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Clamping Down on Catheter-Related Bloodstream Infection

To the Editor—At our institution, a large tertiary care hospital in Los Angeles, we have noted recurrent misuse of valved reflux-type intravenous catheter caps that may be contributing to increased rates of central line infections. Recently a 91-year-old male with an indwelling right femoral triple-lumen central venous catheter developed *Staphylococcus aureus* bacteremia, as documented by 2 positive blood cultures, one of a sample drawn from the central line and another of a sample drawn from a peripheral site. The primary physician requested line removal. On arrival at the bedside, the dressing was minimally soiled, and the line site was without erythema, tenderness, or discharge. Valved positive-pressure flush caps (CLC-2000; ICU Medical) were present on all 3 lumens, as was standard practice at our institution until recently. Closer examination revealed all 3 ports to be clamped proximal to the hubs. All 3 caps were also noted to have depressed centers, consistent with the ports having been clamped before disconnecting them from the flush syringe (Figure 1). The line was removed without difficulty.

Since their introduction in the late 1990s, positive-pressure valved catheter caps have been introduced at many institutions to decrease needle-related injuries to staff, reduce catheter occlusion rates, and reduce the need for heparin flushing—all of which are important goals.[1,2] Many institutions, however, have documented increased catheter-related bloodstream infection rates following the introduction of these devices.[3-8]

Connection of a Luer lock access device to the CLC-2000 cap compresses a spring-loaded piston within the cap. When the access device is disconnected, this spring moves the piston outward to its baseline position. As the piston moves outward, it provides a positive-pressure flush through the catheter lumen. Clamping the catheter proximal to the hub prevents this flushing action, causing the piston or plunger to remain depressed below the surface of the cap housing. With the piston in the depressed position, the interior surface of the cylindrical cap body is exposed to air, and the piston surface is several millimeters below the surface of the cylindrical body. A 70% isopropyl alcohol swab cannot contact the surface of the piston in this position and cannot reach the interior of the cap body. With the piston depressed, it is impossible to disinfect the cap adequately with conventional nursing practice methods, potentially leaving nondisinfected surfaces exposed to infusate when the cap is next connected to a Luer lock device.

Recommended clamping procedures for valved positive-pressure caps differ from other types of cap. Needle-based access devices, for example, require catheter clamping prior to removal of the access needle to prevent blood reflux into the catheter tip. Many needleless split-septum (ie, non–positive pressure) devices require clamping prior to access device removal also, for similar reasons. Positive-displacement mechanical valve caps, however, require just the opposite sequence: de-access, then clamp. In the busy world of patient care, the distinction between a positive-displacement cap and a non-positive-displacement cap is easily overlooked, leading to suboptimal access and de-access procedures. Unfortunately, the implication of this simple difference between cap types is potentially serious: with a valved device, the improper access sequence not only prevents it from flushing as designed but is likely to also prevent adequate surface decontamination when the device is next accessed.

Positive-displacement valved catheter caps previously have been linked to increased catheter-related infection rates in intensive care settings,[6] long-term care institutions,[8] general inpatient settings,[3] and hematology-oncology wards.[4,7] Though these caps have been shown by culture to be contaminated,[3] to our knowledge, no obvious mechanism of contamination related to use of these devices has yet been suggested in the literature. While we cannot, on the basis of our

