A Review of Guidelines and Recommendations on the Prevention of Catheter-related Infections

Houston Chapter
Association for Professionals in Infection Control and Epidemiology, Inc.
Houston, Texas
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William R. Jarvis, M.D.
Jason and Jarvis Associates, LLC
www.jasonandjarvis.com

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Objectives
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• Review guidelines and recommendations set forth by:
  – Center for Disease Control and Prevention (CDC)
  – Society for Hospital Epidemiologists of America (SHEA)
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  – Society for Hospital Epidemiologists of America (SHEA)
• Analyze some of the evidence used to formulate these publications.
• Compare and Contrast the CDC and SHEA recommendations.
Hospital-acquired Infections (HAIs): A Big Problem

According to the Centers for Disease Control and Prevention (CDC), HAIs accounted for an estimated 1.7 million infections and 99,000 deaths annually.

Top 4 Hospital Acquired Infections by Type

<table>
<thead>
<tr>
<th>Infection Type</th>
<th>Annual Number of Infections</th>
<th>Total Annual Cost to Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloodstream Infections</td>
<td>248,678</td>
<td>$5,779,774,076</td>
</tr>
<tr>
<td>SSI</td>
<td>290,485</td>
<td>$3,033,534,855</td>
</tr>
<tr>
<td>Urinary Tract Infections</td>
<td>561,667</td>
<td>$425,743,586</td>
</tr>
<tr>
<td>Pneumonia VAP</td>
<td>250,205</td>
<td>$6,273,139,760</td>
</tr>
</tbody>
</table>

Department of Health and Human Services, Action Plan to Prevent Healthcare-Associated Infections 06222009, Section 3 Introduction, pg 7, 8.
Extraluminal biofilm:
• Major source of CRBSI within first week of catheterization in short-term catheters
• Major source of tunnel infections in long-term catheters

Intraluminal biofilm:
• Major source of CRBSI after 1 week in both short- and long-term catheters

SHEA Recommended Basic and Special Approaches for the Prevention of CLA-BSIs

Catheter Insertion Bundle

Catheter Maintenance Bundle

**SHEA Recommended Basic and Special Approaches for the Prevention of CLA-BSIs**

### Basic Practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Recommendation</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter Checklist</td>
<td></td>
<td>B– II</td>
</tr>
<tr>
<td>Hand Hygiene</td>
<td></td>
<td>B– II</td>
</tr>
<tr>
<td>Insertion site–Femoral</td>
<td></td>
<td>A– I</td>
</tr>
<tr>
<td>Cart Kit</td>
<td></td>
<td>B– II</td>
</tr>
<tr>
<td>Maximal Barrier Precaution</td>
<td></td>
<td>A– I</td>
</tr>
<tr>
<td>Chlorhexidine (CHG) Skin Prep</td>
<td></td>
<td>A– I</td>
</tr>
</tbody>
</table>

**Marschall J, et al.  ICHE 2008;29:S22-30.**
# SHEA Recommended Basic and Special Approaches for the Prevention of CLA-BSIs

## Basic Practices

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</tr>
<tr>
<td>Chlorhexidine (CHG) Skin Prep</td>
<td>A–I</td>
</tr>
</tbody>
</table>

## Special Approaches

<table>
<thead>
<tr>
<th>Approach</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHG Baths (ICU patients)</td>
<td>B–II</td>
</tr>
<tr>
<td>Impregnated Catheters</td>
<td>A–I</td>
</tr>
<tr>
<td>BioPatch Disk</td>
<td>B–I</td>
</tr>
<tr>
<td>Antimicrobial Locks</td>
<td>A–I</td>
</tr>
</tbody>
</table>

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*Marschall J, et al. ICHE 2008;29:S22-30* 

Friday, February 12, 2016
Microbiology of the Skin

• 80% of the resident bacteria exist within first 5 layers of stratum corneum.
• 20% are found in biofilms within hair follicles and sebaceous glands.
• Complete recolonization of epidermis can occur within 18 hours of antiseptic application.

