Guide Outline

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<td>Banton</td>
<td>Journal of Vascular Access</td>
<td>2002</td>
<td>Catheter-related bloodstream infections (CRBSIs) pose a serious and costly complication, especially among immunocompromised populations such as oncology patients. This paper evaluated the clinical impact of BIOPATCH Disk on vascular access devices in an outpatient Oncology/Hematology/Bone Marrow Transplant Unit and in a Trauma Life Center. The authors show that antimicrobial BIOPATCH Disk is an efficacious choice for the prevention of CRBSIs.</td>
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<td>Techniques to prevent central venous catheter infections: products, research, and recommendations</td>
<td>Banton</td>
<td>Nutrition in Clinical Practice</td>
<td>2006</td>
<td>Catheter-related blood stream infections (CRBSIs) are one of the most common complications associated with central venous catheters. This paper examined the combined use of three products at the catheter insertion site in the prevention of CRBSIs in a clinical setting. The author demonstrated that the combined use of these three products reduced the rate of CRBSIs, and shared real-world tips on the use of these products.</td>
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<td>In vitro antimicrobial effectiveness of five catheter insertion site dressings</td>
<td>Bhende</td>
<td>Journal of the Association of Vascular Access</td>
<td>2007</td>
<td>BIOPATCH Disk was compared with four silver dressings for antimicrobial efficacy using zone of inhibition (ZOI) assays against seven clinically relevant bacteria and yeast. The study results show that BIOPATCH Disk had excellent antimicrobial activity in vitro and is an efficacious choice for preventing CRBSIs. BIOPATCH Disk showed sustained efficacy for a period of seven days. Three of the silver dressings had different patterns of efficacy varying from one to six days compared to BIOPATCH Disk, and a hydrogel dressing containing silver performed poorly compared to all other dressings.</td>
<td>In Vitro</td>
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<td>In vitro assessment of chlorhexidine gluconate-impregnated polyurethane foam</td>
<td>Bhende</td>
<td>Infection Control and Hospital Epidemiology</td>
<td>2004</td>
<td>Most catheter-related blood stream infections (CRBSIs) are caused by the migration of skin organisms at insertion site. This study examined the in vitro antimicrobial activity of chlorhexidine gluconate-impregnated foam against the primary organisms associated with these infections. The data show that BIOPATCH Disk is effective in vitro against a variety of antibiotic-resistant clinical isolates and the most common infections related to percutaneous devices.</td>
<td>In Vitro</td>
<td>NA</td>
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<td>Reduction of exit-site infections of tunnelled intravascular catheters among neutropenic patients by sustained-release chlorhexidine dressings</td>
<td>Chambers</td>
<td>Journal of Hospital Infection</td>
<td>2005</td>
<td>Infections of tunnelled central intravascular catheters are a common source of morbidity and increased healthcare costs among neutropenic patients. This randomized clinical trial examined the activity of chlorhexidine gluconate-impregnated dressing in the prevention of exit-site and tunnel infections. The data show that sustained-release BIOPATCH Disk reduced the exit-site/tunnel infections and reduced premature removal of catheters due to infection.</td>
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<td>Cost-benefit analysis of chlorhexidine gluconate dressing in the prevention of catheter-related bloodstream infections</td>
<td>Crawford</td>
<td>Infection Control and Hospital Epidemiology</td>
<td>2004</td>
<td>While clinical trials have demonstrated the efficacy of chlorhexidine gluconate (CHG) in reducing the incidence of catheter related bloodstream infections (CRBSI), the financial implications have not been examined. The authors conducted a cost-benefit analysis of BIOPATCH Disk on central venous catheter insertion sites to reduce CRBSIs, costs, and mortality. The data show that BIOPATCH Disk would reduce costs, local infections, CRBSI, and death, and should be considered in patients with catheters.</td>
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<td>The promise of novel technology for the prevention of intravascular device-related bloodstream infection I. Pathogenesis and short-term devices</td>
<td>Crnich</td>
<td>Clinical Infectious Diseases</td>
<td>2002</td>
<td>Intravascular devices (IVD) are widely used but associated with substantial risk of IVD related bloodstream infections (BSI). The authors reviewed novel technologies that promised to reduce these infections by reducing microorganisms that colonize the skin around the insertion site. The authors conclude that cutaneous antiseptics all reduce the risk of IVD-related BSI in prospective randomized trials and that future challenges include identifying new preventive technologies and more widely adopting those proven efficacious and cost effective.</td>
<td>SR</td>
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<td>Randomized Trial of Drain Antisepsis After Mastectomy and Immediate Prosthetic Breast Reconstruction</td>
<td>Degnim</td>
<td>Annals of Surgical Oncology</td>
<td>2014</td>
<td>Development of a surgical site infection (SSI) in this population is often devastating, with many resulting in implant loss. Local antiseptic measures using a chlorhexidine disc to each site and drain bulb irrigation with hypochlorite solution significantly reduced bacterial colonization of the surgical drain and bulb drain fluid. Reduced colonization of the drain was associated with decreased frequency of surgical site infections.</td>
<td>RCT</td>
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<td>Protected Clinical Indication of Peripheral Intravenous Lines: Successful Implementation</td>
<td>DeVries</td>
<td>Journal of the Association for Vascular Access</td>
<td>2016</td>
<td>Clinically indicated replacement of peripheral IVs was selected over routine replacement because it can lower healthcare expenditures without involving any extra risks of complications. As a result of the clinically indicated replacement protocol, the organization documented a 37% reduction (P= 0.03) in primary bacteremias (combining PIV and central line-associated bloodstream infections) and a 19% reduction in PIV bloodstream infections. CLABSI standardized infection rates for the publicly reported intensive care units decreased from 1.3 to 0.32 (P= 0.02). IV start kit use decreased 48% during the year following bundle implementation. Using an evidence based approach allowed for the adoption of the latest standards while taking proactive steps to mitigate risk proved to be a successful strategy.</td>
<td>Case Report</td>
<td>CVC PICC</td>
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<td>Reducing catheter-related bloodstream infections: an extended-care facility’s process improvement experience</td>
<td>Earhart</td>
<td>Journal of the Association for Vascular Access</td>
<td>2006</td>
<td>In 2002, the authors’ hospital noted a significant increase in catheter-related bloodstream infection (CRBSI) from 0.5 per 1,000 patient days to 12 per 1,000 patient days. A process improvement team evaluated the key elements causing the CRBSI increase and instituted a process improvement process. The authors review the details of this experience, including the use of reverse-tapered peripherally inserted central catheters, the use of BIOPATCH Disk, increasing supplies, and educating core staff.</td>
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<td>Treatment of external fixation pins about the wrist</td>
<td>Egol</td>
<td>Journal of Bone and Joint Surgery</td>
<td>2006</td>
<td>Pin-track infections following the use of external fixators are one of the most troublesome complications in the treatment of distal radial fractures and can compromise successful treatment. This randomized clinical trial examined the efficacy of three different methods of pin-site care in the prevention of pin-track infection: weekly dry dressings without pin-site care, daily saline solution/hydrogen peroxide pin-site care, and use of BIOPATCH Disk. The data show no significant difference in pin-site complications among the three groups.</td>
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<td>Continuing evolution of multidisciplinary approach to prevention of central line-associated bacteremias</td>
<td>Fauerbach</td>
<td>American Journal of Infection Control</td>
<td>2004</td>
<td>Prevention of central line-associated bacteremias (CLABs) is a major focus for the 570-bed tertiary/transplant center. Historical risk-reduction strategies include use of antimicrobial impregnated CVL. CVL insertion tray designed to facilitate total barrier technique compliance, and use of 0.5% chlorhexidine gluconate and 70% alcohol solution (0.5% CHG) for site prep. This study examined the impact of a new 2% CHG skin prep solution (2% CHG and 70% alcohol) and BIOPATCH Disk.</td>
<td>Case Control</td>
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<td>Adding a chlorhexidine patch to the IHI bundle: goal zero in reducing central line associated bacteremia</td>
<td>Garcia</td>
<td>American Journal of Infection Control</td>
<td>2006</td>
<td>Brookdale University Medical Care has implemented since 2000 various interventions recommended by IHI for improving rates of central line-associated bacteremia (CLAB). This paper reports on an eight-month study that assessed the effect of adding BIOPATCH Disk to the IHI bundle treatment for the prevention of bacteremia in patients who had central lines inserted. The data suggest that use of BIOPATCH Disk adds considerably to a CLAB reduction bundle and reduces infection costs.</td>
<td>Case Control</td>
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<td>Chlorhexidine dressing for reduction in microbial colonization of the skin with central venous catheters</td>
<td>Hanazaki</td>
<td>Journal of Hospital Infection</td>
<td>1999</td>
<td>Central venous catheter-related infection (CVC) has low associated mortality that markedly increases with CVC-related sepsis. This letter to the editor reviews a randomized controlled study by the authors to evaluate the efficacy of BIOPATCH Disk in reducing skin colonization at CVC insertion site. The authors report that theirs was the first study to show that BIOPATCH Disk can effectively reduce Staphylococcus epidermidis colonization on the skin — the most common organism associated with septicemia.</td>
<td>RCT</td>
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<td>Achieving zero catheter related bloodstream infections: 15 months success in a community based medical center</td>
<td>Harnage</td>
<td>Journal of the Association for Vascular Access</td>
<td>2007</td>
<td>Catheter-related bloodstream infections (CRBSIs) pose a serious and costly complication. This author reviews the development and implementation of a central line bundle to reduce CRBSI rates at the 180-bed acute care, community-based, not-for-profit Sutter Roseville Medical Center. The author creates a multimodality bundle incorporating three extraluminal practices, three intraluminal practices and team monitoring to decrease the rate of CRBSIs. BIOPATCH Disk was selected as one of the extraluminal practices in the bundle.</td>
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<td>Use of chlorhexidine-impregnated dressing to prevent vascular and epidural catheter colonization and infection: a meta-analysis</td>
<td>Ho</td>
<td>Journal of Antimicrobial Chemotherapy</td>
<td>2006</td>
<td>Vascular and epidural catheters, commonly used in patients requiring anesthesia, cause significant morbidity and mortality in hospitalized patients. This meta-analysis examined the effect of chlorhexidine-impregnated dressing on the risk of vascular and epidural catheter bacterial colonization and infection. These authors concluded that chlorhexidine-impregnated dressing effectively reduces vascular and epidural catheter bacterial colonization and is also associated with a trend towards reducing catheter-related bloodstream or coagulase-negative staphylococci (CNS) infections.</td>
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<td>Erratum: Use of chlorhexidine-impregnated dressing to prevent vascular and epidural catheter colonization and infection</td>
<td>Ho</td>
<td>Journal of Antimicrobial Chemotherapy</td>
<td>2010</td>
<td>Since previous publication 2 large randomized controlled studies on the use of chlorhexidine-impregnated dressing have been published showing that the use of chlorhexidine-impregnated dressing was associated with a reduction in the risk of catheter-related bloodstream infections (CRBSI). Chlorhexidine-impregnated dressing is effective in preventing CRBSI in vascular catheters. A chlorhexidine-impregnated dressing should be used in adult patients unless contraindicated.</td>
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<td>Infectious risk associated with arterial catheters compared to center venous catheters</td>
<td>Lucet</td>
<td>Critical Care Medicine</td>
<td>2010</td>
<td>Catheter colonization and catheter-related infection rates were similar between arterial catheters and central venous catheters in critical care patients. Arterial catheters should be monitored and received the same precautions as central venous catheters. The daily hazard rate for central venous catheters was constant after fifth catheter day. The daily hazard rate of arterial catheter colonization significantly increased over time after the seventh catheter day.</td>
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<td>Technology and practice collaboration for successful positive patient outcomes</td>
<td>Macklin</td>
<td>White Paper April 2007 <a href="http://www.rymedtech.com/assets/Catheter_Bundle_WP_rev8.pdf">http://www.rymedtech.com/assets/Catheter_Bundle_WP_rev8.pdf</a></td>
<td>2007</td>
<td>Based on a catheter-related nosocomial infection rate of 5% with a mortality rate of 15%, bloodstream infections represent the eighth leading cause of death in the United States. This paper reviews the causes of CRBSI and identifies behavior-based practices and technological innovations that can significantly reduce CRBSI. The author concludes that the synergistic effect of preventive behavioral measures and innovative technology is greater than the implementation of single measures, and that reducing CRBSI rates to zero is possible.</td>
<td>Opinion</td>
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<td>The efficacy of chlorhexidine-impregnated sponge (BIOPATCH Disk) for the prevention of intravascular catheter-related infection</td>
<td>Maki</td>
<td>Abstracts of the 40th Interscience Conference on Antimicrobial Agents and Chemotherapy</td>
<td>2000</td>
<td>Many intravascular catheter-related infections result from organisms that colonize the insertion site. This randomized, controlled trial examined the efficacy of BIOPATCH Disk versus standard care on catheter colonization and catheter-related bloodstream infection (CRBSI). BIOPATCH Disk reduces the risk of catheter colonization and CRBSI. Widespread use of this inexpensive device on the short-term, high-risk catheters could have a major impact on reducing the risk of life-threatening CRBSIs.</td>
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<td>The effect of the BIOPATCH Disk, a chlorhexidine-impregnated dressing, on bacterial colonization of epidural catheter exit sites</td>
<td>Mann</td>
<td>Anaesthesia and Intensive Care</td>
<td>2001</td>
<td>The reported incidence of epidural space infections following epidural anesthesia may be increasing, with recent reports of between one in 1,930 and one in 5,000 per catheter. This randomized trial evaluated the clinical impact of BIOPATCH Disk on bacterial colonization of epidural exit sites. The data show that colonization rates of epidural sites were significantly lower with BIOPATCH Disk.</td>
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<td>Arterial Catheters as a Source of Bloodstream Infection: A Systematic Review and Meta-Analysis</td>
<td>O’Horo</td>
<td>Critical Care Medicine</td>
<td>2014</td>
<td>Arterial catheters are an under recognized source for CRBSI. Pooled data indicated an increase infection rate in studies which cultured all catheters. The rate of infection seen in cultured arterial catheters was similar to infection rates associated with short term central venous catheters. The femoral site created an increased risk of infection. Use of technologies, such as the chlorhexidine impregnated sponge should be considered for high risk patient with femoral arterial catheters.</td>
<td>Systematic Review/ Meta-analysis</td>
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(cont.)
Infections related to venous catheters (CVCs) in the intensive care unit (ICU) are common and associated with high morbidity and mortality (10% to 20%). This randomized clinical trial evaluated the clinical impact of BIOPATCH Disk on catheter-related infections in ICU insertion site management.

The data show that use of BIOPATCH Disk results in very low colonization rates of CVC tip and exit-site swab comparable to control. It concludes that a much larger study group will be required to demonstrate the efficacy of BIOPATCH Disk.

Use of chlorhexidine-impregnated sponge (CHGIS) dressings with intravascular catheters cause more than 250,000 bloodstream infections (BSIs) each year. This prospective cohort study examined the pathogenesis of catheter-related BSIs (CRBSIs) in a clinical setting.

The data show that most of these CVC-related BSIs were extraluminally acquired and derived from cutaneous microflora, and that successful suppression of this flora can reduce the risk of CRBSIs with short-term CVCs.

The chain of events leading to infection by organisms that colonize the skin at epidural site may be broken by reducing microbial population at insertion point.

This prospective randomized study assessed the efficacy of BIOPATCH Disk in reducing microbial flora at epidural catheter insertion sites.

The data show that BIOPATCH Disk significantly reduced the rate of CRBSI in immunocompromised patients over and above the effect of the antimicrobial impregnated catheters.

The final dressing disruption increased by greater than twelve-fold for major catheter-related infections and catheter-related bloodstream infection. The second dressing disruption was associated with a higher than three-fold increase in major catheter-related infections.

The number of dressing disruptions related to an increased risk of catheter colonization. Dressing disruption was higher in patients with high severity illness scores.

