

## **Technologies, New Guidelines Work to Reduce Invasive Device-Related Infections**

*By Kelli M. Donley*

Infections related to invasive devices are receiving unprecedented attention since the release of a Centers for Disease Control and Prevention (CDC) guideline that updated the topic.

The “Guidelines for the Prevention of Intravascular Catheter-Related Infections,” was prepared by numerous infection control experts, including CDC director Julie L. Geberding, MD, MPH. The update highlights five significant methods of reducing such infections:

- Increased education of those inserting such devices
- Using sterile barrier precautions during device insertion
- Using 2 percent chlorhexidine preparation for skin antisepsis before insertion
- Preventing replacing central venous catheters regularly
- Using catheters impregnated with antiseptic/antibiotics<sup>1</sup>

The guidelines use several methods of categorizing invasive catheters: by type of occupied vessel (peripheral venous, central venous, arterial); life span (temporary, short-term, long-term, permanent); insertion site (subclavian, femoral, internal jugular, peripheral, peripherally inserted central catheter); type of skin to vessel pathway (tunneled, nontunneled); physical length (short, long); or special feature (cuff, antibiotic impregnation). Rates of infection associated with invasive catheters are divided among these subgroups. However, the research shows more than 80,000 central venous catheter (CVC)-related infections are reported each year from American intensive care units alone. The average cost of each infection varies from \$34,000 to \$56,000; depending on the research figures used, these infections incur an annual financial burden of \$296 million to \$2.3 billion to the American healthcare system.

CVC-related infections reported hospitalwide total more than 250,000 annually in the United States, costing the healthcare system an estimated \$25,000 per infection. Such high rates of infection and costs have fueled medical device companies to develop innovative methods of preventing infections associated with their devices.

Kelly Powers, vice president of research and development at CR Bard, based in Murray Hill, N.J., says the company's Access Division specializes in long-term vascular access products.

"Long-term vascular access devices are typically given for chemotherapy treatment," he says. "These cancer patients need long-term infusions of chemotherapeutic drugs. There are four major categories that these devices fall into.

Implanted ports can be placed and left in place for several years. In general, those patients either die from their cancer or they recover and the ports are removed. The next is peripherally inserted central catheters. Those are called PICC lines and they are long-term central catheters that are placed in the arm.

Also, there are chronic catheters, placed in the jugular vein and used primarily for the same thing. The final category of long-term vascular access is for dialysis — used for hemodialysis treatment."

Patricia Johnson, RN, MSN, senior marketing manager at Arrow Medical, based in Libertyville, Ill., says these devices are used for a variety of patients.

"They are used many times by critically ill patients," she says. "Sometimes these are patients that need total perinatal nutrition. They can't be fed through their stomach or mouth and they need to get the proteins, fats and carbohydrates through the veins. If you do that in the peripheral aspect, through the arm, you can cause a lot of phlebitis or thrombosis just because of the osmolarity and pH of the medications you are infusing.

Many times trauma patients, burn patients and patients with major surgery are candidates for a central venous catheter."

However, Johnson warns, central venous catheters are not inserted without considerable thought.

"These devices remain inserted on average from 5 to 10 days," she says. "Most people have an average of 7 days. There are certainly patients who have them in for 2 to 3 weeks because they are just that critically ill.

Yet, I think any practitioner today only uses these catheters as they are needed and tries to get them out as soon as they possibly can."

She says this rush is due to infections associated with the devices. The challenge for manufacturers has been developing infection control technologies that last for the entire use of long-term catheters.

"We know there is an average 5 percent infection rate associated with central venous catheters," she says. "In 1991, we introduced a technology to help decrease the risk of catheter-related blood stream infections. This included silver sulfadiazine and chlorhexidine being impregnated onto the external surface of the catheter."

Within the last few years, she says company officials have also been able to impregnate internal lumens, extension line and the hub of the catheter with the antimicrobials. Research has shown this technology is effective for 10 to 14 days. Other studies, Johnson says, report effectiveness of 45 to 54 days after implantation. Further research is needed.

“There are different ways of managing catheters, the most important focusing on sterile technique when they are being placed,” says Powers. “From a technology standpoint, we have a major research and development focus to develop anti-infective coatings. There is a lot of science working on this right now, but no one has completely mastered long-term effectiveness.

Short-term effectiveness has been demonstrated.

Our devices are in there anywhere from 30 days to 24 months. Nothing has shown that you can put on a catheter to prevent infection (for that long).

The primary technology is antibiotics, but this is less preferred because of bacterial resistance. Silver ion eluting coatings are fairly promising, but difficult to control the kinetics to be effective for very long.”