Ryder, MA. Catheter-Related Infections: It’s All About Biofilm. Topics in Advanced Practice Nursing eJournal. 2005;5 (3) ©2005 Medscape
Pathogenesis: Where do the pathogens come from that cause CR–BSI?


Friday, February 12, 2016
Pathogenesis: Where do the pathogens come from that cause CR-BSI?

Contaminated Catheter Hub 12%

Pathogenesis: Where do the pathogens come from that cause CR-BSI?

1. Contaminated Catheter Hub: 12%
2. Contaminated Infusate: <1%
Pathogenesis: Where do the pathogens come from that cause CR-BSI?

1. Contaminated Catheter Hub 12%
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3. Skin Organisms 60%

---

Pathogenesis: Where do the pathogens come from that cause CR-BSI?

1. Contaminated Catheter Hub: 12%
2. Contaminated Infusate: <1%
3. Skin Organisms: 60%

Unknown = 28%

Hierarchy of Medical Evidence

http://library.downstate.edu/ebm/2500.htm
2011 CDC Guidelines


Intended to provide evidence-based recommendations for preventing intravascular catheter-related infections

2011 CDC Guidelines

**Guideline Categorization**

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

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

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

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

- **Unresolved issue.** Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.
2011 CDC Guidelines
2011 CDC Guidelines
5 major areas of emphasis:

• Education of healthcare professionals

• Use maximal sterile barrier precautions (MSBP)

• Use of $\geq 0.5\%$ CHG skin prep

• Avoiding routine replacement of CV catheters as a strategy to prevent

• Use antiseptic/antibiotic impregnated catheters and CHG impregnated sponge dressing (If rate of infection not decreasing despite adherence to above 4

Targets elimination of CR-BSI from ALL patient care areas
2011 CDC Guidelines
2011 CDC Guidelines

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

- Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections.

- Periodically assess knowledge of and adherence to guidelines for all persons who are involved in the insertion and maintenance of intravascular catheters.

- Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters.
Selection of Catheters and Sites

• Avoid using the femoral vein for central venous access in adult patients.

• Avoid the subclavian site in hemodialysis patients and patients with advanced kidney disease, to avoid subclavian vein stenosis.

• Promptly remove any intravascular catheter that is no longer essential.
Aseptic Technique

- Sterile gloves should be worn for the insertion of arterial, central, and midline catheters.
- Prepare clean skin site with $\geq 0.5\%$ chlorhexidine preparation with alcohol before central venous catheter and peripheral artery 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.
Dressings and Antibiotics

• Use either sterile gauze or sterile, transparent, semi-permeable dressing to cover the catheter site.

• Use a chlorhexidine/silver sulfadiazine or minocycline/rifampin-impregnated CVC in patients whose catheter is expected to remain in place > 5 days*.

*Implement if, after successful implementation of a comprehensive strategy to reduce rates of CLA-BSI, the CLA-BSI rate is not decreasing.

The comprehensive strategy should include at least the following three components: educating persons who insert and maintain catheters, use of maximal sterile barrier precautions, and a ≥ 0.5% chlorhexidine preparation with alcohol for skin antisepsis during CVC insertion.
Administration sets, port/connector disinfection

• Minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor or 70% alcohol) and accessing the port only with sterile devices.
2011 CDC Guidelines

Category IB

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

• Maintain aseptic technique for the insertion and care of intravascular catheters.
• Use ultrasound guidance to place central venous catheters to reduce the number of cannulation attempts and mechanical complications, if this technology is available.
• Ensure that catheter site care is compatible with the catheter material.
• Do not administer systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or CR-BSI.
• Antiseptics should be allowed to dry according to the manufacturer’s recommendation before placing the catheter.

• 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.

• 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.

