterial catheters unless in the pulmonary artery, aorta or umbilical artery
- Arteriovenous fistula
- Arteriovenous graft
- Extracorporeal life support (ECMO)
- Hemodialysis reliable outflow (HERO) dialysis catheter
- Intra-aortic balloon pump (IABP) devices
- Peripheral IV or Midlines
- Ventricular Assist Device (VAD)

CLABSI events reported to NHSN as mucosal barrier injury laboratory-confirmed bloodstream infections (MBI-LCBIs) are also excluded.

Reference

https://www.cdc.gov/nhsn/cdaportal/terminology/index.html
https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf

1.15 Denominator

Number of annually predicted central-line associated bloodstream infections (CLABSI) in hospital inpatients.

1.15a Denominator Details

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 at least one central line of any type (device-days).
a. Central line-days in the neonatal ICU are stratified by birthweight.
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 CLABSIs 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 central line associated bloodstream infections (CLABSI) and are used in the negative binomial regression model to calculate the number of predicted healthcare facility-onset central line associated bloodstream infections (CLABSI) in hospital inpatients under the 2022 baseline data.

See Q 1.15a in attachment 7.1 Supplemental Attachment for risk models.

1.15b Denominator Exclusions

1. The following devices are not considered central lines and are excluded:
- Arterial catheters unless in the pulmonary artery, aorta or umbilical artery
- Arteriovenous fistula
- Arteriovenous graft
- Extracorporeal life support (ECMO)
- Hemodialysis reliable outflow (HERO) dialysis catheter
- Intra-aortic balloon pump (IABP) devices

- Peripheral IV or Midlines
- Ventricular Assist Device (VAD)

2. CLABSI events reported to NHSN as mucosal barrier injury laboratory-confirmed bloodstream infections (MBI-LCBIs) are excluded.

1.15c Denominator Exclusions Details

A central line is defined as an intravascular catheter that terminates at or close to the heart or in one of the great vessels that is used for infusion, withdrawal of blood, or hemodynamic monitoring. Any other devices that do not meet this definition are not considered central lines and are excluded.

The number of predicted mucosal barrier injury laboratory-confirmed bloodstream infections (MBI-LCBIs) is calculated using a negative binomial regression risk model and 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 central line associated blood stream infection (CLABSI) standardized infection ratio (SIR) compares the actual number of CLABSIs reported to the number of CLABSIs 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) CLABSIs across the facility.

2. Calculate the number of predicted (denominator) CLABSIs for the facility.
The number of predicted infections is the estimated number of events (e.g. CLABSIs) 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 CLASBI. 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. As such, to reduce facility burden, NHSN risk models utilize patient location and facility factors that are reported by all facilities to NHSN. NHSN does not collect additional patient characteristics for inclusion in the risk model, because this would create additional burden on facilities.

Negative binomial regression models are used when estimating incidence from a summarized

population (e.g., CLABSIs in a Medical Critical Care Unit). 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 CLABSIs by the number of predicted CLABSIs 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 central line associated bloodstream infections (CLABSI) and are used in the negative binomial regression model to calculate the number of predicted healthcare facility-onset central line associated bloodstream infections (CLABSI) in hospital inpatients under the 2022 baseline data.
The negative binomial generalized linear model for acute care hospitals, critical access hospitals, long term acute care hospitals, and inpatient rehabilitation facilities are listed below.

See question 1.18 in 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

Bloodstream Infection (BSI) Events

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

https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf

NHSN Primary BSI collection
form https://www.cdc.gov/nhsn/forms/57.118_DenominatorICU_BLANK.pdf)

NHSN Denominator for ICU
form https://www.cdc.gov/nhsn/forms/57.118_DenominatorICU_BLANK.pdf
NHSN Denominator for NICU
form https://www.cdc.gov/nhsn/forms/57.116_DenominatorNICU_BLANK.pdf
NHSN Denominator for Specialty Care Area/Oncology
Form https://www.cdc.gov/nhsn/forms/57.117_DenominatorSCA_BLANK.pdf

NHSN Standard Infection Ratio (SIR) Guide NHSN SIR Guide
https://www.cdc.gov/nhsn/2022rebaseline/sir-guide.pdf

1.26 Minimum Sample Size

The measure is not based on a sample.

2.1 Attach Logic Model

2.1 CLABSI Logic Model_0.pdf

2.2 Evidence of Measure Importance

Central line associated blood stream infections (CLABSI) are preventable and associated with increased morbidity and mortality, cost, and patient length of stay (Burke et al., 2021). In 2022, 3,728 general acute care hospitals reported a total of 23,389 CLABSIs to CDC's National Healthcare Safety Network, which signified a 16% decrease in the CLABSI Standardized Infection Ratio (SIR) from national baseline in 2015 to 2022 (Centers for Disease Control and Prevention). A recent 2021 study of four hospitals in Ohio and Michigan found that patients who developed a CLABSI were 36.6% more likely to die in the hospital and were 37% more likely to be readmitted (Chovanec et al., 2021). Even though CLABSI prevention bundles have been proven to reduce CLABSI rates, studies continue to show that there is still limited adherence to all elements in the bundle with compliance with the following elements most frequently reported: hand hygiene, site insertion choice, chlorhexidine skin prep and dressings (Burke et al., 2021) Through implementation of a bundle that included components of insertion (hand hygiene, aseptic technique, maximal sterile barrier precautions), maintenance (replacing dressings, chlorhexidine baths, using sterile devices to access the line) and healthcare personal education and training and daily audits decreased the hospitals CLABSI rate by 68% from 34 to 11 patients from 2013 to 2017 (Wei et al., 2021).

Bundle use in pediatric patients has also been successful in decreasing CLABSI rates. Use of specific bundle elements (appropriate line access, dressing changes and cap changes) saw a decrease in a pediatric hospital's CLABSI standardized infection ratio from 0.9 in November 2017 to 0.53 in June 2021 (Hugo et al., 2022). Long term acute care hospitals (LTACHs) have also demonstrated similar reductions when implementing CLABSI bundles. A study of 30 LTACHs that implemented the bundle showed a significant and sustained reduction in CLABSI rates with the mean number of CLABSIs, per LTACH decreased by 4.5, from 14 months prior to the intervention through to 14 months after the intervention (Grigonis et al., 2016). This evidence supports a link between processes included in CLABSI prevention practices, such as proper catheter maintenance, chlorhexidine skin prep and the reduction of CLABSIs.

• Burke C, Jakub K, Kellar I. Adherence to the central line bundle in intensive care: An integrative review. Am J Infect Control. 2021 Jul;49(7):937-956.
• Centers for Disease Control and Prevention (2022). https://www.cdc.gov/healthcare-associated-infections/media/pdfs/2022-Pr...

