Actionable Patient Safety Solution (APSS) #2A: HAND HYGIENE

Executive Summary Checklist

The lack of consistent, appropriate hand hygiene in all patient-care areas is a “medical error” that results in avoidable infections and even deaths.

- Accountability for Performance Improvement at facility and unit leadership levels as part of an overall Organizational Hand Hygiene Guideline. Ensure that alcohol-based hand rubs and soap are available as close to the point of care as possible.
- Establish a multi-disciplinary hand hygiene team responsible for implementation of the Hand Hygiene Protocol, including nursing, physicians, infection preventionists and administration.
- The protocol must include mandatory training for all healthcare workers (HCWs) upon hire and at least once annually. Training to include:
  - Proper technique for hand rubbing and soap and water washing
  - Indications for hand rubbing vs soap and water washing (WHO or CDC Guideline)
  - How to speak up when fellow HCWs do not comply.
  - Education for patients, family members and visitors.
  - Performance Evaluation and Feedback
- Hand hygiene compliance must be measured using a validated method of capturing and reporting all hand hygiene events. Such compliance systems have been shown to lead to sustainable improvement, reduced infections & costs and a positive impact on patient safety culture (Bouk, Mutterer, Schore and Alper, 2016) (Kelly, Blackhurst, McAtee and Steed, 2016)(Michael, Einloth, Fatica, Janszen and Fraser, 2017)(Son et al., 2011).
- Measure hand hygiene compliance using an evidence-based, validated electronic hand hygiene compliance system.
- Provide performance feedback to unit leadership and frontline staff on a regular basis, using evidence-based behavior change feedback models (Welsh, Flanagan, Hoke, Doebbeling and Herwaldt, 2012).
- Reminders in the workplace, such as posters, brochures, leaflets, badges, stickers, can be used, provided they are consistent with the overall Hand Hygiene Protocol.
The Performance Gap

Hand hygiene contributes significantly to keeping patients safe. While hand hygiene is not the only measure to counter HAI (for example effective environmental decontamination is essential), compliance with it alone can dramatically enhance patient safety (Kelly, Blackhurst, McAtee and Steed, 2016), because there is much scientific evidence showing that microbes causing HAI are most frequently spread between patients on the hands of healthcare workers. Many patients may carry microbes without any obvious signs or symptoms of an infection (colonized or sub clinically-infected). Microbes have an impressive ability to survive on the hands, sometimes for hours, if hands are not cleaned. This clearly reinforces the need for hand hygiene, regardless of the type of patient being cared for.

Health-care facilities which readily embrace strategies for improving hand hygiene also prove more open to a closer scrutiny of their infection control practices in general. Therefore, the impact of focusing on hand hygiene can lead to an overall improvement in patient safety across an entire organization (Kelly, Blackhurst, McAtee and Steed, 2016). The hands of staff can become contaminated even after seemingly ‘clean’ procedures such as taking a pulse, blood pressure, or touching a patient’s hand (Organization and others, 2009).

A vital element of the Performance Gap is the accurate and reliable measurement of hand hygiene compliance which has typically been accomplished by Direct Observation (DO) by human observers sometimes known as “secret shoppers”. It is clear from the research that DO and Secret Shoppers should no longer “measure” HH as they have been shown to consistently overstate compliance by as much as 300% giving a false sense of security and complacency that blocks the sense of urgency to improve (Srigley, Furness, Baker and Gardam, 2014) (Scheithauer et al., 2009). Further, allowing “secret shoppers” to observe the lack of HH compliance and do nothing to intervene enables a healthcare worker to provide care with potentially contaminated hands putting patients at unnecessary risk of harm. The solution is to measure hand hygiene compliance with an evidence-based and validated electronic hand hygiene compliance system - this is addressed in detail below in the Technology Plan.

CMS/CMMI and their Partnership for Patients are now promoting this approach around the deployment of electronic hand hygiene compliance systems to reduce infections and costs to the Hospital Improvement Innovation Networks (HIINs) via their website and a web broadcast Pacing Event on May 25, 2017, Partnership for Patients Pacing Event - Hand Hygiene and HAI.

Leadership Plan

The following is a practical guide for driving sustainable behavior change and results, starting with hospital leadership.

- Ensure top-down leadership engagement is authentic and known by all and that leaders model the expected behavior.
- Foster psychological safety and promote a “just” safety culture. It must be safe for everyone to be able to speak up and “stop the line” when hand hygiene does not occur as indicated.
- Use Direct Observation (DO) for Unit Based feedback (not the measurement of compliance) and real-time barrier identification - then develop and agree on an action plans to remove them. This approach has been proven effective in driving sustainable improvement. (Steed, 2016).
- Agree on unit specific improvement goals & celebrate even small successes (Son et al., 2011) (The goal is progress vs. perfection)
- Give frequent feedback on performance – share the data daily and/or according to monitoring technology supplier's recommendations. – frontline staff engagement is essential.
- Make HHC improvement part of performance evaluation with routine reporting of results to senior leadership for facility-wide feedback

Practice Plan

Change management (that is changing the safety culture) is a critical element that must be included to sustain any improvements. Recognizing the needs and ideas of the people who are part of the process—and who are charged
with implementing and sustaining a new solution—is critical in building the acceptance and accountability for change. A technical solution without acceptance of the proposed changes will not succeed. Building a strategy for acceptance and accountability of a change initiative greatly increase the opportunity for success and sustainability of improvements. “Facilitating Change,” the change management model The Joint Commission developed, contains four key elements to consider when working through a change initiative to address HAIs (Appendix A).

The Joint Commission Center for Transforming Healthcare Targeted Solutions Tool (TST)® provides healthcare organizations this type of comprehensive approach and is proven to improve hand hygiene compliance (“Joint Commission Center for Transforming Healthcare. Joint commission resources hot topics in health care—transitions of care: the need for a more effective approach to continuing patient care”, 2012). However, when using the tool, measurement should only be accomplished with an evidence-based, validated electronic hand hygiene compliance system. This combination of electronic monitoring + DO has been proven to drive sustainable improvement (Steed, 2016)(Boyce, 2017).

This involves a proven four-step process:
1. Identify barriers and obstacles unique to the unit using interventional Direct Observation as described above.
2. Work with unit leadership to put in place training and an action plan to remove the barriers.
3. Implement the training and action plan.
4. Measure improvement using an evidence-based, validated electronic hand hygiene compliance system and give appropriate feedback to ensure successes are acknowledged and that remaining barriers and obstacles are addressed (Steed, 2016).

Technology Plan

Suggested practices and technologies are limited to those proven to show benefit or are the only known technologies with a particular capability. As other options may exist, please send information on any additional technologies, along with appropriate evidence, to info@患者安全运动.org.

The recommendations of specific technologies or products herein are those of the Patient Safety Movement Foundation and do not necessarily represent the opinions of guideline setting organizations. The Joint Commission Center for Transforming Healthcare was not consulted on, nor did it participate in the decision or choice of any specific product or technology, and as a matter of policy the Joint Commission Center for Transforming Healthcare does not endorse any specific technologies, equipment, or other products.

There is emerging evidence that electronic hand hygiene compliance systems are accurate and reliable (Diller et al., 2014)(Pittet, Harbarth and Voss, 2013) when combined with appropriate staff feedback and multimodal action plans can lead to reduced infections and avoided costs (Kelly, Blackhurst, McAtee and Steed, 2016)(Robinson, Boeker, Steed and Kelly, 2014).

What to Look for in an Electronic Hand Hygiene Compliance System

Must have criteria:
1. The system must be capable of capturing and reporting on 100% of all hand hygiene events (soap and sanitizer)
2. The system must be able to provide room level soap vs. sanitizer reporting in the case of C Diff. Timely feedback to staff on soap vs. sanitizer use has been shown to reduce C Diff Rates (Robinson, Boeker, Steed and Kelly, 2014).
3. The technology must include a behavior change framework for how to use the data with front line staff to drive sustainable behavior change. The behavior change framework must also inherently foster a “just culture” and promote true “psychological safety”
4. The system must have validated accuracy
5. The system must be evidence based
Other Considerations – User Must Decide Based on What is Best for their Institution and Culture

These options have their respective advantages and organizations must decide what is right for them based on the evidence and knowledge of their culture and staff.

