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**Winning the War on CLABSIs:  
The Role of Education and New Technology**

# Winning the War on CLABSIs: The Role of Education and New Technology

By Nancy Moureau, RN, CRNI

**ALTHOUGH PROGRESS HAS** been made in many areas, central line-associated bloodstream infections (CLABSIs) remain a national healthcare problem of crisis proportions. The stakes for healthcare institutions that haven't effectively addressed CLABSIs continue to mount. The Joint Commission, which accredits hospitals and other healthcare institutions, has made prevention of CLABSIs one of its 2009 National Patient Safety Goals. This sends a strong message to facilities under the commission's purview to implement aggressive CLABSI minimization programs.

The financial stakes for institutions with CLABSI problems have risen, too. Acting on a directive from Congress, the Centers for Medicare and Medicaid Services (CMS) has stopped reimbursing hospitals for hospital-associated conditions it considers preventable. One of the designated preventable conditions is CLABSIs. Many private insurers are taking similar steps in the wake of CMS's action.

How can a healthcare institution avoid infections that at one time seemed intrinsic to widespread catheter use? Solutions are emerging. Education and new product technology are clearly part of the answer. New products alone accomplish little unless clinicians understand how to use them correctly. Additionally, medical personnel must be trained to adhere to basic precautions such as appropriate handwashing protocols.

An understanding of what CLABSIs are and how they occur is necessary before one can fully comprehend the importance of adhering to evidence-based technologies such as chlorhexidine gluconate (CHG) on the skin and the effects that valve disinfection caps may have in reducing infection rates. Additionally, strategies are included below that have been proven effective at minimizing or eliminating CLABSIs at some institutions.

## The Issue

The Centers for Disease Control and Epidemiology (CDC) notes that CLABSIs are the fourth most common type of healthcare-associated infections (HAIs). The threat to patients is particularly pronounced for CVCs placed in the intensive care unit (ICU) (O'Grady, 2002). CLABSIs constitute a significant threat to patients' lives given that the attributable mortality rate for this type of infection is 12 percent to 25 percent (Mermel, 2000). The financial toll exacted by CLABSIs is also daunting. According to the CDC, each

CLABSI costs an estimated \$25,000 to \$45,000 per case to treat with the highest costs occurring in the ICUs patient (O'Grady, 2002).

To better understand why the protocols for preventing infections must be comprehensive and why meticulous adherence to these protocols is necessary, let's examine the biological process behind CLABSIs. Biofilm is created when microorganisms come into contact with a surface, including a medical device such as a catheter, and attach themselves to it by excreting certain polymers. Those same polymers help the microorganism form colonies that transform the cells physically and genetically. This growth activity is part of a drive to form new colonies on other surfaces and also to prevent starvation in an overly dense colony. Microorganisms that form a mature biofilm colony eventually detach from the colony and disperse into the host system.

If the organisms have access to the bloodstream as they do in intravenous catheterization, they can cause bloodstream infection (Ryder, 2005). The whole process is a survival mechanism for the microorganism that pits the "intelligence" of biological adaptation against the best minds in infection control. The microorganisms are far more resistant to antimicrobials, as well the patient's immune system, in their altered, colonized state than in their single-celled state.

It should be noted that dosing the patient with antibiotics is not an effective strategy for preventing CLABSIs. Antibiotics were developed to combat microorganisms in their single-cell state, not in their colonized, biofilm state in which they have altered phenotypes and genotypes. Studies show the drugs to be 100 to 1,000 times less potent against microorganisms in biofilm (Ryder, 2005). This places an overwhelming burden of CLABSI prevention on healthcare workers executing appropriate preventive protocols during the catheter placement and maintenance phases.

Now consider that some 48 percent of ICU patients receive central venous catheters (CVCs) (ICT, 2007), and you see why CVCs, ICUs, and CLABSIs are so closely linked. The extraluminal cases of infection are caused by the offending organisms entering the catheter insertion site from the skin and then traveling down the catheter path into the bloodstream. Intraluminal infections result when contamination occurs and organisms violate the bloodstream via the fluid pathway. Studies show that extraluminal and

intraluminal infections occur with about equal frequency, so preventative methods must focus on both possibilities. Whether extraluminal or intraluminal, it only takes a few single-celled microorganisms to initiate colony formation (Ryder, 2005).

