TABLE 1. Surgical Site Infection Case Identification by Surgical Specialty over Time

| Service (no. of infections) | 1 month | 3 months | 6 months | 9 months | 12 months |
|---|---|---|---|---|---|
| Cardiac (205) | 86 (177) | 92 (189) | 96 (198) | 97 (200) | 100 (205) |
| Ortho (135) | 79 (107) | 86 (116) | 94 (127) | 99 (133) | 100 (135) |
| Neuro (69) | 75 (52) | 88 (61) | 93 (64) | 99 (68) | 100 (69) |
| Spinal (327) | 92 (302) | 97 (317) | 99 (323) | 99 (324) | 100 (327) |
| Thoracic (40) | 83 (33) | 95 (38) | 98 (39) | 100 (40) | 100 (40) |
| Vascular (112) | 83 (93) | 97 (109) | 100 (112) | 100 (112) | 100 (112) |
| Total (888) | 86 (764) | 93 (830) | 97 (863) | 99 (877) | 100 (888) |

NOTE. Columns 2–6: data shown as percentage (no.) of infections.

dures) were identified. Thirteen cases had an SSI detected beyond the standard 1-year follow-up and were excluded from the analysis. Table 1 outlines SSI case identification by surgical specialty over time. The majority (86%) of infections was identified within the first month of the operative event, and by 3 months most surgical services identified over 90% of SSIs. Hip and knee replacements and craniotomies with implants required 6 months to capture over 90% of cases.

In contrast to the article by Lankiewicz et al,[1] our data were prospectively collected in a consistent manner across our surgical centers over a 10-year period. Our review supports their recommendation for a shorter surveillance follow-up period and extends their observations to include spinal, thoracic, neurosurgical, and vascular surgeries.

The ultimate goal of an SSI prevention program is to reduce infections. Systematic surveillance methodology is crucial to obtain valid and reliable data to evaluate the success of such programs.[3] Equally as important, however, is the timely communication of SSI rates, particularly when assessing performance improvement initiatives. Surveillance need not capture every case in order to be effective; it simply needs to detect sufficient cases to permit informed decision making as well as to allow benchmarking with peer facilities. As can be seen by this large, consistently collected set of data, these criteria can be met by limiting case ascertainment to 3 months when 93% of all SSIs were detected. Although orthopedic (hip and knee replacements) and neurosurgical (craniotomies, shunts) procedures did not quite capture 90% of SSIs at 3 months, the actual number of cases that would be missed if 3-month follow-up was practiced would be, on average, only 1.9 cases/year for orthopedic and 0.8 cases/year for neurosurgical procedures. One could argue that a 1-month follow-up would be adequate; however, using this scenario a total of 124 SSIs in all 6 surgical specialties (12.4 SSI/yr) would have been missed.

Healthcare time spent following cases for 1 year can be more appropriately allocated, particularly when one considers that SSIs occurring after such long periods may either be not preventable or not related to the surgical procedure. A 3-month follow-up period with more timely dissemination of results would capture 93% of all SSIs and be a more efficient and relevant use of surveillance resources.

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## Beyond Bundles and Coated Catheters: Effective Interventions to Decrease Central Line–Associated Bloodstream Infections (CLABSI)

*To the Editor*—Central line–associated bloodstream infections (CLABSIs), as defined by the Centers for Disease Control and Prevention, are a common nosocomial infection problem. Because of necessarily high rates of central venous catheter

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TABLE 1. Central Line–Associated Bloodstream Infections in the Surgical Intensive Care Unit (2009–2011)

| Patient | Age (years) | Sex | Year | CVC dwell days | CVC location | Blood culture isolates |
|---|---|---|---|---|---|---|
| 1 | 64 | M | 2009 | 8 | IJ | *Candida albicans* |
| 2 | 83 | F | 2009 | 3 | IJ | VRE |
| 3 | 55 | M | 2009 | 15 | SC | VSE |
| 4 | 73 | M | 2009 | 3 | IJ | VRE |
| 5 | 83 | F | 2009 | 9 | IJ | VSE |
| 6 | 28 | M | 2009 | 7 | PICC | *C. albicans* |
| 7 | 27 | M | 2009 | 1 | FV | VSE |
| 8 | 88 | M | 2009 | 19 | SC | *Klebsiella pneumoniae* |
| 9 | 69 | M | 2009 | 12 | IJ | *K. pneumoniae* |
| 10 | 63 | F | 2009 | 6 | IJ | CoNS |
| 11 | 72 | M | 2009 | 14 | SC | *C. albicans* |
| 12 | 64 | M | 2009 | 7 | SC | VSE |
| 13 | 60 | M | 2009 | 3 | SC | CoNS |
| 14 | 74 | F | 2009 | 9 | SC | *Pseudomonas aeruginosa* |
| 15 | 63 | F | 2009 | 2 | FV | *Serratia marcescens* |
| 16 | 42 | M | 2009 | 4 | SC | *Enterobacter cloacae* |
| 17 | 81 | M | 2010 | 3 | IJ | CoNS |
| 18 | 70 | M | 2010 | 7 | SC | CoNS |
| 19 | 52 | M | 2010 | 20 | SC | *P. aeruginosa* |
| 20 | 82 | M | 2010 | 5 | NA | VRE |
| 21 | 73 | F | 2010 | 2 | FV | VSE |
| 22 | 73 | M | 2010 | 6 | PICC | CoNS |
| 23 | 80 | F | 2011 | 7 | SC | VSE |
| 24 | 72 | M | 2011 | 1 | IJ | CoNS |

NOTE. CoNs, coagulase-negative staphylococci; CVC, central venous catheter; FV, femoral vein; IJ, internal jugular vein; NA, not available; PICC, peripherally inserted central catheter; SC, subclavian vein; VRE, vancomycin-resistant enterococci; VSE, vancomycin-sensitive enterococci.