  —* Use povidone iodine antiseptic ointment or bacitracin/neomycin/polymyxin B ointment at the hemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the hemodialysis catheter per manufacturer’s recommendation.
Skin Prep and Site Care

• Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled.
• Do not submerge the catheter or catheter site in water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (e.g., if the catheter and connecting device are protected with an impermeable cover during the shower).
• Replace dressings used on short-term CVC sites at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing.
2011 CDC Guidelines
Category 1B Recommendations
Highlights
2011 CDC Guidelines
Category 1B Recommendations
Highlights

No recommendation is made for other types of chlorhexidine dressings. Unresolved Issue
2011 CDC Guidelines
Category 1B Recommendations
Highlights

Skin Prep and Site Care

No recommendation is made for other types of chlorhexidine dressings. Unresolved Issue
Skin Prep and Site Care

• Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients >2 months of age, if the CLA–BSI rate is not decreasing despite adherence to basic prevention measures, including education and training, use of chlorhexidine skin antisepsis, and MBSP.

No recommendation is made for other types of chlorhexidine dressings. **Unresolved Issue**
**Skin Prep and Site Care**

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  No recommendation is made for other types of chlorhexidine dressings. Unresolved Issue

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

• There is no need to replace peripheral catheters more frequently than every 72–96 hours to reduce risk of infection and phlebitis in adults.

• Replace peripheral catheters in children only when clinically indicated.
Personnel and Performance

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

• Ensure appropriate nursing staff levels in ICUs. Observational studies suggest that a higher proportion of "pool nurses" or an elevated patient-to-nurse ratio is associated with CR-BSI in ICUs where nurses are managing patients with CVCs.
2011 CDC Guidelines
2011 CDC Guidelines

Category II
Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.
• Replace arterial catheters only when there is a clinical indication.
• Change the needleless components at least as frequently as the administration set. There is no benefit to changing these more frequently than every 72 hours.
• Change needleless connectors no more frequently than every 72 hours or according to manufacturers' recommendations for the purpose of reducing infection rates/
• If the patient is diaphoretic or if the site is bleeding or oozing, use gauze dressing until this is resolved.
• Use a 2% chlorhexidine wash for daily skin cleansing to reduce CR–BSI.

• Use a sutureless securement device to reduce the risk of infection for “intravascular catheters”.

• Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected.

• Replace transparent dressings used on tunneled or implanted CVC sites no more than once per week (unless the dressing is soiled or loose), until the insertion site has healed.
2011 CDC Guidelines
2011 CDC Guidelines

Unresolved Issue
Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.
• No recommendation can be made;
  – for a preferred site of insertion to minimize infection risk for a tunneled CVC.
  – regarding the use of a designated lumen for parenteral nutrition.
  – between using chlorhexidine preparations with alcohol and povidone–iodine in alcohol to prepare clean skin.
  – for the safety or efficacy of chlorhexidine in infants aged <2 months.
  – for other types of chlorhexidine dressings.
No recommendation can be made:
- regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs.
- regarding replacement of peripheral catheters in adults only when clinically indicated.
- regarding the frequency for replacing intermittently used administration sets.
- regarding the frequency for replacing needles to access implantable ports.
- regarding the length of time a needle used to access implanted ports can remain in place.
SHEA Compendium
2014 Update

• Intent
  – highlight practical recommendations in a concise format designed to assist acute care hospitals in implementing and prioritizing their (CLA–BSI) prevention efforts.

• Update to

• Sponsored by the
  – SHEA (Society for Healthcare Epidemiology of America)
  – In Collaboration with
    • IDSA (Infectious Diseases Society of America)
    • AHA (American Hospital Association)
    • APIC (Association for Professionals in Infection Control and Epidemiology)
    • TJC (The Joint Commission)
Table 1. Grading of the Quality of Evidence

<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. High</td>
<td>Highly confident that the true effect lies close to that of the estimated size and direction of the effect. Evidence is rated as high quality when there is a wide range of studies with no major limitations, there is little variation between studies, and the summary estimate has a narrow confidence interval.</td>
</tr>
<tr>
<td>II. Moderate</td>
<td>The true effect is likely to be close to the estimated size and direction of the effect, but there is a possibility that it is substantially different. Evidence is rated as moderate quality when there are only a few studies and some have limitations but not major flaws, there is some variation between studies, or the confidence interval of the summary estimate is wide.</td>
</tr>
<tr>
<td>III. Low</td>
<td>The true effect may be substantially different from the estimated size and direction of the effect. Evidence is rated as low quality when supporting studies have major flaws, there is important variation between studies, the confidence interval of the summary estimate is very wide, or there are no rigorous studies, only expert consensus.</td>
</tr>
</tbody>
</table>

Note. Based on Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) and the Canadian Task Force on Preventive Health Care.