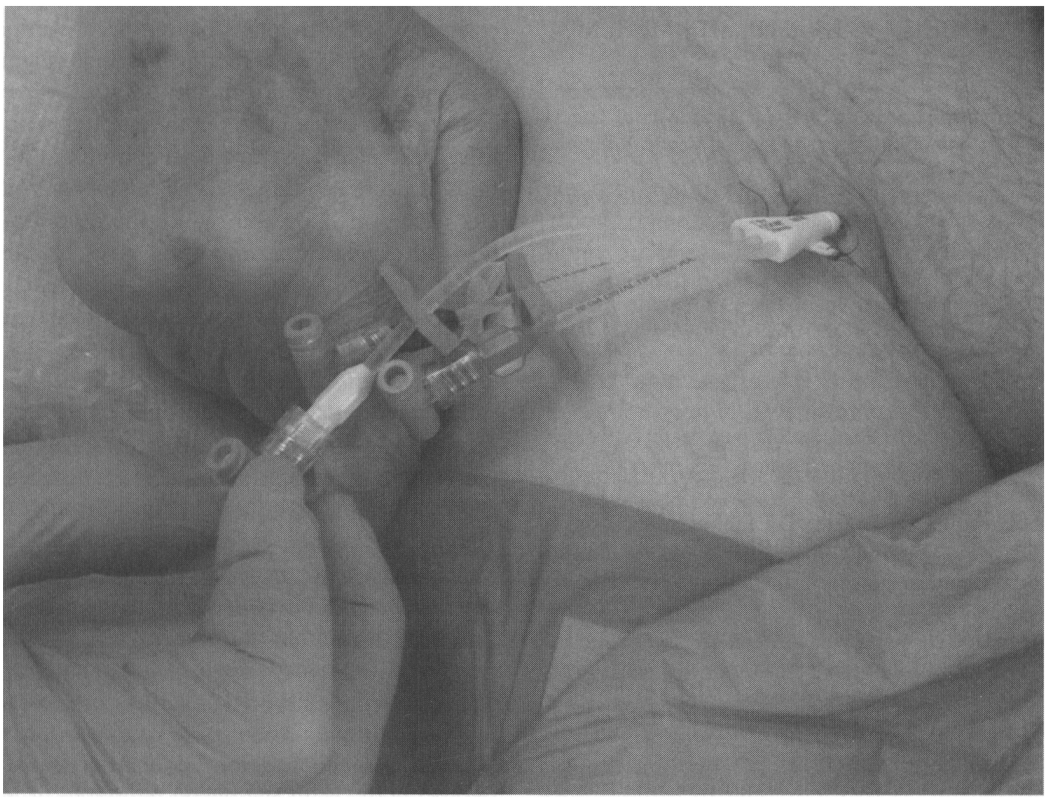

FIGURE 1. Valved catheter caps on an infected femoral catheter showing depressed centers due to incorrect clamping sequence.

observations alone, establish a causative link between our finding of persistently depressed valved catheter caps and catheter-related bloodstream infections, we hope this case will serve to illustrate the ease with which some positive-displacement catheter caps can be misused and thereby inadvertently can contribute to infection risk.

Though this proposed mechanism of catheter contamination involves misuse of catheter caps by hospital staff, other investigators have found educational efforts relatively ineffectual as a means of reducing infection rates.[1] This finding is perhaps not surprising, given the variety and number of both positive- and non-positive-displacement valves available for use.[6] Valved caps are inherently more complicated than nonvalved caps and may be more difficult to sterilize adequately, even when used correctly. Cap designs have been shown in vitro to vary in their transmission of surface contaminants to infusate, suggesting a role for improved mechanical design in reducing catheter-related bloodstream infection risk.[9] Similarly, alternative disinfection methods have proven superior to wiping with 70% isopropyl alcohol in decontaminating valved caps, suggesting that this long-established practice may be inadequate for more complicated devices.[10]

Our observations suggest that effective strategies for reducing catheter-related bloodstream infection are likely to involve a shift toward end caps with design features that preclude operator error and minimize the infectious risks of such errors to patients.

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Cost-Effectiveness of Universal Screening of Healthy Newborns for Nasal Methicillin-Resistant *Staphylococcus aureus* Colonization at Birth

To the Editor—Community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) infections are increasing in frequency and are an emerging problem among pregnant women and newborn infants.[1] The incidence of MRSA vaginal colonization among pregnant women usually ranges from 0.5% to 3.5%.[2,3] However, in a recent study of pregnant women in Tennessee, 10.5% of genital swab specimens submitted for routine screening for Group B beta-hemolytic streptococcus also tested positive for MRSA.[4] MRSA colonization is a risk factor for nosocomial transmission and subsequent MRSA infection. The incidence and consequence of MRSA colonization among newborn infants is not well characterized.

Our institution, a 571-bed tertiary care academic institution, is a state-designated perinatal center that serves 8 regional hospitals. We have approximately 1,400 deliveries per year. Since December 2007, our institution has conducted universal surveillance of all patients for nasal MRSA colonization upon admission to the hospital. However, the cost-effectiveness of universal surveillance for MRSA colonization among healthy newborn infants is not known. We analyzed our data to determine the incidence of nasal MRSA colonization among newborn infants at birth and the cost-effectiveness of universal MRSA screening of healthy term newborns.

All newborn infants born between December 1, 2007, and August 31, 2009, were screened at birth for nasal MRSA colonization using the GeneXpert System and the Xpert MRSA real-time PCR test kit (Cepheid). The cost of MRSA screening testing was obtained from the microbiology laboratory. The transmission rate of MRSA was calculated based on published estimates by Jernigan et al[5] of 0.14 patient-per-day rate of transmission for an unrecognized newborn who has been colonized and 0.009 for a recognized newborn who has been colonized in isolation precautions.[5] Illinois Public Act 095-0312 mandates MRSA screening for all patients admitted to an intensive care unit (ICU) as well as patients admitted to non-ICU settings deemed to be at high risk for MRSA carriage.[6] Therefore, only screening costs of children admitted to the newborn nursery who would not be tested under the legislative mandate were included in the cost analysis. Microbiology laboratory data were also reviewed to detect any invasive MRSA infections in newborns less than 48 hours of age.

During the study period, 2,110 children were born, and 2,031 (96%) infants underwent MRSA screening at birth. Overall, 4 of 2,031 (0.2%) infants tested positive for nasal MRSA colonization. A total of 520 babies were excluded from the cost analysis because they were admitted to the neonatal ICU, either from labor and delivery or from the newborn nursery, and thus would have been tested for MRSA colonization under our state mandate. Similarly, 2 of 4 infants who tested positive for MRSA colonization were born prematurely and required NICU care; they were not included in the cost analysis.

The total cost of screening of 1,582 newborns who were admitted to and stayed in the newborn nursery was $79,100 at $50 per test for our healthcare system, and for payers, the cost was $316,400 at $200 per test. Thus, the cost of detection of a carrier was $39,550 for our healthcare system and $158,200 for payers. The study period was 3,348 patient-days, with an average length of stay of 2.1 days in our nursery. The 2 newborns who had been colonized stayed for a total of 3