preparation of the sterile field, and poor insertion technique. We believe that, as a quality assurance tool, it may be useful to assess compliance with protocols for catheter insertion. Correlation with accepted definitions of catheter infection and catheter-associated bacteremia was not attempted in this study. Other methods for detecting the small number of organisms on the guidewire that may be more sensitive include immersing it directly into culture medium or direct impression of it onto a solid culture medium. Our method reduces manipulation of the guidewire and thus the risk of post-insertion contamination and is simple to apply. Further study is required to determine whether routine testing of guidewires has any role in predicting early colonization of CVCs.

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Positive Predictive Value of a Percutaneously Drawn Blood Culture Growing Skin Flora Varies Markedly by Organism

To the Editor:

Positive blood cultures may be the result of contamination when a patient's skin flora is introduced into the blood specimen during collection. Coagulase-negative staphylococci are the leading cause of bloodstream infections (BSIs) in hospitals,[1,2] but they are also frequent blood culture contaminants.[3] Judging the clinical meaning of blood cultures positive for common skin organisms is essential but often difficult. The authors of guidelines on the management of catheter-related BSIs and others have recommended requiring multiple blood culture sets positive for the same skin organism.[4-6] However, sometimes a second blood culture set is unavailable, which can make interpretation of growth of common skin organisms in a single blood culture set difficult.[7]

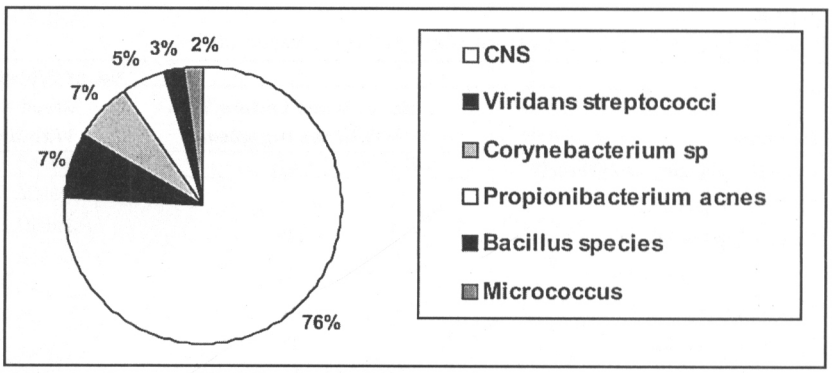

FIGURE. Distribution of species in the blood cultures with skin organisms. CNS = coagulase-negative staphylococci.

This study sought to evaluate blood culture practices at a university hospital, to determine the relative frequency distribution of skin organisms in percutaneously drawn blood cultures, and to calculate the predictive value of a first blood culture positive for common skin organisms in situations where multiple blood cultures were available for interpretation.

This retrospective study was conducted in a 600-bed hospital. Computerized clinical microbiology laboratory data from October 1998 through September 2003 were used. In this hospital, blood cultures were drawn only from patients with symptoms suggesting BSI, such as fever; clinicians were advised to draw multiple blood culture sets from different sites for evaluating a new fever; and clinicians had been required to reveal whether a blood culture was percutaneous or drawn from a central venous catheter or from an arterial catheter. This labeling had been found to be usually correct in discussing individual cases with attending physicians, but no formal study of the accuracy of clinician labeling of percutaneous blood cultures was conducted.