Not all recommendations within this publication were accompanied by a quality grade.
Section 1: Rational and Statements of Concern

- Besides central venous catheters (CVCs), peripheral arterial catheters also carry a risk of infection.
- Factors associated with increased risk of CLA-BSI includes heavy microbial colonization at the insertion site.
- Patients at risk; non–ICU population: ... Majority of CLA–BSIs occur in hospital units outside the ICU or in outpatient units.
- Infection prevention and control efforts should include... patient receiving hemodialysis through catheters.
Section 2: Background – Strategies to Detect CLA–BSI

• Recent data suggests that inter-rater reliability using CDC NHSN definitions is lower than expected. This may also affect the reliability of public reporting. Additionally, the NHSN surveillance definition for CLA–BSI is different from the clinical definition for CR–BSI.

Section 3: Background – Strategies to Prevent CLA–BSIs

• The recommendations in this document focus on CVCs unless noted otherwise. These recommendations: (1) are not stratified on the basis of catheter type (e.g., tunneled, implanted, cuffed, non-cuffed catheters and dialysis catheter) and (2) may not be applicable for prevention of bloodstream infections with other intravascular devices.
Section 4: Recommended Strategies for the Prevention of CLA–BSIs

- Basic Strategies for preventing and monitoring CLA–BSIs are recommended for all acute care hospitals.

- The optimal choice of antiseptic agents is unresolved for children <2 months of age. However, chlorhexidine is widely used in children <2 months of age. A U.S. survey found that in the majority of neonatal ICUs (NICUs) chlorhexidine products are used for catheter insertion in this age group... Some institutions have used chlorhexidine–containing sponge dressings for CVCs and chlorhexidine for cleaning CVC insertion sites in children in this age group with minimal risk of such reactions. Providers must carefully weigh the potential benefit in preventing CLA–BSI in children <2 months.
Section 4: Recommended Strategies for the Prevention of CLABSI

- Basic Strategies for preventing and monitoring CLABSI; recommended for all acute care hospitals.

- Do not use peripherally inserted central catheters (PICCs) as a strategy to reduce the risk of CLA-BSI.

- Use an all-inclusive catheter cart or kit…A catheter cart or kit that contains all necessary components for aseptic catheter insertion has to be available and easily accessible in all units where CVCs are inserted. (quality of evidence II).

- Use antimicrobial ointment for hemodialysis catheter-insertion sites (quality of evidence: I)...if compatible with catheter material...certain manufacturers have indicated that the glycol constituents of ointments should not be used on their polyurethane catheters.
II. Special approaches for preventing CLA–BSI

• Use antiseptic– or antimicrobial–impregnated CVCs in adult patients (quality of evidence: I).

• Use chlorhexidine–containing dressings for CVCs in patients >2 months of age (quality of evidence I).
  – It is unclear whether there is additional benefit to using a chlorhexidine–containing dressing if daily chlorhexidine bathing is already established and vice versa.

• Use an antiseptic–containing hub/connector cap/port protector to cover connectors (quality of evidence I).
IV. Unresolved Issues

• Intravenous therapy teams for reducing CLA–BSI rates
  – Studies have shown that an intravenous therapy team responsible for insertion and maintenance of peripheral intravenous catheters reduces the risk of bloodstream infections. However, few studies have been performed regarding the impact of intravenous therapy teams on CLA–BSI rates.

• Peripheral artery catheters and peripheral venous catheters are not included in most surveillance systems, although they are associated with risk of bloodstream infection independent of CVCs.
  – Future surveillance systems may need to include bloodstream infections associated with these types of catheters.

