

Modifying Infection Prevention and Control Behaviors

by Herbert Partrick, MD, MSEE



Infection rates in healthcare environments have profound effects on patient outcomes, therapeutic procedures and costs. Controlling infections is an ongoing task that continues to gain attention with the emergence of new and resistant bacterial strains. "Infection Protection" is a new monthly feature of Healthcare Purchasing News that addresses infection control issues ranging from patient safety to the impact of purchasing decisions on healthcare-acquired illnesses.

The first article in this series is written by Dr. Herbert Partrick, associate professor of pulmonary and critical care medicine at Drexel University College of Medicine and director of the medical intensive care and progressive care units at Hahnemann University Hospital in Philadelphia. We hope you find this article informative and encourage you to send questions to our Q&A forum at jakridge@hpnonline.com or call (941) 927-9345 extension 202.

*Welcome—we look forward to hearing from you.
—Cynthia T. Crosby, vice president, clinical affairs for Medi-Flex, Inc.*

Introduction

Hospital care routinely involves the insertion of an intravascular catheter. Although these devices are necessary, they may introduce pathogens into the body that cause local or systemic infections. Catheter-related bloodstream infections (CRBSIs) are associated with significantly increased risks for patient morbidity and mortality. Patients in intensive care units (ICUs) are at especially high risk of infection compared to patients in ambulatory settings.¹

CRBSI rates vary depending on the type of catheter used and the patient's underlying condition. Central venous catheters (CVCs) are associated with the highest infection risk for various reasons. CVCs are used most often in ICUs or emergency care environments. When rapid vascular access is needed in emergencies, proper aseptic techniques may not be

followed as closely as in more controlled environments. CVCs also may be inserted for long durations, increasing the risk that a pathogen may be introduced through the insertion site. Extended hospital stays increase patient exposure to hospital-acquired organisms, as well.¹

The annual incidence of CRBSIs in the United States is most commonly calculated as the number of infections per 1000 days of catheter use (catheter days), based on recommendations by the Centers for Disease Control (CDC) and the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO).^{2,3} According to data reported by the CDC in 2002, the average rate of CVC-associated bloodstream infections was 5.3 per 1000 catheter days in the ICU, or approximately 80,000 infections annually. The annual estimated number of CVC-associated infections increased to 250,000 when data were calculated for the entire hospital.¹ CRBSIs are known to contribute to morbidity and mortality, but gathering precise mortality rates is difficult due to other factors, such as the contributing role of the underlying disease. Costs associated with infection care are somewhat clearer, however. In a study of infection rates among critically ill surgical patients with ICU stays of at least three days, the CRBSI rate was 3.6 episodes per 1000 catheter days, resulting in an increase of \$56,000 (1998 dollars) in total hospital costs and an increase of more than \$71,000 in ICU costs per infection. The need for increased hospital stays of 22 days due to CRBSI contributed to total costs of care.⁴

In 2002 the CDC published its most recent version of *Guidelines for the Prevention of Intravascular Catheter-Related Infections*.¹ These guidelines provide information to help healthcare organizations reduce CRBSI rates. Recommendations are included for practitioners who insert catheters and for staff who are responsible for surveillance and control of infections. A partial list of CDC recommendations is presented in Table 1. Data included in the guidelines are gathered from the CDC's National Nosocomial Infection Surveillance System

(NNIS). The NNIS has been collecting infection incidence rates and etiological information about hospital-acquired infections since 1970. Data are collected from approximately 300 hospitals in the United States and are published annually. From 1992 to 2001, participating hospitals gathering NNIS data reported ICU infection rates ranging from 2.9 to 11.3 CRBSIs per 1000 catheter days. This information is published to help healthcare practitioners track their infection rates against those of comparable institutions.

CRBSI control methods at Hahnemann

In 2002, the CRBSI rate in the ICU at Hahnemann University Hospital in Philadelphia rose above the 50th percentile of NNIS data published by the CDC. Tenet Healthcare Corporation, the owner of Hahnemann University Hospital, requested that steps be taken to address the increasing infection rate. An interdisciplinary infection control committee was convened to review current data and to make recommendations for improvement. Members included a pulmonary critical care physician, an intensivist, a senior director of nursing, a nurse who specialized in infection control and the director of purchasing. The inclusion of a representative from purchasing is worth highlighting because purchasing departments often are not represented on interdisciplinary healthcare committees. The objectives of this committee in reducing CRBSI required the inclusion of someone who was familiar with materials needed for site preparation and catheterization.

Data review

The committee's first priority was to review internal CRBSI rates and to compare them to NNIS data. Hahnemann's CRBSI rates per 1000 catheter days were tabulated monthly. The committee then began to develop an approach designed to review and address issues associated with materials, procedures and training.