1. **What standard of Care is Measured** - Tracks World Health Organization (WHO) 5 Moments for Hand Hygiene (Steed *et al*., 2011) (Diller, 2013) or Wash in/Wash Out (Kelly, Blackhurst, Steed and Diller, 2015)

2. **Hand Hygiene Products Used Requirement** – Universal system (deployment of the technology requires no hand hygiene product change required) or HH Brand Specific (deployment of the technology does require use of a specific brand)

3. **Compliance Data Reporting Level** – Group, Unit, Department Level, Individual Level or Both

4. **System Functionality** – Such as Gentle Reminders for healthcare workers & Patient Awareness Function; Auto Push Reports via E Mail (eliminates the need to log on to access the system)

5. **System Infrastructure** - Stand Alone or Real Time Locating System (RTLS) Application

6. **Financial Model** - Capital expense; subscription/annual fee model or hybrid

Hand hygiene compliance should only be measured with a system that meets the “must criteria” above. For a list of suppliers that meet those criteria, visit The Electronic Hand Hygiene Compliance Organization (EHCO), Inc. website (www.EHCOhealth.org). EHCO is a 501C6 not for profit industry association focused on the public health and patient safety issues associated with poor hand hygiene, is a resource for the evidence in support of adoption of electronic monitoring.

**Metrics**

There is no direct calculation for mortality related to the hand hygiene performed in hospitals. Hospitals would need to link mortality to a healthcare-associated infection rate (ex: APSS 2A-2F). The most commonly accepted metric for measuring a hospital’s compliance is offered below.

**Key Performance Indicators to be used within the Hand Hygiene Protocol should be:**

- Compliance rates at the Unit, Facility and IDN (Integrated Delivery Network) level plus individual when such as technology is employed.
- Daily, Weekly, Monthly, Quarterly, Annually.
- HAI rates and changes at the Unit, Facility and IDN level.
- Safety Culture Assessment Annually

Based on the WHO “My five moments for hand hygiene” method (Sax *et al*., 2007; Sax *et al*., 2009) Moments defined as:

1. Before patient contact,
2. Before aseptic task,
3. After body fluid exposure,
4. After patient contact and
5. After contacts with patient surroundings.

The formula can be used to calculate hand hygiene compliance during all 5 moments (Pittet, Harbarth and Voss, 2013). A similar approach can be applied if only the Wash in Wash Out Method is used. However the “in room” moments provide a high risk of infection (Kelly, Blackhurst, Steed and Diller, 2015) and thus training on, and measurement of all 5 Moments is indicated. Also, the WHO 5 Moments mirror the CDC Guideline so if a facility wants to adhere to CDC Guidelines, either the CDC or WHO 5 Moments needs to be the standard of care that is taught, measured and used for feedback.

**Numerator:** Number of hand hygiene events performed as measured by a validated electronic hand hygiene compliance system
**Denominator:** Number of hand hygiene events required (hand hygiene opportunities or HHOs) based on how the technology software calculates the denominator - for example, the denominator could be based on the WHO 5 Moments, Wash In/Wash Out Method or some other algorithm depending on the technology system used.

**Metric Recommendations:**

**Direct Impact:** All Patients

Deploying Use of the Electronic Hand Hygiene Compliance Data - Evidence Based Practice (Son et al., 2011)

1. Share the data with Front Line Staff routinely (daily or weekly to start)
2. Empower Unit Leadership to identify unit based barriers and obstacles along with action plans to eliminate them
3. Enable Units to establish their own performance improvement goals
4. Measure performance improvement against the goals and celebrate all successes; use Direct Observation to understand any lack of improvement
5. Hold Unit Leadership accountable for performance improvement goals and make this part of the performance appraisal process
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Conflicts of Interest Disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSS recommend technologies offered by companies involved in the Patient Safety Movement Foundation that the workgroups have concluded, based on available evidence, are beneficial in addressing the patient safety issues addressed in the APSS. Workgroup members are required to disclose any potential conflicts of interest.

*This Workgroup member has reported a financial interest in an organization that provides a medical product or technology recommended in the Technology Plan for this APSS.

References


Appendix A

“Facilitating Change,” the change management model The Joint Commission developed, contains four key elements to consider when working through a change initiative to address HAIs.

Plan the Project:
- Build a strong foundation for change by assessing the culture for change, defining the change, building a strategy, engaging the right people, and painting a vision of the future. This should be done at the outset of the project.

Inspire People:
- Solicit support and active involvement in the plan to reduce HAIs, obtain buy-in and build accountability for the outcomes.
- Identify a leader for the HAI initiative. This is critical to the success of the project.
- Understand where resistance may come from.

Launch the Initiative:
- Align operations and ensure the organization has the capacity to change, not just the ability to change.
- Launch the HAI initiative with a clear champion and a clearly communicated vision by leadership.

Support the Change:
- The capacity to support change is critical; therefore, all leaders within the organization must be a visible part of the HAI initiative.
- Frequent communication regarding all aspects of the HAI initiative will enhance the initiative.
- Celebrate success as it relates to a reduction in HAIs or a positive change in HAI organizational culture.
- Identify resistance to the HAI initiative as soon as it occurs.
Executive Summary Checklist

Catheter-associated Urinary Tract Infections (CAUTI) are a frequent cause of morbidity and mortality in hospitals.

☐ Insert catheters only for appropriate indications
☐ Ensure that only properly trained persons insert and maintain catheters
☐ Insert catheters using aseptic technique and sterile equipment
☐ Perform perineal care routinely for patients who have indwelling catheters to reduce the risk of skin breakdown and irritation
☐ Remove catheters as soon as possible
☐ Following aseptic insertion, maintain a closed drainage system
☐ Select technology has shown early success to reduce infections and positively enhance outcomes of patients
**The Performance Gap**

Urinary tract infections are the most common nosocomial infection, accounting for up to 40% of infections reported in acute care hospitals (Edwards et al., 2009). There are an estimated 560,000 nosocomial UTIs annually in the United States with an estimated cost of $450 million annually (Klevens et al., 2007). Up to 80% of UTIs are associated with the presence of an indwelling urinary catheter (Apisarnthanarak et al., 2007).

A catheter-associated urinary tract infection (CAUTI) increases hospital cost and is associated with increased morbidity and mortality (Laupland et al., 2005; Wald and Kramer, 2007; Cope et al., 2009). There are an estimated 13,000 deaths annually attributable to CAUTIs (Klevens et al., 2007). CAUTIs are considered by the Centers for Medicare and Medicaid Services to represent a reasonably preventable complication of hospitalization. As such, no additional payment is provided to hospitals for CAUTI treatment-related costs.

Urinary catheters are used in 15-25% of hospitalized patients (Weinstein et al., 1999) and are often placed for inappropriate indications. According to a 2008 survey of U.S. hospitals >50% did not monitor which patients were catheterized, and 75% did not monitor duration and/or discontinuation (Saint et al., 2008). The pathogenesis of CAUTIs may occur early at insertion or late by capillary action, or occur due to a break in the closed drainage tubing or contamination of collection bag urine (Maki and Tambyah, 2001). The source of the organisms may be endogenous (meatal, rectal, or vaginal colonization) or exogenous, usually via contaminated hands of healthcare personnel during catheter insertion or manipulation of the collecting system.

Prevention strategies have been recommended by HICPAC/Centers for Disease Control and Prevention (Gould, Umscheid, Agarwal, Kuntz and Pegues, 2010). The Core Strategies are supported by high levels of scientific evidence and demonstrated feasibility, whereas the Supplemental strategies are supported by less robust evidence and have variable levels of feasibility.

**Core Prevention Measures include:**

- Insert catheters only for appropriate indications
- Compliance with evidence-based guidelines e.g. Surgical Care Improvement Project (SCIP-Inf-9) requires urinary catheter removal on Postoperative Day 1 (POD1) or Postoperative Day 2 (POD 2) with day of surgery being day zero
- Leave catheters in-place only as long as needed
- Only properly trained persons insert and maintain catheters
- Insert catheters using aseptic technique and sterile equipment
- Maintain a closed drainage system
- Maintain unobstructed urine flow
- Hand hygiene and standard (or appropriate) isolation precautions

**Supplemental Prevention Measures include:**

- Alternatives to indwelling urinary catheterizations
- Portable ultrasound devices to reduce unnecessary catheterizations

The following practices are **NOT** recommended for CAUTI prevention (HICPAC guidelines):

- Complex urinary drainage systems
- Changing catheters or drainage bags at routine, fixed intervals
- Routine antimicrobial prophylaxis
- Cleaning of periurethral area with antiseptics while catheter is in place
- Irrigation of bladder with antimicrobials
- Instillation of antiseptic or antimicrobial solutions into drainage bags
- Routine screening for asymptomatic bacteriuria (ASB)
Prior to the implementation of new preventive measures, an evaluation should assess baseline policies and procedures with regard to CAUTI. New policies and practices should be tracked once implemented to ensure adherence and to remove any barriers to effective change.