• Impact of the use of chlorhexidine–based products on bacterial resistance to chlorhexidine
  – Widespread use of chlorhexidine–based products (e.g., use of chlorhexidine bathing, antisepsis, and dressings) may promote reduced chlorhexidine susceptibility in bacterial strains. However, testing for chlorhexidine susceptibility is not standardized. The clinical impact of reduced chlorhexidine susceptibility in gram–negative bacteria is unknown.
Section 6: Examples of Implementation Strategies

• Insertion of CVCs is one of the most common procedures performed at the patient’s bedside. The insertion procedure represents only one aspect of the risk for CLA–BSI, with the risk extending to all aspects of nursing care and maintenance during the CVC dwell time.

• Both extraluminal and intraluminal avenues for CVC infection should be addressed in the education plan.
Section 6: Examples of Implementation Strategies

• Changes of products, devices or technology used in the insertion and care of CVCs require adequate device training for all healthcare personnel expected to use the product(s). This training follows a period of device evaluation and its impact or CLA–BSI. Most device manufacturers employ personnel with clinical experience to provide product training, and this resource should not be overlooked.

• Measurement of healthcare professionals’ current level of knowledge about CVC insertion and care can provide valuable information for designing educational programs.
Section 6: Examples of Implementation Strategies

- Process measurement includes, but is not limited to, compliance with insertion bundles, CVC utilization by insertion site or type (e.g., femoral catheters vs. other CVC sites, PICCs vs. centrally inserted lines), the condition of CVC dressing and timely dressing changes, and integrity and appropriate management of needleless connectors, other add-on-devices, and intravenous administration sets.

- Establish baseline compliance with evidence-based practices for line maintenance, such as the presence of clean and intact dressings.
Section 6: Examples of Implementation Strategies

- Accountability is an essential principle for preventing HAIs... begins with the chief executive officer and other senior leaders who provide the imperative for HAI prevention, thereby making HAI prevention an organizational priority. Senior leadership is accountable for providing adequate resources needed for effective implementation of an HAI prevention program. These resources include necessary personnel (clinical and nonclinical), education, and equipment.

- Education of facility administrators is necessary to ensure adequate funding and implementation of CLA–BSI prevention. Additionally, the goal of zero tolerance for CLA–BSI may be set by the chief officers of an institution; however, whether this goal can be reached depends on a number of factors.
<table>
<thead>
<tr>
<th></th>
<th>CDC</th>
<th>SHEA</th>
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<tbody>
<tr>
<td>Maximum Sterile Barrier Precautions</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>(CVC insertion)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Use of Ultrasound Guidance (USG)</td>
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<td>✔</td>
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<td></td>
<td></td>
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<tr>
<td>CHG Skin Prep</td>
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<tr>
<td>Antiseptic/anitmicrobial catheters</td>
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<tr>
<td>CHG dressing</td>
<td>✔    **</td>
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<tr>
<td>Port/needleless connector disinfection</td>
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<tr>
<td>Remove Non-essential catheters</td>
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<tr>
<td>House-Wide surveillance</td>
<td>✔</td>
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*SHEA specifies use of USG for IJ access, CDC generalizes and says it should be used if available.

**CDC Guideline specifies chlorhexidine sponge dressing. Other chlorhexidine dressings are an unresolved issue.

Friday, February 12, 2016
Chlorhexidine-Impregnated Sponges and Less Frequent Dressing Changes for Prevention of Catheter-Related Infections in Critically Ill Adults: A Randomized Controlled Trial

Jean-François Timeit, MD, PhD
Carola Schwabel, MD, PhD
Lila Beaudina, MD
Arnaud Geoffroy, MD
Mathis Carrouste-Orgeas, MD
Sébastien Pasca, MD
Marie-Christine Barreux, MD
Hakim Haouache, MD
Silvia Calvino-Cunha, RN
Brice Cestin, PhD
Laurence Arnaud-Lafaye, PharmD
Véronique Leclercq, PharmD
Chantal Chaplain, PharmD
Adol Banali, MD
Adrien François, MSc
Christophe Adri, MD, PhD
Jean-Ralph Zahir, MD
Marie Thoong, MD
Xavier Arnault, PharmD
Jacques Croise, PharmD
Jean-Christophe Lucot, MD, PhD
for the Dressing Study Group

Context: Use of a chlorhexidine gluconate-impregnated sponge (CHGIS) in intravascular catheter dressing may reduce catheter-related infections (CRIs). Changing catheter dressing every 3 days may be more frequent than necessary.