Materials selection

The committee used the CDC catheter-related infection control guidelines as a template for initiating new procedures.¹ Many of the CDC strategies for infection control are based on materials used when a patient is catheterized. The purchasing agent serving on the committee played a key role in making recommendations for quality improvements. For example, the committee decided to switch from povidine iodine for antisepsis to 2% chlorhexidine gluconate (ChlorPrep, Medi-Flex, Inc.; Leawood, KS), as recommended by the CDC, because 2% chlorhexidine is associated with a substantially reduced risk of CRBSI. Other materials recommendations included the use of face masks with clear plastic visors, rather than goggles, to reduce the exchange of potentially infectious substances. Elastic-ringed bonnets and full-sized gowns made of impermeable material were selected, and full-sized drapes for covering the entire patient, along with small drapes for the insertion site, were selected for barrier control. These materials were selected after determining that physicians needed to improve maximal barrier precaution methods.

After recommending materials to improve quality of care and reduce infection risks, the purchasing agent then negotiated pricing with suppliers. Despite the emphasis on increased quality of materials, the choices recommended by the purchasing agent were projected to produce long-term savings. This was partly due to projected substantial decreases in costs of care due to infections. Another contributor to cost savings was Tenet's system-wide network of suppliers. The purchasing agent was able to specify and obtain assembled central line accessory kits containing all materials needed for two clinicians to properly insert a catheter, including saline and 20-mL syringes. Only the CVC had to be separately selected.

Traditionally, Vantex triple-lumen catheters and AVA-HF quad-lumen introducers were used (Edwards Lifesciences LLC; Irvine, CA). The infection control committee decided to compare Vantex catheters to ARROWGard Blue Plus (A.M.I. Technologies Ltd; Hod Hasharon, Israel) to determine whether catheter selection would affect infection rates. Vantex triple-lumen CVCs were used in the medical and progressive care units, and ARROWGard Blue Plus triple-lumen CVCs were used in the coronary, surgical-trauma, cardio-thoracic and neonatal ICUs, on the hospital floors,

and in the emergency department. Data were gathered regarding infection rates for the two types of triple-lumen CVCs.

Procedural changes

The committee also recommended procedural changes in the location and manner of catheter insertion and maintenance. Based on data collected by the author, insertion sites were selected to reduce CRBSI risk. Preferred sites were selected as follows:

- First choice: subclavian left vein (preferred) or right vein
- Second choice: internal jugular right vein (preferred) or left vein
- Third choice: femoral vein

CVC dressing choices included Tegaderm (3M Corporation) for occlusive dressings and

gauze for oozing sites that were not dressed with Tegaderm. No antiseptic ring or disc was recommended. Prophylaxis included recommendations for the duration of catheter insertion. Although catheter replacement at scheduled times has not been recommended for CRBSI control,¹ data review at Hahnemann revealed that infection rates increased with the duration of catheter insertion. Therefore, new prophylactic procedures were implemented. New procedures state that if no local erythema or systemic inflammatory response is noted, CVCs can stay in place for a maximum of eight days at subclavian or internal jugular sites but must then be replaced with a new stick. Although catheter replacement over a guidewire is commonly performed when a malfunction occurs,¹ this practice is not

CDC strategies for prevention of catheter-related infections	
CDC Guideline Strategy	Summary
Quality assurance and continuing education	Staff education and experience are associated with reduced infection risk
Site of catheter insertion	Insertion location influences infection risk
Type of catheter material	Teflon or polyurethane catheters are associated with decreased infection risk
Hand hygiene and aseptic techniques	Hand hygiene and appropriate barriers for CVCs reduce infection risk
Skin antisepsis	2% chlorhexidine gluconate is recommended by the CDC as the most effective preparation for reducing infection risk
Catheter site dressing regimens	Infection risk does not differ by dressing type (transparent or gauze)
Catheter securement devices	Sutureless securement devices reduce infection risk
In-line filters	In-line filters reduce infusion-related phlebitis but have not been clinically shown to prevent intravascular catheter-related infections
Antimicrobial/antiseptic impregnated catheters and cuffs	Certain catheters and cuffs are associated with reduced infection rate; a review of clinical data is included
Systemic antibiotic prophylaxis	Prophylaxis has not been clinically shown to reduce CRBSI in adults; vancomycin prophylaxis in infants may reduce CRBSI but not mortality
Antibiotic/antiseptic ointments	Various ointments have been studied and yielded conflicting results; a review of data is included
Antibiotic lock prophylaxis	Prophylaxis in patients with long-term catheters has been shown to reduce infection risk
Anticoagulants	Risk of infection is reduced with some anticoagulants; a review of data is included

Table 1

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used once a catheter has been in place for eight days. At femoral sites, CVCs must be replaced by 48 hours. Emergency insertions are limited to 24 hours. Pulmonary artery catheters must be replaced through the introducer at four days. The introducer can remain in place for eight days, allowing two pulmonary artery catheters. Once a catheter is no longer needed, it should be removed immediately.