**Leadership Plan**
- Hospital governance and senior administrative leadership must champion efforts in raising awareness around the high incidence of CAUTIs and prevention measures.
- Healthcare leadership should support the design and implementation of standards and training programs on catheter insertion and manipulation.
- Senior leadership will need to address barriers, provide resources (budget/personnel), and assign accountability throughout the organization.
- Leadership commitment and action are required at all levels for successful process improvement.

**Practice Plan**
- Reduce the use and duration of use of urinary catheters
  - While there have been multiple attempts to deploy antimicrobial catheters to reduce the rate of infection, there is no literature to support that this technology has made a significant impact.
  - It has been estimated that 80% of hospital-acquired UTIs are directly attributable to use of an indwelling urethral catheter (Gokula, Hickner and Smith, 2004) and studies have shown that there is a very high utilization in patients where it was not indicated or for durations that may have been longer than clinically necessary (Saint et al., 2000).
  - Thus the greatest opportunities to reduce the rate of UTI are 1) to place catheters only for appropriate indications and 2) to limit the duration of catheter placement.

**Technology Plan**

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Implementing an anti-infective Foley catheter kit with enhanced components to prepare, insert and maintain a safe urinary catheter. One standard kit that has been effective:
- BARDEX® I.C. Advance Complete Care® Trays
Metrics

Topic:
Catheter-associated urinary tract infections (CAUTI)
Rate of patients with CAUTI per 1,000 urinary catheter-days – all in-patient units

Outcome Measure Formula:
Numerator: Catheter-associated urinary tract infections based on CDC NHSN definitions for all inpatient units (CDC, 2015)
Denominator: Total number of urinary catheter-days for all patients that have an urinary catheter (48 hours or more) in all tracked units
*Rate is typically displayed as CAUTI/1000 urinary catheter-days

Metric Recommendations:
Indirect Impact:
All patients with conditions that lead to temporary or permanent incontinence

Direct Impact:
All patients that require a urinary catheter

Lives Spared Harm:
\[ \text{Lives} = (\text{CAUTI RATE}_{\text{baseline}} - \text{CAUTI Rate}_{\text{measurement}}) \times (\text{Urinary Catheter}) \text{ days}_{\text{baseline}} \]

Lives Saved:
\[ \text{Lives Saved} = \text{Lives Spared Harm} \times \text{Mortality Rate} \]

Notes:
To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards (CDC, 2015). Infection rates can be stratified by unit types further defined by CDC (CDC, 2016). Infections that were present on admission (POA) are not considered HAIs and not counted.

Data Collection:
CAUTI and urinary catheter-days can be collected through surveillance (at least once per month) or gathered through electronic documentation. Denominator documented electronically must match manual counts (+/- 5%) for a 3 month validation period.

CAUTI can be displayed as a Standardized Infection Ratios (SIR) using the following formula:
\[ \text{SIR} = \frac{\text{Observed CAUTI}}{\text{Expected CAUTI}} \]
Expected infections are calculated by NHSN and available by location (unit type) from the baseline period.

Mortality (will be calculated by the Patient Safety Movement Foundation):
The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient’s grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. “At the outset of the PIP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PIP. In conjunction with CMS’s overall leadership of the PIP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the “AHRQ National Scorecard,” which provides summary data on the national HAC rate (AHRQ, 2013). Catheter Associated Urinary Tract Infections was included in this work with
published metric specifications. This is the most current and comprehensive study to date. Based on these data the estimated additional inpatient mortality for Catheter Associated Urinary Tract Infection Events is 0.023 (23 per 1000 events).

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Executive Summary Checklist

Postoperative infection at the site of surgery remains a major source of perioperative morbidity and mortality.

☐ Educate patients and families on SSI prevention.
☐ Implement surveillance and metrics to measure patient outcomes. The results of this monitoring should be reviewed at periodic caregiver education sessions, such as “grand rounds.”

Pre-operative:

☐ Administer antimicrobial prophylaxis in accordance with evidence-based standards and guidelines (Bratzler et al., 2013).
☐ Administer within 1 hour prior to incision (2 hours for vancomycin and fluoroquinolones)
☐ Select appropriate agents on basis of:
  ● Surgical Procedure
  ● Most common SSI pathogens for the planned procedure
  ● Known allergies or drug reactions of each specific patient.
  ● Published recommendations
☐ Do not remove hair at the operative site unless it will interfere with the operation.
☐ Use appropriate antiseptic agent and technique for skin preparation, preferably an alcohol containing preparation (Ban et al., 2017; Berrios-Torres et al., 2017)
☐ If appropriate, mechanically prepare patients for colorectal surgery by enema or cathartic agents. (Ban et al., 2017)
☐ Patient should stop smoking 4 to 6 weeks before surgery (Ban et al., 2017)

Intraoperative:

☐ Maintain intraoperative and postoperative normothermia (Ban et al., 2017)
☐ Re-dose prophylactic antibiotics based on agent half-life or for every 1,500 mL blood loss (Ban et al., 2017)
☐ Keep operating room (OR) doors closed during surgery except as needed for passage of equipment, personnel, and the patient. Ensure that interior of operating room is at “positive pressure”.
☐ Use an impervious plastic wound protector after open abdominal surgery, particularly colorectal and biliary procedures (Ban et al., 2017)
☐ Change gloves before closure in colorectal cases (Ban et al., 2017)
☐ Perform topical irrigation of the incision site, particularly in colorectal surgery (Mueller et al., 2015)

Postoperative:

☐ Protect primary closure incisions with sterile dressing for 24-48 hours post-op
☐ Discontinue antibiotics within 24 hours after the surgery end time (48 hours for cardiac patients), unless signs of infection are present.
☐ Keep operating room (OR) doors closed during surgery except as needed for passage of equipment, personnel, and the patient. Ensure that interior of operating room is at “positive pressure” relative to adjacent corridors.

Postoperative:

☐ Protect primary closure incisions with sterile dressing for 24-48 hours post-op
☐ Discontinue antibiotics within 24 hours after the surgery end time (48 hours for cardiac patients), unless signs of infection are present.
The Performance Gap
There are approximately 300,000 surgical site infections (SSIs) annually (17% of all HAI; second to UTI). SSIs occur in 2%-5% of patients undergoing inpatient surgery (CDC, 2010). The SSIs mortality rate is 3%, with a 2-11 times higher risk of death versus other infections. Seventy-five percent of deaths among patients with SSI are directly attributable to the SSI. Long-term disabilities can result from SSIs and while studies have been done on mortality, no studies have been done on the life-altering long-term disabilities and associated financial burdens that can result from SSIs.

A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. Most patients who have surgery do not develop an infection. Some of the common symptoms of a surgical site infection include redness and pain around the surgical site area, drainage of cloudy fluid from the surgical wound, and fever.

Surgical site infections can result in 7-10 additional postoperative hospital days due to an SSI. Direct costs can be between $3,000-$29,000 per SSI, depending upon the procedure and pathogen. On a national scale, direct and indirect medical costs combined can reach up to $10 billion annually (Quicho, 2016). These estimated costs do not account for the additional costs of rehospitalization, post-discharge outpatient expenses, and long-term disabilities.

The pathogenesis of SSIs can be endogenous (patient flora, seeding from a distant site of infection) and exogenous (surgical personnel, OR physical environment and ventilation, tools, equipment, and materials brought to the operative field). Challenges exist in detecting SSIs such as the lack of standardized methods for post-discharge/outpatient surveillance due to an increased number of outpatient surgeries and shorter postoperative inpatient stays. Another challenge is the increasing trend toward resistant organisms which may undermine the effectiveness of existing recommendations for antimicrobial prophylaxis.

Education and awareness of risk factors amongst healthcare workers, physicians and nurses followed by the implementation of standardized guidelines can minimize the incidence of SSIs in hospitals. Some key preventive measures include appropriate antimicrobial prophylaxis, preoperative identification and treatment of existing infections, proper site preparation methods (hair removal, skin site), maintenance of normothermia in the immediate postoperative period, and keeping OR doors closed during surgical procedures.