Objective: To assess superiority of CHGIS dressing regarding the rate of major CRIs (clinical sepsis with or without bloodstream infection) and noninferiority (less than 3% colonization-rate increase) of 7-day vs 3-day dressing changes.

Design, Setting, and Patients: Assessor-blind, 2 × 2 factorial, randomized controlled trial conducted from December 2006 through June 2008 and recruiting patients from 7 intensive care units in 3 university and 2 general hospitals in France. Patients were adults (>18 years) expected to require an arterial catheter, central-vein catheter, or both inserted for 48 hours or longer.

Interventions: Use of CHGIS vs standard dressings (controls). Scheduled change of unscented adhesive dressings every 3 vs every 7 days, with immediate change of any soiled or leaking dressings.

Main Outcome Measures: Major CRIs for comparison of CHGIS vs control dressings; colonization rate for comparison of 3- vs 7-day dressing changes.

Results: Of 2095 eligible patients, 1636 (778 catheters, 28931 catheter-days) could be evaluated. The median duration of catheter insertion was 6 (interquartile range [IQR], 4–10) days. There was no interaction between these interventions. Use of CHGIS dressings decreased the rates of major CRIs (10/1915 [0.5%], 0.6 per 1000 catheter-days vs 19/1825 [1.1%], 1.4 per 1000 catheter-days; hazard ratio [HR], 0.39 [95% confidence interval [CI], 0.17–0.93], P = .03) and catheter-related bloodstream infections (6/1915 catheters, 0.40 per 1000 catheter-days vs 17/1825 catheters, 1.3 per 1000 catheter-days; HR, 0.24 [95% CI, 0.09–0.65]). The CHGIS dressing was not associated with greater resistance of bacteria in skin samples at catheter removal. Severe CHGIS-associated contact dermatitis occurred in 8 patients (5.3 per 1000 catheter-days). Use of CHGIS dressings prevented 1 major CRI per 117 catheters. Catheter colonization rates were 142 of 1687 catheters (8.0%) in the 3-day group (10.4 per 1000 catheter-days) and 168 of 1828 catheters (8.6%) in the 7-day group (11.0 per 1000 catheter-days), a mean absolute difference of 0.8% (95% CI, 1.78% to 2.15%), (HR, 0.99; 95% CI, 0.77–1.28), indicating noninferiority of 7-day changes. The median number of dressing changes per catheter was 4 (IQR, 3–6) in the 3-day group and 3 (IQR, 2–5) in the 7-day group (P < .001).

Conclusions: Use of CHGIS dressings with intravascular catheters in the intensive care unit reduced risk of infection even when background infection rates were low. Reducing the frequency of changing unscented adhesive dressings from every 3 days to every 7 days modestly reduces the total number of dressing changes and appears safe.

Trial Registration: clinicaltrials.gov Identifier: NCT00441733

See also p 1285 and Patient Page.
This randomized clinical trial assessed the superiority of BIOPATCH Disk regarding the rate of major CRIs (clinical sepsis with or without bloodstream infection) and noninferiority (less than 3% colonization-rate increase) of 7-day vs. 3-day dressing changes.

- 1,636 patients from 7 intensive care units in 3 university and 2 general hospitals.
- Patients required an arterial catheter, CVC, or both for ≥48 hours.
  - 1,727 of the total 3,778 lines enrolled in this study were arterial catheters
- The median duration of catheter insertion was 6 days.
- A chlorhexidine gluconate-impregnated sponge or standard dressing (control) was used for the patients.
- The scheduled change of unsoiled adherent dressings was every 3 or 7 days, with immediate change of any soiled or leaking dressings.