Use of chlorhexidine-impregnated patch at pin site to reduce local morbidity: the CHIPPS pilot trial.
Evidence-based Medicine

Evaluation methods and devices in the reduction of catheter-related bloodstream infections

Overview

Catheter-related bloodstream infections demonstrate significant morbidity and mortality in the clinical setting and prevention has been a primary focus over the past decade. Greater knowledge of the pathogenesis of infections associated with intravascular devices has benefited prevention efforts.

Challenges of assessing prevention efforts

Clinical judgment

Most clinical CRBSI are identified through traditional surveillance methods that rely on manual collection of data from patient medical records, clinical laboratory, and pharmacy by trained infection control professionals. This requires considerable clinical judgment that may be inconsistently applied, exhibit a lack of sensitivity (not all cases are identified), and can vary considerably.

Low rates of CRBSI

Relatively low estimated rates of BSIs per 1,000 catheter days require a large number of observations to determine a stable rate for comparative purposes.

The probability of acquiring a CRBSI

Many factors are associated with the development of CRBSI, such as ventilator support, nutritional status, APACHE score, ICU or non-ICU setting, type of ICU, adherence to guidelines, and use of various devices such as skin preparations, coated catheters, location of catheter, and type of dressing. These are usually taken into consideration during analyses through the use of multivariate techniques.

Selection bias in assigning treatment

Two commonly used approaches to assessing efficacy are using separate techniques or test articles in two different hospital units and comparing rates of CRBSI pre- and post-intervention. Both are usually ineffective due to the inherent differences in patient populations or risks associated with different hospital units (different type of ICU, different personnel).

Effective assessment of prevention efforts for CRBSI: Evidence-based medicine

Practice should be based on scientific data that eschews subjectivity as much as possible. When generating evidence or data for efficacy of intervention in reducing CRBSIs, it is important to remember that:

- Any objective assessment will require time and resources
- Assessments must take into account the challenges presented above to ensure that results are informative, meaningful, and unbiased

Evidence-based medicine is an approach that does just that. It is defined as a, "conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients." It should be noted that there are many levels of evidence including in vitro studies, editorials and opinions, randomized clinical trials, and meta-analyses. Not all are assigned equal value or strength in the decision-making process. Alongside is the hierarchy of evidence and values assigned to the different types of research and literature that an evidence-based approach relies on. Randomized controlled trials and systematic reviews are accorded the highest level of evidence based on the value assigned to decision making.


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Hierarchy of BIOPATCH® Protective Disk with CHG evidence

Catheter-related bloodstream infections demonstrate significant morbidity and mortality in the clinical setting and prevention has been a primary focus over the past decade. Greater knowledge of the pathogenesis of infections associated with intravascular devices has benefited prevention efforts.

Levels of evidence*

**Level I:**
Evidence from at least one properly randomized clinical trial

**Level II:**
Evidence from trials without randomization, well-designed cohort or case control analytic studies – preferably from more than one center or research group, case series, and case reports

**Level III:**
Opinions of respected authorities, decisions based on clinical experience, descriptive studies and case reports, or reports of expert committees

The remainder of this document will review the evidence of BIOPATCH Disk in the prevention of CRBSI.

When reading these clinical summaries please note the following:

- Chlorhexidine gluconate is a cationic biguanide, a well-known broad-spectrum antimicrobial and antifungal agent
- BIOPATCH Disk is product of ETHICON, INC., Somerville, NJ.

Clinical Studies

**Title**
Impact on catheter-related bloodstream infections with the use of BIOPATCH® Proctective Disk with CHG dressing

**Author(s)**
Jane Banton, Vicki Bann

**Source**
*Journal of Vascular Access Devices* 2002:Fall

**Key Takeaways**
Catheter-related bloodstream infections (CRBSIs) pose a serious and costly complication, especially among immunocompromised populations such as oncology patients.

This paper evaluated the clinical impact of BIOPATCH Disk on vascular access devices in an outpatient Oncology/Hematology/Bone Marrow Transplant Unit and in a Trauma Life Center.

The authors show that antimicrobial BIOPATCH Disk is an efficacious choice for the prevention of CRBSIs.

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**Objective**
Based upon positive results from various randomized clinical trials, the authors implemented use of the BIOPATCH Disk in a real-world setting to assess the impact on the incidence of CRBSIs.

**Methods**
In the first part of the evaluation, in August 2001 in the Oncology/Hematology/Bone Marrow Transplant Unit, BIOPATCH Disk were applied primarily to PICCs.

The vascular access devices were placed either by nurses at the patient’s bedside or in the interventional radiology department.

Dressings were changed every three days. Prior to study initiation clinicians participated in a BIOPATCH Disk inservice program provided by a product representative. Nurses were exposed to complete written instructions and a poster that detailed the sizes of BIOPATCH Disk available and catheter site care. The training stressed the importance of correct orientation of BIOPATCH Disk to the insertion site with the shiny grid side up.

A unit nurse and an infection control specialist made weekly rounds to ensure that the disks were placed correctly and that dates were recorded appropriately. The condition of the site, and whether dry and intact, were also recorded.

A second phase of the study included the use of BIOPATCH Disk in the Trauma Life Center starting in February 2002. This was done after reviewing the initial results in the Oncology/Hematology/Bone Marrow Transplant Unit.

Training similar to that provided in Hematology, Oncology, Bone Marrow Transplant Unit was given to the Trauma Unit.

The Trauma Life Center patients often had multiple access lines.

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Clinical Studies

Outcomes Measured

- CRBSI – defined by the standard definitions of hospital-acquired primary bloodstream infections proposed by the CDC. CRBSI were identified by blood and semiquantitative catheter tip cultures, and patient charts.
- CRBSI incidence was recorded both in the Hematology, Oncology, Bone Marrow Transplant Unit and the Trauma Life Center from January 2001 to June 2002.

Results

**BIOPATCH Disk is a convenient and effective way to reduce CRBSIs**

**Hematology, Oncology, Bone Marrow Transplant Unit**
- With the use of BIOPATCH Disk, median CRBSI rates per 1,000 patient-days dropped from 5.8 to 1.6 (P=0.02)
- With the use of BIOPATCH Disk, the total number of CRBSIs requiring treatment in a six-month period dropped from 20 to seven – for a cost savings of $65,000

**Trauma Life Center**
- With the use of BIOPATCH Disk, median CRBSI rates per 1,000 central line-days dropped from 9.4 to 4.1 (P=0.04)
- With the use of BIOPATCH Disk, the total number of CRBSIs requiring treatment in a 6-month period dropped from 21 to 11 – for a cost savings of $50,000

Adverse Events

Adverse events were not reported in the study.

Study Limitations

BIOPATCH Disk was sometimes placed incorrectly due to difficulty in identifying the drug side – both sides were the same color.

Instructions were not readily available to nurses by bed side, nor were they available on the packaging. In the initial phase of the Trauma Life Center experience, many of the dressings in neck and groin region came loose due to the different type of transparent dressing used.
Clinical Studies

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<tr>
<th>Title</th>
<th>Techniques to prevent central venous catheter infections: products, research, and recommendations</th>
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<tr>
<td>Author(s)</td>
<td>Jane Banton</td>
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<tr>
<td>Source</td>
<td>Nutrition in Clinical Practice 2006:21:56-61</td>
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<tr>
<td>Key Takeaways</td>
<td>Catheter-related blood stream infections (CRBSIs) are one of the most common complications associated with central venous catheters. This paper examined the combined use of three products at the catheter insertion site in the prevention of CRBSIs in a clinical setting. The author demonstrated that the combined use of these three products reduced the rate of CRBSIs, and shared real-world tips on the use of these products.</td>
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**Objective**

To evaluate the combined use of BIOPATCH® Proctective Disk with CHG, 2% chlorhexidine for skin antisepsis, and transparent split dressings at catheter insertion site in the prevention of CRBSIs in the clinical setting; share useful techniques to maximize efficacy.

**Methods**

A three-step protocol based upon current national infection-prevention guidelines was used at catheter insertion site: 2% chlorhexidine skin antisepsis to reduce microbes on the skin, BIOPATCH Disk to prevent regrowth of microbes, and a split transparent film dressing to keep the BIOPATCH Disk in direct contact with the skin.

**Study population:**
Patients with CVC’s in the Hematology, Oncology, Bone Marrow Transplant Unit and in the ICU at a university hospital

**OutcomesMeasured**

CRBSI rates per 1,000 patient days or line days pre and post-implementation of 2% CHG antisepsis/ BIOPATCH Disk/ transparent dressing protocol

**Results**

Use of proper three-product infection-prevention protocol reduces CRBSI

**Hematology, Oncology, Bone Marrow Transplant Unit**

- With the use of BIOPATCH Disk, median CRBSI rates per 1,000 patient-days dropped from 5.8 to 1.6

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Intensive care unit
• With the use of BIOPATCH Disk, median infection rates per 1,000 central line-days dropped from 9.4 to 41

BIOPATCH Disk techniques and tips
• Clean the catheter insertion site with 2% chlorhexidine solution and allow to dry
• Select correct BIOPATCH Disk size to fit the diameter of the catheter
• Because BIOPATCH Disk is absorbent, it can be applied to the insertion site immediately after the line is placed
• Secure the BIOPATCH Disk in contact with the skin using the transparent portion of the semipermeable split dressing
Clinical Studies

**Objective**
To evaluate the antimicrobial properties of BIOPATCH Disk versus four silver-impregnated dressings against organisms primarily associated with catheter-related infections, including antibiotic-resistant isolates.

**Methods**
Five dressings (including BIOPATCH Disk and four silver-impregnated dressings: ALGIDEX®, SILVERLON®, SILVERSITE®, and SILVASORB®).

The dressings were transferred onto Mueller-Hinton agar plates inoculated with seven of the most common microorganisms associated with percutaneous device infections. The challenge microorganisms were obtained from the American Type Culture Collection (ATCC) and included the following:

- Methicillin-resistant Staphylococcus epidermidis
- Methicillin-resistant S. aureus
- Vancomycin-resistant Enterococcus faecalis
- Candida albicans
- Pseudomonas aeruginosa
- Acinetobacter baumanii
- Klebsiella pneumoniae

Sterile polyurethane foam was used as negative control.

Two stainless steel washers were placed on all test articles to represent the securement of the devices in vivo by a transparent film dressing.

The test was carried out with serial transfer of the dressings to freshly inoculated agar plates for seven consecutive days. Antimicrobial activity exhibited by different dressings was assessed by zone of inhibition (ZOI) resulting from the diffusion of the active agents out of the test articles and into the agar medium.

(continued)
Outcomes Measured

Zones of inhibition against each bacterial species:
- Plates were measured for zones of inhibition and microbicidal effect after 24 hours of incubation (35-37°C) on each day of the study.
- ZOI was measured from the outermost edge of the test article to the outermost edge of the ZOI. Average ZOI measurements and swab results were based on duplicate plates.

Bacterial Growth Assay:
Bactericidal/static activity was assessed by swabbing the area under the test articles after transfer to a new agar plate. Swabs were transferred to D/E neutralizing agar plates to rule out any carryover of residual of antimicrobial and cultured for bacterial growth (no growth = bactericidal action; any growth = bacteristatic action).

Results

Zone of Inhibition Assay:
BIOPATCH Disk was effective against all challenge organisms tested
Efficacy of BIOPATCH Disk was consistently higher against MRSA, MRSE, VRE, K. pneumoniae, and C. albicans over seven days compared to all other test products.

Zone of inhibition
- Of the seven microorganisms tested, BIOPATCH Disk had the greatest average zone of inhibition for the seven-day period for every organism except P. aeruginosa
- Algidex® and Silversite® were most efficacious against P. aeruginosa, with Silverlon® a close third
- Silvasorb® performed poorly against all of the microorganisms evaluated

Bacterial growth evaluation
- BIOPATCH Disk showed no growth of challenge organisms under the dressing for five of the seven organisms on any day of the seven-day assay
- Silverlon® and Silvasorb® exhibited growth under the dressing for all test organisms evaluated
- Algidex® exhibited growth under the dressing for five out of seven organisms tested
- Silversite® exhibited growth under the dressing for four out of seven organisms tested
- Silvasorb® was the worst performing dressing

Study Limitations
It should be noted that this study has the inherent limitations posed by all in vitro experiments – in vitro results may not necessarily be indicative of results in practice.

When reading the paper, please note:
- Test materials included are trade names of their respective companies:
  BIOPATCH® Johnson & Johnson Wound Management, ETHICON, INC., Somerville, NJ
  Algidex® Ag IV Catheter Patch (DeRoyal)
  Silverlon® “Lifesaver” 7 Day Antimicrobial IV/Catheter Dressing (Argentum Medical LLC)
  Centurion® Silversite Antimicrobial Dressing (Tri-State Hospital Supply Corporation)
  Silvasorb® Site Dressing (Medline)

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Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>In vitro assessment of chlorhexidine gluconate-impregnated polyurethane foam antimicrobial dressing using zone of inhibition assays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Shubhangi Bhende, Daniel Spangler</td>
</tr>
<tr>
<td>Source</td>
<td><em>Infection Control and Hospital Epidemiology</em> 2004;25(8):664-667</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Most catheter-related blood stream infections (CRBSIs) are caused by the migration of skin organisms at insertion site. This study examined the in vitro antimicrobial activity of chlorhexidine gluconate-impregnated foam against the primary organisms associated with these infections. The data show that BIOPATCH® Protective Disk with CHG is effective in vitro against a variety of antibiotic-resistant clinical isolates and the most common infections related to percutaneous devices.</td>
</tr>
</tbody>
</table>

**Objective**

To evaluate the BIOPATCH Disk consisting of hydrophilic polyurethane foam containing chlorhexidine gluconate for in vitro antimicrobial activity against several antibiotic-resistant clinical isolates and American Type Culture Collection (ATCC) reference strains using conventional zone of inhibition assays.

**Methods**

Sterile polyurethane foam samples impregnated with chlorhexidine gluconate and unimpregnated controls were transferred onto Mueller-Hinton agar plates inoculated with the 10 most common microorganisms associated with percutaneous device infections. Two sterile microscope slides were placed on top of the disks to ensure complete contact with the plates and mimic the securement of the disk in vivo with a transparent film dressing. Plates were measured for zones of inhibition after 24 hours of incubation. Average zone of inhibition measurements were based on triplicate plates. Zones of inhibition were measured from one edge of the zone to the other including the diameter of the disk.

Reference strains obtained from ATCC included the following:
- Methicillin-resistant Staphylococcus epidermidis (MRSE)
- Methicillin-resistant Staphylococcus aureus (MRSA)
- Vancomycin-resistant Enterococcus faecium (VRE)
- *Candida albicans* ATCC 10231
- *C. albicans* ATCC 58716
- *Pseudomonas aeruginosa*

Antibiotic-resistant clinical isolates included the following:
- *S. epidermidis* – MRSE
- *S. aureus* – MRSA
- *E. faecium* – VRE
- *E. faecalis* – VanB (vancomycin-resistant)

(continued)
Outcomes Measured

Zones of inhibition against the 10 challenge organisms.

Results

BIOPATCH Disk is effective against a variety of antibiotic-resistant clinical isolates as well as against organisms commonly involved in CRBSIs

- Even against the most resistant microorganisms associated with CRBSI, consistent zones of inhibition were seen in vitro with BIOPATCH Disk
- No zones of inhibition were seen with the untreated controls

Study Limitations

It should be noted that this study has the inherent limitations posed by all in vitro experiments – in vitro results may not necessarily be indicative of results in practice.