Leadership Plan
- Hospital governance and senior administrative leadership must champion efforts in raising awareness around the high incidence of SSIs and prevention measures.
- Healthcare leadership should support the implementation of standards on pre-, intra- and postoperative guidelines to minimize incidence of SSIs.
- Senior leadership will need to address barriers, provide resources, and assign accountability throughout the organization.
- Hospital administration should implement surveillance and metrics to measure outcomes.

Practice Plan
- Pre-operative skin cleansing
  - Develop standardized process for pre-operative skin cleansing that includes the repeated use of chlorhexidine gluconate (CHG).
  - Educate patients on how to appropriately apply the CHG prior to surgery, and about the risk that they might reduce the residual beneficial effects of the CHG if they apply lotions or deodorants after cleansing.
- Pre-operative screening for patients at risk for SSI
  - Develop a protocol to conduct nasal Staphylococcus aureus (SA) screening in patients undergoing cardiac and elective orthopedic surgery.
  - Develop a protocol to attempt to decolonize SA carriers that includes intranasal Mupirocin.

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● Educate patients and families on SSI prevention
  ○ The adverse effect of tobacco use on wound healing and the importance of ceasing tobacco use for a minimum of 1 month pre- and post-surgery.
  ○ Importance of proper nutrition pre- and post-operatively to support competent immune response to infection.
  ○ In patients with diabetes, the importance of ensuring their blood sugar is well controlled.
  ○ Appropriate preoperative bathing and skin cleansing.
  ○ Identify any skin irritation or hypersensitivity in prior surgical experiences, and any new skin conditions.
  ○ Postoperative wound handling techniques and hand hygiene.
  ○ Early signs of sepsis

● Peri-operative skin antisepsis
  ○ Use preoperative skin antiseptic agents that have been FDA-approved or -cleared and approved by the health care organization’s infection control personnel; these should be used for all preoperative skin preparation. This preparation should significantly reduce microorganisms on intact skin, contain a non irritating antimicrobial preparation, be broad spectrum, be fast acting, and have a persistent effect.
  ○ Develop standardized practices, guided by the product insert, for the peri-operative application of skin antiseptic agents that ensures an appropriate therapeutic dose covers and is maintained across the entirety of the skin surface.
  ○ Educate perioperative personnel on the safe application and use of selected skin antiseptic agents, and the benefits of skin antisepsis to reduce the microbial burden on the skin prior to surgery.

● Proper hair removal
  ○ Remove only hair that interferes with the surgical procedure.
  ○ Clip hair at the surgical site using a single-use hair clipper, or with a clipper with removable head that can be disinfected between patients. Razors should not be used.

● Appropriate timing, selection, and duration of prophylactic antibiotics

● Maintenance of normothermia
  ○ Use warmed forced-air blankets preoperatively, during surgery, and in PACU.
  ○ Use warmed fluids for IVs and flushes in surgical sites and openings.

Technology Plan

Suggested practices and technologies are limited to those proven to show benefit or are the only known technologies with a particular capability. As other options may exist, please send information on any additional technologies, along with appropriate evidence, to info@patientsafetymovement.org

● Consider implementing technologies that provide skin antiseptic activity such as:
  ○ 3M® Duraprep™ and Carefusion® Chloraprep™

● Consider implementing technologies that support intraoperative wound protection such as:
  ○ Applied Medical® Alexis™ and 3M® SteriDrape™

● Consider implementing technologies that actively clean and remove infectious contamination from the surgical incision such as:
  ○ CleanCision™ Wound Retraction and Protection System (Suh et al., 2017)
Metrics

Topic:

**Colon Surgical Site Infection Rate (Colo SSI):** Rate of patients with a Colon Surgical Site Infection per 100 NHSN colon operative procedures

Outcome Measure Formula:

**Numerator:** Colon surgical site infections based on [CDC NHSN definitions](https://www.cdc.gov/nhsn)

**Denominator:** Total number of colon operative procedures based on [CDC NHSN definitions](https://www.cdc.gov/nhsn)

*Rate is typically displayed as SSI/100 Operative Procedures*

Metric Recommendations:

**Indirect Impact:**
All patients requiring a colon operative procedure

**Direct Impact:**
All patients requiring a NHSN colon operative procedure

**Lives Spared Harm:**

\[
\text{Lives Spared Harm} = (\text{SSI Rate}_{\text{baseline}} - \text{SSI Rate}_{\text{measurement}}) \times \text{Operative Procedures}_{\text{baseline}}
\]

**Lives Saved:**

\[
\text{Lives Saved} = \text{Spared Harm} \times \text{Mortality Rate}
\]

Notes:
To meet the NHSN definitions, infections must be validated using the [hospital acquired infection (HAI) standards](https://www.cdc.gov/nhsn).

Data Collection:

All NHSN colon operative procedures require infection surveillance for 30 days following the procedure date. Operative procedures are defined by ICD and CPT codes.

Colon SSIs can be displayed as a Standardized Infection Ratios (SIR) using the following formula:

\[
\text{SIR} = \frac{\text{Observed SSI}}{\text{Expected SSI}}
\]

Expected infections are calculated by NHSN and available by location (unit type) from the baseline period.

Mortality (will be calculated by the Patient Safety Movement Foundation):

The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient’s grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. “At the outset of the PiP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PiP. In conjunction with CMS’s overall leadership of the PiP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the “AHRQ National Scorecard,” which provides summary data on the national HAC rate (AHRQ, 2015). Based on these data the estimated additional inpatient mortality for Colo SSI is 0.028 (28 per 1000 events).

Topic:
Abdominal Hysterectomy Surgical Site Infection Rate (Hyst SSI)
Rate of patients with an abdominal hysterectomy surgical site infection per 100 NHSN abdominal hysterectomy operative procedures

Outcome Measure Formula:
Numerator: Abdominal hysterectomy surgical site infections based on CDC NHSN definitions
Denominator: Total number of abdominal hysterectomy operative procedures based on CDC NHSN definitions
* Rate is typically displayed as SSI/100 Operative Procedures

Metric Recommendations:

Direct Impact:
All patients requiring a NHSN abdominal hysterectomy operative procedure

Lives Spared Harm:
Lives = (SSI Rate \text{ baseline} - SSI Rate \text{ measurement}) \times\text{Operative Procedures baseline}

Lives Saved:
Lives Saved = Spared Harm \times Mortality Rate

Notes:
To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards (CDC, 2017).

Data Collection:
All NHSN abdominal hysterectomy operative procedures require infection surveillance for 30 days following the procedure date. Operative procedures are defined by ICD and CPT codes.

Colon SSIs can be displayed as a Standardized Infection Ratios (SIR) using the following formula:
$$SIR = \frac{Observed\ SSI}{Expected\ SSI}$$
Expected infections are calculated by NHSN and available by location (unit type) from the baseline period.

Mortality (will be calculated by the Patient Safety Movement Foundation):
The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient’s grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. “At the outset of the PiP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PiP. In conjunction with CMS’s overall leadership of the PiP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the “AHRQ National Scorecard,” which provides summary data on the national HAC rate (AHRQ, 2015).

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References
Executive Summary Checklist

Pneumonia that is acquired while a patient is receiving mechanically-assisted ventilation (VAP) is a serious problem in critically-ill patients, resulting in many patient deaths each year.

☐ Commitment from hospital leadership to support a program to eliminate VAP.
☐ Implement evidence-based guidelines to prevent the occurrence of VAP.
   ● Prevent aspiration of secretions
     ○ Maintain elevation of head of bed (HOB) (30–45 degrees)
     ○ Avoid gastric over-distention
     ○ Avoid unplanned extubation and re-intubation
     ○ Use cuffed endotracheal tube with in-line or subglottic suctioning
     ○ Maintain the endotracheal tube cuff pressure at greater than 20 cmH2O
     ○ Encourage early mobilization of patients with physical/occupational therapy
     ○ Ensure that patient is conscious and responsive prior to extubation.
   ● Reduce duration of ventilation
     ○ Conduct “sedation vacations”
     ○ Assess readiness to wean from ventilator daily
     ○ Conduct spontaneous breathing trials
   ● Reduce colonization of aero-digestive tract
     ○ Use non-invasive ventilation methods when possible (i.e. CPAP, BiPap)
     ○ Use oro-tracheal over naso-tracheal intubation
     ○ Use cuffed Endotracheal Tube (ETT) with inline or subglottic suctioning
     ○ Perform regular oral care with an antiseptic agent
     ○ Reduce opportunities to introduce pathogens into the airway
   ● Prevent exposure to contaminated equipment
     ○ Use sterile water to rinse reusable respiratory equipment
     ○ Remove condensation from ventilator circuits
     ○ Change ventilator circuit only when malfunctioning or visibly soiled
     ○ Store and disinfect respiratory equipment effectively
   ● Measure adherence to VAP prevention practices and consider monitoring compliance
     ○ Hand Hygiene
     ○ Daily sedation vacation/interruption and assessment of readiness to wean
     ○ Regular antiseptic oral care
     ○ Semi-recumbent position of all eligible patients
   ● Monitor ventilated patients for: positive cultures, temperature chart/log, pharmacy reports of antimicrobial use, and change in respiratory secretions
     ○ When complications exist, raise them on top of the patient’s EHR problem list.