Chlorhexidine-Impregnated Sponges and Less Frequent Dressing Changes for Prevention of Catheter-Related Infections in Critically Ill Adults: A Randomized Controlled Trial

Table 3. Hazard Ratios in the Intention-To-Treat and Per-Protocol Analyses

<table>
<thead>
<tr>
<th>Variable</th>
<th>Incidence, No./1000 Catheter-Days</th>
<th>ITT Analysis</th>
<th>Per-Protocol Analysis&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Incidence, No./1000 Catheter-Days</th>
<th>ITT Analysis</th>
<th>Per-Protocol Analysis&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter colonization &gt;10 CFUs/plate</td>
<td>Control (n = 1825)</td>
<td>15.8 (95% CI 0.28-0.46)</td>
<td>0.36 &lt;.001</td>
<td>0.35 (95% CI 0.27-0.45)</td>
<td>0.01 &lt;.001</td>
<td>10.4 (95% CI 0.77-1.28)</td>
</tr>
<tr>
<td>Catheter-related bloodstream infection</td>
<td>Control (n = 1815)</td>
<td>1.3 (95% CI 0.09-0.65)</td>
<td>0.24 .005</td>
<td>0.24 (95% CI 0.09-0.63)</td>
<td>0.7</td>
<td>0.9 (95% CI 0.47-3.34)</td>
</tr>
<tr>
<td>Major catheter-related infection</td>
<td>Control (n = 1963)</td>
<td>1.4 (95% CI 0.16-0.93)</td>
<td>0.39 .03</td>
<td>0.38 (95% CI 0.16-0.92)</td>
<td>0.9</td>
<td>1.1 (95% CI 0.50-2.69)</td>
</tr>
</tbody>
</table>

Abbreviations: CFU, colony-forming unit; CHGIS, chlorhexidine gluconate–impregnated sponge; CI, confidence interval; HR, hazard ratio; ITT, intention-to-treat.

<sup>a</sup>Analysis adjusted on imbalanced parameters (ie, presence of ≥1 chronic disease for comparison of control and CHGIS groups).

Chlorhexidine-Impregnated Sponges and Less Frequent Dressing Changes for Prevention of Catheter-Related Infections in Critically Ill Adults: A Randomized Controlled Trial

<table>
<thead>
<tr>
<th>Variable</th>
<th>Incidence, No./1000 Catheter-Days</th>
<th>Dressing</th>
<th>ITT Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter colonization &gt;10 CFUs/plate</td>
<td>Control (n = 1825)</td>
<td>CHGIS (n = 1953)</td>
<td>HR (95% CI)</td>
</tr>
<tr>
<td></td>
<td>15.8</td>
<td>6.3</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>(0.28-0.46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catheter-related bloodstream infection                                   1.3 0.4 0.24 .005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.09-0.65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major catheter-related infection                                           1.4 0.6 0.39 .03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.16-0.92)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dressing Change Interval</th>
<th>Per-Protocol Analysis(^a)</th>
<th>Incidence, No./1000 Catheter-Days</th>
<th>ITT Analysis</th>
<th>Per-Protocol Analysis(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR (95% CI)</td>
<td>Value</td>
<td>3 d (n = 1815)</td>
<td>7 d (n = 1963)</td>
</tr>
<tr>
<td>Catheter colonization &gt;10 CFUs/plate</td>
<td>0.35 0.27-0.45</td>
<td>&lt;.001 0.004</td>
<td>10.4 0.47-3.34</td>
<td>11.0 0.48-3.40</td>
</tr>
<tr>
<td>Catheter-related bloodstream infection</td>
<td>0.24 0.09-0.63</td>
<td>.005 0.62</td>
<td>0.7 0.47-3.34</td>
<td>0.9 0.48-3.40</td>
</tr>
<tr>
<td>Major catheter-related infection</td>
<td>0.38 0.16-0.92</td>
<td>.03 0.70</td>
<td>0.9 0.50-2.69</td>
<td>1.1 0.51-2.73</td>
</tr>
</tbody>
</table>

Abbreviations: CFU, colony-forming unit; CHGIS, chlorhexidine gluconate-impregnated sponge; CI, confidence interval; HR, hazard ratio; ITT, intention-to-treat.