CDC 2023 HAI Progress Report

https://www.cdc.gov/healthcare-associated-infections/php/data/progress-... Line-Associated Bloodstream Infections.
• Chovanec K, Arsene C, Gomez C, Brixey M, Tolles D, Galliers JW, Kopaniasz R, Bobash T, Goodwin L. Association of CLABSI With Hospital Length of Stay, Readmission Rates, and Mortality: A Retrospective Review. Worldviews Evid Based Nurs. 2021 Dec;18(6):332-338.
• Grigonis AM, Dawson AM, Burkett M, Dylag A, Sears M, Helber B, Snyder LK. Use of a Central Catheter Maintenance Bundle in Long-Term Acute Care Hospitals. Am J Crit Care. 2016 Mar;25(2):165-72.
• Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.
• Wei AE, Markert RJ, Connelly C, Polenakovik H. Reduction of central line-associated bloodstream infections in a large acute care hospital in Midwest United States following implementation of a comprehensive central line insertion and maintenance bundle. J Infect Prev. 2021 Sep;22(5):186-193.

The following guideline supports the measure and is evidence-based. The guideline recommendations include specific interventions and practices to reduce central venous catheter use and Central Line-Associated Bloodstream Infections (CLABSI). Evidence supports a link between processes included in CLABSI prevention practices, such as proper techniques for catheter maintenance, and the reduction of CLABSIs.

O'Grady NP, Alexander M, Burns LA, Dellinger EP, Garland J, Heard SO, Lipsett PA, Masur H, Mermel LA, Pearson ML, Raad II, Randolph AG, Rupp ME, Saint S; Healthcare Infection Control Practices Advisory Committee (HICPAC). Guidelines for the prevention of intravascular catheter-related infections. Clin Infect Dis. 2011 May;52(9):e162-93.
https://www.cdc.gov/infectioncontrol/guidelines/BSI/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.
Level of Confidence in the 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 central line associated blood stream infections:

Central Venous Catheters

1. Weigh the risks and benefits of placing a central venous device at a recommended site to reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement). Category IA
2. Avoid using the femoral vein for central venous access in adult patients. Category IA
3. Use a subclavian site, rather than a jugular or a femoral site, in adult patients to minimize infection risk for non-tunneled CVC placement. Category IB
4. No recommendation can be made for a preferred site of insertion to minimize infection risk for a tunneled CVC. Unresolved issue
5. Avoid the subclavian site in hemodialysis patients and patients with advanced kidney disease, to avoid subclavian vein stenosis. Category IA
6. Use a fistula or graft in patients with chronic renal failure instead of a CVC for permanent access for dialysis. Category IA
7. Use ultrasound guidance to place central venous catheters (if this technology is available) to reduce the number of cannulation attempts and mechanical complications. Ultrasound guidance

should only be used by those fully trained in its technique. Category IB
8. Use a CVC with the minimum number of ports or lumens essential for the management of the patient. Category IB
9. No recommendation can be made regarding the use of a designated lumen for parenteral nutrition. Unresolved issue
10. Promptly remove any intravascular catheter that is no longer essential. Category IA
11. When adherence to aseptic technique cannot be ensured (i.e., catheters inserted during a medical emergency), replace the catheter as soon as possible, i.e., within 48 hours. Category IB

Hand Hygiene and Aseptic Technique

1. Perform hand hygiene procedures, either by washing hands with conventional soap and water or with alcohol-based hand rubs (ABHR). Hand hygiene should be performed before and after palpating catheter insertion sites as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained. Category IB
2. Maintain aseptic technique for the insertion and care of intravascular catheter. Category IB
3. Wear clean gloves, rather than sterile gloves, for the insertion of peripheral intravascular catheters, if the access site is not touched after the application of skin antiseptics. Category IC
4. Sterile gloves should be worn for the insertion of arterial, central, and midline catheters. Category IA
5. Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. Category II
6. Wear either clean or sterile gloves when changing the dressing on intravascular catheters. Category IC

Maximal Sterile Barrier Precautions

1. Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a sterile full body drape for the insertion of CVCs, PICCs, or guidewire exchange [14, 75, 76, 80]. Category IB
2. Use a sterile sleeve to protect pulmonary artery catheters during insertion [81]. Category IB

Skin Preparation

1. Prepare clean skin with an antiseptic (70% alcohol, tincture of iodine, or alcoholic chlorhexidine gluconate solution) before peripheral venous catheter insertion. Category IB
2. Prepare clean skin with a >0.5% chlorhexidine preparation with alcohol before central venous catheter and peripheral arterial catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives. Category IA
3. No comparison has been made between using chlorhexidine preparations with alcohol and povidone-iodine in alcohol to prepare clean skin. Unresolved issue.
4. No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged <2 months. Unresolved issue

5. Allow antiseptics to dry according to the manufacturer's recommendation prior to placing the catheter. Category IB

Catheter Site Dressing Regimens

1. Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site. Category IA
2. If the patient is diaphoretic or if the site is bleeding or oozing, use a gauze dressing until this is resolved. Category II
3. Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled. Category IB
4. Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters, because of their potential to promote fungal infections and antimicrobial resistance. Category IB
5. Do not submerge the catheter or catheter site in water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (e.g., if the catheter and connecting device are protected with an impermeable cover during the shower). Category IB
6. Replace dressings used on short-term CVC sites every 2 days for gauze dressings. Category II
7. Replace dressings used on short-term CVC sites at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing. Category IB
8. Replace transparent dressings used on tunneled or implanted CVC sites no more than once per week (unless the dressing is soiled or loose), until the insertion site has healed. Category II
9. No recommendation can be made regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs. Unresolved issue
10. Ensure that catheter site care is compatible with the catheter material. Category IB
11. Use a sterile sleeve for all pulmonary artery catheters [81]. Category IB

Recommendation Update [July 2017] For patients aged 18 years and older: a. Chlorhexidine-impregnated dressings with an FDA-cleared label that specifies a clinical indication for reducing catheter-related bloodstream infection (CRBSI) or catheter-associated blood stream infection (CABSI) are recommended to protect the insertion site of short-term, non-tunneled central venous catheters. Category IA

Recommendation Update [July 2017] For patients younger than 18 years: a. Chlorhexidine-impregnated dressings are NOT recommended to protect the site of short-term, non-tunneled central venous catheters for premature neonates due to risk of serious adverse skin reactions. Category IC

1. Monitor the catheter sites visually when changing the dressing or by palpation through an intact dressing on a regular basis, depending on the clinical situation of the individual patient. If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local or bloodstream infection, the dressing should be removed to allow

thorough examination of the site. Category IB
2. Encourage patients to report any changes in their catheter site or any new discomfort to their provider. Category

Patient Cleansing
Use a 2% chlorhexidine wash for daily skin cleansing to reduce CRBSI. Category II

