Actionable Patient Safety Solution (APSS) #2F:
CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS (CLABSI)

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 CLABSIs

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*).
**Figure 1: My CVL Plan (Developed by Hospital for Sick Children, Toronto)**

<table>
<thead>
<tr>
<th>My name is:</th>
<th>Today's Date is:</th>
<th>Bed Spot:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central line #1</strong></td>
<td><strong>Central line #2</strong></td>
<td></td>
</tr>
<tr>
<td>My type of central line is:</td>
<td>My type of central line is:</td>
<td></td>
</tr>
<tr>
<td>_____ lumens</td>
<td>_____ lumens</td>
<td></td>
</tr>
<tr>
<td>❑ I have a positive blood culture from my line</td>
<td>❑ I have a positive blood culture from my line</td>
<td></td>
</tr>
<tr>
<td>My central line is _____ days old</td>
<td>My central line is _____ days old</td>
<td></td>
</tr>
<tr>
<td>Do I still need my central line?</td>
<td>Do I still need my central line?</td>
<td></td>
</tr>
<tr>
<td>My central line is accessed _____ times per shift</td>
<td>My central line is accessed _____ times per shift</td>
<td></td>
</tr>
<tr>
<td>❑ Which of my IV meds can go to oral dosing?</td>
<td>❑ Which of my IV meds can go to oral dosing?</td>
<td></td>
</tr>
<tr>
<td>❑ Can we decrease my frequency of blood work?</td>
<td>❑ Can we decrease my frequency of blood work?</td>
<td></td>
</tr>
<tr>
<td>❑ Do I have a PIV we could use instead?</td>
<td>❑ Do I have a PIV we could use instead?</td>
<td></td>
</tr>
<tr>
<td>❑ Both lumens pull back and flush well</td>
<td>❑ Both lumens pull back and flush well</td>
<td></td>
</tr>
<tr>
<td>❑ My central line site is clean and intact</td>
<td>❑ My central line site is clean and intact</td>
<td></td>
</tr>
<tr>
<td>My next dressing is due:</td>
<td>My next dressing is due:</td>
<td></td>
</tr>
<tr>
<td><strong>What can we do today to prevent a central line infection:</strong></td>
<td><strong>What can we do today to prevent a central line infection:</strong></td>
<td></td>
</tr>
</tbody>
</table>

**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®, ARROWgard 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:

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

Lives Saved:

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

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:

$= Observed \text{ CLABSI}/Expected \text{ CLABSI}$

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 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). 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).

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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.
References

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CDC. (2016). Bloodstream infection event (central line-associated bloodstream infection and non-central line-associated bloodstream infection.
CDC. (2016). Instructions for mapping patient care locations in NHSN.

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.