When reading the paper, please note:
- Sterile polyurethane foam with chlorhexidine gluconate (250 ug of chlorhexidine gluconate per milligram of disc was used; BIOPATCH®, Johnson & Johnson Wound Management, ETHICON, INC., Somerville, NJ) was used as test material
**Clinical Studies**

<table>
<thead>
<tr>
<th>Title</th>
<th>Reduction of exit-site infections of tunnelled intravascular catheters among neutropenic patients by sustained-release chlorhexidine dressings: results from a prospective randomized controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>ST Chambers, J Sanders, WN Patton, P Ganly, M Birch, JA Crump, RL Spearing</td>
</tr>
<tr>
<td>Source</td>
<td><em>Journal of Hospital Infection</em> 2005;61:53-61</td>
</tr>
</tbody>
</table>
| Key Takeaways | Infections of tunnelled central intravascular catheters are a common source of morbidity and increased healthcare costs among neutropenic patients.  
This randomized clinical trial examined the activity of chlorhexidine gluconate-impregnated dressing in the prevention of exit-site and tunnel infections.  
The data show that sustained-release BIOPATCH® Protective Disk with CHG reduced the exit-site/tunnel infections and reduced premature removal of catheters due to infection.

---

**Objective**

To compare the rate of exit-site/tunnel infections in neutropenic patients with tunnelled intravascular catheters dressed using standard guidelines from the British Committee for Standards in Hematology versus those dressed using sustained-release chlorhexidine dressing.

**Methods**

All 10 French gauge vascular catheters with a surecuff tissue ingrowth, vitacuff antimicrobial cuff (BARD Bard Access systems, Utah, USA) were inserted percutaneously using the Seldinger technique. The skin at insertion site was prepared with Microshield 2® skin wash and three washes of alcoholic povidine-iodine 10%. After insertion, all tunnelled intravascular catheters were randomized but treated in the same manner with sterile gauze and a transparent film dressing until the exit site was dry and free from ooze. The control group received no dressing in accordance with BCHS guidelines. The treatment group received BIOPATCH Disk after insertion and then covered with a transparent film dressing. All dressings were changed weekly, or as needed, for the life of the catheter. If a catheter was removed and replaced, the new catheter was again randomized. Exit sites and tunnels were examined weekly.

- Neutropenia was defined as <0.5x10⁹ neutrophils/L
- Exit-site infection was defined as redness, pain and tenderness at the exit site <2 cm from the skin along the intravascular catheter of sufficient degree to warrant antimicrobial therapy as judged by the attending medical team
- Tunnel infection was defined as pain, tenderness and swelling over the subcutaneous tunnel >2 cm from the exit site
- Bacteraemia was defined as the presence of one or more species of organism in two sets of blood cultures within 24h (both from peripheral veins or one from a peripheral vein and one from the central intravascular catheter)

**Study population**

- 114 tunnelled intravascular catheters in 95 patients were randomized between August 1995 and December 2001 and nearly all patients had underlying malignancies

(continued)
Outcomes Measured

Primary
• Development of exit-site and/or tunnel infections

Secondary
• Removal of catheter for infection
• Incidence of bacteraemia and usage of glycopeptide antibiotics

Results

Approximately five-fold reduction in extraluminal catheter infections and a three-fold reduction rate of premature removal for these infections were observed

Exit-site/tunnel infections
• Significantly fewer of catheters in the BIOPATCH Disk group developed exit site or combined exit-site/tunnel infections versus control group (9% vs 43%, P<0.001)
• Five percent of catheters in the BIOPATCH Disk group developed exit-site infections versus 26% in the control group

Bacteria isolated from exit sites
• Swabs were taken from all patients at the time of exit site or tunnel infections
• In the control group there were 13 patients who showed growth mixed with organisms and one with no growth versus three patients with growth and two with no growth in the BIOPATCH Disk group

Catheter removal
• Seven percent of catheters in the BIOPATCH Disk group were removed prematurely due to exit site or tunnel infections versus 24% in the control group
• Other catheters were removed prematurely without evidence of exit site or tunnel infection due to suspected infection – 3% in the control group vs 13% in the control group had positive tip cultures with the same organism as isolated from blood cultures (P=0.09)
• Overall, fewer catheters were removed for documented infections (exit site, tunnel, or catheter tip) in the BIOPATCH Disk group vs control (10% vs 37%, P<0.01)
• Bacteraemia unrelated to tunnelled catheters occurred in eight patients in the control vs 14 patients in BIOPATCH Disk group

Vancomycin use
• Similar in both groups – 51% in the BIOPATCH Disk group were treated with Vancomycin vs 53% in control group

Surveillance for CHX resistance
• CHX resistance was detected in one isolate of micrococcus taken one month after BIOPATCH Disk was applied

Adverse Events
Two patients discontinued BIOPATCH Disk – one patient developed itchy cutaneous reaction to adhesive urethane dressing, the other developed a similar reaction to BIOPATCH Disk after 35 days. Both were included in analysis.

Study Limitations
The clinical team may have been able to observe minor exit site infections more easily in the control group than in the BIOPATCH Disk group.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Cost-benefit analysis of chlorhexidine gluconate dressing in the prevention of catheter-related bloodstream infections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Albert G Crawford, Joseph P Fuhr, Bhaskar Rao</td>
</tr>
<tr>
<td>Source</td>
<td>Infection Control and Hospital Epidemiology 2004;24:668-674</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>While clinical trials have demonstrated the efficacy of chlorhexidine gluconate (CHG) in reducing the incidence of catheter-related bloodstream infections (CRBSI), the financial implications have not been examined. The authors conducted a cost-benefit analysis of BIOPATCH® Protective Disk with CHG on central venous catheter insertion sites to reduce CRBSIs, costs, and mortality. The data show that BIOPATCH Disk would reduce costs, local infections, CRBSI, and death, and should be considered in patients with catheters.</td>
</tr>
</tbody>
</table>

**Objective**

To compare the costs versus the benefits of using BIOPATCH Disk on central venous catheters and to determine the efficacy of these dressings to reduce local infection, CRBSI, costs, and mortality.

**Methods**

This study was designed to evaluate the net financial benefit of using BIOPATCH Disk, by combining the results of a randomized, controlled trial with estimated numbers of catheters, patients, local infections, and catheter-related BSIs, and the costs of treating these infections, drawn from national data, data from hospitals in the Philadelphia area, and data from an academic medical center in the Philadelphia area.

**Results**

**BIOPATCH Disk has the potential to reduce costs**

- Potential net benefits of CHG are $275M to $1.97B
- Estimated potential annual US benefits persisted in sensitivity analyses varying baseline rate of CRBSI, incremental cost of treating CRBSI, and overall number of catheters used

**BIOPATCH Disk has the potential to reduce mortality**

- Nationwide use of CHG dressing has the potential to reduce mortality by 329 to 3,906 deaths each year

(continued)
Clinical Studies

Crawford, 2004 (continued)

Study Limitations

Study methodology limits the ability to generalize findings. The analysis relied on estimates rather than precise data regarding the following:

- Total number of catheters used in U.S.
- Total number of catheterized patients
- Baseline rates of CRBSI
- Total number of CRBSI
- Incremental costs of treating CRBSI
- Mortality attributable to CRBSI

Data to validate the national estimates were drawn from only one metropolitan area.

The study also extrapolated the findings of a randomized controlled trial regarding reduction of CRBSI incidence among 589 patients to the entire U.S. hospital patient population. It is not known if the patients in the above trial were representative of patients receiving catheters nationally.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>The promise of novel technology for the prevention of intravascular device-related bloodstream infection. I. Pathogenesis and short-term devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Christopher J Crnich, Dennis G Maki</td>
</tr>
<tr>
<td>Source</td>
<td>Clinical Infectious Diseases 2002;34:1232-1242</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Intravascular devices (IVD) are widely used but associated with substantial risk of IVD related bloodstream infections (BSI). The authors reviewed novel technologies that promised to reduce these infections by reducing microorganisms that colonize the skin around the insertion site. The authors conclude that cutaneous antiseptics all reduce the risk of IVD-related BSI in prospective randomized trials and that future challenges include identifying new preventive technologies and more widely adopting those proven efficacious and cost effective.</td>
</tr>
</tbody>
</table>

Objective

To review the novel technologies that could potentially reduce the incidence of intravenous device-related bloodstream infections (IVDR-BSI)

Morbidity and mortality

- More than 250,000 IVD-related BSI occur each year
- Mortality rates are 12%-15%
- Added healthcare costs are $33,000-$35,000 per incident
- Rates have decreased nearly 40% over the last 10 years with more consistent implementation of preventative measures

Pathogenesis

- Two major sources include:
  - Colonization of the IVD
  - Contamination of the fluid administered via the device (known as infusate-related infection)

This paper is devoted to devices that prevent CRBSI by reducing the incidence of device colonization. The paper describes microorganisms gaining access to the bloodstream by one of three mechanisms: 1. skin organisms that invade the tract at the time of device insertion, 2. contamination of the catheter hub when catheter is inserted over guide wire, 3. when organisms are carried hematogenously to the IVD from remote sources of local infection such as pneumonia.

The author notes that detailed recommendations, and the consistent application of those recommendations, for the reduction of CRBSI have resulted in a 40% reduction in incidence rates. New technologies offer even greater promise.
NOVEL TECHNOLOGIES OFFER FURTHER REDUCTIONS IN BSI

Meta-analyses of prospective, randomized, clinical trials of novel technologies for prevention of intravenous device-related bloodstream infections in patients with short-term central venous catheters (CVCs) in place.

<table>
<thead>
<tr>
<th>Technology</th>
<th>No. of trials</th>
<th>No. of CRBSIs/ no. of CVCs studied</th>
<th>RR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorhexidine (vs. povidone-iodine) cutaneous</td>
<td>5</td>
<td>14/931 33/1213</td>
<td>0.55 (0.22-1.15)</td>
<td>.07</td>
</tr>
<tr>
<td>anti-infective cream/ointment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Povidone-iodine ointment</td>
<td>3</td>
<td>10/212 23/228</td>
<td>0.47 (0.14-1.21)</td>
<td>.04</td>
</tr>
<tr>
<td>Mupirocin ointment</td>
<td>1</td>
<td>1/69 10/67</td>
<td>0.10 (0.00-1.24)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Dressings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyurethane (vs. gauze)</td>
<td>7</td>
<td>27/1070 20/725</td>
<td>0.97 (0.43-1.89)</td>
<td>.76</td>
</tr>
<tr>
<td>Hydrocolloid</td>
<td>1</td>
<td>5/77 1/78</td>
<td>5.06 (0.38 to &gt;50)</td>
<td>.12</td>
</tr>
<tr>
<td>Hyperpermeable polyurethane</td>
<td>2</td>
<td>3/259 4/206</td>
<td>0.60 (0.02-8.73)</td>
<td>.70</td>
</tr>
<tr>
<td>Chlorhexidine sponge</td>
<td>1</td>
<td>8/665 24/736</td>
<td>0.37 (0.17-0.81)</td>
<td>.01</td>
</tr>
<tr>
<td>Silver-impregnated cuff</td>
<td>5</td>
<td>10/283 14/247</td>
<td>0.62 (0.28-1.38)</td>
<td>.30</td>
</tr>
<tr>
<td>Anti-infective-coated or -impregnated CVC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzalkonium chloride</td>
<td>2</td>
<td>1/131 3/123</td>
<td>0.31 (0.00-22.90)</td>
<td>.36</td>
</tr>
<tr>
<td>Chlorhexidine-silver sulfadiazine</td>
<td>15</td>
<td>68/2100 107/2135</td>
<td>0.65 (0.45-0.90)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Minocycline-rifampin</td>
<td>1</td>
<td>0/130 7/136</td>
<td>0.00 (0.00-2.80)</td>
<td>.02</td>
</tr>
<tr>
<td>Minocycline-rifampin (vs. chlorhexidine-silver</td>
<td>2</td>
<td>1/394 14/418</td>
<td>0.08 (0.00-0.81)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>sulfadiazine)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver impregnated</td>
<td>4</td>
<td>18/260 42/246</td>
<td>0.40 (0.24-0.68)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Silver iontophoresotic</td>
<td>3</td>
<td>8/275 21/295</td>
<td>0.41 (0.18-0.91)</td>
<td>.02</td>
</tr>
<tr>
<td>Anti-infective hub connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antisepctic hub</td>
<td>2</td>
<td>9/144 15/137</td>
<td>0.57 (0.15-1.61)</td>
<td>.20</td>
</tr>
<tr>
<td>Povidone-iodine sponge wrap</td>
<td>1</td>
<td>0/22 6/25</td>
<td>0.00 (0.00-3.69)</td>
<td>.02</td>
</tr>
<tr>
<td>Needleless connectors</td>
<td>2</td>
<td>4/245 21/263</td>
<td>0.20 (0.07-0.59)</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Note: Data are only from prospective, randomized trials that involved short-term centrally placed central venous catheters (CVCs) and that reported intravenous device-related bloodstream infection as an outcome. CRBSI = catheter-related bloodstream infection.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Randomized Trial of Drain Antisepsis After Mastectomy and Immediate Prosthetic Breast Reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Amy C. Degnim, MD, Tanya L. Hoskin, MS, Rushin D. Brahmbhatt, MD, Anne Warren-Peled, MD, Margie Loprinzi, RN, Emily S. Pavey, MA, Judy C. Boughey, MD, Tina J. Hieken, MD, Steven Jacobson, MD, Valerie Lemaine, MD, James W. Jakub, MD, Chetan Irwin, MD, Robert D. Foster, MD, Hani Sbitany, MD, Michel Saint-Cyr, MD, Erin Duralde, BS, Sheri Ramaker, RN, Robin Chin, BA, Monica Sieg, RN, CNP, Melissa Wildeman, RN, CNP, Jeffrey S. Scow, MD, Robin Patel, MD, Karla Ballman, PhD, Larry M. Baddour, MD, and Laura J. Esserman, MD MBA</td>
</tr>
<tr>
<td>Source</td>
<td>Annals of Surgical Oncology, 21(10), 3240-3248. doi:10.1245/s10434-014-3918-9</td>
</tr>
</tbody>
</table>

**Key Takeaways**

Development of a surgical site infection (SSI) in this population is often devastating, with many resulting in implant loss.

Local antiseptic measures using a chlorhexidine disc to each site and drain bulb irrigation with hypochlorite solution significantly reduced bacterial colonization of the surgical drain and bulb drain fluid.

Reduced colonization of the drain was associated with decreased frequency of surgical site infections.

**Objective**

To assess the effects of simple local antisepsis measures on bacterial colonization of drains and SSI after mastectomy with immediate prosthetic breast reconstruction.

**Methods**

- Patients were recruited prospectively between May 2011 and June 2013.
- Inclusion criteria included bilateral mastectomy with reconstruction (either tissue expander or implant) for benign or malignant disease.
- Exclusion criteria included: pregnancy, antibiotics within 14 days of surgery, history of breast/chest wall radiation, allergy to chlorhexidine, or autologous tissue reconstruction.
- The breasts of 104 patients were randomized - one breast received treatment with drain antisepsis and one breast received standard drain care (control).
- The antisepsis measures included a chlorhexidine disc application every 3 days and twice daily irrigation of the bulb with Dakin’s solution 0.0125% buffered sodium hypochlorite for the first 44 patients
  - The remaining 60 patients received a commercially available 0.125% solution due to ease procurement issues.
- Drainage volume, skin changes, signs of infection, and compliance with care were assessed at the follow up visits.
- Cultures of the bulb fluid were obtained between post-operative day 6-10.
- Subcutaneous drain tubing and bulb fluid were aseptically obtained for cultures at the time of drain removal.
- All clinical infections were treated.
- Late infections were captured at the 1-year telephone follow up and review of medical records

(continued)
Outcomes Measured

- Primary outcome was bacterial growth (1+ or greater) in the drainage bulb at post-operative day 6-10.
- Secondary outcome was drain tubing colonization, defined as >50 CFU.
  - Samples colonized with multiple organism were classified based on the highest degree of quantification.