A blood culture set consisted of a pair of blood culture bottles, usually one aerobic and the other anaerobic; they were usually both inoculated from a single blood specimen drawn at one site. All blood culture sets labeled percutaneous and positive for common skin organisms (ie, coagulase-negative staphylococci, *Micrococcus* species, *Propionibacterium acnes*, viridans streptococci, *Corynebacterium* species other than group JK, or *Bacillus* species) were classified using the following definition: if a common skin organism was isolated from only one of multiple sets of blood cultures (which, in some patients, included one or more catheter-drawn blood cultures) drawn within a 5-hour period, it was considered "contaminated." Each single culture was classified as "probably true" if the same common skin organism was isolated from two or more sets of blood cultures drawn at different times. For this purpose, data such as species and antibiogram from routine clinical microbiology testing were used when available, but the laboratory did not always do such testing. Cultures yielding a common skin organism for which there was no companion set of blood cultures for comparison were excluded from the analysis. The positive predictive value of growing any common skin organism and of growing each type of skin organism was calculated. Positive predictive values of each type of skin organism were compared using chi-square or Fisher's exact test when appropriate.

During the study period, 3,356 (4.9%) of 69,163 percutaneously drawn blood culture sets were positive for a common skin organism. These 3,356 positive blood culture sets were drawn during 3,139 episodes possibly suggestive of BSI (eg, onset of new fever). Of these episodes, 335 (10.7%) were considered to represent true bacteremia due to a common skin organism, with 213 episodes being confirmed by additional percutaneous blood culture sets, 110 by blood cul-

TABLE
POSITIVE PREDICTIVE VALUES FOR COMMON SKIN ORGANISMS

Organism	No. of Blood Culture Sets With the Organism	No. of Probably True Positive Blood Culture Sets With the Organism	Positive Predictive Value	CI_{95}
Coagulase-negative staphylococci	1,631	462	0.28	0.26–0.31
Viridans streptococci	157	84	0.54	0.45–0.61
Corynebacterium species	149	24	0.16	0.11–0.23
Propionibacterium acnes	111	0	0.00	0.00–0.03
Bacillus species	54	5	0.09	0.03–0.20
Micrococcus species	45	0	0.00	0.00–0.08
Total	2,072 blood culture sets (with 2,147 isolates)	552 blood culture sets (with 575 isolates)	0.27	0.25–0.29

CI_{95} = 95% confidence interval.

ture sets drawn from indwelling central venous catheters, and 12 by blood culture sets drawn from arterial catheters. A total of 1,284 (38%) of the positive blood culture sets had to be excluded from further analysis because of the unavailability of a second blood culture set. The other 2,072 positive blood culture sets (62%) had one or more paired blood culture sets within 5 hours (from skin or a catheter) available to classify them as contaminated or not contaminated; these sets grew 2,147 common skin organism isolates. Of those with multiple blood culture sets, 93.1% of the paired blood culture sets were drawn within 1 hour and the rest (6.9%) were drawn within 1 to 5 hours of the first.

The most frequently isolated skin organism was coagulase-negative staphylococci (n = 1,631), followed by viridans streptococci (n = 157), *Corynebacterium* species (n = 149), *P. acnes* (n = 111), *Bacillus* species (n = 54), and *Micrococcus* species (n = 45) (Figure).

A total of 1,520 (73.4%) of the positive blood culture sets were classified as contaminated with a common skin organism because their paired blood culture sets were negative. That means that 2.24% of the 67,879 percutaneously drawn blood cultures were contaminated with a common skin organism. In 552 blood culture sets, the skin organism was not considered a contaminant (positive predictive value, 0.27; 95% confidence interval, 0.25 to 0.29). Half of the blood culture sets with growth of viridans streptococci were classified as probably true, but all blood cultures with *Micrococcus* species or *P. acnes* were classified as contaminated. The positive predictive values and 95% confidence intervals for the different species are listed in the table.

Individual species showed large differences in positive predictive value (contingency table chi-square, $P < .001$). Inter-species differences were thus examined in a series of pairwise comparisons. Finding viridans streptococci in a blood culture was significantly more likely to be associated with confirmation by one or more additional positive sets of blood cultures than was finding any other common skin organism. Finding coagulase-negative staphylococci in a blood culture was also associated with confirmation by one or more additional positive sets of blood cultures.

