Comparison of Iodophor and Alcohol Pledgets with the Medi-Flex Blood Culture Prep Kit II for Preventing Contamination of Blood Cultures

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Iodophor and alcohol pledgets were compared with the Medi-Flex Prep Kit II for skin disinfection before venipuncture. Of 12,367 blood cultures collected, 6,362 were done with conventional pledgets and 6,005 were done with Medi-Flex kits. Contamination occurred in 351 of 6,362 blood cultures (5.5%; range, 3.7 to 8.1%) with conventional pledgets versus 328 of 6,005 (5.5%; range, 3.5 to 7.5%) with Medi-Flex kits.

The clinical problem of blood culture contamination has been recognized for 70 years (12, 19). Currently, in some institutions, blood culture contamination rates remain unacceptably high, exceeding 5% and accounting for up to half of all positive blood cultures (1, 14). Because most contaminants and many pathogens are indigenous human microbial flora (20), differentiating between contaminant isolates and those causing infection can be difficult, complicating clinical interpretation (1, 2, 11). As a result, patients may be treated inappropriately, resulting in unnecessary procedures and therapy, prolonged hospitalization, and increased health care costs (3, 18).

Skin disinfectants may not sterilize all parts of the skin (4), which means that it may be impossible to achieve 0% contamination rates. Even so, it should be possible to minimize contamination rates to less than 3%. Because routine use of commercial skin disinfection kits, which have the advantages of ease of training and use, could result in lower blood culture contamination rates, we compared blood culture contamination rates following skin disinfection with either conventional pledgets or the Medi-Flex Prep Kit II.

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This study was performed at Robert Wood Johnson University Hospital (RWJUH), Duke University Medical Center (DUMC), Denver Health Medical Center (DHMC), and the Salt Lake Veterans Affairs Medical Center (SLVAMC). Approval for the study was obtained prior to the study from the Institutional Review Board at each study site.

Blood culture kits were prepared in each microbiology laboratory. Each month, on an alternating basis, kits were prepared that contained, in addition to blood culture bottles, either conventional povidone-iodine and alcohol pledgets (Aplicare Inc., Branford, Conn.) or the Blood Culture Prep Kit II (Medi-Flex Hospital Products, Inc., Overland Park, Kans.) (hereafter referred to as Medi-Flex). Blood culture bottles were labeled as to the type of disinfectant that was included in the kit. Medi-Flex kits contain one Frepp and one Sepp. The Frepp consists of a sterile foam pad attached to a small handle. Contained within the base of the handle is a breakable ampoule containing 1.1 ml of 70% isopropyl alcohol solution. When the ampoule is broken, the alcohol soaks into the foam pad. The Sepp consists of a plastic sleeve that is sealed at one end. Within the sleeve is a breakable ampoule containing 0.67 ml of 2% iodine tincture. The open end contains a sterile gauze pad. When the ampoule is broken, the tincture of iodine soaks the gauze pad.

Blood culture kits were distributed at the beginning of each month, at which time the other type of kit was removed from nursing units. Blood cultures were performed as part of routine patient care. All four sites provided instructions for obtaining blood cultures during the study. One site (RWJUH) provided written instructions in the kits as well as verbal instructions (via in-service training) to house officers prior to the study. Two sites (SLVAMC and DUMC) provided only written instructions in the kits. At the fourth site (DHMC), where the Medi-Flex kit was used as the routine skin disinfectant prior to the study, the phlebotomy teams were given verbal instructions via in-service training.

Isolates from positive blood cultures were categorized as clinically important, contaminants, or of indeterminate significance based on published criteria (22). Because they are collected in a different fashion, blood cultures known to have been obtained from indwelling venous catheters were excluded from data analysis. Contamination rates were calculated for each study site according to the method of skin disinfection used. Statistical evaluation was made using the chi-square test, with Yate's correction for small numbers (9).

As shown in Table 1, a total of 12,367 blood cultures were

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TABLE 1. Contamination rates according to study site and type of skin preparation used for blood culture

Study site	Conventional pledgets		Medi-Flex	
	No. of cultures	No. (%) contaminated	No. of cultures	No. (%) contaminated
DUMC	3,536	157 (4.4)	2,924	126 (4.3)
RWJUH	1,632	132 (8.1)	1,801	135 (7.5)
DHMC	1,007	55 (5.5)	906	54 (6.0)
SLVAMC	187	7 (3.7)	374	13 (3.5)
Total	6,362	351 (5.5)	6,005	328 (5.5)