### **Epidemiology, Pathogenesis of Catheter-Related Infections**

Officials at the CDC have been monitoring the types of infections reported in the United States since 1970. The National Nosocomial Infection Surveillance System (NNIS) data shows infections in this arena have changed in reaction to developing antibacterial resistance patterns. The following timeline denotes the most prevalent catheter-related infections:

- 1986-1989: Coagulase-negative staphylococci, *Staphylococcus aureus*, *Candida*
- 1992-1999: Coagulase-negative staphylococci, enterococci, *Staphylococcus aureus*

CDC researchers highlight in 1999 they received the first data showing *Staphylococcus aureus* isolates resistant to oxacillin and *Candida albicans* isolates were resistant to fluconazole. Other *Candida* strains have since become resistant to itraconazole as well. Also, ICU-related *Enterobacteriaceae* infections, *Klebsiella pneumoniae* in particular, have become increasingly resistant to extended-spectrum cephalosporins and broad spectrum antimicrobial agents.<sup>1</sup>

Short-term catheter insertion sites primarily develop infections because of migration of skin organisms near the area. However long-term catheter sites more frequently cause infections because of hub contamination.<sup>1</sup>

“We know the pathogenesis of catheter-related infections is that the longer the catheters are left in place, the more prominent it becomes as being the source of an infection,” says Johnson.

Paul Blackburn, RN, senior product manager of clinical information at CR Bard, says besides the complex antimicrobial impregnation technologies, there are simple methods healthcare workers (HCWs) can use to reduce these infections.

“Follow the CDC-recommended guidelines for not only site preparation, but for insertion of the device,” he says. “We recommend that HCWs use Chloraprep as the antimicrobial for the site and then we recommend that they use full sterile barrier precautions during insertion.

Once insertion is complete and HCWs begin the care and maintenance regime, again we recommend that they use sterile gloves when cleaning the site. Also, they should use chlorhexidine gluconate and they should follow their hospital's policy.” Chloraprep is manufactured by Medi-Flex Inc., based in Overland Park, Kan.

Johnson is not as quick to provide company infection control recommendations.

“A manufacturer is responsible to tell you what their product does, how it works, limitations as we know it, but to say to people that you need to use this or that, no,” she says. “We know there is more than one way to approach things. As long as they are within practice guidelines and should be research driven, we don't make such recommendations. We will certainly refer them to the guidelines — we try to help people do critical thinking. What you tell one group of practitioners depending on their practices in their hospital is not applicable. Currently, we think Chloraprep is an excellent skin prep and we have it in many of our kits. But we do have some kits with betadine.”

She says it would be presumptuous for a manufacturer to tell HCWs how to do their jobs.

“There are some people who haven't moved from betadine to Chloraprep yet,” she says. “Some of that is because of financial aspects in their hospitals — they don't want to incur increased costs. Some have not made the intellectual leap into chlorhexidine and Chloraprep as a skin preparation. We can't mandate that. As a manufacturer, we are responsible for our technology and we follow the latest information, guidelines and standards of practice concerning catheter-related infections; we do not set those standards. Practitioners, through their research, set the standards they are expected to practice.”

### **Guidelines, Recommendations**

CDC officials report a variety of quality measures HCWs should be following to minimize catheter-related infections. Their initial findings should come as no surprise: the shortage of HCWs and critical level staffing leads to higher rates of infection. They found “specialized ‘IV’ teams have shown unequivocal effectiveness in reducing the incidence of catheterrelated infections and associated complications and costs.”<sup>1</sup>

Recommendations concerning the site of catheter insertion, type of catheter material, hand hygiene and aseptic technique, site-dressing regimens, skin

antiseptics, securement devices, in-line filters, and others can be found in detail in the report. Notably, the researchers do recommend the use of 2 percent aqueous chlorhexidine gluconate instead of the previously accepted use of povidone iodine for skin preparation.

### **Additional Invasive Devices**

Foley catheter manufacturers are also investing in antimicrobial impregnation technologies. Anthony Conway, president and CEO of Rochester Medical, based in Stewartville, Minn., says catheter-associated urinary tract infections are a proverbial thorn in his company's side.

Yet, they may have found an effective tool to fight this elusive enemy.

"Nitrofurazone has been used for many years," he says. "It is used topically for burn patients, for example, and has been used in the last three of four wars in the field topically to prevent infection in wounded soldiers."

With the drug's history on the market, Conway says its apparent durability led to its selection as company's antimicrobial of choice for their anti-infective line of Foley catheters.

"The reason we selected nitrofurazone is that it hasn't show resistance," he says. "During 50 years of use, there has been essentially no build up of resistance whatsoever. It is not an antibiotic — it is a chemosynthetic. It is a chemical. It has multiple kill mechanism and interferes with not just cell walls but with enzyme production of cells in a number of other ways. It is thought that the reasons for lack of resistant buildup are because of this multiple kill mechanism. Also, it is not systemically absorbed."

Because it isn't absorbed into the system, Conway says, resistance is also prevented.

"The drug is not being exposed to bacteria through the rest of the body, which would increase chance for resistance," he says. "It seems to be the perfect fit. Many experts feel that urinary tract infections create the largest reservoir in hospitals of potential bacteria pools that can help generate resistance. By reducing this pool with a topical application, we certainly feel that it is a positive advancement."

The company specializes in anti-infective Foley and intermittent catheters.

The best practice standards for infection control remain critical: hand hygiene, appropriate personal protective equipment, protection of the sterile field and HCW education concerning invasive devices should be of utmost concern. HCWs should also keep their eyes open for more products, both intravascular catheters and Foley catheters, that feature antimicrobial technologies.