Results

- 110 patients were enrolled with 6 withdrawals or screening failures, leaving 104.
- 101 patients had data on the primary endpoint.
- Bacterial colonization of the drain fluid at 1 week was significantly less in the antisepsis group 9.9% (10/101) vs 20.8% (21/101) in the control group p = 0.02.
- Drain tubing colonization at removal was 0% (0/97) in the treated group versus 6.2% (6/97) in the control p = 0.03.
- Drain bulb colonization at removal was 19.4% (14/72) in the treated group versus 38.9% (28/72) in the control p = 0.003.
- Surgical site infection within 30 days was 0 in the treated group versus 3.8% (4/104) in the control p = 0.03.
- Surgical site infection within 1 year was 2.9% (3/104) in the treated group versus 5.8% (6/104) p=0.45.
- Bacterial colonization of drain sites is significantly associated with infection. Sides with colonization of bulb fluid or tubing showed an SSI rate of 9.7% (6/62) at 1 year compared with 1.5% (2/136) on sides without colonization p = 0.03.
- The most common microbial isolate was coagulase negative Staphylococcus species (43% fluid and 55% tubing)
- Contact dermatitis occurred related to the chlorhexidine disc was seen in 7 out 104 patients which resolved after discontinuation of the disc.

Study Limitations

- This study was not powered to show a difference in SSI.
- A larger study is needed with SSI as the primary endpoint to confirm:
  - Efficacy of drain antisepsis toward SSI reduction
  - Cost effectiveness
  - Effects of each component, Biopatch and Dakin's irrigation
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Protected Clinical Indication of Peripheral Intravenous Lines: Successful Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Michelle DeVries, Mary Valentine, Patricia Mancos</td>
</tr>
</tbody>
</table>

**Key Takeaways**

- Clinically indicated replacement of peripheral IVs was selected over routine replacement because it can lower healthcare expenditures without involving any extra risks of complications.

- As a result of the clinically indicated replacement protocol, the organization documented a 37% reduction (P= 0.03) in primary bacteremias (combining PIV and central line-associated bloodstream infections) and a 19% reduction in PIV bloodstream infections.

- CLABSI standardized infection ratios for the publicly reported intensive care units decreased from 1.3 to 0.32 (P= 0.02).

- IV start kit use decreased 48% during the year following bundle implementation.

- Using an evidence based approach allowed for the adoption of the latest standards while taking proactive steps to mitigate risk proved to be a successful strategy.

**Objective**

To develop an insertion bundle to support the safe implementation of a policy of extended dwell time of inpatient peripheral intravenous lines (PIVs). The main objectives were to have fewer IV restarts with no increased bloodstream infection risk.

**Methods**

- Infection control and the nursing staff collaborated with key stakeholders to identify any concerns or barriers.

- Materials management collaborated in developing IV start kits for use by bedside staff in a community hospital that met the goal of extended dwell time, utilizing products that addressed concerns regarding safe insertion, and maintenance of a protected, intact dressing.

- Components of the Protected Clinical Indication Bundle included:
  - Chlorhexidine gluconate skin prep
  - Sterile gloves
  - Intravenous catheter with integrated extension set
  - Chlorhexidine gluconate-impregnated sponge dressing
  - Securement dressing
  - Alcohol disinfection caps

- The elements of the bundle were driven by internal evaluation of practices through direct observation.
  - PIV insertions were observed.
  - Staff huddles were conducted when an infection was identified.
  - Infection control, a nurse educator, and unit champions rounded on patients with PIVs, observing dressing integrity and the presence of blood in the connectors.

- Existing professional standards and literature were reviewed.

*(continued)*
Education was conducted to help staff become more confident and competent in implementing the changes made to the products being utilized.

The hospital is composed of 2 hospital facilities. Implementation was launched at one site and then the other one month later.

Bloodstream infection surveillance was conducted following the Centers for Disease Control and Prevention National Healthcare Safety Network protocols.

Bloodstream infections meeting the Laboratory Confirmed Bloodstream Infection event definitions were reviewed to determine which line types were present in the days before the infection.

Infections with only peripheral access were categorized as PIV-associated bloodstream infections using the same requirements for CLABSIs.

A statistical analysis to assess the influence of the policy was conducted at 12 months (February 2014 - January 2015).

At 18 months, a further review was done to assess whether the policy resulted in practice changes at the bedside.

Outcomes Measured

Primary outcomes
- Fewer IV starts
- No increase in bloodstream infections

Secondary outcomes
- Successful implementation at the bedside level

Results
- At 12 months the surveillance data for primary bacteremia, which included central and peripheral lines, showed a 37% reduction (P =0.03).
- There was a 19% reduction in PIV related bloodstream infections.
- Standardized infection ratios for CLABSI in the intensive care units improved from 30% to 68% fewer infections (P=0.02).
- 35% of PIVs placed were remained in situ for 5 days or longer.
- Average dwell time was 4.2 days
- IV start kits used decreased by 48% the year following implementation, indicative of successful policy implemented at the bedside.

Study Limitations
- There is a lack of continuous surveillance for other vascular access indicators such as phlebitis, occlusion, and infiltration.
- Usage of surveillance definition may over represent the incidence of infections because there is no definitive link to the device required in the Centers for Disease Control and Prevention protocols.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Reducing catheter-related bloodstream infections: an extended-care facility’s process improvement experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Ann Earhart, Darlene Kaminski</td>
</tr>
<tr>
<td>Source</td>
<td><em>Journal of the Association for Vascular Access</em> 2006;11(2):90-97</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>In 2002, the authors’ hospital noted a significant increase in catheter-related bloodstream infection (CRBSI): from 0.5 per 1,000 patient days to 1.2 per 1,000 patient days. A process improvement team evaluated the key elements causing the CRBSI increase and instituted a process improvement process. The authors review the details of this experience, including the use of reverse-tapered peripherally inserted central catheters, the use of BIOPATCH® Protective Disk with CHG, increasing supplies, and educating core staff.</td>
</tr>
</tbody>
</table>

**Objective**

To identify the key elements leading to the increase of CRBSI and suggest process improvements to reduce incidence.

**Methods**

A process improvement team met every two weeks for four months to evaluate the insertion technique process.

The evaluation team, which included nurses, physicians, members of the PICC team, CNS and infection control, noted the following:

- A PICC nurse or interventional radiologist inserted catheters at the institution
- The PICC nurse inserted the catheter at the bedside; those requiring an interventional radiologist were sent to the hospital
- The radiologists used povidone iodine and the catheter was secured using sutures
- After an observation period of four hours for drainage, and following 24-48 hours post-insertion, the initial gauze dressing was changed to include a BIOPATCH Disk and a transparent film dressing
- Insertions without CHG patch were changed every three days and those with the BIOPATCH Disk were changed every seven days in accordance with the guidelines
- The adoption of the CDC and Infusion Society Nurses Guidelines after 2002 were not being adequately met
- The team noted a time deficit in nurses to carry out and stick to the correct process
- The team also noted that the nursing staff lacked all of the supplies, especially central line kits, in one place

**The process improvement team evaluated the information to generate practice change recommendations, including:**

- Prepping with ChloraPrep instead of Betadine
- Placing the BIOPATCH Disk at time of insertion instead of at 24-hours
- Providing complete equipment and supplies in the central line kits in one bundle
- Educating nursing staff to maintain competency of central line care

(continued)
Outcomes Measured

- The practice changes made a significant difference in the CRBSI rates in the hospital.
- Prior to implementation of the practice recommendations, in 2002, the CRBSI incidence had increased to 1.2 per 1,000 patient days.
- Following initial implementation of recommendations, the rate of CRBSI decreased 0.24/1,000 patient days during the third quarter of 2002 and remained at 0 - 0.2 per 1,000 patient days until 2nd quarter 2003 when rates increased to 0.89 per 1,000 patient days.
- Following reevaluation, it was discovered that dressings were being missed. This resulted in changes to documentation, staffing and dressing change schedules, after which the incidence of CRBSI dropped again to 0 per 1,000 patient days in the following quarter.
- The use of BIOPATCH Disk at the time of catheter insertion decreased the number of dressing changes resulting in reduced costs, supplies and nursing time.
- The use of reverse-tapered PICC lines has less drainage and contributed to a lower CRBSI incidence.
- Product analysis, education, monitoring, follow up and the CNS were key to the improved outcomes.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Treatment of external fixation pins about the wrist: a prospective, randomized trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Kenneth A Egol, Nader Paksima, Steven Puopolo, Jeffrey Klugman, Rudi Hiebert, Kenneth Koval</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Pin-track infections following the use of external fixators are one of the most troublesome complications in the treatment of distal radial fractures and can compromise successful treatment. This randomized clinical trial examined the efficacy of three different methods of pin-site care in the prevention of pin-track infection: weekly dry dressings without pin-site care, daily saline solution/hydrogen peroxide pin-site care, and use of BIOPATCH® Protective Disk with CHG. The data show no significant difference in pin-site complications among the three groups.</td>
</tr>
</tbody>
</table>

Objective

To determine the prevalence of pin-site complications associated with the use of external fixation in distal radial fractures, determine the frequency of antibiotic use and/or surgical debridement in pin-track infections, and determine the efficacy of BIOPATCH Disk in reducing pin-track infections.

Methods

One hundred and eighteen patients (120 wrists) with external fixation devices for the treatment of a displaced, unstable, distal radial fracture were randomized into one of three treatment groups: (1) weekly dry dressing changes without pin-site care; (2) daily pin-site care with a solution of one-half normal saline solution and one-half hydrogen peroxide; and (3) treatment with the placement of BIOPATCH Disk around the pins held in place with a sterile gauze wrap, with weekly changes of the discs by the treating surgeon. In all three groups fixators were covered with elastic bandage. The patients were followed at weekly intervals until the external fixator was removed. Radiographs were made bi-weekly.

Study population

Patient demographics have not been reported up until now.

Outcomes Measured

The patients were evaluated with regard to (1) erythema, (2) cellulitis, (3) drainage, (4) clinical or radiographic evidence of pin-loosening, (5) the need for antibiotics, and (6) the need for pin removal before fracture-healing due to infection.

Results

External fixation pin sites demonstrated a high rate of complications that was not improved by the use of BIOPATCH Disk.

- Overall, rate of pin-related complications are below:
  - Study group (BIOPATCH Disk) - 19%
  - Hydrogen peroxide group - 33%
  - Dry dressing group - 18% (chi-square=3.2; P=0.20)

(continued)
• Increased age was one factor associated with increased risk of pin-track complications
• Twelve patients required antibiotics.
• One patient had pin loosening which was evident both clinically and radiographically and was treated with intravenous antibiotics and debridement

### Distribution of Pin Complications According to Treatment Group

<table>
<thead>
<tr>
<th></th>
<th>Dry, Sterile Dressing (N=40)</th>
<th>Hydrogen Peroxide (N=40)</th>
<th>BIOPATCH* (N=40)</th>
<th>Total (N=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythema Yes</td>
<td>6 (15%)</td>
<td>11 (28%)</td>
<td>7 (18%)</td>
<td>24</td>
</tr>
<tr>
<td>Cellulitis Yes</td>
<td>4 (10%)</td>
<td>11 (28%)</td>
<td>6 (15%)</td>
<td>21</td>
</tr>
<tr>
<td>Drainage Yes</td>
<td>3 (8%)</td>
<td>11 (28%)</td>
<td>5 (13%)</td>
<td>19</td>
</tr>
<tr>
<td>Pin-loosening Yes</td>
<td>0 (0%)</td>
<td>1 (3%)</td>
<td>0 (0%)</td>
<td>1</td>
</tr>
<tr>
<td>Radiographic loosening Yes</td>
<td>0 (0%)</td>
<td>1 (3%)</td>
<td>0 (0%)</td>
<td>1</td>
</tr>
</tbody>
</table>

*The data are given as the number of wrists

### Study Limitations
• Inability to confirm patient compliance with regard to the dressing program
• Duration of follow-up was short as the study focused on early pin-related complications
• Patients could not be blinded with regard to wound dressing and hence follow-up data was not blindly assessed
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Continuing evolution of multidisciplinary approach to prevention of central line-associated bacteremias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>LL Fauerbach, C Ruse, MA Gross, R Kelly, D Danek, L Larson, J Janelle</td>
</tr>
<tr>
<td>Source</td>
<td>American Journal of Infection Control 2004;32(3):E40-E41</td>
</tr>
</tbody>
</table>

**Key Takeaways**
- Prevention of central line-associated bacteremias (CLABs) is a major focus for the 570-bed tertiary/transplant center.
- Historical risk-reduction strategies include use of antimicrobial impregnated CVL, CVL insertion tray designed to facilitate total barrier technique compliance, and use of 0.5% chlorhexidine gluconate and 70% alcohol solution (0.5% CHG) for site prep.
- This study examined the impact of a new 2% CHG skin prep solution (2% CHG and 70% alcohol) and BIOPATCH® Protective Disk with CHG.

**Objective**
To determine the impact of 2% CHG skin prep solution (2% CHG and 70% alcohol) and a BIOPATCH Disk in the prevention of central line-associated bacteremias (BSIc).

**Methods**
BSIc surveillance was performed by infection control professionals according to CDC definitions and reported quarterly. Initially, CVL utilization was 151 patients per day with at least one CVL. Staff was educated about each new product prior to implementation. The skin prep was first changed to 2% CHG. Subsequently, BIOPATCH Disk was introduced.

**Outcomes Measured**
- CVL utilization
- Reduction in BSI

**Results**
- **External fixation pin sites demonstrated a high rate of complications that was not improved by the use of BIOPATCH Disk.**
- CVL utilization increased to 220 patients per day
- Introduction of 2% CHG prep plus BIOPATCH Disk demonstrated a 31% overall reduction in BSIc – 16% of this improvement was attributed to the BIOPATCH Disk
- Cost savings were estimated at $2.5M for 135 infections averted
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Adding a chlorhexidine patch to the IHI bundle: goal zero in reducing central line-associated bacteremia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>R Garcia, L Jendresky, F Nicolas, L Colbert, Y Dumont</td>
</tr>
<tr>
<td>Source</td>
<td>American Journal of Infection Control 2006;34(5):E42</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Brookdale University Medical Care has implemented since 2000 various interventions recommended by IHI for improving rates of central line-associated bacteremia (CLAB). This paper reports on an eight-month study that assessed the effect of adding BIOPATCH® Protective Disk with CHG to the IHI treatment bundle for the prevention of bacteremia in patients who had central lines inserted. The data suggest that use of BIOPATCH Disk adds considerably to a CLAB reduction bundle and reduces infection costs.</td>
</tr>
</tbody>
</table>

**Objective**
To assess the effect of adding BIOPATCH Disk to the treatment bundle for central lines on the occurrence of central-line associated bacteremia (CLABs).

**Methods**
The control group (n=277, May 2005 – Aug 2005) had interventions such as education, proper hand hygiene, maximal sterile barriers, chlorhexidine skin antisepsis, and optimal site care while the study group (n=226, Sept 2005 – Dec 2005) also had a BIOPATCH Disk placed at the catheter insertion site. Compliance of the protocol was assessed by direct observation.

**Study population**
Patients in four adult ICUs at the Brookdale University Medical Care with central lines including triple-lumen, dialysis, swan-ganz, and PICCs were included in the study.

**Outcomes Measured**

**Reduction in CLABs**
- CLAB definition used was that published by the National Nosocomial Infection Study (NNIS) group

**Results**

**Adding BIOPATCH Disk significantly improves the CLAB reduction bundle**
- CLAB rates were significantly reduced from 3.1 per 1,000 catheters days in the control group to 0.0 per 1,000 catheter days in the study group (P < 0.05)

**BIOPATCH Disk delivers cost savings**
- Based on a mean cost of $45,254 per CLAB as published by the Centers for Disease Control, avoided costs for the authors’ institution (minus the cost of the product) is estimated at $314,678 per year

**Adverse Events**
No adverse reactions were noted in any patient
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Chlorhexidine dressing for reduction in microbial colonization of the skin with central venous catheters: a prospective randomized controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>K Hanazaki, K Shingu, W Adachi, T Miyazaki, J Amano</td>
</tr>
<tr>
<td>Source</td>
<td>Journal of Hospital Infection 1999;42(2):165-168</td>
</tr>
</tbody>
</table>

**Key Takeaways**

Central venous catheter-related infection (CVC) has low associated mortality that markedly increases with CVC-related sepsis.

This letter to the editor reviews a randomized controlled study by the authors to evaluate the efficacy of BIOPATCH Protective Disk with CHG in reducing skin colonization at CVC insertion site.

