In this issue of Mayo Clinic Proceedings, Maki et al summarize the relative risk of bloodstream infections that result from various forms of catheters and intravascular devices. Their calculations are based on a review of 200 published prospective observational or clinical trials. The authors point out that their calculations of the infection rates may be slightly high, representing the upper bound of the 95% confidence interval, since they analyzed only studies that took into account all patients with intravascular devices that were prospectively cultured. Nevertheless, their systematic technique for reviewing the literature yields a useful metric for comparing various intravascular appliances and methods of insertion.

Catheter- or device-related bloodstream infections are considered among the most “preventable” classes of nosocomial infections. It is well documented that intravascular catheter infections have an associated mortality of approximately 35% and an increased morbidity and length of hospital stay calculated at 24 days for those who survive any bacteremia. Intravascular catheter infections have become a focus for the 100,000 Lives Campaign of the Institute for Healthcare Improvement.

Several studies, both multicenter and single institutional, have demonstrated that catheter-associated bloodstream infections can be reduced by more than 65% by using relatively straightforward infection control procedures. Physicians at The Johns Hopkins Hospital recently reported a reduction in such infections to zero in one intensive care unit; however, long-term follow-up has not been provided, and it is difficult to believe that a rate of zero can be maintained. Nevertheless, dramatic reductions in the rate of intravenous catheter–associated or device–associated bloodstream infection are achievable.

The specific procedures listed below, along with appropriate training, are becoming standard practice at many institutions because of the emphasis by state agencies as well as payers and third-party quality-of-care monitoring agencies such as The Leapfrog Group. These procedures include the following: (1) targeted, evidence-based insertion practices that use maximal barrier protection, topical chlorhexidine for skin disinfection before catheter insertion, avoidance of femoral insertion when possible, and postinsertion skin disinfection procedures and removal of catheters when they are no longer necessary; (2) promotion and certification of an education program that addresses catheter-associated bloodstream infections; (3) implementation of a tool to quantify adherence to practice; (4) use of catheter insertion kits with standardized supplies to enable the persons performing the procedures to adhere to accepted techniques; and (5) measurement of infection rates. In addition, physicians at The Johns Hopkins Hospital empowered nurses to stop the catheter or device insertion procedure if the technique was not being followed. This latter policy has been considered a bit controversial at my institution, but clearly these measures improve outcomes and save lives.

The data summarized by Maki et al provide some insight into the relative risk of infection of various devices. When expressed as an infection rate per 1000 patient days, the highest risk is among peripheral catheters placed by surgical cutdown, followed by peripheral steel needles, intra-aortic balloon pumps, and short-term noncuffed hemodialysis catheters. Cuffed catheters and cuffed implantable devices have a lower risk of infection than uncuffed ones. Cuffed devices share the lower rates of infection with outpatient, peripherally inserted catheters and peripheral intravenous catheters, as well as all ports. The data from...
Maki et al provide a framework for institutions to compare their rates with others, and the comparison methods and data introduced can be used as a reference for future studies.

It is somewhat surprising, as one looks back at 30 years of research of intravascular catheter–related bloodstream infections, that it has taken so long to think about a certification process for insertion of catheters and devices; training has finally evolved from the “see one, do one, teach one” or “hand-me-down” approach that was once so widespread. The principles enumerated in the care and management of such devices have been in place for more than a decade and have been shown to reduce infection. We have now entered a new era in training and certification for intravascular catheter– or device–related placement. Certification of training and adherence to aseptic techniques have been shown to reduce rates of infection considerably, and adoption of such principles by institutions and clinicians will profoundly impact patient care. However, for appliances such as left ventricular assist devices, dialysis catheters, and intra-aortic balloon pumps, advances in technology will be needed to more effectively prevent biofilm (ie, adherence of microorganisms to a surface by creating a cellular and extracellular matrix of proteins and polymers) formation or microbial colonization at the skin surface. One would anticipate that the rates will ultimately be reduced to an absolute minimum only after such technologic advances are coupled with improved operator training.

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