(CVC) utilization in critically ill patients, CLABSIs are of particular concern in the intensive care units. In the surgical intensive care unit (SICU) of our 600-bed university-affiliated teaching hospital, CLABSI rates remained high until 2009. Before 2009 we had instituted CVC bundles and hexachloradine/silver-coated CVC catheters, but our high CLABSI rate in the SICU persisted. Key interventions were effective in substantially decreasing CLABSIs in our SICU from 15 in 2009 to 2 in 2011.

In reviewing our experience with CLABSIs in our SICU (2009–2011), we found no relationship between CVC insertion site and CLABSIs; that is, 8/24 (33%) were inserted into the jugular vein, 10/24 (42%) were inserted into the subclavian vein, and 3/24 (12%) were inserted into the femoral vein. Only 2/24 (8%) were peripherally inserted central catheter lines. Nationally, the most common CLABSI pathogens are gram-positive cocci, that is, predominately *Staphylococcus* sp., for example, either methicillin-sensitive *S. aureus* (MSSA), methicillin-resistant *S. aureus* (MRSA), or *S. epidermidis*, that is, coagulase-negative staphylococci (CoNS). However, in our SICU there were 6/24 (25%) isolates that were CoNS, 6/24 (25%) that were vancomycin-sensitive enterococci, and 3/24 (12%) that were vancomycin-resistant enterococci (Tables 1, 2). Our hospital has a low prevalence of MRSA, which may explain why there were no MSSA/MRSA CLABSIs in 3 years. Interestingly, 3/24 (13%) CLABSIs had *Candida albicans*. The remainder, 5/24 (24%) were due to gram-negative bacilli, for example, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Serratia marcescens*, and *Enterobacter cloacae*. Our CVC utilization rate increased over the 3 years, which did not explain our decreased CLABSI rate. CVC bundles and the use of internally/externally antimicrobial-coated catheters introduced prior to 2009 had no effect on our CLABSI rates.

We avoided, when possible, femoral vein CVC insertions.[1,2] In our SICU we were able to decrease the number of CLABSIs

TABLE 2. Dwell Days of Central Line–Associated Bloodstream Infections (CLABSIs) in the Surgical Intensive Care Unit (2009–2011)

| Year | Line days | Dwell days (mean; range) | CLABSIs | Rate/ 1,000 line days |
|---|---|---|---|---|
| 2009 | 4,049 | 7.6; 1–19 | 15 | 3.7 |
| 2010 | 4,414 | 7.2; 2–20 | 7 | 1.6 |
| 2011 | 4,314 | 4; 1–7 | 2 | .46 |

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from 16 in 2009 to 6 in 2010 and finally to 2 in 2011. Independent of CVC bundle implementation and antibiotic coated CVCs, this was achieved primarily by implementing key infection control interventions, that is, avoiding drawing blood cultures through CVCs, and by decreasing dwell times.[3-5]) Keeping CLABSI rates to a minimum, but not zero, is reasonable and attainable as our experience shows.

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# Antimicrobial Stewardship on the Frontier: A Pilot Study of Training Using an Electronic Learning Network

*To the Editor*—Rural hospitals in the United States often care for elderly patients who may prefer to stay in their communities for acute and long-term care. The challenges of delivering high-quality care are complicated by limited access to subspeciality experts, including those skilled in antimicrobial stewardship.[1] Antimicrobial stewardship programs originated in large academic healthcare centers, but extension of stewardship to community hospital settings and rural areas is a pressing need.[2]

The Extension for Community Health Outcomes (ECHO) model at University of New Mexico (UNM) Health Sciences Center has demonstrated effectiveness in training primary care providers at distant sites in the management of complex diseases.[3] In New Mexico, 14 of 33 counties are designated rural (6–39 persons per square mile) and 15 are frontier (less than 6 persons per square mile). We used the ECHO technology and concept to deliver a curriculum in antimicrobial stewardship to a group of rural hospitals and surveyed the participants 3 months after the conclusion of the program.

We recruited rural and frontier hospitals to participate in a curriculum on antimicrobial stewardship using the videoconferencing technology provided by the ECHO network. The curriculum consisted of 7 lecture sessions delivered over 14 weeks from March to June 2011, supported by electronic materials, including guidelines, links to open-access literature, and order sets, made available to the participants through a web-based link or via electronic mail. Each session consisted of a lecture with question-and-answer sessions and opportunity for all participants to share their own interventions. Teams were linked together and to the faculty in Albuquerque by desktop computer cameras and microphones, which allowed participants to see and interact with each other as well as faculty. A diverse faculty of infectious diseases physicians, antimicrobial pharmacists, and clinical microbiologists participated. Topics covered included making the case for stewardship, key formulary interventions, developing clinical guidelines, reviewing individual orders, working with the microbiology laboratory and infection control staff, and measuring the impact of the program. Three months after the end of the curriculum, the participating teams were surveyed using an electronic survey to assess the impact of the curriculum on their facilities as well as barriers encountered in accessing the curriculum. The study was approved by the UNM Institutional Review Board.

Four hospitals were recruited to the training program. The hospitals had 22, 25, 91, and 106 beds; 1 hospital had critical access designation. Three hospitals were in rural counties, and 1 was in a frontier county. Responses to the assessment section of the survey are shown in Table 1. At the beginning of the curriculum, 1 of the 4 hospitals had an antimicrobial stewardship team (AST). None of the hospitals required an indication on antimicrobial orders, and none added this element. Three months after the end of the curriculum, 1 hospital had added an AST; both teams included a physician, pharmacist, laboratory technician, and infection preventionist. Two hospitals were planning to create teams. Two of 4 hospitals reviewed selected antimicrobial orders prior to the

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