The authors report that theirs was the first study to show that BIOPATCH Disk can effectively reduce Staphylococcus epidermidis colonization on the skin — the most common organism associated with septicemia.

**Objective**

To evaluate the antimicrobial properties of BIOPATCH Disk in reducing colonization of the skin at the insertion site of CVCs.

**Methods**

Fifty patients undergoing abdominal surgery were elected to receive CVCs for intravenous hyperalimentation (IVH) and divided into two groups: the insertion sites of 25 patients were dressed with BIOPATCH Disk and sealed with transparent Bioclusive® dressing while those of the other 25 were dressed with Bioclusive® alone. Both groups underwent the same cleaning and dressing procedures once weekly for the lifetime of the CVC. Skin swabs near insertion site (beneath the BIOPATCH Disk in the study group) and distant from insertion site (but still beneath the transparent dressing in both groups) and swabs from inside the insertion site to sample the deeper skin layers were taken at each dressing change.

**Outcomes Measured**

Reduction in skin colonization at CVC insertion site.

**Results**

**BIOPATCH Disk prevented bacterial contamination**

- In the study group, no contamination occurred beneath the BIOPATCH Disk while S. epidermidis was detected at the same swab site in >10% of the control group
- The rate of contamination beneath the transparent dressing (F site) was comparable between the two groups

<table>
<thead>
<tr>
<th>Result of Bacterial Culture</th>
<th>Patch group (N=25)</th>
<th>Non-Patch group (N=25)</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>P site</td>
<td>0/60 (0%)</td>
<td>7/64 (10.9%)</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>F site</td>
<td>14/60 (23.3%)</td>
<td>17/64 (26.6%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

*P Value: patch group versus non-patch group Statistical analysis was performed by unpaired Student’s t-test
**P Value: P site versus F site Statistical analysis was performed by paired Student’s t-test
NS: not significant

(continued)
Clinical Studies

Hanazaki, 1999 (continued)

Study Limitations

This randomized controlled trial was not subject to peer review and independently published but simply discussed in a letter to the editor.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Achieving zero catheter related blood stream infections: 15 months success in a community based medical center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Sophie A Harnage</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Catheter-related blood stream infections (CRBSIs) pose a serious and costly complication. This author reviews the development and implementation of a central line bundle to reduce CRBSI rates at the 180-bed acute care, community-based, not-for-profit Sutter Roseville Medical Center. The author creates a multimodality bundle incorporating three extraluminal practices, three intraluminal practices and team monitoring to decrease the rate of CRBSIs. BIOPATCH Protective Disk with CHG was selected as one of the extraluminal practices in the bundle.</td>
</tr>
</tbody>
</table>

**Objective**

Develop a protocol to decrease the CRBSIs outside the ICU.

**Methods**

The team reviewed and selected a combination of seven behavioral practices and product technologies associated with lowering CRBSIs, including:

- Site selection with ultrasound guided insertion
- Full barrier precautions at all insertions
- CHG skin prep and BIOPATCH Disk at insertion and at weekly dressing changes
- Neutral pressure connector system without clamping sequence requirement
- 70% isopropyl alcohol disinfection of connector septum
- Eight hour and PRN saline flushing protocol
- Daily monitoring of PICCs

**Outcomes Measured**

- Incidence of CRBSI.

**Results**

**Implementation of the new bundle decreased the rate of CRBSI**

- From January 2006 through March 2007 there were no occurrences of CRBSI; before the implementation 11 CRBSIs occurred in 2005
- Over this 15 month period, PICC insertions increased by 103% and interventional radiology referral rate decreased to less than 2%
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Use of chlorhexidine-impregnated dressing to prevent vascular and epidural catheter colonization and infection: a meta-analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Kwok M Ho, Edward Litton</td>
</tr>
<tr>
<td>Source</td>
<td>Journal of Antimicrobial Chemotherapy 2006;58:281-287</td>
</tr>
</tbody>
</table>

**Key Takeaways**

Vascular and epidural catheters, commonly used in patients requiring anesthesia, cause significant morbidity and mortality in hospitalized patients.

This meta-analysis examined the effect of chlorhexidine-impregnated dressing on the risk of vascular and epidural catheter bacterial colonization and infection.

These authors concluded that chlorhexidine-impregnated dressing effectively reduces vascular and epidural catheter bacterial colonization and is also associated with a trend towards reducing catheter-related bloodstream or coagulase-negative staphylococci (CNS) infections.

**Objective**

To evaluate the efficacy of chlorhexidine-impregnated dressing in reducing bacterial colonization and systemic infections associated with vascular and epidural catheters.

**Methods**

Literature search of MEDLINE (1966 to November 1, 2005), EMBASE and Cochrane Controlled Trials Register (2005 issue 3) databases for randomized controlled clinical trials that compared chlorhexidine-impregnated dressing with placebo or povidine-iodine dressing.

- Two reviewers independently reviewed and extracted the data for this meta-analysis
- Ten studies were identified and eight met the inclusion criteria for use in the meta-analysis
- The duration of the intravascular and epidural catheters varied between the studies
- Three studies reported outcomes based on each catheter use and others reported patient outcomes
- There was significant heterogeneity in patient populations between each study

**Outcomes Measured**

- Proportion of patients with exit-site or catheter colonization
- Systemic infections such as bloodstream and CNS infection related to intravascular and an epidural catheter respectively

**Results**

**BIOPATCH Disk reduced the risk of catheter colonization and exit site infection**

- For epidural catheters - 36% versus 35% with control (P=0.0005)
- For intravascular catheters - 14.8% versus 26.9% with control (P<0.0001)
- Overall risk for combined catheter types - 14.3% versus 27.2% (P<0.0001)

(continued)
BIOPATCH Disk was associated with a trend towards reduction in CRBSI or CNS infections when results of both catheters were pooled
• 2.2% versus 3.8% with control (P=0.11)

Adverse Reactions
No significant systemic adverse events were reported in the pooled studies
• Local cutaneous reactions due to BIOPATCH Disk were uncommon and occurred mainly in neonatal patients
• Reactions occurred in 5.6% of patients in three studies with 96% of these reactions being in the neonatal population

Study Limitations
• Sample size is too small to confirm a statistically significant reduction in CRBSI
• None of the included studies was double-blinded
• The site of the intravascular catheters was not specified in most studies and could be a potential confounder
### Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Erratum: Use of chlorhexidine-impregnated dressing to prevent vascular and epidural catheter colonization and infection: a meta-analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Kwok M Ho, Edward Litton</td>
</tr>
<tr>
<td>Source</td>
<td><em>Journal of Antimicrobial Chemotherapy</em> 2010; 64(4): 811-814</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Since previous publication 2 large randomized controlled studies on the use of chlorhexidine-impregnated dressing have been published showing that the use of chlorhexidine-impregnated dressing was associated with a reduction in the risk of catheter related bloodstream infections (CRBSI). Chlorhexidine-impregnated dressing is effective in preventing CRBSI in vascular catheters. A chlorhexidine-impregnated dressing should be used in adult patients unless contraindicated.</td>
</tr>
</tbody>
</table>

### Erratum

- There was an error in the information for the study by Levy et al. The number of bloodstream infections in the treatment and control group should have been 4/74 and 3/71.
- The revised forest plot showed a reduction in the risk of bacteremia or CNS infection when pooled by a fixed-effect. [odds ratio (OR) 0.61, 95% confidence interval (CI) 0.38-0.97, P = 0.04; I² = 37.8%], but not by a random-effects model (OR 0.63, 95% CI 0.30-1.31, P = 0.22; I² = 37.8%).
- Since the original publication 2 large randomized controlled studies on the use of chlorhexidine-impregnated dressing have been published.
- Both studies showed that the use of chlorhexidine-impregnated dressing was associated with a reduction in the risk of CRBSI:  
  - OR=0.56 (95%CI: 0.35-0.90; p = 0.02)  
  - 44 % reduction
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Infectious risk associated with arterial catheters compared to center venous catheters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Jean-Christophe Lucet, MD, PhD; Lila Bouadma, MD; Jean-Ralph Zahar, MD; Carole Schwebel, MD; Arnaud Geffroy, MD; Sebastian Pease, MD; Marie-Christine Herault, MD; Hakim Haouache, MD; Christophe Adrie, MD; Marie Thuong, MD; Adrien François, RT; Maïté Garrouste-Orgeas, MD; Jean-François Timsit, MD, PhD</td>
</tr>
</tbody>
</table>
| Key Takeaways | Catheter colonization and catheter related infection rates were similar between arterial catheters and central venous catheters in critical care patients.  
Arterial catheters should be monitored and received the same precautions as central venous catheters.  
The daily hazard rate for central venous catheters was constant after fifth catheter day.  
The daily hazard rate of arterial catheter colonization significantly increased over time after the seventh catheter day. |

**Objective**

To compare the risk factors and daily risk for colonization and catheter related infections (CRI) between arterial catheters (AC) and central venous catheters (CVC).

**Methods**

- Data from a multicenter randomized two by two factorial design evaluating dressing change intervals (3 day vs. 7 day) with or without a chlorhexidine impregnated sponge (CHGIS) was utilized.
- The study was conducted in 7 ICUs in 5 hospitals between December 20, 2006 to May 20, 2008 in adults requiring a CVC or AC > 48 hours.
- Exclusion criteria included pulmonary arterial catheters, hemodialysis catheters, or peripherally inserted CVCs.
- All centers followed French recommendation for catheter insertion and care.
  - Maximal sterile barrier precautions
  - Preferred insertion sites were radial artery or subclavian vein
  - Insertion site scrubbed with 4% aqueous povidone iodine scrub, rinsed with sterile water, dried with sterile gauze, and alcohol based antiseptic solution applied for at least one minute
  - A semipermeable transparent dressing used on all insertion sites
- Dressings were changed in all groups at 24 hours after insertion, and then every 3 days or 7 days.
- Catheters were removed if no longer needed or a CRI was suspected.
  - Catheter tips were cultured
  - If CRI was suspected one or more peripheral cultures were collected
  - If the catheter tip was colonized or blood cultures were positive at the time of removal, an independent blinded review was conducted.

(continued)
Definitions and evaluation criteria used were based on French and American guidelines. The authors defined major CRI as either catheter related clinical sepsis without BSI or catheter related BSI. ACs and CVCs were analyzed separately. Risk factors for catheter colonization were evaluated by univariate and multivariate analysis. A marginal Cox model for cluster data was used to identify variables associated to catheter colonization.

Outcomes Measured

• The primary evaluation measured catheter colonization rate.
• The secondary evaluation measured the rate of major CRI.

Results

• A total of 3532 catheters and 27,541 catheter days were cultured and analyzed.
  - 1617 ACs
  - 1915 CVCs
• Colonization rates between ACs and CVCs did not differ 7.9% vs. 9.6%.
• Daily hazard rates for ACs increased from 1.3% on day 5 to 2.4% on day 10 and 3.0% on day 15.
• The difference between ACs used for < 8 days and ACs used for ≥ 8 days was significant P = .008.
• Daily hazard rates for AC colonization was 1.9% on day 5, 3.8% % on day 10, and 5.5% on day 15.
• Daily hazard rates for CVC colonization was 1.2% on day 5, 1.6% % on day 10, and 1.4% on day 15.
• The incidence density ratio for colonization of catheters used for ≥ 8 days was significantly higher for ACs than for CVCs (24.5 and 15.4 per 1000 catheter days, respectively; rate ratio, 1.59; 1.17–2.17; p = .0001).
• AC and CVC CRI rates were 6.8% and 0.94%.
  - Microorganisms associated with colonization or CRI did not differ between ACs and CVCs.
• Independent risk factors for AC colonization were respiratory failure and femoral insertion site.
• Independent risk factors for CVC colonization were trauma or absence of septic shock at ICU admission, femoral insertion, jugular insertion, and lack of prophylactic antibiotic treatment at time of the CVC insertion.

Study Limitations

• The main limitation of the study is the observation design.
  - A randomized controlled trial evaluating scheduled AC replacement on CRI and complications is needed to determine if AC related infections increase over time.
• Catheter colonization was used at the primary endpoint rather than CRI rate because of low rate of CRI.
• In patients that had a CVC and AC, attributing a CRI to one or the other device may be difficult unless only one catheter tip is colonized.
• Misclassification may occur with AC-BSI being mistaken for CVC-BSIs in patients with a AC and CVC, since it is believed that CVC-BSI have a higher risk of infection.
• Interactions may have occurred between the four study groups due to the design of the database to investigate the effect of CHGIS and dressing change intervals.
• A cluster effect may have occurred since many patients had ACs and CVCs and or successive ACs or CVCs.
# Objective

- A general CRBSI overview
  - As many as 10% to 25% of all hospital complications are CVC related
  - 87% of bacteremias are catheter-related
  - CRBSI mortality has been reported to range from 2% to 32% with the highest rates occurring in the ICU
  - The CDC has made reducing CRBSI one of their top patient safety goals

- A review of the intraluminal fluid pathway, the source of 50% of CRBSI (intraluminal colonization can occur in as early as three days)
  - CRBSI have increased since the introduction of needle-free IV connectors
  - Bacteria are known to enter the intraluminal pathway through the septum
  - The fluid infusing and the heparin lock left in the fluid pathway provide the food source for microorganisms

- A summary of current extraluminal prevention strategies, including:
  - Behavior based barrier precautions, dressing changes, and education
  - New technology-based hand washing antiseptics, skin antiseptics, chlorhexidine gluconate-impregnated external catheter surfaces, chlorhexidine gluconate-impregnated foam discs, and stabilization systems

- A review of proposed CVC bundle in the prevention of CRBSI, including:
  - Handwashing with approved antisepctic formulations before and after every CVC procedure
  - The use of Chloraprep®, 2% CHG, or 2% CHG/70% isopropyl alcohol skinprep with every CVC insertion and dressing change
  - Full barrier precautions with every CVC insertion
  - PICC selected as CVC of choice whenever possible
  - Use of BIOPATCH Disk at insertion and with every dressing change
  - StatLock® catheter securement at insertion and with every dressing change
  - Use of InCision Plus® Neutral® IV connector
  - Septum cleansing with approved disinfective before each access
  - Manual saline flush at least once per shift

---

**Title**  
Technology and practice: collaboration for successful positive patient outcomes

**Author(s)**  
Denise L Macklin

**Source**  

**Key Takeaways**  
Based on a catheter-related nosocomial infection rate of 5% with a mortality rate of 15%, bloodstream infections represent the eighth leading cause of death in the United States.  
This paper reviews the causes of CRBSI and identifies behavior-based practices and technological innovations that can significantly reduce CRBSI.  
The author concludes that the synergistic effect of preventive behavioral measures and innovative technology is greater than the implementation of single measures, and that reducing CRBSI rates to zero is possible.
The author notes that a synergy of strategies, when applied together, yields positive results. The author cites the experience of using bundles at two hospitals which was successful in reducing CRBSI rate to zero at one of the institutions.

**Hospital A**

**Bundle in place prior to neutral pressure connector system implementation:**
- Waterless hand sanitizer
- CHG skin prep
- Full barrier precautions at insertion
- Ultrasound PICC placement
- 5-10 second swab at each connector access

**Bundle components added at the time of neutral pressure IV connector conversion:**
- BIOPATCH Disk Disk
- Saline flush only
- Manual saline flush every shift

**Results**

CRBSI rate dropped to zero in the first quarter after the new bundle components were added.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>The efficacy of chlorhexidine-impregnated sponge (BIOPATCH® Protective Disk with CHG) for the prevention of intravascular catheter-related infection - a prospective, randomized, controlled, multicenter study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>DG Maki, LA Mermel, D Kluger, D Narans, V Knasinski, S Parenteau, P Covington</td>
</tr>
<tr>
<td>Source</td>
<td><em>Abstracts of the 40th Interscience Conference on Antimicrobial Agents and Chemotherapy</em>, 2000:422</td>
</tr>
</tbody>
</table>

**Key Takeaways**

- Many intravascular catheter-related infections result from organisms that colonize the insertion site.