Catheter Securement Devices
Use a suture less securement device to reduce the risk of infection for intravascular catheters. Category II

Antimicrobial/Antiseptic Impregnated Catheters and Cuffs
Use a chlorhexidine/silver sulfadiazine or minocycline/rifampin -impregnated CVC in patients whose catheter is expected to remain in place >5 days if, after successful implementation of a comprehensive strategy to reduce rates of CLABSI, the CLABSI rate is not decreasing. The comprehensive strategy should include at least the following three components: education for persons who insert and maintain catheters, use of maximal sterile barrier precautions, and a >0.5% chlorhexidine preparation with alcohol for skin antisepsis during CVC insertion. Category IA

Systemic Antibiotic Prophylaxis
Do not administer systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or CRBSI. Category IB

Antibiotic/Antiseptic Ointments
Use povidone iodine antiseptic ointment or bacitracin/gramicidin/polymyxin B ointment at the hemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the hemodialysis catheter per manufacturer’s recommendation. Category IB

Antibiotic Lock Prophylaxis, Antimicrobial Catheter Flush and Catheter Lock Prophylaxis
Use prophylactic antimicrobial lock solution in patients with long term catheters who have a history of multiple CRBSI despite optimal maximal adherence to aseptic technique. Category II

Anticoagulants

Do not routinely use anticoagulant therapy to reduce the risk of catheter-related infection in general patient populations. Category II

Replacement of CVCs, Including PICCs and Hemodialysis Catheters

1. Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. Category IB
2. Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected. Category II
3. Do not use guidewire exchanges routinely for non-tunneled catheters to prevent infection. Category IB
4. Do not use guidewire exchanges to replace a non-tunneled catheter suspected of infection. Category IB
5. Use a guidewire exchange to replace a malfunctioning non-tunneled catheter if no evidence of infection is present. Category IB
6. Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. Category II

Replacement of Administration Sets

1. In patients not receiving blood, blood products, or fat emulsions, replace administration sets that are continuously used—including secondary sets and add-on devices—no more frequently than at 96-hour intervals, but at least every 7 days. Category IA
2. No recommendation can be made regarding the frequency for replacing intermittently used administration sets. Unresolved issue
3. No recommendation can be made regarding the frequency for replacing needles to access implantable ports. Unresolved issue
4. Replace tubing used to administer blood, blood products, or fat emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion. Category IB
5. Replace tubing used to administer propofol infusions every 6 or 12 hours, when the vial is changed, per the manufacturer's recommendation (FDA website Medwatch). Category IA
6. No recommendation can be made regarding the length of time a needle used to access implanted ports can remain in place. Unresolved issue

Performance Improvement

Use hospital-specific or collaborative-based performance improvement initiatives in which multifaceted strategies are "bundled" together to improve compliance with evidence-based recommended practices. Category IB

Reference: Buetti N, Marschall J, Drees M, Fakih MG, Hadaway L, Maragakis LL, Monsees E, Novosad S, O'Grady NP, Rupp ME, Wolf J, Yokoe D, Mermel LA. Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update. Infect Control Hosp

Epidemiol. 2022 May;43(5):553-569.

SHEA/IDSA/APIC Practice Recommendation
Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update
Summary of Recommendations to Prevent CLABSI

Reference: Buetti N, Marschall J, Drees M, Fakih MG, Hadaway L, Maragakis LL, Monsees E, Novosad S, O'Grady NP, Rupp ME, Wolf J, Yokoe D, Mermel LA. Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update. Infect Control Hosp Epidemiol. 2022 May;43(5):553-569.

Quality of Evidence, Category Definition
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, and/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, and/or there are no rigorous studies.

Essential Practices

Before insertion
1. Provide easy access to an evidence-based list of indications for CVC use to minimize unnecessary CVC placement. (Quality of Evidence: LOW)
2. Require education and competency assessment of HCP involved in insertion, care, and maintenance of CVCs about CLABSI prevention. (Quality of Evidence: MODERATE)
3. Bathe ICU patients aged >2 months with a chlorhexidine preparation on a daily basis. (Quality of Evidence: HIGH)

At insertion
1. In ICU and non-ICU settings, a facility should have a process in place, such as a checklist, to ensure adherence to infection prevention practices at the time of CVC insertion. (Quality of Evidence: MODERATE)
2. Perform hand hygiene prior to catheter insertion or manipulation. (Quality of Evidence:

MODERATE)
3. The subclavian site is preferred to reduce infectious complications when the catheter is placed in the ICU setting. (Quality of Evidence: HIGH)
4. Use an all-inclusive catheter cart or kit. (Quality of Evidence: MODERATE)
5. Use ultrasound guidance for catheter insertion. (Quality of Evidence: HIGH)
6. Use maximum sterile barrier precautions during CVC insertion. (Quality of Evidence: MODERATE)
7. Use an alcoholic chlorhexidine antiseptic for skin preparation. (Quality of Evidence: HIGH)

After insertion
1. Ensure appropriate nurse-to-patient ratio and limit use of float nurses in ICUs. (Quality of Evidence: HIGH)
2. Use chlorhexidine-containing dressings for CVCs in patients over 2 months of age. (Quality of Evidence: HIGH)
3. For non-tunneled CVCs in adults and children, change transparent dressings and perform site care with a chlorhexidine-based antiseptic at least every 7 days or immediately if the dressing is soiled, loose, or damp. Change gauze dressings every 2 days or earlier if the dressing is soiled, loose, or damp. (Quality of Evidence: MODERATE)
4. Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter. (Quality of Evidence: MODERATE)
5. Remove nonessential catheters. (Quality of Evidence: MODERATE)
6. Routine replacement of administration sets not used for blood, blood products, or lipid formulations can be performed at intervals up to 7 days. (Quality of Evidence: HIGH)
7. Perform surveillance for CLABSI in ICU and non-ICU settings. (Quality of Evidence: HIGH)

Additional Approaches
1. Use antiseptic- or antimicrobial-impregnated CVCs. (Quality of Evidence: HIGH in adult patients and Quality of Evidence: MODERATE in pediatric patients)
2. Use antimicrobial lock therapy for long-term CVCs. (Quality of Evidence: HIGH)
3. Use recombinant tissue plasminogen activating factor (rt-PA) once weekly after hemodialysis in patients undergoing hemodialysis through a CVC. (Quality of Evidence: HIGH)
4. Utilize infusion or vascular access teams for reducing CLABSI rates. (Quality of Evidence: LOW)
5. Use antimicrobial ointments for hemodialysis catheter insertion sites. (Quality of Evidence: HIGH)
6. Use an antiseptic-containing hub/connector cap/port protector to cover connectors. (Quality of Evidence: MODERATE)

2.4 Performance Gap

Using data submitted in 2023, there were 2,345 Hospitals that qualified for the acute care metric. The mean performance score was 0.870 and consisted of 26,368,963 central line days. There were 321 LTAC hospitals with a mean performance score of 0.992 and consisted of 1,259,755 central line days. Additionally, zero CAH hospitals qualified for the metric as none had at least 1 expected event.