☐ Develop an education plan for attendings, residents and nurses to cover key curriculum pertaining to the prevention of VAP.
☐ Encourage continuous process improvement through the implementation of quality process measures and metrics and a monthly display through a dashboard
Ventilator-associated pneumonia (VAP) is an infection that appears in the lungs when a patient is mechanically ventilated. Mechanically ventilated hospital patients are typically critically ill and treated in an intensive care unit (ICU). The infection develops after 48 hours or more of mechanical ventilation and is caused when bacteria reaches the lower respiratory tract via the endotracheal tube or tracheostomy; in addition, when airways are not properly maintained intubation may allow oral and gastric secretions to enter the lower airways (Amanullah, 2015).

VAP is the leading cause of death associated with healthcare-associated infections (HAIs) (IHI, 2012). In the US, a multi-state prevalence survey estimated the incidence of VAP in the US at 49,900 cases annually (Magill, 2014). As many as 28% of all patients who receive mechanical ventilation in the hospital will develop VAP and the incidence increases with the duration of mechanical ventilation. The crude mortality rate for VAP is between 20% and 60%; and incidence ranges from 4% to 48% (Cook, 1998, Heyland, 1999). Depending on the type of pneumonia the mortality rate may vary; Pseudomonas and Acinetobacter are associated with higher mortality rates than other strains of bacteria (Fagon, 1996). It is believed that when antibiotic therapy is delayed or improperly dosed, mortality also increases. These factors are largely preventable.

Patients who acquire VAP have significantly longer durations of mechanical ventilation, length of ICU stay as well as hospital stay (Rello, 2002). In addition, the development of VAP is associated with significant increase in hospital costs and poor economic outcomes. VAP is associated with greater than $40,000 in mean hospital charges per patient.

It is estimated that the use of process change and technology to reduce VAP can save up to $1.5 billion per year while significantly improving quality and safety (Scottm 2009). Closing the performance gap will require hospitals and healthcare systems to commit to action in the form of specific leadership, practice, and technology plans, examples of which are delineated below for utilization or reference. This is provided to assist hospitals in prioritizing their efforts at designing and implementing evidence-based bundles for VAP reduction.

Leadership Plan

- Hospital governance and senior administrative leadership must champion efforts in raising awareness to prevent and manage VAP infections safely.
- Healthcare leadership should support the design and implementation of an antimicrobial stewardship program.
- Senior leadership will need to integrate surveillance and metrics to ensure prevention measures are being followed.
- Leadership commitment and action are required at all levels for successful process improvement.

Practice Plan

Establish and consistently implement VAP prevention guidelines that focus on surveillance, minimization of ventilator patient days, prevention of aspiration and gastric distention, equipment cleansing, oral hygiene and avoidance of unintended extubation and reintubation (Coffin, 2008). An example of an evidence-based bundle is the Institute for Healthcare Improvement’s How-to Guide: Prevent Ventilator Associated Pneumonia. This Guide can be accessed online through the Institute for Healthcare Improvement (IHI). In addition the Armstrong Institute for Patient Safety and Quality at John Hopkins University has published a Toolkit to Improve Safety of Mechanically Ventilated Patients that includes recommendations on preventing, measuring and tracking outcomes related to VAP. This Toolkit can be accessed online through the John Hopkins Medicine website.
We have also listed the key components here:

- If tolerated by patient, elevate the Head of the Bed to between 30 and 45 degrees
- Daily Sedation Interruption and Daily Assessment of Readiness to Extubate
- Peptic Ulcer Disease (PUD) Prophylaxis
- Deep Venous Thrombosis (DVT) Prophylaxis
- Daily Oral Care with Chlorhexidine
- Check the patient’s ability to breathe on his/her own every day so the patient can be taken off the ventilator as soon as possible (CDC).
- Before and after touching the patient, ensure that healthcare providers are following hand hygiene procedures.

Technology Plan

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- Implement endotracheal tubes designed to drain subglottic secretions
  - Such as Kimberly-Clark® KIMVENT MICROCUFF Subglottic Suctioning Endotracheal Tube, Teleflex® ISIS HVT, Smiths Medical Portex SACETT Suction Above Cuff Endotracheal Tube or Mallinckrodt® SealGuard Evac Endotracheal Tube
- If endotracheal tubes designed to drain subglottic secretions are not available, consider use of the Vyaire Medical Tri-Flo Subglottic Suction System
- Implement oral hygiene including the use of Chlorhexidine
- Such as SAGE Q-Care Rx Oral Cleansing and Suctioning Systems or HALYARD or Medline Oral Care Kits with CHG
- Implement electronic surveillance technologies that support antimicrobial stewardship (in late onset cases of VAP bacteria is often multi-drug resistant, and can have great clinical and economic challenges)
- Considering implementation of Electronic Measurement of hand hygiene compliance. See APSS 2A for details.
Metrics

Topic:

**Ventilator-associated Pneumonia Rate (VAP)**
Rate of patients on a ventilator for more than 48 hours who develop pneumonia while on the ventilator or within 1 day of ventilator removal per 1,000 ventilator-days

Outcome Measure Formula:

**Numerator:** Ventilator-associated Pneumonia infections based on CDC NHSN definitions for all inpatient units (CDC, 2016).

**Denominator:** Total number of ventilator-days for all patients on a ventilator in all tracked units

*Rate is typically displayed as VAP/1000 ventilator days*

**Metric Recommendations:**

**Indirect Impact:**
All patients with conditions that lead to temporary or permanent ventilation

**Direct Impact:**
All patients that require invasive ventilation.

**Lives Spared Harm:**

\[
Lives = (VAP \text{ Rate }_{\text{baseline}} \cdot VAP \text{ Rate }_{\text{measurement}}) \cdot \text{Ventilator days }_{\text{baseline}}
\]

**Notes:**
To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards (CDC, 2016). Infection rates can be stratified by unit types further defined by CDC (CDC, 2016). Infections that were present on admission (POA) are not considered HAI and not counted.

**Data Collection:**
VAP and ventilator-days can be collected through surveillance (collected at least once per month and reported monthly) or gathered through electronic documentation. Denominators documented electronically must match manual counts (+/- 5%) for a 3 month validation period.

**Mortality (will be calculated by the Patient Safety Movement Foundation):**
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Executive Summary Checklist

Clostridium difficile (C. diff) is a spore-forming, Gram-positive anaerobic bacillus that produces two exotoxins: toxin A and toxin B (CDC, 2012). It is a common cause of antibiotic-associated diarrhea (AAD), and it accounts for 15-25% of all episodes of AAD.

☐ Implement an antimicrobial stewardship programs to prevent and/or minimize infection rates in healthcare settings. Refer to APSS #3A.
☐ Maintain contact precautions for duration of diarrhea
☐ Comply with hand hygiene as described in APSS #2A
☐ Clean and disinfect equipment and environment, including equipment that comes into contact with the patient (e.g. blood pressure cuffs and pulse oximeters are not frequently cleaned between patients).
☐ Use a laboratory-based alert system for immediate notification of all positive test results
☐ Implement technologies that support proper surface cleaning and utilize as part of a defined environmental control best practice program (e.g. Clorox® Healthcare Bleach Germicidal Wipes or Xenex® UV Light Disinfection System)
☐ Educate healthcare providers, housekeeping, administration, patients and families about CDI
☐ Encourage continuous process improvement through the implementation of quality process measures and metrics.
☐ All CDIs should have a root cause analysis (RCA) completed by the unit where the infection occurred with multidisciplinary participation including nurses, physicians and infection prevention specialists.
☐ Implement all learnings from the RCA.
The Performance Gap

Clostridium difficile (C. diff) is a spore-forming, Gram-positive anaerobic bacillus that produces two exotoxins: toxin A and toxin B (CDC, 2012). It is a common cause of antibiotic-associated diarrhea (AAD), and it accounts for 15-25% of all episodes of AAD. Various diseases result from C. diff infection (CDI), including: pseudomembranous colitis (PMC), toxic megacolon, perforations of the colon, sepsis, and death (rarely). The clinical symptoms include watery diarrhea, fever, loss of appetite, nausea and abdominal pain/tenderness. Certain patient populations are at an increased risk for C. diff, including patients with: antibiotic exposure, proton pump inhibitors, gastrointestinal surgery/manipulation, long length stay in healthcare settings, a serious underlying illness, immunocompromising conditions and advanced age.