- This randomized, controlled trial examined the efficacy of BIOPATCH Disk versus standard care on catheter colonization and catheter-related bloodstream infection (CRBSI).

- BIOPATCH Disk reduces the risk of catheter colonization and CRBSI. Widespread use of this inexpensive device on the short-term, high-risk catheters could have a major impact on reducing the risk of life-threatening CRBSIs.

**Objective**

To evaluate the efficacy of BIOPATCH Disk on reducing catheter colonization and catheter-related bloodstream infection in patients needing short-term, but high-risk, catheters.

**Methods**

Adult patients requiring central venous, pulmonary artery, or peripheral arterial catheters were randomized to transparent film dressing alone or to the BIOPATCH Disk under the transparent film dressing. Dressings were changed every two days for the control group and every seven for the treatment group. Ten percent povidone iodine was used for skin antisepsis in both groups.

A total of 687 subjects with 1,699 arterial or central venous catheters were randomized to either the BIOPATCH Disk or the control group. Five-hundred eighty-nine patients with 1,401 sites were included in the efficacy analysis. Seven-hundred thirty-six catheters were in the control group and 665 in the BIOPATCH Disk group.

**Outcomes Measured**

- Catheter colonization (defined by 15 CFU by roll plate method)
- CRBSI (concordance between percutaneously drawn blood cultures and catheter tip, hub, or infusate using Pulsed-Field Gel Electrophoresis.)

**Results**

**BIOPATCH Disk reduces risk of catheter colonization and CRBSI in short-term, arterial and central venous catheters**

**BIOPATCH Disk significantly reduced catheter colonization**

- Sixteen percent of study catheters versus 29% of control catheters demonstrated catheter colonization (P<0.0001)
Using BIOPATCH Disk can have a major impact in reducing bloodstream infections in patients with short-term, high-risk intravenous catheters.

**BIOPATCH Disk significantly reduced the risk of life threatening CRBSI**

- 1.2% of study catheters in the BIOPATCH Disk group versus 3.3% in the control group developed CRBSI (P=0.026)
- Waterless hand sanitizer

**Adverse Advents**
No systemic adverse reactions were observed in either the treatment group or the control group.

**Study Limitations**
Catheters with long dwell times were not included in the study.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>The effect of the BIOPATCH® Protective Disk with CHG, a chlorhexidine-impregnated dressing, on bacterial colonization of epidural catheter exit sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>TJ Mann, CE Orlikowski, LC Gurrin, AD Keil</td>
</tr>
<tr>
<td>Source</td>
<td>Anaesthesia and Intensive Care 2001;29(6):600-603</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>The reported incidence of epidural space infections following epidural anesthesia may be increasing, with recent reports of between one in 1,930 and one in 5,000 per catheter. This randomized trial evaluated the clinical impact of BIOPATCH Disk on bacterial colonization of epidural exit sites. The data show that colonization rates of epidural sites were significantly lower with BIOPATCH Disk.</td>
</tr>
</tbody>
</table>

**Objective**
To evaluate the efficacy of BIOPATCH Disk on bacterial colonization of epidural exit sites.

**Methods**
Seventy-four women undergoing gynecological surgery that included and epidural catheter were randomly assigned to a standard transparent Tegaderm® dressing or a BIOPATCH Disk in combination with a Tegaderm® dressing. Incidence of bacterial colonization at the epidural exit site following catheter removal was compared. Nineteen were excluded in the final analysis because the exit site was not swabbed when the catheter was removed. Data from 55 patients were included in the analysis (control group n=26, BIOPATCH Disk group n=29).

Consultant anaesthetists or trainee registrars inserted the epidural catheters using an aseptic technique involving gown, gloves, cap and mask. Skin was prepared with 0.5% chlorhexidine in 70% alcohol.

Following removal of the epidural catheter, the exit site was inspected and the exit hole swabbed and cultured. A positive swab culture was defined as greater than or equal to 100 cfu/ml performed using standard semi-quantitative techniques.

**Outcomes Measured**
Incidence of bacterial colonization of the epidural exit site following catheter removal.

**Results**
**BIOPATCH Disk significantly reduced exit site colonization rates in epidural catheters**
- Positive cultures were found in only 3.45% of BIOPATCH Disk 29 patients versus 42.3% of control patients (P=0.001).
- The most common organisms were:
  - Coagulase-negative Staphylococci in seven patients
  - Staphylococcus aureus in four patients
  - Enterococcus species in one patient
  - Enterococcus species as a second organism in three patients

(continued)
Adverse Advents
No systemic adverse reactions were observed in either the treatment group or the control group.

Study Limitations
An anaesthetic registrar, who reviewed all patients daily, could not be blinded since the BIOPATCH Disk could be seen through the transparent dressing. This had the potential to introduce bias.
Clinical Studies

Title | Arterial Catheters as a Source of Bloodstream Infection: A Systematic Review and Meta-Analysis
Author(s) | John C. O’Horo, MD; Dennis G. Maki, MD, MS; Anna E. Krupp, RN; Nasia Safdar, MD, PhD

Key Takeaways
- Arterial catheters are an under recognized source for CRBSI.
- Pooled data indicated an increase infection rate in studies which cultured all catheters.
- The rate of infection seen in cultured arterial catheters was similar to infection rates associated with short term central venous catheters.
- The femoral site created an increased risk of infection.
- Use of technologies, such as the chlorhexidine impregnated sponge should be considered for high risk patient with femoral arterial catheters.

Objective
To determine the prevalence of bloodstream infection (BSI) associated with arterial catheters.

Methods
- A systematic review and meta-analysis of articles on BSI in arterial catheters.
- Inclusion criteria included human trials or reports that evaluated BSI in arterial catheters.
  - Studies needed to include a definition of arterial CRBSI as well as correlation of catheter tip culture to a separate blood culture with signs and symptoms of infection and no other source identified.
- Excluded were those studies using arterial catheters for reasons other than critical illness and postsurgical monitoring.
- The study population, site of insertion, antiseptic preparation, catheter days, and prevalence of catheter-related bloodstream infection were abstracted.
- Incidence rates of infection were calculated for infection per 1,000 arterial catheters and infections per 1,000 catheter days.
- Confidence Interval (CI) of infection per 1,000 catheter days was calculated using the Freeman-Tukey transformation.
- Risk ratios were combined using the fixed-effects modeling.
- Heterogeneity was assessed with the I^2 statistic.
  - 0% indicates no heterogeneity.
  - 100% indication the highest level of heterogeneity.

Outcomes Measured
- Primary outcome was to determine the prevalence of catheter related bloodstream infection (CRBSI).
  - Pooled observed rates of catheter infection in studies where all catheters were cultured versus studies where cultures were only taken when the arterial catheter was suspected as the source of the BSI.
Clinical Studies

O’Horo, 2014 (continued)

• Secondary outcomes were infection rates from different insertion sites and insertion techniques.
  - Radial vs. femoral insertion site
  - Sterile barrier precautions
  - Site preparation
  - Maintenance techniques such as chlorhexidine impregnated sponge.

Results

• The search strategy returned 970 articles, 49 of which met the inclusion criteria.
• The studies were conducted between 1970 through 2012.
• Two hundred two cases of arterial CRBSI were reported in 30,841 arterial catheters.
  - The pooled incidence using a random effects model was 3.40/1,000 catheters (95% CI, 3.39–3.41/1,000 catheters).
  - The rate was 0.96/1,000 catheter days in studies reporting that denominator (95% CI, 0.84–1.12 CRBSI/1,000 catheter days).
  - In studies where all catheters were cultured, the rate in catheter days was 1.26/1,000 (95% CI, 1.05–1.52/1,000 catheter days) vs. 0.70/1,000 (95% CI, 0.55–0.87/1,000 catheter days) in other studies.
• The rate of infection (1.6 infections/1,000 catheter days) seen in cultured arterial catheters was similar to infection rates associated with short term central venous catheters.
• The femoral site had a relative risk of infection 1.94 times greater than the radial site (95% CI, 1.32–2.84; p = 0.001; I² = 17%).
• There was no statistical significance between chlorhexidine over povidone-iodine in the subgroup analysis (RR, 1.01; 95% CI, 0.99–1.03) or 70% isopropanol (RR, 1.00; 95% CI, 0.99–1.02).
• The risk of infection was significantly reduced with the use of chlorhexidine-impregnated dressings (RR = 0.35, 95% CI, 0.13–0.91, I² = 0%).

Study Limitations

• Limitations of the study originate from the designs of the studies included.
  - Drawing blood cultures from arterial catheters makes differentiating colonization from CRBSI difficult.
  - Limits the number of which could be included
  - Few studies prospectively evaluated risk factors for BSI associated with duration of arterial catheter placement.
  - Unable to address safety of brachial, axillary, dorsalis pedis, or cubital arterial catheter sites.
  - Unable to address the impact of insertion by different practitioners.
  - Lack of research on maintenance practices.
  - No study evaluated the frequency of catheter manipulation.
• It is likely that there is a degree of bias in the study.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Vascular access nursing practice, standards of care, and strategies to prevent infection: a review of skin cleansing agents and dressing materials (part 1 of a 3-part series)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Deborah Richardson</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Effective skin antisepsis is of primary importance in preventing catheter-related bloodstream infections (CRBSI).</td>
</tr>
<tr>
<td></td>
<td>The vascular nurse is at the forefront of developing, defining, and implementing evidence-based practice and standards of care in IV therapy.</td>
</tr>
<tr>
<td></td>
<td>The author reviews information appropriate for the novice and expert vascular access nurse in preventing CRBSI.</td>
</tr>
</tbody>
</table>

Summary

The author overviews:

• The dermis, the epidermis, and the skin's flora

• The skin's response to a central venous catheter (CVC) insertion
  - The insertion of a central venous catheter is one of the most common invasive procedures done today. There is new research supporting the idea that the skin organisms attach to the extraluminal wall of the catheter during insertions. Evidence shows that the biofilm forms within 90 minutes of catheter insertion despite skin disinfection and strict aseptic technique.
  - One of the main causes for CRBSI is the patient's skin
  - The efficacy of disinfecting agents such as IPA, CHG, CHG in combination with povidone iodine, and povidone iodine alone

• National standards for the insertion of CVCs
  - The author reviews CDC guidelines for preparing the insertion site which endorse CHG-based preparations as the preferred cleansing agents
  - Dressing materials which included semipermeable transparent dressings, gauze dressings, and BIOPATCH® Protective Disk with CHG are also reviewed
  - The author notes that several studies show that BIOPATCH Disk significantly reduced CRBSIs and provides ongoing skin antisepsis for seven days (this product should not be used in patients allergic to CHG and infants)

• The author also reviews preventive strategies for CRBSI which include six strategies as follows:
  - Strict adherence to aseptic technique
  - Good hand hygiene
  - Acceptable skin antisepsis using 70% IPA, 10% PI, tincture of iodine, or 2% aqueous CHG
  - Skilled vascular access teams
  - Standardization of CVC insertion and maintenance care
  - BIOPATCH Disk

Finally, the author reviews the Institute of Healthcare Improvement's (IHI) goal of reducing CRBSI through the adoption of a central line bundle as a national standard for all CVC insertions.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>BIOPATCH® Protective Disk with CHG – a new concept in antimicrobial dressings for invasive devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Brigit L. Roberts, Daisy Cheung</td>
</tr>
<tr>
<td>Source</td>
<td>Australian Critical Care 1998;11(1):16-19</td>
</tr>
</tbody>
</table>

**Key Takeaways**

Infections related to venous catheters (CVC) in the intensive care unit (ICU) are common and associated with high morbidity and mortality (10% to 20%).

This randomized clinical trial evaluated the clinical impact of BIOPATCH Disk on catheter-related infections in ICU insertion-site management.

The data show that use of BIOPATCH Disk results in very low colonization rates of CVC tip and exit-site swab comparable to control. It concludes that a much larger study group will be required to demonstrate the efficacy of BIOPATCH Disk.

**Study Objective**

To examine reduction in the rates of catheter-related infections associated with BIOPATCH Disk used for insertion-site management of CVCs placed in the ICU.

**Methods**

In 32 ICU patients, CVCs were inserted using aseptic Seldinger technique that included sterile gloves, sterile gown, cleaning the proposed insertion site with 0.5% chlorhexidine in 70% alcohol, draping the insertion site with a sterile towel, and application of sterile dressing post-insertion. Catheters were randomly assigned to receive either a BIOPATCH Disk plus occlusive Opsite IV 3000TM superscript or Opsite IV 3000TM superscript alone.

**Study population**

Thirty-two patients in the ICUs receiving CVCs were enrolled over a seven-week period. There were 40 CVCs in total. Each CVC was treated as a separate event and randomized either to the control or the BIOPATCH Disk group.

Post-insertion CVC care followed standard ICU policy and was performed by the nursing staff. This included change of giving sets every third day and dressing care (0.5% CHX in 70% alcohol) or as needed. Insertion sites were checked for infection every shift. Blood was cultured from patients showing clinical signs of infection, i.e., raised temperature and white cell count.

Patient demographics were collected including age, sex, diagnosis, and number of days the line was in situ. Exit site was swabbed and sent for microbiology lab for culture along with the catheter tip.

**Outcomes Measured**

- Catheter tip and exit site colonization
- Positive cultures were classified as:
  - Probable contamination – when the organism isolated from exit site or tip was a known pathogen
  - Possible contamination – when the organism isolated from exit site or tip was a low virulence organism
- Colonization – defined as isolation of the same organism from both exit site and tip, without signs of clinical infection
- Rate of catheter-related infections (CRI)
- Defined as any infection where the organism isolated from the exit site and/or catheter tip was the same as the clinical isolate associated with clinical signs of infection

(continued)
Clinical Studies

Roberts, 1998 (continued)

Results
Data was available from only 33 catheters – 17 in the BIOPATCH Disk group and 16 in the control group.

BIOPATCH Disk demonstrated low rates of CVC tip and exit-site colonization

• The BIOPATCH Disk group had an 11.8% rate of positive CVC tip cultures vs a 6.3% rate for control (NS; P>0.05)
• The BIOPATCH Disk group had a 23.5% rate of positive exit-site swabs vs an 18.8% rate for control (NS; P > 0.05)
• No patients in the BIOPATCH Disk group and one patient in the control group was classified as colonized
• No patients in the control group and one patient in the BIOPATCH Disk group were classified as having a CRI

Staphylococcus epidermidis was the most common organism isolated.
S. epidermidis was the most common isolate from both CVC tips (3/3) and exit-site (6/7) swabs.

Adverse Events
The study did not report any adverse events.

Study Limitations
The trial data was insufficient to draw a conclusion due to the small sample size of the study. Statistically, a sample size of 11,000 patients would be required to prove clinical significance of CVC-tip and exit-site infection rates between the treatment and control groups.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Antiinfective wound dressing reduces catheter-related infections in oncological patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>H Ruschulte, M Franke, B Hertenstein, KH Mahr, H Hecker, P Gastmeier</td>
</tr>
<tr>
<td>Source</td>
<td>Poster abstract presented at Euroanaesthesia 2006, the European Society of Anaesthesiology's Annual Meeting in Madrid, Spain June 3-6, 2006</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Immunocompromised patients such as those undergoing chemotherapy are at increased risk of catheter-related blood stream infections (CRBSIs). This randomized clinical trial examined the incremental efficacy of BIOPATCH® Protective Disk with CHG in addition to antimicrobial impregnated catheters on the rate of CRBSIs in immunocompromised chemotherapy patients. The data show that BIOPATCH Disk significantly reduced the rate of CRBSI in immunocompromised patients over and above the effect of the antimicrobial impregnated catheters.</td>
</tr>
</tbody>
</table>

Study Objective

To determine the incremental efficacy of BIOPATCH Disk on CVC sites for the prevention of catheter-related infections in patients receiving antineoplastic therapy through impregnated catheters.

Methods

Six-hundred one patients receiving catheters were randomized to receive either BIOPATCH Disk 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 CRBSI 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.