\(^a\) Analysis adjusted on imbalanced parameters (ie, presence of ≥1 chronic disease for comparison of control and CHGIS groups).

Prevention of central venous catheter–related infections with chlorhexidine gluconate impregnated wound dressing: A randomized controlled trial.

- 601 patients receiving catheters were randomized to receive either BIOPATCH® over the catheter insertion site or a standard sterile control dressing.

- All patients received triple-lumen CVCs (Arroguard® Blu, Arrow, Erding, Germany) impregnated with chlorhexidine-silversulphadiazine under standardized sterile conditions.

- Catheters were removed when no longer needed or CR-BSI was suspected.

- Daily routine included clinical assessment of insertion site, body temperature, white blood count, and C-reactive protein.

- The groups were comparable in demographic and clinical data.

- Nineteen cases of CR-BSI occurred in the BIOPATCH® group (300 patients) vs. 34 cases in the control group (301 patients). This difference was statistically significant (P=0.0271).
Keystone Project

- **Study design**: Intervention cohort study in 108 Michigan Intensive care units (ICUs) over 18 months. Comparison of CVC-BSI rates before, during, and after intervention.

- **Results**: 103 ICUs. 1,981 months of ICU data and 375,757 catheter-days.

<table>
<thead>
<tr>
<th>Median CVC-BSI Rates per 1,000 CVC-days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>2.7</td>
</tr>
</tbody>
</table>

**Conclusion**: An evidence-based intervention resulted in a large and sustainable decrease (up to 66%) in CVC-BSI rates that was maintained for 18 months.

Pronovost P. et al NEJM 2006;355:2725-32

- **Study Design**: Centers for Disease Control and Prevention (CDC) estimate of CLA-BSI rates from their National Healthcare Safety Network (NHSN) surveillance system.

<table>
<thead>
<tr>
<th>Population</th>
<th>Year</th>
<th>Estimated number of CLA-BSIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive care unit (ICU)</td>
<td>2001</td>
<td>43,000</td>
</tr>
<tr>
<td>ICU</td>
<td>2009</td>
<td>25,000</td>
</tr>
<tr>
<td>Inpatient wards</td>
<td>2009</td>
<td>23,000</td>
</tr>
<tr>
<td><strong>Outpatient hemodialysis</strong></td>
<td>2008</td>
<td><strong>37,000</strong></td>
</tr>
</tbody>
</table>

**Conclusion**: Currently, outpatient hemodialysis patients have the highest rate of CLA-BSIs. More aggressive CLA-BSI prevention interventions (proven in ICU patients) need to be applied to these patients.  

*CDC MMWR Morb Mortal Wkly Rep 2011;60:243-8.*

• In 2009, an estimated 25,000 fewer CLA-BSIs.
• 58% reduction from 2001 to 2009.
• 6,000 lives saved.
• $414 million in potential excess healthcare costs in 2009.
• An estimated $1.8 billion cumulative excess healthcare costs since 2001.

Incidence of CR-BSI in PICC Lines
House-Wide; January 2005-March 2009

Incidence of CR-BSI- all CVC
House-Wide; January 2005- March 2009

Sophie Harnage RN, BSN
Clinical Manager Infusion Services
Sutter Roseville Medical Center
Roseville, CA

Sophie Harnage RN, BSN
Clinical Manager Infusion Services
Sutter Roseville Medical Center
Roseville, CA
Conclusion

• Prevention of CLA–BSIs requires both an insertion and maintenance bundle.
• With full implementation of these bundles, many if not most CLA–BSIs are preventable.
• Hospital administrations should provide the education, training and resources to fully implement these bundles and foster an atmosphere of Zero Tolerance for CLA–BSIs.