2.4a Attach Performance Gap Results

2.4 Performance Gap by Decile_0.pdf

2.6 Meaningfulness to Target Population

The Patient Safety Action Network is a coalition of individuals and organizations consisting of patients who have been medically harmed, their loved ones, and concerned patient safety advocates.“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."

Central Line-Associated Bloodstream Infection (CLABSI) 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 CLABSIs.
Measuring CLABSIs has also been a priority for CMS as indicated by the use of the measure in five CMS Measure Programs, including Hospital Acquired Condition Reduction Program, Hospital Value-Based Purchasing, 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 CLABSI 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 CLABSIs. 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 data.

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 are 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) data, which collects healthcare infection data from facilities throughout the United States.

Validation Studies:

I. Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.

a. Dates of data used in testing: November 2017 to June 2021

II. 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.

a. Dates of data used in testing: January 2020 to July 2021

III. Martillo M, Zarbiv S, Gupta R, Brito A, Shittu A, Kohli-Seth R. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices. Am J Infect Control. 2020 Apr;48(4):460-464.

a. Dates of data used in testing: January 2017 to December 2018

IV. Garcia, C. A., Taflin, S., Assalone, D., Rodriguez, G., McHugh, C., Whitmore, B., ... & Shore, T. (2022). Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service. Journal of Clinical Oncology 40, no. 28_suppl (October 01, 2022) 283-283.

a. Dates of data used in testing: February 1, 2022 – June 30, 2022.

V. Lightheart, E., Guyton, M. E., Gilmar, C., Tuzio, J., Ziegler, M., & Kucharczuk, C. (2023). Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation. Patient Safety (2689-0143), 5(1).

a. Dates of data used in testing: November 2020–August 2022.

VI. 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).

a. Dates of data used in testing: January 2020 – December 2021.

VII. 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.

a. Date of data used in testing: January 1, 2016- December 2019

VIII. Kathleen McMullen, Fran Hixson, Megan Peters, Kathryn Nelson, William Sistrunk, Jeff Reames, Cynthia Standlee, David Tannehill, Keith Starke, Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures, The Joint Commission Journal on Quality and Patient Safety, Volume 51, Issue 2, 2025, Pages 126-134.
a. Date of data used in testing: July 2021-December 2022

IX. 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.
a. 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 CLABSI data and risk factors are 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) data, 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 CLABSI and CAUTI SIR were included in the analysis. Facilities must have had at least 1 or more predicted event to be included.

Validation Studies:
I. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds: CLABSI SIR data was reported by the facility to NHSN between November 2017 to June 2021.

Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.

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

III. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices: CLABSI SIR data was reported by the facility to NHSN between January 2017-December 2018.
Martillo M, Zarbiv S, Gupta R, Brito A, Shittu A, Kohli-Seth R. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices. Am J Infect Control. 2020 Apr;48(4):460-464.

IV. Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service: CLABSI SIR data was reported by the facility to NHSN between February 1, 2022 – June 30, 2022.
Garcia, C. A., Taflin, S., Assalone, D., Rodriguez, G., McHugh, C., Whitmore, B., ... & Shore, T. (2022). Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service. Journal of Clinical Oncology 40, no. 28_suppl (October 01, 2022) 283-283.
V. Preventing Central Line Bloodstream Infections: Adult inpatients admitted to the oncology unit. CLABSI SIR data was reported by the facility to NHSN between November 2020–August 2022.
Lightheart, E., Guyton, M. E., Gilmar, C., Tuzio, J., Ziegler, M., & Kucharczuk, C. (2023). Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation. Patient Safety (2689-0143), 5(1).

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

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) 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.

VIII. Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures: Data from the National Healthcare Safety Network (NHSN) looked at trends at 12 acute care hospitals in Missouri, Oklahoma, and Arkansas that were part of a midwestern US health care system.
Kathleen McMullen, Fran Hixson, Megan Peters, Kathryn Nelson, William Sistrunk, Jeff Reames, Cynthia Standlee, David Tannehill, Keith Starke, Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures, The Joint Commission Journal on Quality and Patient Safety, Volume 51, Issue 2, 2025, Pages 126-134.

IX. 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 CLABSI model. Based on the surveillance protocol for CLABSI, data were excluded from modeling consideration if it met the criteria. Data from patients who are not assigned to an inpatient bed are excluded from the denominator counts, including 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 CLABSI model creation. Inpatient rehab locations and inpatient psychiatric locations that have their own Centers for Medicare and Medicaid Services (CMS) Certification Number (CCN) are 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. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds: A 364-bed urban, academic children's hospital with seven inpatient units and an ambulatory infusion center. Units include pediatric intensive care, comprehensive cardiac care, neonatal intensive care, stem cell transplant/hematology/oncology, and three surgical and medical acute care units along with the ambulatory infusion center.
Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.

II. 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.

III. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices: A 1,134-bed tertiary care university teaching hospital in New York City.
Martillo M, Zarbiv S, Gupta R, Brito A, Shittu A, Kohli-Seth R. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices. Am J Infect Control. 2020 Apr;48(4):460-464.

IV. Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service: An academic medical center with a bone marrow transplant unit in New York City.
Garcia, C. A., Taflin, S., Assalone, D., Rodriguez, G., McHugh, C., Whitmore, B., ... & Shore, T. (2022). Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service. Journal of Clinical Oncology 40, no. 28_suppl (October 01, 2022) 283-283.

V. Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation: Academic medical center with a 144-bed oncology unit.
Lightheart, E., Guyton, M. E., Gilmar, C., Tuzio, J., Ziegler, M., & Kucharczuk, C. (2023). Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation. Patient Safety (2689-0143), 5(1).

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. Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures: Hospitals ranged in size from 58 beds in 3 units to 900 beds in 26 units. Kathleen McMullen, Fran Hixson, Megan Peters, Kathryn Nelson, William Sistrunk, Jeff Reames, Cynthia Standlee, David Tannehill, Keith Starke, Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures, The Joint Commission Journal on Quality and Patient Safety, Volume 51, Issue 2, 2025, Pages 126-134.

IX. 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) 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 the National Healthcare Safety Network (NHSN) for 2023 was included in the final risk model(s). The final sample included 2,260 ACH and 313 LTACs with complete data on CLABSI outcome and relevant risk factors. 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 CLABSI performance measure in each care setting.

5.1.4 Characteristics of Units of the Eligible Population

Reliability Testing:
The CLABSI 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 CLABSI 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.