In practice, the unavailability of a second blood culture was a frequent event (38% of all blood culture sets with growth of common skin organisms and 41% of all episodes resulting in at least one positive set of blood cultures). This result confirms the findings of other authors.[3,4] In our study, common skin organisms accounted for a large proportion of all positive blood cultures, and most often were due to contamination. We found that 2.24% of percutaneously drawn blood cultures were contaminated with common skin organisms. Recent studies have reported contamination rates ranging from 0.6% to 6.25%.[8,9] Mirrett et al. found that the positive predictive value was 37% for coagulase-negative staphylococci.[10] Our results suggested that 27% of all blood culture sets growing coagulase-negative staphylococci were probably true positive. However, the predictive values for different kinds of common skin organisms varied considerably. Whereas viridans streptococci were associated with contaminated blood cultures in half of the cases in which they were grown, all blood cultures with *Micrococcus* species or *P. acnes* were classified as contaminated. Knowledge of the positive predictive values for different species could aid interpretation of blood cultures positive for common skin organisms.

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Bacteremia Due to *Streptococcus agalactiae*

To the Editor:

Streptococcus agalactiae bacteremia is common in neonates and sometimes occurs in females after obstetric or gynecologic surgery. However, it is unusual in males.[1] During a 3-year prospective survey of streptococcal bacteremia in three university hospitals in the Slovak Republic, we analyzed 32 cases of *S. agalactiae* bacteremia; data are summarized in the table. Twenty occurred in neonates and 12 in patients 24 to 82 years old. Surprisingly, 9 of the patients were male, and only 4 of them had identified risk factors (dialysis, 2; abdominal surgery, 2). The other five males had no underlying risk factors for bacteremia. They had been healthy and had not been in other hospitals. The 20 neonates with bacteremia were presumably infected at birth, despite implementation of the 1990 guidelines for prevention of *S. agalactiae* bacteremia.

Six of the 32 patients had bacteremia due to erythromycin-resistant, 2 due to trimethoprim/sulfamethoxazole-resistant, and 6 due to doxycycline-resistant strains. One strain isolated from blood culture was penicillin resistant (minimum inhibitory concentration, 0.5 µg/mL). Six of the 32 patients died, all of whom were neonates with very low birth weights (< 1,500 g). The attributable mortality rate was 18.5%. In comparison of our results with those of the largest *S. agalactiae* bacteremia study, which included 41 cases from Spain,[2] the rates of erythromycin resistance were similar. Penicillin resistance was not observed in the Spanish study, despite high rates of penicillin resistance in pneumococci and viridans streptococci in Spain. We have no explanation for 12 cases with no risk factors leading to *S. agalactiae* bacteremia in patients other than neonates and women. Five of the nine male patients were young and previously healthy without a history of urinary tract infection. More studies on *S. agalactiae* are needed.

TABLE
RISK FACTORS AND OUTCOMES OF *STREPTOCOCCUS AGALACTIAE* BACTEREMIA IN THE 32 PATIENTS

Factor	All Patients (N = 32)	No. (%) of Neonates (n = 20)	No. (%) of Others (n = 12)
Male	18	9 (45)	9 (75.0)
Diabetes	4	0 (0)	4 (33.3)
Age > 65 y	7	0 (0)	7 (58.8)
Catheter	24	19 (95)	5 (43.0)
Dialysis	2	0 (0)	2 (17.0)
Surgery	5	0 (0)	5 (41.6)
Ventilator	8	6 (30)	2 (17.0)
Previous antibiotic therapy	6	5 (25)	1 (8.3)
Gestational age < 32 weeks	6	6 (30)	0 (0.0)
Birth weight < 1,500 g	6	6 (30)	0 (0.0)
Erythromycin resistant	6	2 (10)	4 (33.3)
TETs and TMP/SMX resistant	2	2 (10)	0 (0.00)
Complications	2	0 (0)	2 (17.0)
Death	6	6 (30)	0 (0.0)

TETs = tetracyclines; TMP/SMX = trimethoprim/sulfamethoxazole.

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