## Current Methods for Preventing CLABSIs

### Bundles

Many experts agree that the most effective way to prevent CLABSIs is to create "bundles" that prevent contamination at every critical point along the catheter placement/maintenance timeline. A bundle is a set of best practices for achieving a desired care outcome. The most widely accepted bundles for preventing CLABSIs combine behaviors and technologies that support or enhance those behaviors that achieve the best outcomes. The current Central Line Bundle (see [www.IHI.org](http://www.IHI.org)) includes:

1. Hand hygiene
2. Maximum barriers
3. Chlorhexidine skin prepping
4. Selection of best device site
5. Daily review of device necessity

### Skin Antisepsis

Thorough skin antisepsis prior to insertion reduces bacteria at the insertion site, which is why it is part of standard CLABSI prevention protocols. Nevertheless, some bacteria will inevitably survive and enter the bloodstream with the catheter increasing risks for extraluminal infection (Ryder, 2005).

### Device Selection

Peripherally inserted central catheters (PICCs), as opposed to other vascular access devices, are associated with fewer infections than central lines placed in the jugular or subclavian insertion sites. The lower infection rates are probably due to the fact that the resident skin bacteria counts are 1,000-fold fewer on the average patient's arm, which tends to be dry, as opposed to the upper chest, neck and groin which are warm, moist, and dark (Macklin, 2007).

### Disinfection Devices

Intraluminal biofilm can form when microorganisms inhabit an improperly disinfected access portal or connection site giving them access to the catheter's flow system. It is important that key parts of the catheter administration set be

disinfected. There is concern now in the vascular access community that needless mechanical valve devices (NMVDs) may be problematic in this regard (SHEA guidelines, 2008). A study published in 2007 shows a significant increase in CLABSI rates when a hospital switched from needleless split-septum devices (NSSDs) to NMVDs (Salgado, 2007). This increase occurred despite the fact that nursing staff attended multiple educational sessions about the proper use and disinfection of NMVDs. This was not an isolated report. Three abstracts from national scientific meetings and one article in a peer-reviewed journal describe similar increases (Salgado, 2007). Other anecdotal reports concern a variety of NMVDs from different makers. In addition, a Veterans Administration medical center found increased bloodstream infection rates after implementing luer-activated mechanical valves (NMVDs) and positive displacement needle-free intravascular connector valves (NMVDs) (Salgado, 2007).

NMVDs originally came into wide use because, as a needleless device, they protected nursing staff from potential sharps injuries while providing easy connection with only a syringe. They were considered an advance over NSSDs, which were associated with frequent occlusions, backflow issues, and in some reports, increased bloodstream infections. NMVDs do appear to reduce occlusions and backflow but perhaps at the expense of a higher infection rate. Many of those studying NMVD use believe the increased CLABSIs occur because the multi-part devices are difficult to disinfect (Salgado, 2007).

## The Role of Technology in Preventing CLABSIs

The following are current product technologies that have already established their worth in current bundles plus newer technologies that may fill holes in antimicrobial practices. Because biofilm is so insidious, it is important to use antimicrobial methods that act on the nature of the problem.

### Options for the Reduction of Intraluminal Contamination

- **SwabCap™** (Excelsior Medical): Inside the SwabCap™ is a foam pad containing 70 percent isopropyl alcohol. When the cap is twisted onto an IV access port, the alcohol is dispensed disinfecting the top and threads without activating any mechanical valve. The cap also serves as a physical barrier against airborne or touch contamination providing security that what is under the cap is clean and ready for use. This design makes the cap more effective than alcohol wipes in disinfecting hard-to-reach surfaces (Menyhay, 2006). Other products in the same disinfecting cap category include Lifeshield® Effect-IV™ (Hospira), Curost™ Port Protector (IVera



Medical Corporation), and Site-Scrub™ (PFM Medical, Inc.)