- 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 CLABSI 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 CLABSI 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.

- 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. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds: Over the 2.5-year postimplementation period a total of 7,836 direct observations of the bundle were completed, with the potential for multiple rounds to occur on the same patient. Demographic data on patients was not available for analysis as demographic data is

not collected in the NHSN Module.
Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.

II. 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.

III. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices: Adult and pediatric inpatients and outpatients from all specialties across the hospitals were included in the study. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Martillo M, Zarbiv S, Gupta R, Brito A, Shittu A, Kohli-Seth R. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices. Am J Infect Control. 2020 Apr;48(4):460-464.

IV. Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service: Adult inpatients admitted to the bone marrow transplant unit. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Garcia, C. A., Taflin, S., Assalone, D., Rodriguez, G., McHugh, C., Whitmore, B., ... & Shore, T. (2022). Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service. Journal of Clinical Oncology 40, no. 28_suppl (October 01, 2022) 283-283.

V. Preventing Central Line Bloodstream Infections: Adult inpatients admitted to the oncology unit. Demographic data on patients was not available for analysis as demographic data is not collected in the NHSN Module.
Lightheart, E., Guyton, M. E., Gilmar, C., Tuzio, J., Ziegler, M., & Kucharczuk, C. (2023). Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation. Patient Safety (2689-0143), 5(1).

VI. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients: Inpatients on a 25-bed hematology/oncology unit with a central line, 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. Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures All patients with central lines were included (regardless of unit or floor designation)
Kathleen McMullen, Fran Hixson, Megan Peters, Kathryn Nelson, William Sistrunk, Jeff Reames, Cynthia Standlee, David Tannehill, Keith Starke, Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures, The Joint Commission Journal on Quality and Patient Safety, Volume 51, Issue 2, 2025, Pages 126-134.

IX. Results from the beta version of the APIC staffing calculator: Most of the hospitals have an intensive care unit (ICU) (n = 355, 91.0%), 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 rehab unit (IRF) (n = 64, 87.7%) compared to about 50% of hospitals with < 200 beds. The Case Mix Index (CMI) increased by hospital size with hospitals with 101 to 200 beds (median: 1.54, IQR: 0.25) lower than 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 CLABSI 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 CLABSI 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.

- 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 reliability testing results in the attached document.

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 CLABSI event. Reliability testing was performed on data from 2023, for all care settings that report the measure. The mean reliability score for CLABSI ACH was 0.726 and for CLABSI LTAC was 0.723. There was not sufficient data in the CAH cohort for reliability analysis. The median signal-to-noise reliability score demonstrates substantial agreement

The percentage of facilities with an estimated reliability of >=0.6 was as follows: 74% in the acute care hospitals and 83% in the LTAC. No hospitals in the CAH strata qualified for having 1 predicted event. Above in section 5.2.3a is the decile distribution of reliability measurements.

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.

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.

Table 2. Accountable Entity Level Reliability Testing Results by Denominator, Target Population Size

Accountable Entity-Level Reliability Testing Results

	Overall	Minimum	Decile_1	Decile_2	Decile_3	Decile_4	Decile_5	Decile_6	Decile_7	Decile_8	Decile_9	Decile_10	Maximum
Reliability													
Mean Performance Score													
N of Entities													

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 central line associated blood stream infections (CLABSI) and catheter associated urinary tract infections (CAUTI). 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 CLABSI and CAUTI data for 2023 with at least 1 predicted event for each was included. If a facility reported only CLABSI or only CAUTI, 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 CLABSI and CAUTI SIRs because there is overlap in the infection prevention practices preventing both types of infections (for example, hand hygiene, assessing catheter need and implementing protocols for removal, performing aseptic technique for insertion, performing surveillance in ICU and non-ICU locations, and use of care and maintenance bundles.) Thus, we predicted that while the correlation would be positive, it would be a weak correlation.

Validation Studies:
Empirical validity testing at the accountable entity level was performed by evaluating published studies from facilities that implemented CLABSI prevention activities and hypothesized that these approaches would reduce their NHSN CLABSI SIR. After a literature review, no published literature that examines prevention activities and reports the results of the NHSN CLABSI SIR in long term acute care hospitals or inpatient acute rehabilitation facilities were available. Given this challenge, and after consulting with experts in the field, we selected the following articles from acute care hospitals, as it was determined that healthcare facilities will utilize the same strategies to prevent CLABSIs. The studies support the hypothesis that the measure score (CLABSI SIR) correctly reflects the quality of care provided and adequately identifies differences in quality. Each study was performed at a single institution.

I. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds:

In this study a maintenance bundle to prevent CLABSI was implemented. The process also included direct observations of each element in the bundle and hard procedure stops in real-time to educate staff of errors. The facility hypothesized that implementing these direct observation rounds would decrease their NHNS CLABSI SIR. The assessment tool which focused on tasks that must be completed to effectively maintain complain with the bundle included: hand hygiene, use of alcohol impregnated caps, masks worn by all personal in the room during dressing changes, sterile gloves, appropriate antiseptic used to clean skin, and clean tubbing connected when a new cap is placed. Patients with a central line were identified and a time for direct observations to assess compliance with the maintenance bundle determined. Direct observations begin in November 2018, with 12 observations per unit per week being completed. Weekly spreadsheets were distributed which detailed each completed observation and individual element compliance. In addition, Microsoft Power BI displayed CLABSI 12-month cumulative SIR, bundle compliance, individual element compliance, and rounding frequency in a hospital-wide preventable harm dashboard. Initially maintenance bundle compliance was defined as the total number of compliant elements divided by the number of observed elements. PDSA cycles were implemented, and the maintenance bundle compliance definition was revised to “all-or-nothing” compliance, defined as compliant rounds divided by the total number of observed rounds. Observers considered an observation to be compliant if every element associated with the observation had a compliant response of either “yes” or “N/A”. CLABSI incidence, via a 12-month cumulative SIR throughout the PDSA cycles was monitored. Over the 2.5-year postimplementation period a total of 7,836 direct observations of the bundle were completed.

Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.

II. Nurse-Sensitive Indicator Quality Improvement Toolkit: A Scalable Solution to Improve Health Care-Associated Infections:
The facility implemented a nurse-sensitive indicator quality improvement (NSIQI) toolkit, which allowed an assigned nurse to visually audit one patient per shift on the following CLABSI prevention bundle elements: occlusive and intact dressing with appropriate labeling, evaluation of line necessity, 30-second catheter hub cleaning. The facility hypothesized that the NSIQI toolkit would reduce their NHSN CLABSI SIR. The bundle elements were monitored 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 November 2020 to August 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.

III. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices:
A vascular access service (VAS) was creased and tasked with reducing the rate of complications related to vascular access devices (VAD). The vascular access service was comprised of nurses and physicians with expertise in inserting different VADs. The vascular access requests are placed through the hospital’s electronic medical record system, which prompts the requesting team to include the indication and type of VAD requested, as well as duration of therapy. After evaluation, the vascular access service nurse makes recommendations for insertion of the most appropriate VAD. The VAS nurses also conducts random audits and provides education to bedside nurses to ensure proper maintenance of each device. During these inspections, the VAS team follows up on those patients who are at high risk for complications related to chronic use of tunneled and non-tunneled CVCs. The facility hypothesized that the creation of a VAS and tracking and follow-up of patients who received a VAD would decrease the facilities NHSN CLABSI SIR. Data was collected over a 24-month period after VAS implementation. The number and rate of CLABSIs as was analyzed as an indicator of quality using National Health Safety Network reporting standards per the standardized infection ratio (SIR). Statistical significance was set at $P < .05$.

Martillo M, Zarbiv S, Gupta R, Brito A, Shittu A, Kohli-Seth R. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices. Am J Infect Control. 2020 Apr;48(4):460-464.

IV. Reducing central-line associated bloodstream infections (CLABSIs) through patient

accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service.
The academic medical center had previously implemented a CLBASI prevention bundle to receive their CLABSI SIR. Patient noncompliance with daily recommendations for central line care was identified as a possible intervention that was not addressed in the bundle. The facility hypothesized that implementing a patient education prevention strategy and a patient central line maintenance contract with their cancer patients admitted to the bone marrow transplant unit would reduce their CLABSI SIR.

Garcia, C. A., Taflin, S., Assalone, D., Rodriguez, G., McHugh, C., Whitmore, B., ... & Shore, T. (2022). Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service. Journal of Clinical Oncology 40, no. 28_suppl (October 01, 2022) 283-283.

V. Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation.
To reduce their CLABSI SIR, the 144-bed oncology unit hypothesized that implementing a consultation-based service to address central lines on the unit would reduce their CLABSI SIR. Staff on the unit initiated a consultation via a virtual platform with an interdisciplinary team composed of oncology and infectious disease experts. The virtual discussion included recommendations for a line-related plan of care.
Lightheart, E., Guyton, M. E., Gilmar, C., Tuzio, J., Ziegler, M., & Kucharczuk, C. (2023). Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation. Patient Safety (2689-0143), 5(1).

VI. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology
Patients:
A 25-bed hematology/oncology unit hypothesized that after a cluster of CLABSIs on the unit that implementation of daily chlorhexidine baths would decrease their NHSN CLABSI SIR. The unit implemented the bathing protocol for all patients with a central line, who were age 60 or above. 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. Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures: After seeing an increase in CLABSI SIRs through early 2021, a health care

system including 12 acute care hospitals in the midwestern United States focused on processes and process measures for CLABSI prevention. Each hospital was asked to identify a medical provider, nursing, and infection prevention lead to champion the work (identified as a CLABSI triad). CLABSI triads emphasized best practice expectations, standardized technology and products, and implemented reporting and trending of compliance. Work started in July 2021, with multiple initiatives rolled out through the end of 2022. CLABSI SIRs and standardized utilization ratios (SURs) were analyzed with interrupted time series analysis; changes in several process measures were analyzed using Wilcoxon rank sum exact testing.
Kathleen McMullen, Fran Hixson, Megan Peters, Kathryn Nelson, William Sistrunk, Jeff Reames, Cynthia Standlee, David Tannehill, Keith Starke, Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures, The Joint Commission Journal on Quality and Patient Safety, Volume 51, Issue 2, 2025, Pages 126-134.
IX. In this study, a staffing calculator was developed and piloted to provide facilities with customized
infection prevention staffing recommendations. They 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. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds:

The facilities CLABSI 12-month cumulative NHSN SIR started at 0.9 in November 2017 was at its highest point of 0.96 in May 2020 and ultimately decreased to 0.53 June 2021.

Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.

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

The facilities CLABSI SIR decreased by 19% in the 10-months postintervention. In addition to reduction in their CLABSI 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.

III. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices:

From January 2017 to December 2018, the vascular access service inserted 9,806 VADs. In 2017, there were 102 CLABSIs and 58,321-line days. The CLABSI rate was 1.75 infections per 1,000 days, and the SIR was 1.25. In 2018, there was a 58% reduction of the number of CLABSIs, with 59 reported cases and 56,893-line days. The CLABSI rate was 1.037 infections per 1,000 days, and the SIR was 0.91 (P = .00123).

Martillo M, Zarbiv S, Gupta R, Brito A, Shittu A, Kohli-Seth R. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices. Am J Infect Control. 2020 Apr;48(4):460-464.

IV. Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service.

Prior to implementing the patient education prevention strategies in February 2022, the facilities CLABSI SIR was 1.29. After implementation of the prevention strategies the facilities CLABSI SIR decreased to 0.6.

Garcia, C. A., Taflin, S., Assalone, D., Rodriguez, G., McHugh, C., Whitmore, B., ... & Shore, T. (2022). Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service. Journal of Clinical Oncology 40, no. 28_suppl (October 01, 2022) 283-283.

V. Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation.
The prevention-based consultation service saw about five consultations per month being addressed. Many of these consultations, 27.4% resulted in the central line being removed. The CLABSI SIR decreased from 0.85 prior to the intervention (November 2020-October 2021) to 0.57 after the intervention (November 2021-August 2022), a 33% reduction.
Lightheart, E., Guyton, M. E., Gilmar, C., Tuzio, J., Ziegler, M., & Kucharczuk, C. (2023). Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation. Patient Safety (2689-0143), 5(1).

VI. Recognizing Risk: Implementing a Successful CHG Bathing Protocol for Hematology/Oncology Patients:
In 2020 the CLABSI SIR was 0.632 and after implementation of the daily chlorhexidine baths the

SIR decreased to 0.218.
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. Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures: A 47.5% decrease was seen in CLABSI SIR through the study period, with SIR = 0.61 from 2023 to April 2024. The slope of the trend line for CLABSI SIR and central line utilization had a significant downward trend in the intervention time frame ($p = 0.04$ and $p < 0.01$, respectively). CLABSI prevention best practices improved statistically during the study period.
Kathleen McMullen, Fran Hixson, Megan Peters, Kathryn Nelson, William Sistrunk, Jeff Reames, Cynthia Standlee, David Tannehill, Keith Starke, Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures, The Joint Commission Journal on Quality and Patient Safety, Volume 51, Issue 2, 2025, Pages 126-134,

IX. The study showed that a significant association existed between higher standard infection ratio ranges and staffing status for central line-associated bloodstream infection ($P = .02$), 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

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5.3.5 Interpretation of Validity Results

Validity Testing:
The CLABSI standardized infection ratio (SIR) and CAUTI 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, 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 will be a weak positive correlation between the CAUTI SIR and CLABSI SIR. We predicted only a weak correlation between the two measures as 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 CLABSI and CAUTI 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:

I. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds:

The facilities CLABSI 12-month cumulative NHSN SIR started at 0.9 in November 2017 was at its highest point of 0.96 in May 2020 and ultimately decreased to 0.53 June 2021.
This study demonstrates that implementation of a CLABSI prevention bundle along with direct observations of care led to a significant reduction in the reported CLABSI SIR. 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.
Hugo MC, Rzucidlo RR, Weisert LM, Parakati I, Schroeder SK. A Quality Improvement Initiative to Increase Central Line Maintenance Bundle Compliance through Nursing-led Rounds. Pediatr Qual Saf. 2022 Jan 21;7(1):e515.