Clostridium difficile is shed in feces. Any surface, device, or material that becomes contaminated with feces may serve as a reservoir for the C. diff spores. The spores are primarily transferred to patients mainly via the hands of healthcare personnel who have touched a contaminated surface or item. It is important to note that C. diff spores are not killed by alcohol-based hand rubs (Oughton et al., 2009; Jabbar et al., 2010; Gerding et al., 2008). The WHO recommends washing hands with soap and water before gloving and after degloving (WHO, n.d.). CDI will resolve within 2-3 days of discontinuing the antibiotic to which the patient was previously exposed in approximately 20% of patients. The infection can usually be treated with an appropriate course (about 10 days) of antibiotics. After treatment, repeat C. diff testing is not recommended if the patients’ symptoms have resolved, as patients may remain colonized. The differences between C. diff colonization and infection are important to note:

- **Clostridium difficile colonization**
  - Patient exhibits NO clinical symptoms
  - Patient tests positive for Clostridium difficile organism and/or its toxin
  - More common than Clostridium difficile infection

- **Clostridium difficile infection**
  - Patient exhibits clinical symptoms
  - Patient tests positive for the C. diff organism and/or its toxin

Common laboratory tests used to diagnose C. diff infection include stool culture, molecular tests, antigen detection for C diff, toxin testing (tissue culture cytoxicity assay or enzyme immunoassay). The toxin is very unstable and degrades at room temperature, and may be undetectable within 2 hours after collection of a stool specimen. False-negative results occur when specimens are not promptly tested or kept refrigerated until testing can be done.

Leadership Plan

- Hospital governance and senior administrative leadership must champion efforts in raising awareness to prevent and manage CDIs safely.
- Healthcare leadership should support the design and implementation of an antimicrobial stewardship program
- Senior leadership will need to integrate surveillance and metrics to ensure prevention measures are being followed
- Leadership commitment and action are required at all levels for successful process improvement

Practice Plan

Establish and consistently implement Clostridium difficile infection (CDI) prevention guidelines that focus on the education of healthcare providers, patients, and families, surveillance, hand hygiene, contact and isolation precautions, and establishment of an antimicrobial stewardship program (CDC, 2012; WHO, n.d.). An example of an evidence-based approach is the Association for Professionals in Infection Control and Epidemiology Guide to Preventing Clostridium difficile Infections. This Guide can be accessed online (Carrico, 2013).

We have also listed key elements of CDI prevention below:

- Surveillance
○ Implement a facility-wide CDI surveillance method of both process measures and the infection rates to which the processes are linked.

● Hand Hygiene (Oughton, 2009; WHO, n.d.)
  ○ It is recommended that healthcare providers wash hands with soap and water before donning gloves and following glove removal when caring for patients with CDI. No agent, including alcohol-based hand rubs, is effective against C. diff spores.
  ○ Appropriate use and removal of gloves is essential when caring for patients with diarrheal illnesses, like CDI.

● Contact/Isolation Precautions
  ○ Use Standard Precautions for all patients, regardless of diagnosis.
  ○ Place patients with CDI on Contact Precautions in private rooms when available.
  ○ Perform hand hygiene and put on gown and gloves before entry to the patient’s room.
  ○ Use dedicated equipment (blood pressure cuff, thermometer, and stethoscope).
  ○ Remove gown and gloves and perform hand hygiene before exiting the room.
  ○ Educate the patient and family about precautions and why they are necessary and ensure that visitors are properly attired in personal protective equipment.

● Environmental Infection Prevention
  ○ Use EPA-approved germicide for routine disinfection during non-outbreak situations (EPA, 2014).
  ○ Ensure that personnel allow appropriate germicide contact time.
  ○ Ensure that personnel responsible for environmental cleaning and disinfection have been appropriately trained.
  ○ For routine daily cleaning of all patient rooms, address at least the following items:
    ■ Bed, including bedrails and patient furniture (including the bedside and over-the-bed tables and chairs).
    ■ Bedside commodes and bathrooms, including sink, floor, tub/shower, toilet.
    ■ High-touch surfaces like call buttons and TV remotes.
    ■ Communication devices such as walkie-talkies used by nurses to communicate with the nursing station as well as personal cell phones carried by healthcare personnel.

● Antimicrobial Stewardship and CDI
  ○ Implement a program that supports the judicious use of antimicrobial agents (CDC, 2016).
  ○ The program should incorporate a process that monitors and evaluates antimicrobial use and provides feedback to medical staff and facility leadership.

Technology Plan

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● Implement technologies that support proper surface cleaning and utilize as part of a defined environmental control best practice program
  ○ Such as Clorox® Healthcare Bleach Germicidal Wipes or Xenex® UV Light Disinfection System.

● Implement technologies that support proper hand hygiene and utilize as part of a defined hand hygiene best practice program such as product utilization and staff movement tracking, sensor bracelets, alcohol sensing technologies.
  ○ See APSS 2A for a list of hand hygiene technology suppliers
Metrics

Topic:

Healthcare-associated Clostridium Difficile Infection Rate (CDiff)
Rate of patients with a healthcare associated CDI per 1,000 patient days

Outcome Measure Formula:
Numerator: Number of healthcare associated CDI based on CDC NHSN definitions
Denominator: Total number of patient days based on CDC NHSN definitions
* Rate is typically displayed as Infections/1000 Patient Days

Metric Recommendations:

Direct Impact:
All hospitalized patients

Lives Spared Harm:
\[ \text{Lives Spared Harm} = (\text{CDI Rate}_{\text{baseline}} - \text{CDI Rate}_{\text{measurement}}) \times \text{Patient Days}_{\text{baseline}} \]

Lives Saved:
\[ \text{Lives Saved} = \text{Spared Harm} \times \text{Mortality Rate} \]

Notes:
To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards (CDC, 2016). Infection rates can be stratified by unit types further defined by CDC. Infections that were present on admission (POA) are not considered HAI and not counted.

Data Collection:
CDiff and patient days can be collected through surveillance (at least once per month) or gathered through electronic documentation. Infections must be monitored according to NHSN surveillance definitions. Denominators documented electronically must match manual counts (±5%) for a 3 month validation period.

Settings:
Infection Surveillance will occur in any inpatient location where denominator data can be collected, which may include critical/intensive care units (ICU), specialty care areas (SCA), step-down units, wards, and chronic care units. Surveillance will NOT be performed in Neonatal Intensive Care Units (NICU), Specialty Care Nurseries (SCN), babies in LDRP, or well-baby nurseries. If LDRP locations are being monitored, baby counts must be removed.

Mortality (will be calculated by the Patient Safety Movement Foundation):
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Executive Summary Checklist

Central Line Associated Bloodstream Infections (CLABSI) are a source of serious morbidity and potential mortality in hospitalized patients.

- Implement evidence-based guidelines to prevent the occurrence of CLABSIs, including: insertion, maintenance, and standardized access procedures.
- During insertion of a central catheter, doctors should always:
  - Perform a “time-out”
  - Wash their hands with soap.
  - Clean the patient’s skin with appropriate antiseptic.
  - Place sterile drapes over the entire patient.
  - Wear a sterile mask, hat, gown and gloves.
  - Put a sterile dressing over the catheter site.
- Develop an education plan for physicians and nurses to cover key curriculum pertaining to the insertion and maintenance of central lines.
- Encourage continuous process improvement through the implementation of quality process measures and metrics.
- Standardize a central-line kit based on the needs of your facility, and implement technology that will have a significant return on investment (ROI) such as:
  - Arrow International® PSI Kit with Integral Hemostasis Valve/Side Port or Arrow International® Pressure Injectable Quad-Lumen Central Venous Catheterization Kit with Blue FlexTip®, ARROWg+ard Blue PLUS® Catheter and Sharps Safety Features, and 3M® Tegaderm CHG dress.
- Minimize blood draws from central access catheters.
- Conduct a root cause analysis (RCA) in the unit where the infection occurred with multidisciplinary participation including nursing, physicians and infection prevention specialists.
- Implement all learnings from the RCA.
The Performance Gap

Each year in the United States there are more than 700,000 healthcare-associated infections (HAIs) resulting in 75,000 deaths and $28-$45 billion in extra health care costs (Klevens et al., 2007),(Scott, 2009).