Education

After new materials were selected and procedures developed, the interdisciplinary infection control committee implemented a comprehensive education program for the staff. Physicians were required to demonstrate proficiency in CVC insertion techniques using maximal barrier precautions.

As noted, the committee determined that barrier precautions needed improvement. Selecting more effective barrier materials such as gowns and drapes addressed only part of the problem. The committee also found that physicians were not adequately trained in the use of barrier precautions. After failing to find appropriate training materials, the committee chose to create a video and slides based on the CDC infection control guidelines. Drexel University College of Medicine assisted in the development of the videotape illustrating proper catheter insertion and barrier techniques. All physicians were required to watch the video or attend a one-hour lecture with slides to review proper procedures. Physicians were then quizzed to ensure that they met credentialing criteria for CVC insertion. Because Hahnemann is a teaching institution, all resident physicians and fellows in training also were required to train in proper catheter insertion methods. Residents had to be certified in the new procedures by the residency review committee before being permitted to graduate. Even if residents had completed training before the new procedures were implemented, they were required to re-train

to the new standards. After training, all physicians had to successfully complete five central venous catheter insertions to be certified before being allowed to catheterize a patient without supervision.

Nurses also received training about appropriate occlusive dressing selection and application techniques and were encouraged to participate in performance improvement to the extent that they were empowered to stop physicians if approved insertion procedures were not followed. The institutional review board authorized the nursing staff to collect data for internal review and future publication.

Results

Table 2 presents CRBSI rates from September 2000 through March 2004. Rates are calculated per 1000 catheter days. Data shown are for rates observed in the surgical-trauma

continual staff rotations in this teaching hospital.

Although all physicians complied with re-training and certification procedures, many had difficulty believing that their prior procedures contributed to infection rates. The committee's efforts to collect internal CRBSI rates helped all staff members understand the need to take immediate action to reduce infections.

Having a dedicated, interdisciplinary committee also was of paramount importance. Everyone working in the hospital environment is already busy—adding another task and maintaining the momentum necessary to achieve objectives is time-consuming. Organizations who wish to create a similar structure must choose the people who are most likely to be motivated to make improvements, even when they encounter obstacles. In many organiza-

tions, a certified infection control practitioner would be a likely choice for committee leader. In Hahnemann's experience, having a purchasing representative on the committee resulted in better equipment and overall cost savings.

Conclusion

Ultimately, the best result of the committee's efforts was improved patient care. The CRBSI rate continues to decline, and we are confident that our new processes will continue to enhance outcomes. In addition, the intensive education program we established improved the performance of our physicians and the physicians they were teaching. Finally, we were able to reduce costs by ensuring that we negotiated effectively with suppliers and, ultimately, by decreasing infection-related costs of care. We believe that our efforts have added significantly to the overall success of Hahnemann in providing quality patient care. **HPN**

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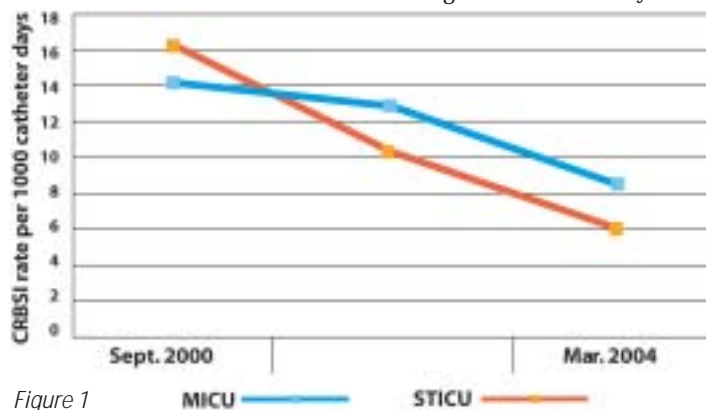


Figure 1

and medical ICUs. Data were not stratified by type of catheter (CVC or peripherally inserted central catheters). The comparison of triple-lumen CVC brand (Vantex vs ARROWGard Blue Plus) revealed no difference in CRBSI rates. Figure 1 graphically illustrates the significant downward trend in infections after new insertion procedures and education were initiated.

Observations about the process

The interdisciplinary infection control committee found that the time it took to accurately assess and address the CRBSI rate exceeded initial expectations. A goal of three months was originally established to identify materials and change CVC procedures. In fact, it took six months before CRBSI rates began to decline. The delay was due in part to

Location	Sept. 2000 to Sept. 2001	Apr. 2002 to Apr. 2003	Mar. 2002 to Mar 2004
STICU	16.3	10.4	6.2
MICU	14.2	13.1	8.5

Table 2- CRBSI rates per 1000 catheter days