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

The facilities CLABSI SIR decreased by 19% in the 10-months postintervention. In addition to reduction in their CLABSI SIR the facility reported increased nursing awareness around nurse-sensitive infection prevention bundle elements.
This study demonstrates that implementing nursing sensitive bundle produces significant improvements in CLABSI SIRs. A SIR > 1.0 represents that more CLABSIs were observed than

predicted, a SIR < 1.0 represents that fewer CLABSIs were observed than predicted, and a SIR= 1.0 represents the same number of CLABSIs were observed as predicted. The results of 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.

III. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices:

From January 2017 to December 2018, the vascular access service inserted 9,806 VADs. In 2017, there were 102 CLABSIs and 58,321-line days. The CLABSI rate was 1.75 infections per 1,000 days, and the SIR was 1.25. In 2018, there was a 58% reduction of the number of CLABSIs, with 59 reported cases and 56,893-line days. The CLABSI rate was 1.037 infections per 1,000 days, and the SIR was 0.91 (P = .00123) (Table 1).
This study demonstrates that implementing vascular access service to insert and track maintenance of VADs produce significant improvements in the facilities CLABSI SIR. A SIR > 1.0 represents that more CLABSIs were observed than predicted, a SIR < 1.0 represents that fewer CLABSIs were observed than predicted, and a SIR= 1.0 represents the same number of CLABSIs were observed as predicted. This data supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.

Martillo M, Zarbiv S, Gupta R, Brito A, Shittu A, Kohli-Seth R. A comprehensive vascular access service can reduce catheter-associated bloodstream infections and promote the appropriate use of vascular access devices. Am J Infect Control. 2020 Apr;48(4):460-464.

IV. Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service.

Prior to implementing the patient education prevention strategies in February 2022, the CLABSI SIR at the facility was 1.29. After implementation of the prevention strategies, the CLABSI SIR decreased to 0.6. The study demonstrates that engaging patients in their own care of the central line significantly reduced the hospital's CLABSI SIR. A SIR > 1.0 represents that more CLABSIs were observed than predicted, a SIR < 1.0 represents that fewer CLABSIs were observed than predicted, and a SIR= 1.0 represents the same number of CLABSIs were observed as predicted. The result of the study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.

Garcia, C. A., Taflin, S., Assalone, D., Rodriguez, G., McHugh, C., Whitmore, B., ... & Shore, T. (2022). Reducing central-line associated bloodstream infections (CLABSIs) through patient accountability contracts: A pilot project for patients on Weill Cornell Medicine (WCM) bone marrow transplant (BMT) service. Journal of Clinical Oncology 40, no. 28_suppl (October 01, 2022) 283-283.

V. Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for

Central Line Rounding and Consultation.
The prevention-based consultation service saw about five consultations per month being addressed. Many of these consultations, 27.4% resulted in the central line being removed. The CLABSI SIR decreased from 0.85 prior to the intervention (November 2020-October 2021) to 0.57 after the intervention (November 2021-August 2022), a 33% reduction.
This study demonstrates that implementing a consultation service to address CLABSI risks in patients on an oncology unit improved the facilities CLABSI SIR. SIR > 1.0 represents that more CLABSIs were observed than predicted, SIR < 1.0 represents that fewer CLABSIs were observed than predicted, and SIR= 1.0 represents the same number of CLABSIs were observed as predicted. The result of the study supports the hypothesis that the measure score correctly reflects the quality of care provided and adequately identifies differences in quality.
Lightheart, E., Guyton, M. E., Gilmar, C., Tuzio, J., Ziegler, M., & Kucharczuk, C. (2023). Preventing Central Line Bloodstream Infections: An Interdisciplinary Virtual Model for Central Line Rounding and Consultation. Patient Safety (2689-0143), 5(1).

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

In 2020 the CLABSI SIR was 0.632 and after implementation of the daily chlorhexidine baths the SIR decreased to 0.218. This study demonstrates that implementation of daily chlorhexidine bathing protocols in high-risk hematology and oncology patients led to a significant reduction in the reported CLABSI SIR. SIR > 1.0 represents that more CLABSIs were observed than predicted, SIR < 1.0 represents that fewer CLABSIs were observed than predicted, and SIR= 1.0 represents the same number of CLABSIs 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).

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 : 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
VIII. Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures: Intense focus by leadership on key CLABSI prevention process measures was associated with lower CLABSI 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.
Kathleen McMullen, Fran Hixson, Megan Peters, Kathryn Nelson, William Sistrunk, Jeff Reames, Cynthia Standlee, David Tannehill, Keith Starke, Prevention of Central Line–Associated Bloodstream Infections by Leadership Focus on Process Measures, The Joint Commission Journal on Quality and Patient Safety, Volume 51, Issue 2, 2025, Pages 126-134.
IX. 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 IP 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)https://www.cdc.gov/nhsn/2022rebaseline/obtaining_predicted_events_SIR...

5.4.2a Attach Conceptual Model

5.4.2 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 guided by a statistician that assess model fit using AIC, BIC, and Deviance and where possible evaluated model 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 were 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 1 variables did not meet statistical significance for the final model: Number of ICU Beds, the rest of the variables noted in section 1.1.5a were retained. For the Acute Care Model (ACH) NICU specific 5 variables did not meet statistical significance in the final model: Location, Medtype, Facility Type, Proportion ICU, Bed Size. For the Acute Care Model (ACH) SCA specific 2 variables did not meet statistical significance in the final model: Bed Size, Proportion ICU. For the CAH model 4 variables did not meet statistical significance: Med Type, Number of Beds, ICU beds, ICU bed proportion. One variable was retained being the combined location/LOS. For the LTAC model 8 variables did not meet statistical significance: Census, bedsize, ICU bedsize, hi observation beds, single occupancy rooms, proportion ICU, proportion hi observation, proportion single occupancy, the rest of the variables noted in section 1.1.5a were retained. Finally, the model discrimination was computed with the pseudo-adjusted R-squared.