An estimated 41,000 patients in US hospitals acquire central line-associated infections each year (O’Grady et al., 2011). Heavy bacterial colonization at the insertion site, catheter placement in the arm or leg rather than the chest, catheterization longer than 3 days, and insertion with less stringent barrier precautions all significantly increase the risk of catheter-related infection (Mermel, McCormick, Springman and Maki, 1991). While intensive care unit (ICU) patients are at the highest risk for CLABSIs, central venous catheters are becoming increasingly utilized outside the ICU, exposing more patients to the risk. In fact, recent data suggest that the greatest numbers of patients with central lines are in hospital units outside the ICU (Vonberg et al., 2006). While central line use is increasing outside the ICU, since 2008 CMS has implemented a policy of reduced reimbursement for reasonably preventable hospital-acquired conditions, including CLABSI. This policy change can represent a significant financial burden to the hospital because increased hospital costs due to CLABSI can be as much as $23,000 per case (Scott, 2009).

CLABSI and other HAIs, however, are largely preventable. Interventions focusing on reducing CLABSIs in particular resulted in reductions ranging from 38 to 71%.3 Pronovost et al. for example, observed a 66% decrease in CLABSIs after implementing a multi-component intervention in the ICUs of 67 Michigan hospitals (Pronovost et al., 2006). In a separate study conducted in 32 hospitals in Pennsylvania, CLABSIs decreased by 68%, following targeted interventions between April 2001 and March 2005 (CDC, 2005). Other studies have shown similar reductions in CLABSI, saving lives and dramatically reducing costs (Rosenthal et al., 2012),(Hong et al., 2013),(Gozu, Clay and Younus, 2011).

A variety of guidelines and recommendations have been identified to prevent CLABSIs including those published by The Healthcare Infection Control Practices Advisory Committee, (O’Grady et al., 2011). The Institute for Healthcare Improvement (IHI)(Improvement, n.d.) and the Agency for Healthcare Research and Quality (AHRQ) (Quality, 2014).

Important shared components of these recommendations include: implementing a method to detect the true incidence of CLABSI, including information technology to collect and calculate catheter days; providing adequate infrastructure for the intervention including an adequately staffed infection prevention and control program and adequate laboratory support for timely processing of samples; implementing a catheter insertion checklist; monitoring the continued need for intravascular access on a daily basis; and measuring unit-specific incidence of CLABSI as part of performance evaluations.

It is estimated that the use of process change and technology to reduce CLABSI can save up to $2.7 billion per year while significantly improving quality and safety (Scott, 2009). Closing the performance gap will require hospitals and healthcare systems to commit to action in the form of specific leadership, practice, and technology plans, examples of which are delineated below for utilization or reference. This is provided to assist hospitals in prioritizing their efforts at designing and implementing evidence-based bundles for CLABSI reduction.

Leadership Plan

- Hospital governance and senior administrative leadership must commit to becoming aware of major performance gaps in their own organization.
- Hospital governance, senior administrative leadership, and clinical/safety leadership must close their own performance gap by implementing a comprehensive approach.
- Healthcare leadership must reinforce their commitment by taking an active role in championing process improvement, giving their time, attention and focus, removing barriers, and providing necessary resources.
- Leadership must demonstrate their commitment and support by shaping a vision of the future, clearly defining goals, supporting staff as they work through improvement initiatives, measuring results, and communicating progress towards goals. Actions speak louder than words. As role models, leadership must
‘walk the walk’ as well as ‘talk the talk’ when it comes to supporting process improvement across an organization.

- There are many types of leaders within a healthcare organization and in order for process improvement to truly be successful, leadership commitment and action are required at all levels. The Board, the C-Suite, senior leadership, physicians, directors, managers, and unit leaders all have important roles and need to be engaged.

Change management is a critical element that must be included to sustain any improvements. Recognizing the needs and ideas of the people who are part of the process—and who are charged with implementing and sustaining a new solution—is critical in building the acceptance and accountability for change. A technical solution without acceptance of the proposed changes will not succeed. Building a strategy for acceptance and accountability of a change initiative greatly increase the opportunity for success and sustainability of improvements. “Facilitating Change,” the change management model The Joint Commission developed, contains four key elements to consider when working through a change initiative to address HAIs (Appendix A).

In addition to the change management model leaders should:

- Include fundamentals of change outlined in the National Quality Forum safe practices, including awareness, accountability, ability, and action.
- Meet with ICU team, infection control staff, quality and safety leaders, nurse educators, and physician champions.
  - Understand barriers (walk the process)
  - Use 4E grid to develop strategy to engage, educate, execute and evaluate
  - Engage: stories, show baseline data
  - Educate staff on evidence
  - Execute practice change
  - Evaluate feedback performance, view infections as defects
  - Use surveillance data to drive improvement
  - Monitor and provide feedback of compliance with best practice over time

Practice Plan
Use of current evidence-based guidelines and/or implementation aids regarding the prevention of CLABSIs:

Insertion
- Create a standardized central line insertion kit or line cart that contains all needed supplies (see Technology Plan).
- Ensure insertion checklist is in your electronic medical record.
- Wear sterile clothing – gowns, mask, gloves and hair covering.
- Cover patient with a sterile drape, except for a very small hole where line goes in.
- Maintain strict sterile technique when placing the line.
- Hand Hygiene - 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 (CDC, 2002). Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained (O’Grady et al., 2002).
- Ultrasound guidance should be used for all non-emergent central line placements.
- For directly inserted central lines, avoid veins in arm and leg, which are more likely to get infected than veins in chest.
- Before commencing the procedure, perform a “time-out.”
- Position patient appropriately

Prepare insertion site
● 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.

● No iodine ointment - 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.

● When inserting near the lungs, ensure line aspirates blood to ensure proper catheter placement.

● Apply a sterile dressing to the site.

● Prepackaged or filled insertion cart, tray or box – cart/tray/box that contains all the necessary supplies.

● Insertion checklist with staff empowerment to stop non-emergent procedure - include a checklist to ensure adherence to proper practices;

● Full sterile barrier for providers and patients - 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. Use a sterile sleeve to protect pulmonary artery catheters during insertion.

● Insertion training for all providers.

**Maintenance**

● Perform daily assessments of need for line and remove when no longer needed.
  ○ Daily discussion of line necessity, functionality and utilization including bedside and medical care team members.
  ○ Discuss with the medical team continued necessity of line.
  ○ Discuss with the medical team the function of the line and any problems.
  ○ Discuss with the medical team the frequency of access and utilization of line. Consider bundling labs and line entries.
  ○ Consider best practice is documentation that the discussion occurred in the medical record.

● Regular assessment of dressing to assure clean/dry/occlusive:
  ○ Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled.
  ○ Replace dressings used on short-term central venous catheters sites according to CDC or institution’s protocol.

● Daily CHG bathing and linen changes - Follow manufacturer recommendations for usage

● Perform weekly rounds.

● Send monthly data to team and leadership.
  ○ Celebrate success
  ○ Perform in-depth case reviews in instances where infections do occur (identify the risk(s) that could’ve been avoided and modifications needed moving forward, if any).
  ○ Utilize a systematic approach to review all hospital acquired CLABSI

**Standardized Access Procedure**

● Refer to Hand Hygiene details in APSS #2A.

● Disinfect cap before all line entries by scrubbing with an appropriate antiseptic and accessing the port only with sterile devices.

● Scrub the Hub: Alcohol (15 second scrub + 15 second dry) or CHG (30 second scrub + 30 second dry).

● Standardized dressing, cap and tubing change procedures/timing:
  ○ Scrub skin around site with CHG for 30 seconds (2 minute for femoral site), followed by complete drying. (Note: there may be institutional preference for CHG use for infant < 2 months of age).

● Change crystalloid tubing no more frequently than every 72 hours.