evaluated. Of these, 6,362 were drawn following skin disinfection with conventional pledgets, and 6,005 were drawn following skin disinfection with Medi-Flex kits. Overall, 679 of 12,367 (5.5%) blood cultures were contaminated, yielding 713 isolates. Contamination rates did not differ between conventional pledgets (351 of 6,362; 5.5%; range, 3.7 to 8.1%) and Medi-Flex kits (328 of 6,005; 5.5%; range, 3.5 to 7.5%). Contamination rates varied between hospitals, but there were no statistically significant differences in contamination rates associated with the two types of disinfection at any study hospital. At RWJUH, where resident physicians were instructed at the start of the study, contamination rates were slightly lower with Medi-Flex kits (7.5 versus 8.1% with pledgets). At DHMC, where Medi-Flex kits had been used as the standard skin disinfection system prior to the study, contamination rates were slightly higher with Medi-Flex kits (6.0 versus 5.5%). At DUMC, where conventional pledgets had been used prior to the study and resident physicians were not instructed at the start of the study, contamination rates with the two methods were the same (4.4 versus 4.3%).

As shown in Table 2, 571 of 713 (80%) of the contaminant isolates were coagulase-negative staphylococci. The majority of the remaining contaminant isolates were commensal bacteria that are common causes of blood culture contamination.

Conclusions. Contamination rates observed in this study (5.5%) were higher than those of Little et al. (8) but were not that different from those of Strand et al. (17) or Schifman and Pindur (13). In this study, blood culture contamination rates did not differ between the two methods of skin disinfection. These findings differ from those of Little et al. (8), who found lower rates with the Medi-Flex product. The discrepancy between their findings and ours may be accounted for by (i) differing definitions of contaminant and "true" isolates, particularly for assessing the clinical importance of coagulase-negative staphylococci; (ii) patient populations within each study;

TABLE 2. Contaminant isolates recovered from blood cultures

Isolate	No.
Coagulase-negative staphylococci	571
Corynebacterium spp.	38
Viridans group streptococci	29
Anaerobic diphtheroids	28
Enterococcus spp.	13
Bacillus spp.	9
Staphylococcus aureus	8
Other gram-positive bacteria	9
Gram-negative bacteria[a]	7
Candida glabrata	1
Total	713

[a] Includes three *Neisseria* spp. and one each of *Pseudomonas aeruginosa*, *Acinetobacter baumanii*, *Prevotella bivia*, and *Veillonella parvula*.

(iii) the length of incubation and testing of blood culture bottles (5 days in our study and 7 days in the study of Little et al. [8], which would be expected to result in additional contaminants but few or no pathogens); and (iv) the fact that users were not given education about the kits at two of the four hospitals (or education about the importance of adequate disinfection techniques). Strand et al. (17) also observed statistically lower contamination rates with tincture of iodine than with iodophors. The discrepancy between their observed contamination rates and ours is probably explained by differing definitions of contaminants. Published data regarding skin disinfection for purposes other than culture suggests that tincture of iodine is superior to povidone-iodine (6). This may be because tincture of iodine provides more rapid killing through release of free iodine.

Marginally lower contamination rates with Medi-Flex kits were observed at RWJUH, where instruction of resident physicians was done prior to the study. The rates, however, were not statistically significant from those observed at the other three study sites. On the other hand, at DHMC, where Medi-Flex kits are used routinely for skin disinfection, contamination rates were marginally higher with Medi-Flex kits than with conventional pledgets. The latter observation indicates that prior experience with one method did not affect contamination rates, suggesting that education may have minimal impact on use of the products and, ultimately, contamination rates. Whether lower contamination rates can be achieved with more intensive educational efforts, such as competency testing, remains to be determined.

Because of conflicting results reported here and in the published literature, the best method for disinfecting skin for blood cultures remains unclear. Recently, Mimoz et al. (10) compared chlorhexidine with povidone-iodine and found significantly lower contamination rates with the former. The numbers of patients and specimens in that study were small, however, so their results need to be confirmed. In addition, there has not been a published comparison of chlorhexidine and tincture of iodine.

Skin disinfection is only one step in reducing blood culture contamination. Other steps that help minimize contamination rates include use of dedicated phlebotomy teams to collect specimens for culture (18, 21), continuous-monitoring blood culture instruments, careful laboratory quality control to minimize contamination of plate media, and 4- or 5-day incubation and testing cycles on instrumented blood culture systems. Disinfection of bottles prior to inoculation has also been shown to reduce contamination rates (14). The issue of changing needles prior to inoculation of collection tubes or bottles remains controversial; published data both support and refute this process (14, 16). Schifman et al. (14) found that laboratories that used tincture of iodine rather than povidone-iodine had lower blood culture contamination rates except at institutions where blood cultures were collected by dedicated phlebotomy teams. At those sites, contamination rates did not differ with use of the two preparations, indicating that technique may be as important as, if not more important than, the type of disinfectant used. The latter hypothesis is supported by published observations that use of alcohol alone as a disinfectant results in contamination rates no higher than those observed following disinfection with povidone-iodine (15) or tincture of iodine (7).

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