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

Risk Model Tables.pdf

5.4.5 Calibration and Discrimination

Discrimination of risk models was 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 model, the Dispersion based pseudo r-square was 26.98% (NICU Specific: 43.5%, SCA Specific: 27.5%), for CAH 50.1%, for LTAC 34.78%. For each of the 3 CLABSI models there was no obvious deviation from the y=x line in the decile calibration plot. The RMSE for each of the models were low: Acute Care 1.13 (NICU Specific: 0.60, SCA Specific: 1.62) , CAH 0.85, LTAC 3.3

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 didn’t meet criteria for inclusion, which supports the strength of the selection process. 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 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
http://www.cdc.gov/nhsn/
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, Inpatient/Hospital

,
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 and compare experience.
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/payment/prospective-payment-systems/acute-inpatien…
Purpose of the program
The Hospital-Acquired Condition Reduction Program encourages hospitals to improve patients' safety and reduce the number of conditions people experience
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

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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
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.qualitynet.cms.gov/pch/pchqr
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

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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
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 CLABSI prevention strategies can vary. Success in reducing CLABSI 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 CLABSI Standardized Infection Ratio (SIR) and central line 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 SIR, they could implement a facility- wide hand hygiene improvement program in addition to daily assessment of central line catheter need and prompt removal of unnecessary central line catheters. Both of which are recommendations based on clinical guidelines for CLABSI 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 CLABSIs.

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 CLABSI 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.

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 CLABSI Standardized Infection Ratio (SIR) for Acute Care Hospitals (ACH) demonstrated a significant decrease from the 2015 baseline. The SIR decreased from 0.992 in 2015 to 0.922 in 2021, indicating a reduction of approximately 7.7% ($p < 0.001$; 95% CI: 5.8%-9.5%). This trend suggests improvements in infection prevention and control across these

facilities. The median percent change in the SIR when comparing year to year was approximately 8.6% (Min: -19.6%, Max: 11.1%), indicating a consistent downward trend. The most notable improvement occurred between 2015 (0.992) and 2016 (0.839), with a significant decrease of 11.1% ($p < 0.001$; 95% CI: 9.1%-13.0%). However, the steady decrease in the SIR between 2015 and 2019 was interrupted by the COVID-19 pandemic, which has been well documented in the literature. The largest increase in the SIR occurred between 2020 (0.857) and 2021 (0.922), with a 19.6% increase ($p < 0.001$; 95% CI: 21.2%-18.0%). Although there is evidence of an overall improvement in the SIR from 2015 to 2019, the number of facilities with a SIR greater than the national SIR varied by year, ranging between 8% and 14% of the total number of facilities with at least one predicted CLABSI. This suggests a need for targeted interventions to support these facilities in reducing the number of observed CLABSIs.

Critical Access Hospitals (CAH):
Between 2015 and 2021, the CLABSI Standardized Infection Ratio (SIR) for Critical Access Hospitals (CAH) showed an increase from the initial baseline. The SIR increased from 1.042 in 2015 to 1.073 in 2021, reflecting a statistically insignificant 2.9% increase ($p = 0.899$; 95% CI: -37.2%-47.8%). This trend indicates that infection prevention and control measures within these facilities may require further attention. The most substantial improvement in the SIR occurred between 2018 (0.860) and 2019 (0.523), with a significant decrease of 64.4% ($p = 0.048$; 95% CI:0.5%-172.2%). However, consistent improvement was disrupted in 2020 and 2021 by the COVID-19 pandemic. Overall, while there is evidence of fluctuations in the SIR for CAHs from 2015 to 2021, the data indicates that continued efforts are essential to improve infection control practices in these facilities.

Long-term Acute Care (LTAC) Hospitals:
Between 2015 and 2021, the CLABSI Standardized Infection Ratio (SIR) for Long-Term Acute Care Hospitals (LTAC) exhibited a significant downward trend from the initial baseline. The SIR decreased from 0.999 in 2015 to 0.745 in 2021, reflecting a reduction of approximately 34.1% ($p < 0.001$; 95% CI: 26.4%-42.3%). This trend indicates improvements in infection prevention and control measures within these facilities. The most notable improvement in the SIR occurred between 2016 (0.961) and 2017 (0.842), with a significant decrease of 14.1% ($p < 0.001$; 95% CI: 8.3%-20.3%). However, similar to other facility types, the consistent improvement in the SIR was disrupted in 2021, where the SIR increased from 0.710 in 2020 to 0.745 in 2021. Overall, while there is clear evidence of improvement in the SIR for LTAC facilities from 2015 to 2019, the data suggests 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 CLABSI Standardized Infection Ratio (SIR) for Inpatient Rehabilitation Facilities (IRF) exhibited inconsistencies. The SIR decreased from 0.701 in 2015 to 0.561 in 2021, representing a statistically insignificant 25.2% decrease ($p = 0.354$; 95% CI: -22.6%-100.2%). While an overall decrease was observed, some fluctuations were noted throughout the years. Notably, the largest improvement in the SIR occurred from 2018 (0.668) to 2019 (0.550), reflecting a statistically insignificant decrease of 13.9% ($p = 0.426$; 95% CI:

-24.8%-96.3%). However, despite this decrease, the SIR rebounded to 0.561 in 2021, indicating ongoing challenges in achieving consistent improvements in infection control measures. Throughout this period, the national SIR consistently remained below 1, indicating that less CLABSI events were observed than predicted. Despite some fluctuations, the overall data suggests that IRFs have made marginal progress in reducing CLABSI events, highlighting the 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 CLABSI. It is possible that reviewers may miss symptoms or fail to identify that patients meet criteria, thereby under-reporting CLABSI events. Data collectors might also intentionally under-report CLABSIs. Both actions would result in an SIR that is calculated to be lower than actual. Alternatively, patients may be identified as having a CLABSI when in fact they do not meet CLABSI criteria, and thereby the reviewer may calculate an SIR that is higher than actual. The NHSN reporting tool includes business logic to minimize misclassification of CLABSI and inaccurate reporting of catheter days.

Surveillance for CLABSI uses the results of cultures of blood specimens. Suboptimal blood culture collection and testing technique can result in not only false-CLABSI reporting but also unnecessary antibiotic administration to patients. Unnecessary antibiotics can result in unnecessary adverse reactions, antibiotic resistance, and Clostridioides difficile infection and its complications. Facilities may be motivated to assess and improve blood culture collection and testing techniques to avoid identifying false-CLABSIs and in the process may prevent unnecessary patient complications.

7.1 Supplemental Attachment

7.1 Supplemental Attachment.pdf

Developer POC email

ujb1@cdc.org

Measure Developer POC

Paula Farrell
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Atlanta , GA
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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

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Steward Organization

Centers for Disease Control and Prevention, National Healthcare Safety Network

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