● Change tubing used to administer blood products every 24 hours or more frequently per institutional standard.
● Change tubing used for lipid and TPN infusions every 24 hours.
● Document date dressing/cap/tubing was changed or is due for change.
● Consider when hub of catheter or insertion site are exposed, wear a mask (all providers and assistants) shield patient’s face, ETT or trach with mask or drape.

**In the Neonatal ICU:**

● A monthly report-out at team/quality committee and leadership meetings.
● Implement standardized central venous catheter (CVC) practices:
  ○ Insertion checklist
  ○ Daily assessment
  ○ Electronic health record prompt to remove catheter based on feeding volume
  ○ 24-hour catheter tubing change, experienced nurses only
  ○ Enhanced nursing education and competency for CVC care

**Education**

● Nursing education – care and maintenance bundle
● Neonatal ICU nursing education – enhanced and competency for CVC care
● Central Line Simulation Program
  ○ Develop education for attendings, residents, nurses
  ○ Key Curriculum Concepts – reinforcement
    ■ Hand hygiene
    ■ Appropriate gowning and gloving
  ○ Key Curriculum Concepts – new
    ■ Standardized central line insertion best practice
      ➢ Ultrasound guided cannulation
    ■ Updated insertion checklist
      ➢ Maintaining sterile technique – immediate feedback
    ■ Central Line Navigator documentation
● General Medical Education
  ○ MD rounding navigators (removal prompt)
  ○ Resident infection prevention training
● Evidence-based practice adherence
● Remain current with new literature findings, e.g., “Guidelines for the Prevention of Intravascular Catheter-Related Infections” 2011 compendium by the CDC (Miller et al., 2010).
● Patient education document (**Figure 1**).
### Quality Process Measures/Metrics

- **Complete documentation elements**
  - Number of operator attempts per line placement
  - % of patients with site disinfection per protocol
  - % insertion with completed checklist
- **Bundle compliance** – insertion and maintenance to be measured separately
  - % of line insertions following all bundle components
  - Hospitals can choose to include additional bundle components. Including more than 5 may confuse and overwhelm providers.
- **Patient education**
  - % of patients/families educated about infection prevention
- **Repetitive patterns, trends, or variables**
  - Complication rate
  - PICC v. Central Lines
  - Insertion site choice
- **Perform a minimum of 20 audits per month. If procedures are fewer than 20, then include all procedures.**
Technology Plan

*Suggested practices and technologies are limited to those proven to show benefit or are the only known technologies with a particular capability. As other options may exist, please send information on any additional technologies, along with appropriate evidence, to info@patientsafetymovement.org*

Implement a central venous catheterization (CVC) kit to prepare, insert and maintain a safe central line. Kits can be custom designed to fit the needs of one hospital or hospital system. Two such kits are used at the University of Vermont Medical Center and have been included below:

- Arrow International® PSI Kit with Integral Hemostasis Valve/Side Port.
- Arrow International® Pressure Injectable Quad-Lumen Central Venous Catheterization Kit with Blue FlexTip®, ARROWg+ard Blue PLUS® Catheter and Sharps Safety Features.

Consider implementing Electronic Hand Hygiene Compliance technology to ensure accurate and reliable measurement, feedback and improvement of this essential performance indicator.

- See APSS 2A for detailed information on the evidence in support of electronic solutions to measure hand hygiene behavior and a list of technology suppliers.
Metrics

Topic:

Central line-associated bloodstream infections (CLABSI)

Rate of CLABSI (healthcare-associated primary bloodstream infection (BSI)) in an ICU patient that had a central line within the 48-hour period before the development of the BSI and that is not related to an infection at another site.

Outcome Measure Formula:

Numerator: A laboratory-confirmed bloodstream infection based on CDC NHSN definitions (CDC, 2016)

Denominator: Device days or patient days

* Rate is typically displayed as CLABSI/1000 Line days

Metric Recommendations:

Indirect Impact:

Any patient with a peripheral or central line will benefit from several of the interventions being instituted

Direct Impact:

All patients that require a central line

Lives Spared Harm:

\[ \text{Lives} = (\text{CLABSI Rate}_{\text{baseline}} - \text{CLABSI Rate}_{\text{measurement}}) \times \text{Line days}_{\text{baseline}} \times \text{Patient Days}_{\text{baseline}} \]

Lives Saved:

\[ \text{Lives Saved} = \text{Lives Spared Harm} \times \text{Mortality Rate} \]

Notes:

To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards (CDC, 2016). Infection rates can be stratified by unit types further defined by CDC. Infections that were present on admission (POA) are not considered HAIs and not counted.

Data Collection:

CLABSI and Line days can be collected through surveillance (at least once per month) or gathered through electronic documentation. Denominators documented electronically must match manual counts (+/- 5%) for a 3-month validation period.

CLABSI can be displayed as a Standardized Infection Ratios (SIR) using the following formula:

\[ \text{SIR} = \frac{\text{Observed CLABSI}}{\text{Expected CLABSI}} \]

Expected infections are calculated by NHSN and available by location (unit type) from the baseline period.

Mortality (will be calculated by the Patient Safety Movement Foundation):

The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient’s grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. "At the outset of the PfP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PfP. In conjunction with CMS’s overall leadership of the PfP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the “AHRQ National Scorecard,” which provides summary data on the national HAC rate (AHRQ, 2015). Central Line
associated bloodstream infections was included in this work with published metric specifications. This is the most current and comprehensive study to date. Based on these data the estimated additional inpatient mortality for Central Associated Bloodstream Infection Events is 0.185 (185 per 1000 events).

Workgroup

Chair:

Members:
- Paul Alper (DebMed)
- Emily Appleton (Parrish Medical Center)
- Jonathan Coe (Prescient Surgical)
- Alicia Cole (Patient Safety Movement Foundation)
- Peter Cox (SickKids)
- Brent D. Nibarger (Patient Safety Movement Foundation)
- Maria Daniela DaCosta Pires (Geneva University Hospitals)
- Todd Fletcher (Resources Global Professionals)
- Kate Garrett (Ciel Medical)
- Haskell Helen (Patient Safety Movement Foundation)
- Mert Iseri (SwipeSense)
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- Christian John Lillis (Peggy Foundation)
- Terry Kuzma-Gottron (Patient Safety Movement Foundation)
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- Jacob Lopez (Patient Safety Movement Foundation)
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- Anna Noonan (University of Vermont Medical Center)
- Kate O'Neill (iCareQuality)
- Kathleen Puri (Patient Safety Movement Foundation)
- Caroline Puri Mitchell (Fitsi Health)
- Kellie Quinn (Patient Safety Movement Foundation)
- Julia Rasooly (PuraCath Medical)
- Yisrael Safeek (Patient Safety Movement Foundation)
- Steve Spaanbroek (MSL Healthcare Partners, Inc.)
- Philip Staehl (Patient Safety Movement Foundation)
- Jeanin Thomas (MRSA Survivors Network)
- Greg Wiita (Poiesis Medical)

Metrics Integrity:
- Nathan Barton (Intermountain Healthcare)
- Robin Betts (Intermountain Healthcare)
- Jan Orton (Intermountain Healthcare)
Conflicts of Interest Disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSS recommend technologies offered by companies involved in the Patient Safety Movement Foundation that the workgroups have concluded, based on available evidence, are beneficial in addressing the patient safety issues addressed in the APSS. Workgroup members are required to disclose any potential conflicts of interest.

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**Appendix A**

“Facilitating Change,” the change management model The Joint Commission developed, contains four key elements to consider when working through a change initiative to address HAIs.

**Plan the Project:**
- Build a strong foundation for change by assessing the culture for change, defining the change, building a strategy, engaging the right people, and painting a vision of the future. This should be done at the outset of the project.

**Inspire People:**
- Solicit support and active involvement in the plan to reduce HAIs, obtain buy-in and build accountability for the outcomes.
- Identify a leader for the HAI initiative. This is critical to the success of the project.
- Understand where resistance may come from.

**Launch the Initiative:**
- Align operations and ensure the organization has the capacity to change, not just the ability to change.
- Launch the HAI initiative with a clear champion and a clearly communicated vision by leadership.

**Support the Change:**
- The capacity to support change is critical; therefore, all leaders within the organization must be a visible part of the HAI initiative.
- Frequent communication regarding all aspects of the HAI initiative will enhance the initiative.
- Celebrate success as it relates to a reduction in HAIs or a positive change in HAI organizational culture.
- Identify resistance to the HAI initiative as soon as it occurs.