Outcomes Measured

- CRBSI occurrence
- Confirmed with blood cultures via the catheter lumina and peripheral blood cultures according to the time-to-positivity method

(continued)
Clinical Studies  

Ruschulte, 2006 (continued)

Results

Chlorhexidine gluconate–impregnated dressing significantly reduced CRBSI in immunocompromised patients receiving impregnated catheters.

- Nineteen cases of CRBSI occurred in the BIOPATCH Disk group (300 patients) versus 34 cases in the control group (301 patients). This difference was statistically significant (P=0.0271).

<table>
<thead>
<tr>
<th>Germs causing CRBSI</th>
<th>Control</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus epidermidis</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Staphylococcus hominis</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>E. coli</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lactobacillus spp.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Candida tropicalis</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Staphylococcus haemolyt.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Enterococcus faecalis</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Adverse Events

No systemic or local adverse events were observed.

Study Limitations

Due to technical limitations of producing non-CHG impregnated placebo patches, the trial could not be double-blinded.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>The pathogenesis of catheter-related bloodstream infection with noncuffed short-term central venous catheters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Nasia Safdar, Dennis G Maki</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Widely used, short-term, noncuffed, percutaneously inserted central venous catheters (CVCs) cause more than 250,000 bloodstream infections (BSIs) each year. This prospective cohort study examined the pathogenesis of catheter-related BSIs (CRBSIs) in a clinical setting. The data show that most of these CVC-related BSIs were extraluminally acquired and derived from cutaneous microflora, and that successful suppression of this flora can reduce the risk of CRBSIs with short-term CVCs.</td>
</tr>
</tbody>
</table>

### Study Objective
To determine the pathogenesis of CVC-related BSI.

### Methods
This prospective cohort study included patients from two randomized trials during 1998-2000 in a university hospital 24-bed medical-surgical intensive care unit. One trial examined the efficacy of 1% chlorhexidine-75% alcohol solution for cutaneous antisepsis, and the other examined the efficacy of BIOPATCH® Protective Disk with CHG.

The two trials were very similar in their overall design of patient populations. The majority of patients studied were elderly or had underlying conditions. Data was obtained for 1,263 CVCs for a total of 6,075 catheter days.

At the time of catheter removal, skin at the insertion site was cultured quantitatively. For each catheter two 5-cm segments, the intracutaneous segment and the tip, were cultured semiquantitatively. Each hub and fluid aspirated aseptically from the most distal injection port of the line were also cultured. Microorganisms were identified according to standard criteria.

### Outcomes Measured
- If concordance between isolates from catheter segments, skin, and blood cultures was confirmed, the CVC-related BSI was considered extraluminally acquired.
- If concordance between hub or infusate and blood culture isolates was confirmed, the CVC-related BSI was considered intraluminally required.

Catheter-tip colonization was defined as a positive semiquantitative culture of an intravascular catheter segment that was >15 colony-forming units.

Catheter related BSI was defined as an isolation of the same strain from the catheter segment, a hub, or infusate from one or more blood cultures, as confirmed by restriction fragment subtyping, with no other clearcut source for BSI.

(continued)
**Clinical Studies**

_Safdar, 2004 (continued)_

**Results**

**Most CVC-related BSIs are extraluminally acquired and from cutaneous microflora**

- Of 1,263 catheters, 333 (26.3%) were colonized at removal
  - 35 (2.7%) caused BSI (5.9 per 1,000 CVC days)
  - 27 of those were caused by coagulase-negative staphylococci, 4 by enterococci, 3 by enteric Gram-negative bacilli, and 1 by Candida
  - 45% were determined to be extraluminally acquired (versus 26% intraluminally acquired and 29% indeterminate, i.e., both routes may have been operative)

- Pooled data from the two trials show 25 CVC-related BSIs (7.0 per 1,000 CVC days)
  - 605 of these were determined to be extraluminally acquired (versus 12% intraluminally acquired and 28% indeterminate)

**Successful suppression of cutaneous microflora reduces extraluminally acquired BSI rates**

<table>
<thead>
<tr>
<th></th>
<th>Extraluminal</th>
<th>Intraluminal</th>
<th>Indeterminate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>15 (60%)</td>
<td>3 (12%)</td>
<td>7 (28%)</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control groups</td>
<td>15 (60%)</td>
<td>3 (12%)</td>
<td>7 (28%)</td>
</tr>
<tr>
<td>Treatment groups*</td>
<td>1 (10%)</td>
<td>6 (60%)</td>
<td>3 (30%)</td>
</tr>
</tbody>
</table>

*P=0.006 vs. control (χ² test)

Successful suppression of cutaneous microflora reduces extraluminally acquired BSI rates but can shift the pathogenesis of CRBSIs that still occur to the intraluminal route.

BIOPATCH Disk had no effect in CRBSI caused by intraluminal etiology and may not be able to suppress infections due to indeterminate or mixed etiology.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Use of a chlorhexidine dressing to reduce microbial colonization of epidural catheters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Jeffrey M Shapiro, Emmett L Bond, J Kent Garman</td>
</tr>
</tbody>
</table>

Key Takeaways
- The chain of events leading to infection by organisms that colonize the skin at epidural site may be broken by reducing microbial population at insertion point.
- This prospective randomized study assessed the efficacy of BIOPATCH® Protective Disk with CHG in reducing microbial flora at epidural catheter insertion sites.
- The data show that BIOPATCH Disk reduces catheter colonization with a possible reduction in risk of epidural catheter-related infection.

Study Objective
To evaluate the efficacy of BIOPATCH Disk versus a control dressing in preventing expansion of skin flora at the insertion site of epidural catheters.

Methods
Patients who received epidural catheters for acute pain management were prospectively studied. Insertion sites were prepped with povidone iodine and after insertion of the epidural catheter via the L3-L5 interspace were randomized to being dressed with BIOPATCH Disk secured beneath a sterile catheter support pad or with the sterile catheter support pad alone. Catheters were left in place as long as clinically indicated and no insertion site care was performed. Catheter sites were only examined at the time of catheter removal.

In addition to the clinical study, multiple other evaluations were performed:
- An evaluation of BIOPATCH Disk versus a placebo on non-wounded sited in healthy volunteers with outcomes measures of skin colonization, skin irritation and level of CHG left on the skin
- A kinetic study of the release of CHG into saline solution over seven days
- A bioassay of the release of CHG from BIOPATCH Disk versus CHG-spiked cellulose disks via daily measurement of zones of inhibition in bacteria-inoculated agar plates over 10 days of serial transfers

The skin at the site of catheter insertion was cultured immediately upon catheter removal. The catheter wound tract was swabbed with a mini-tip and cultured. Catheters were removed with care taken to avoid touching adjacent skin for culture. Catheter tips, hubs and lumens were cultured for colonization.

Study population
There were two separate study populations for the clinical study portion. A pilot study with 17 patients was done to determine the amount of catheter colonization with a control urethane foam patch without CHG. This was followed by a randomized controlled clinical trial of the CHG-impregnated dressing in 57 patients.
Clinical Studies

Outcomes Measured

**Clinical Outcome Measures**

Catheter colonization: a catheter was considered colonized if both the tip and wound tract had colonies of 10^3 colonies and concurrent isolation from skin cultures of the same isolates.

**In vitro Assessment Outcomes**

- Kinetics of CHG delivery:
  - Weighed disks were placed into normal saline at room temperature while being agitated with a rotary shaker. Disks were transferred to fresh saline daily for seven sequential days and an aliquot of the saline solution was analyzed for CHG concentration after each transfer to determine CHG release.

- Bioassay of BIOPATCH Disk and CHG-spiked cellulose disks:
  - BIOPATCH Disk and cellulose disks spiked with either 25 or 100 micrograms of CHG were placed on Mueller-Hinton agar plates seeded with S. epidermidis and zones of inhibition measured over 10 days of serial transfers.

- Evaluation of BIOPATCH Disk versus non-CHG controls on nonwounded skin sites in 30 volunteers:
  - Volunteers wore either BIOPATCH Disk or control patches for one to five days. Control patches were made from the polyurethan foam without CHG.
  - Skin flora was measured by scrubbing the skin beneath the dressing with a recovery solution which was then cultured on agar plates and quantitated.
  - CHG concentration on skin measured using bioassays or HPLC method.
  - Skin irritation: patients were questioned daily about skin irritation, burning and itching, and examined for erythema upon removal.

**Results**

**Pilot clinical study of a control patch without CHG:**

- Of the 17 patients in the pilot study 29.4% had positive cultures.
- All cultures of catheter hubs and lumen were negative (so this outcome measure was abandoned in the randomized study).
- Average number of days for positive catheters was 4.5 days versus 3.5 for negative ones.
- S. epidermidis was the predominant isolate.

**Randomized clinical study of BIOPATCH Disk versus control dressing:**

- One of 26 BIOPATCH Disk catheters (3.8%) was colonized versus nine of 31 control catheters (29%). This difference was statistically significant (P=0.006).
- S. epidermidis was the predominant isolate from all catheters and wound tracts.

**Adverse events in the clinical study:**

- There was no significant difference in skin irritation between the two dressing regimens.
- BIOPATCH Disk was well tolerated and did not cause any adverse skin reactions.

(continued)
Continuous delivery of antiseptic to insertion site may reduce infection.

BIOPATCH Disk absorbed blood and exudates from the catheter site and prevented the growth substrate for microorganisms.

Chlorhexidine release kinetics results:
- Greater concentrations of drug are delivered from days one through three while steady-state release occurs from days four through ten
- CHG delivery measured by efflux in saline showed increasing amounts delivers at each time point through seven days

Bioassay results:
- CHG dressing generated consistent ZOI (18-21 mm) on every day of the 10-day assay indicating consistent, sustained release of CHG.
- The cellulose disks spiked with CHG-only generated zones for three through four days and were widely variable from day to day.

Evaluation of BIOPATCH Disk versus controls in nonwounded skin sites in volunteers:
- No skin irritation was noted in either dressing group, BIOPATCH Disk was well tolerated and did not cause any adverse skin reactions
- In data from skin cultures taken after three through five days, BIOPATCH Disk reduced CFU by an average of two logs compared to the control dressing without CHG
- CHG levels on the skin were highly variable due to issues in skin recovery technique

Study Limitations
Although it was not possible to visualize the insertion site with BIOPATCH Disk in place, assessment was possible by palpation.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Dressing disruption is a major risk factor for catheter-related infections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Jean-François Timsit, MD, PhD; Lila Bouadma, MD, PhD; Stéphane Ruckly, MSc; Carole Schwebel, MD, PhD; Maité Garrouste-Orgeas, MD; Régis Bronchard, MD; Silvia Calvino-Gunther, RN; Kevin Laupland, MD; Christophe Adrie, MD, PhD; Marie Thuong, MD; Marie-Christine Herault, MD; Sebastian Pease, MD; Xavier Arrault, PharmD; Jean-Christophe Lucet, MD, PhD</td>
</tr>
<tr>
<td>Source</td>
<td>Critical Care Medicine, vol. 40, no. 6, 2012, pp. 1707-1714, doi:10.1097/CCM.0b013e31824e0d46</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>The final dressing disruption increased by greater than twelve-fold for major catheter related infections and catheter related bloodstream infection. The second dressing disruption was associated with a higher than three-fold increase in major catheter related infections. The number of dressing disruptions was related to an increased risk of colonization of skin around catheter at removal. Dressing disruption was higher in patients with high severity illness scores.</td>
</tr>
</tbody>
</table>

Study Objective

To define factors associated with catheter dressing disruptions and to evaluate the link between dressing disruption and the risk of catheter colonization and infection.

Methods

- Ancillary study based on data from a multicenter randomized two by two factorial design evaluating dressing change intervals (3 day vs. 7 day) with or without a chlorhexidine impregnated sponge (CHGIS).
- The study was conducted in 7 ICUs.
- All centers followed French recommendation for catheter insertion and care.
  - Maximal sterile barrier precautions
  - Preferred insertion sites were radial artery or subclavian vein
  - Insertion site scrubbed with 4% aqueous povidone iodine scrub, rinsed with sterile water, dried with sterile gauze, and alcohol based antiseptic solution applied for at least one minute
  - A semipermeable transparent dressing used on all insertion sites
- Dressings were changed in all groups at 24 hours after insertion, and then every 3 days or 7 days.
- Dressing disruption was defined by leakage or soiling that led to an immediate dressing change
  - A new planned time was scheduled for 3 or 7 days depending on the randomization group.
- First and second dressing disruptions were recorded at the time of occurrence.
- The final disruption was the last dressing before the catheter removed was replaced because of disruption.
- The cost per dressing was estimated. The cost of the chlorhexidine impregnated sponge was not included in the cost calculation.
- A hierarchical mixed logistic regression model was used to evaluate risk factors for dressing disruption.
- A marginal Cox model was used to estimate the degree of risk of catheter infection associated with disruption.

(continued)
Outcomes Measured

- Catheter tip colonization, catheter related bloodstream infections (CR-BSI), and major catheter related infection (M-CRI) associated with first, second, and final dressing disruption.
- Risk factors of dressing disruption.
- Dressing cost related to dressing disruption.

Results

- 1,419 patients with at least one dressing change were included in the study.
- 11,036 dressing changes were studied.
  - 7,347 (67%) were done prior to the scheduled date due to soiling or undressing
- 3,275 catheters equaling a total of 24,127 catheter days were cultured and analyzed.
  - 296 colonized catheters
  - 29 major catheter related infections
  - 23 catheter related bloodstream infections
- Dressing disruption was increased in patients being treated with extra renal replacement and those with higher Sequential Organ Failure Assessment scores.
- Dressing disruption increased with the duration of catheter maintenance
- It was less frequent in males and comatose patients
- Use of the subclavian insertion site was protective against dressing disruption
- The number of dressing disruptions was related to an increased risk of colonization of skin around catheter at removal \( p < .0001 \).
- The second dressing disruption was associated with a higher than three-fold increase in major catheter related infections \( p = .023 \).
- The final dressing disruption increased by greater than twelve-fold for major catheter related infections and catheter related bloodstream infection.
  - M-CRI - adjusted hazard ratio 12.51, 95% CI 3.95-39.62, \( p < .0001 \)
  - CR-BSI - adjusted hazard ratio 18.11, 95% CI 5.66-57.88, \( p < .0001 \)
- The mean dressing cost was inversely associated with dressing disruption (adjusted odds ratio 0.58, 95% CI 0.41-0.81).

Study Limitations

- The main outcome of the Dressing study was not dressing disruption.
- It did not allow for distinctions between dressing moistening and secondary disruption and dressing disruption due to other causes.
Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Chlorhexidine-impregnated sponges and less frequent dressing changes for prevention of catheter-related infections in critically ill adults: a randomized controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>JF Timsit, C Schwebel, L Bouadma, A Geffroy, M Garrouste-Orgeas, S Pease, MC Herault, H Haouache, S Calvino-Gunther, B Gestin, L Armand-Lefevre, V Leflon, C Chaplain, A Benali, A Francais, C Adrie, JR Zahar, M Thuong, X Arrault, J Croize, JC Lucet</td>
</tr>
<tr>
<td>Source</td>
<td>JAMA 2009; 301(12):1231-1241</td>
</tr>
<tr>
<td>Key Takeaways</td>
<td>Use of chlorhexidine-impregnated sponge (CHGIS) dressings with intravascular catheters in the ICU reduced the risk of infection even when background infection rates were low. Reducing the frequency of changes of unsoiled adherent dressings from every 3 days to 7 days appears safe and modestly reduces the total number of dressing changes.</td>
</tr>
</tbody>
</table>

Study Objective

To evaluate the superiority of CHGIS dressings regarding the incidence of major catheter-related infections (CRIs) and noninferiority (<3% increase in rate of catheter colonization) of 7-day vs 3-day dressing change intervals.

Methods

Adult (>18 years of age) patients were recruited between December 20, 2006 and May 20, 2008 from 7 ICUs in France (2 medical, 2 surgical, 3 medical-surgical from 3 university and 2 general hospitals) and randomized to 1 of 4 treatment groups (CHGIS or standard dressing with a 3-day or 7-day interval between dressing changes).