- **Antimicrobial CLAVE™** connector (ICU Medical): The CLAVE™ reduces intraluminal bacterial colonization in a randomized clinical trial. The new product is based on the original CLAVE™ design but, as a further protection against infection, adds ionic silver to all components that have contact with the fluid pathway. Silver ions, a known antimicrobial, are released throughout the product's 96-hour use life.

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### Options for the Reduction of Extraluminal Bacterial Contamination

- **Chloraprep®** (CareFusion, Inc.): Chloraprep® combines 2 percent CHG with 70 percent isopropyl alcohol. It is used as a pre-insertion skin prep because of its proven effectiveness. Chlorhexidine (2 percent) as a skin prep has been widely recommended by groups such as the Society for Healthcare Epidemiology of America (SHEA)/Infectious Diseases Society of America (IDSA), the Institute for Healthcare Improvement, and the CDC.
- **SAGE® CHG Cloths** (Sage Products): Sage CHG cloths were designed to be used primarily as preoperative skin prep. The CHG reduces resident bacterial counts on the patient's skin thereby reducing the risk of surgical site infections. Some facilities use the cloths in a two-step process with Chloraprep® as a skin prep prior to intravascular catheter insertion. The cloths are used first and followed up with Chloraprep® for additional effectiveness against skin bacteria.



SAGE® 2% CHG Preoperative Skin Preparation Cloths reduce skin bacterial counts thereby decreasing the risk of surgical site infections.

- **BIOPATCH®** protective disk with CHG (Ethicon/Johnson & Johnson): This foam disk is designed to be placed around the central venous catheter at the insertion site where it provides a sustained release of CHG for seven days. This evidence-based technology helps defeat the bacteria re-colonization that can occur after the patient's skin is disinfected for catheter insertion.
- **Tegaderm™** CHG (3M Health Care): A transparent IV securement dressing (CHG gel dressing) which provides a sustained release of antimicrobial activity for up to 10 days. This dressing combines the advantages of a transparent dressing with the antimicrobial benefits of chlorhexidine in an integrated, easy to use design.



Tegaderm™ CHG (3M Health Care) is a transparent IV securement dressing, releases the antimicrobial chlorhexidine gluconate (CHG) for up to 10 days.


- **InVizion Plus® Neutral®** IV Connector System (RyMed Technologies): This system appears to provide built-in protection against intraluminal biofilm formation (Harnage, 2007). In particular, the device's septum has a smooth surface that is easily cleaned as opposed to a positive pressure product previously used at the hospital.

## The Role of Education in Preventing CLABSIs

It is intuitive that education enhances the effectiveness of preventative practices and research confirms that conclusion. Two ICUs in Saint Louis implemented a 10-page self-study module on CLABSI prevention including additional lectures and posters. The CLABSI rate decreased by 57 percent in those facilities, from 4.9 per 1,000 catheter-days in the pre-intervention period to 2.1 per 1,000 catheter-days in the post-intervention period (Warren, 2003). In a larger study of a similar educational intervention, the program reduced the CLABSI rate by 66 percent, from 10.8 per 1,000 catheter days to 3.7 per 1,000 catheter-days (Coopersmith, 2003).

Education plays an additional role for home care and hospice organizations. Patients receiving home care may receive catheter-related care from a variety of caregivers between home

visits, such as in doctor's offices or ambulatory infusion centers. If home caregivers, patients, and patients' families are better educated about CLABSI prevention, patients will have a better chance of receiving appropriate care at home and caregivers will be better positioned to advocate for that same level of care when patients are in other settings (McGoldrick, 2009).

All told, the effectiveness of educational interventions reinforces the overall message in CLABSI prevention: A multi-factorial approach that addresses every conceivable entry point for bacteria and every conceivable lapse in compliance gives the best chance of success. This means that no evidence-based behavior or product technology should be overlooked. It takes multiple steps and multiple technologies to reach a zero CLABSI rate. When zero is the goal, interventions must contain innovations, education, and the safest technology available. 

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