Prior to catheter insertion, the insertion site was scrubbed with a 4% aqueous povidone iodine solution, rinsed with sterile water, and dried with sterile gauze. A 5% providone-iodine/70% ethanol solution was applied for at least 1 minute, and sterile drapes were placed around the insertion site.

Patients in all treatment groups received the same semipermeable, transparent dressing (Tagaderm, 3M Inc., St Paul, Minnesota); in the CHGIS groups, this dressing was applied over the CHGIS dressing.

Dressings were changed 24 hours after initial catheter insertion and then every 3 or 7 days thereafter, with the use of the alcohol-providone-iodine solution for skin antisepsis during changes; dressings that leaked or became soiled were changed immediately.

Following catheter removal, cultures of the catheter tips were taken using a simplified quantitative broth dilution technique and semiquantitative insertion-site cultures were taken before catheter removal by pressing an agar plate to the skin for 5 seconds.

If a major CRI was suspected, peripheral blood samples were taken for culturing within 48 hours of catheter removal; major CRI was defined as either a catheter-related bloodstream infection or catheter-related clinical sepsis without bloodstream infection.

(title continued)
Outcomes Measured

- Major CRIs for comparison of CHGIS versus standard dressings
- Colonization rate for comparison of 3-day versus 7-day dressing change intervals

Results

A total of 1,636 patients received 3,778 catheters for a total of 28,931 catheter days.

Use of CHGIS dressings significantly decreased the rate of major CRI from 1.40 per 1,000 catheter-days to 0.60 per 1,000 catheter-days (hazard ratio [HR] = 0.39, 95% CI, 0.17-0.93, P = 0.03).

The use of CHGIS dressings (vs standard dressings) significantly reduced the rates of catheter colonization (>10 colony-forming units per plate; 6.3/1,000 catheter-days vs 15.8/1,000 catheter days, respectively; HR = 0.36; 95% CI, 0.28-0.46; P <0.001) and catheter-related bloodstream infection (0.4/1,000 catheter-days vs 1.3/1,000 catheter-days; HR = 0.24; 95% CI, 0.09-0.65; P = 0.005).

The semiquantitative skin culture count was significantly lower at catheter removal in the CHGIS group compared with the control group (P <0.01).

The 7-day dressing change schedule met the criteria for noninferiority when compared with the 3-day dressing change interval based on the rate of catheter colonization (8.6% [11.0 events/1,000 catheter-days] vs 7.8% [10.4 events/1,000 catheter-days], respectively; HR = 0.99, 95% CI, 0.77-1.28, P = 0.95).

The median number of dressing changes was significantly lower in the 7-day dressing change interval group (3/catheter, 0.4/catheter-day) versus the 3-day dressing change group (4/catheter, 0.46/catheter-day, P <0.001).

Adverse Events

8 patients experienced severe contact dermatitis leading to permanent removal of the CHGIS.

Skin allergy attributed to the semipermeable transparent dressing was diagnosed in 2 patients (1 each in the CHGIS and control groups); lesions resolved following dressing removal.

There were no systemic adverse reactions attributable to chlorhexidine.

Study Limitations

This was not a double-blind study for 2 reasons: visually identical sponges without chlorhexidine were not available and nurses were informed of the schedule for changing the dressings.

Major CRIs, most notably in ICU patients, may be difficult to diagnose.

No cultures were taken on 6.5% of catheters (because the patients left the ICU with the CVCs inserted or because of technical problems).

Alcohol-based providone iodine was used for skin antisepsis and catheter dressings because aqueous 2% chlorhexidine was not available in France at the beginning of the study.


Clinical Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Use of chlorhexidine-impregnated patch at pin site to reduce local morbidity: the ChIPPS pilot trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Stephanie C Wu, Ryan T Crews, Charles Zelen, James S Wrobel, David G Armstrong</td>
</tr>
<tr>
<td>Source</td>
<td>International Wound Journal 2008</td>
</tr>
</tbody>
</table>

| Key Takeaways | Pin tract infection is one of the most common complications associated with external fixation. The success of chlorhexidine gluconate (CHG) in reducing the incidence of catheter-related bloodstream infections led the authors to investigate the effect of BIOPATCH® Protective Disk with CHG on pin site insertion sites. The data from this retrospective cohort study show that BIOPATCH Disk patients developed fewer pin tract infections. |

Study Objective

To evaluate the effectiveness of CHG-impregnated polyurethane foam dressings in reducing percutaneous device related skin colonization and local infection.

Methods

In this initial retrospective cohort study, data were abstracted for 40 consecutive patients who received surgical treatment of the foot/ankle that required the application of a hybrid external fixator. The study recruited patients from January 1999 to March 2002.

Half of the patients had received BIOPATCH Disk and half had received control (standard care that included the application of triple antibiotic ointment to pin sites twice daily until the 12-week endpoint). The BIOPATCH Disk was changed every week until the 12-week endpoint.

All patients were operated on by the same surgeon and had the same brand of pins.

Outcomes Measured

Postoperative pin tract infection – clinically determined by the surgeon and defined as pin site erythema extending >2 cm beyond the pin portal with or without drainage.

Results

CHG reduces pin tract infections:

- None of the BIOPATCH Disk patients developed pin tract infections compared to five patients in the control group
- Fisher’s exact test demonstrated a lower rate of pin tract infections in the study group vs the control group 0% vs 25%. (P= 0.047)

(continued)
Clinical Studies

Study Limitations

One inherent limitation of this cohort study was the lack of randomization which may bias the results of this study. The control group was a convenience sample of 20 consecutive patients, and the experimental group the subsequent group of 20 patients.

Lack of quantitative cultures to determine pin tract colonizations was another limitation of this study which relied on clinician evaluation and was defined as pin site erythema extending >2 cm beyond the pin portal.
BIOPATCH* ANTIMICROBIAL DRESSING with Chlorhexidine Gluconate

INSTRUCTIONS FOR USE
(Please Read Carefully Before Using)

PRODUCT DESCRIPTION
BIOPATCH* Antimicrobial Dressing is a hydrophilic polyurethane absorptive foam with chlorhexidine gluconate (CHG). The foam material absorbs up to eight times its own weight in fluid, while the CHG incorporated into the dressing inhibits bacterial growth under the dressing.

Chlorhexidine Gluconate is a well-known antiseptic agent with broad-spectrum antimicrobial and antifungal activity.

INDICATION FOR USE
BIOPATCH Dressing containing Chlorhexidine gluconate is intended for use as a hydrophilic wound dressing that is used to absorb exudate and to cover a wound caused by the use of vascular and non-vascular percutaneous medical devices such as: IV catheters, central venous lines, arterial catheters, dialysis catheters, peripherally inserted central catheters, mid-line catheter, drains, chest tubes, externally placed orthopedic pins, and epidural catheters. It is also intended to reduce local infections, catheter-related blood stream infections (CRBSI), and skin colonization of microorganisms commonly related to CRBSI, in patients with central venous or arterial catheters.

PRECAUTIONS
BIOPATCH Dressing should not be placed over infected wounds. It is not intended to be used as a treatment of percutaneous device-related infections.

WARNING
WARNING: DO NOT USE BIOPATCH DRESSING ON PREMATURE INFANTS. USE OF THIS PRODUCT ON PREMATURE INFANTS HAS RESULTED IN HYPERSENSITIVITY REACTIONS AND NECROSIS OF THE SKIN. FOR EXTERNAL USE ONLY. DO NOT ALLOW THIS PRODUCT TO CONTACT THE EYES, EARS, MOUTH, OR MUCOUS MEMBRANES.

THE SAFETY AND EFFECTIVENESS OF BIOPATCH* ANTIMICROBIAL DRESSING HAS NOT BEEN ESTABLISHED IN CHILDREN UNDER 16 YEARS OF AGE.

DO NOT USE BIOPATCH DRESSING ON PATIENTS WITH A KNOWN SENSITIVITY TO CHLORHEXIDINE-GLUCONATE. ADVERSE REACTIONS TO CHLORHEXIDINE GLUCONATE SUCH AS DERMATITIS, HYPERSENSITIVITY, AND GENERALIZED ALLERGIC REACTIONS ARE VERY RARE, BUT IF ANY SUCH REACTIONS OCCUR, DISCONTINUE USE OF THE DRESSING IMMEDIATELY.

HYPERSENSITIVITY REACTIONS ASSOCIATED WITH THE TOPICAL USE OF CHLORHEXIDINE GLUCONATE HAVE BEEN REPORTED IN SEVERAL COUNTRIES. THE MOST SERIOUS REACTIONS (INCLUDING ANAPHYLAXIS) HAVE OCCURRED IN PATIENTS TREATED WITH LUBRICANTS CONTAINING CHLORHEXIDINE GLUCONATE, WHICH WERE USED DURING URINARY TRACT PROCEDURES. PREPARATIONS OF THIS TYPE ARE NOT APPROVED FOR SALE IN THE U.S. UNDER ANY CIRCUMSTANCES. CAUTION SHOULD BE USED WHEN USING CHLORHEXIDINE-CONTAINING PREPARATIONS, AND THE PATIENT SHOULD BE OBSERVED FOR THE POSSIBILITY OF HYPERSENSITIVITY REACTIONS. THE GOVERNMENT OF JAPAN HAS REPORTED ANAPHYLACTOID-TYPE ADVERSE EVENTS IN 13 PATIENTS WHILE USING CENTRAL VENOUS CATHETERS IMPREGNATED WITH CHLORHEXIDINE.

CLINICAL TRIAL RESULTS
A controlled, randomized, clinical trial consisting of 687 subjects with 1699 central venous or arterial catheter insertion sites was conducted at two centers. Results showed that the use of BIOPATCH Dressing resulted in a statistically significant 44% reduction in the incidence of local infection (p = 0.0001).

Table 1: Summary of local infections in 1401 evaluable lines

<table>
<thead>
<tr>
<th></th>
<th>No Local Infection %</th>
<th>Local Infection %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOPATCH*</td>
<td>556 (83.3%)</td>
<td>109 (16.4%)</td>
<td>665</td>
</tr>
<tr>
<td>Control</td>
<td>520 (70.7%)</td>
<td>216 (29.3%)</td>
<td>736</td>
</tr>
<tr>
<td>Total</td>
<td>1076</td>
<td>325</td>
<td>1401</td>
</tr>
</tbody>
</table>

Results also showed that the use of BIOPATCH* Dressing resulted in a statistically significant 60% reduction in the incidence of catheter-related blood stream infections (p = 0.026).

Table 2: Summary of catheter-related blood stream infections (CRBSI) in 589 evaluable subjects

<table>
<thead>
<tr>
<th></th>
<th>No CRBSI Frequency (%)</th>
<th>CRBSI Frequency (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOPATCH*</td>
<td>289 (97.6%)</td>
<td>7 (2.4%)</td>
<td>296</td>
</tr>
<tr>
<td>Control</td>
<td>276 (93.0%)</td>
<td>18 (6.1%)</td>
<td>294</td>
</tr>
<tr>
<td>Total</td>
<td>564</td>
<td>25</td>
<td>589</td>
</tr>
</tbody>
</table>

† Clinical diagnosis based on positive blood cultures and DNA typing.

Results of this study also showed that use of BIOPATCH Dressing resulted in statistically significant reduction in skin colonization of microorganisms commonly associated with CRBSI (p < 0.05). Patients randomized to the BIOPATCH* Dressing Treatment Group experienced no serious device-related adverse events.


Information regarding the use of BIOPATCH Dressing on patients < 16 years of age is limited. A study performed on 16 patients, ages 3 days to 15 years, was performed to evaluate the effectiveness of BIOPATCH Dressing in the management of insertion or exit sites of indwelling CVCs. No cases of catheter-related infections were reported during the course of the trial. Compared to the institution’s standard therapy, BIOPATCH Dressing resulted in better appearance of entrance/exit sites in 56% of cases (p = 0.002); less irritation of entrance/exit sites in 50% of cases (p = 0.011); better entrance/exit site protection in 94% of cases (p < 0.001). BIOPATCH* Dressing was the preference of the investigators over standard therapy in 81% of cases (p < 0.001).

DIRECTIONS FOR USE
1. Prepare the skin surrounding the percutaneous device according to hospital protocol.
2. Remove the BIOPATCH Dressing from the sterile packaging using aseptic technique.
3. Place the BIOPATCH Dressing around the catheter, making sure the blue grid side is facing upward. The smooth white foam side should be next to the patient’s skin.
4. In order to ensure easy removal when used with a film dressing, place the BIOPATCH Dressing around the catheter/pin site in such a way that the catheter rests upon the slit portion of the BIOPATCH Dressing. The edges of the radial slit must approximate one another to assure efficacy.
5. Secure the catheter and BIOPATCH* Dressing to the skin with BIOLUX* Transparent Dressing. Ensure complete contact between skin and the BIOPATCH Dressing.
6. Change the patch as necessary, in accordance with facility protocol; dressing changes should occur at a minimum of every 7 days. Dressing changes will be needed more frequently with highly exudative wounds.
7. To remove the BIOLUX Dressing, pick up the corner of the dressing and stretch the dressing away from the catheter, holding the catheter in place. (Dressing will partially lift.) Peel back until resistance is felt. Repeatedly stretch and peel as necessary until the dressing is removed.
8. BIOPATCH Dressing will remain attached to the BIOLUX Dressing, so removal will be simultaneous.

STORAGE INFORMATION
Store at Controlled Room Temperature 15° - 30°C (59° - 86° F). Do not resterilize. Do not use if individual pack damaged/opened.

The use by date of this product is printed on the packaging.

NOTE: Over time the BIOPATCH Dressing may turn yellow in color. This coloration does not reduce the antimicrobial efficacy of the dressing.

HOW SUPPLIED
BIOPATCH Dressing is supplied sterile. Each package contains a single dressing. BIOPATCH Dressing is intended for single use only. Do not resterilize.

<table>
<thead>
<tr>
<th>Product Code</th>
<th>BIOPATCH* Size</th>
<th>Per Box</th>
<th>Per Case</th>
<th>Average Amount of CHG Per Dressing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3150</td>
<td>1” DISK (2.5cm) 4.0 mm center hole with radial slit</td>
<td>10</td>
<td>4</td>
<td>92 mg</td>
</tr>
<tr>
<td>3151</td>
<td>1/2” DISK (1.9cm) 1.5 mm center hole with radial slit</td>
<td>10</td>
<td>4</td>
<td>52.5 mg</td>
</tr>
<tr>
<td>3152</td>
<td>1” DISK (2.5cm) 7.0 mm center hole with radial slit</td>
<td>10</td>
<td>4</td>
<td>86.8 mg</td>
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<tr>
<td>9150 (US only)</td>
<td>1” DISK (2.5cm) 4.0 mm center hole with radial slit</td>
<td>Kit Component</td>
<td>Kit Component</td>
<td>92 mg</td>
</tr>
<tr>
<td>9151 (US only)</td>
<td>1/2” DISK (1.9cm) 1.5 mm center hole with radial slit</td>
<td>Kit Component</td>
<td>Kit Component</td>
<td>52.5 mg</td>
</tr>
<tr>
<td>9152 (US only)</td>
<td>1” DISK (2.5cm) 7.0 mm center hole with radial slit</td>
<td>Kit Component</td>
<td>Kit Component</td>
<td>86.8 mg</td>
</tr>
</tbody>
</table>

*Trademark

Manufactured for
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Johnson & Johnson MEDICAL Limited, Gargrave, North Yorkshire, BD23 3RX, U.K
Banton J, Banning V. Impact on catheter-related bloodstream infections with the use of BIOPATCH® dressing. J Assoc Vasc Access. 2002; Fall.


Timsit J, Bouadma L, Geffray A. Chlorhexidine-impregnated sponges and less frequent dressing changes for prevention of catheter-related infections in critically ill adults: a randomized controlled trial. *JAMA* 2009; 301(12):1231-1241.