Effect of Routine Sterile Gloving on Contamination Rates in Blood Culture
A Cluster Randomized Trial
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Background: Blood culture contamination leads to inappropriate or unnecessary antibiotic use. However, practical guidelines are inconsistent about the routine use of sterile gloving in collection of blood for culture.

Objective: To determine whether the routine use of sterile gloving before venipuncture reduces blood culture contamination rates.

Design: Cluster randomized, assessor-blinded, crossover trial (ClinicalTrials.gov registration number: NCT00973063).

Setting: Single-center trial involving medical wards and the intensive care unit.

Participants: 64 interns in charge of collection of blood for culture were randomly assigned to routine-to-optional or optional-to-routine sterile gloving groups for 1854 adult patients who needed blood cultures.

Intervention: During routine sterile gloving, the interns wore sterile gloves every time before venipuncture, but during optional sterile gloving, sterile gloves were worn only if needed.

Measurements: Isolates from single positive blood cultures were classified as likely contaminant, possible contaminant, or true pathogen. Contamination rates were compared by using generalized mixed models.

Results: A total of 10,520 blood cultures were analyzed: 5265 from the routine sterile gloving period and 5255 from the optional sterile gloving period. When possible contaminants were included, the contamination rate was 0.6% in routine sterile gloving and 1.1% in optional sterile gloving (adjusted odds ratio, 0.57 [95% CI, 0.37 to 0.87]; P = 0.009). When only likely contaminants were included, the contamination rate was 0.5% in routine sterile gloving and 0.9% in optional sterile gloving (adjusted odds ratio, 0.51 [CI, 0.31 to 0.83]; P = 0.007).

Limitation: Blood cultures from the emergency department, surgical wards, and pediatric wards were not assessed.

Conclusion: Routine sterile gloving before venipuncture may reduce blood culture contamination.

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Blood culture is a simple and basic diagnostic procedure routinely used in clinical practice that yields essential information for the evaluation of various infectious diseases. A positive blood culture can demonstrate not only an infectious cause of disease but also a microbiological response to antibiotic therapy (1).

However, studies have reported that 35% to 50% of positive blood cultures are falsely positive owing to contamination (1–3). False-positive cultures often cause serious interpretation problems, leading to the use of inappropriate or unnecessary antibiotics, additional testing and consultation, and increased length of stay, all of which increase health care costs (3). In a closed culture system in which blood is drawn directly into vacuum culture bottles, blood culture contamination occurs mainly during specimen collection (4). Various methods have been widely studied to reduce contamination rates, including skin disinfectants (5, 6), source of culture (7, 8), specialized phlebotomists (9), and changing of needles before inoculating culture bottles (10).

To our knowledge, no data are available on the influence of sterile gloving on blood culture contamination rates. Consequently, some controversy exists about whether sterile gloving should be routinely used during collection of blood for culture. The current guidelines do not recommend the routine use of sterile gloving (11), whereas some experts prefer sterile gloving for collection of blood for culture (12).

We sought to evaluate whether the routine use of sterile gloving before venipuncture reduces blood culture contamination rates compared with the optional use of sterile gloving in actual clinical practice.

Methods
Study Design
We conducted a prospective, cluster randomized, assessor-blinded, crossover, controlled trial. Our study was conducted for 6 months in 2009 in 17 medical wards, including 14 general wards, 2 hematlogy wards, and...
Commercially available, unpowdered, sterilized latex gloves individually packaged in pairs were used as the sterile gloves. The gloves were not reused, and a different pair of gloves had to be opened whenever sterile gloving was necessary. For clean (nonsterile) gloves, we used unpowdered, nonsterilized latex gloves, which were commercially provided in boxed sets of 100 gloves and routinely used on the wards. The clean gloves had to be drawn directly from the box before collection of blood for culture and were not reused.

Crossover allocation between the gloving techniques was done on the 15th day of the month. The method for routine or optional sterile gloving was retaught at the time of crossover in order to minimize the carryover effect. Our study design allowed a patient to have blood drawn by using both gloving techniques, by the same intern if near the crossover time or by different interns.

The skin disinfectant consisted of 10% aqueous povidone–iodine, and the rubber septums on the blood culture bottles were disinfected with 70% isopropyl alcohol. Without use of needle change methods (10), blood specimens were inoculated into both aerobic and anaerobic vials of blood culture media (BacT/ALERT FA and FN, bioMérieux, Durham, North Carolina). Blood cultures were incubated at 37 °C for 7 days. Organisms and their susceptibilities to antibiotics were identified by using automated methods and standard criteria (Microscan WalkAway-96, Siemens Healthcare Diagnostics, Deerfield, Illinois).

The interns were instructed to record actual gloving methods for an individual patient to investigate their adherence to gloving methods.

Classification of Blood Culture Isolates

At our hospital laboratory, blood culture bottles are only accepted in paired sets, consisting of an anaerobic bottle and an aerobic bottle. According to the current blood culture guidelines (11), 2 or 3 sets of blood are routinely drawn when blood culture is needed. If any organism was isolated from any bottle in a blood culture set, it was considered a positive blood culture. If an organism was isolated from only 1 set of 2 or more blood cultures done from 1 blood collection, it was considered a single positive blood culture. For example, if 2 sets of blood cultures were done from 1 blood collection and *Staphylococcus aureus* was isolated from 2 sets, that episode was counted as 2 positive blood cultures and no single positive blood culture. If the same organism was isolated from only 1 set of cultures, it was counted as 1 positive blood culture and 1 single positive blood culture. In cases of polymicrobial cultures, if any isolated organism was classified as a likely or possible contaminant, the blood culture was regarded as a single contaminated culture for calculating contamination rates.

Three infectious disease specialists who were blinded to the intern assignments independently classified each isolate from single positive blood cultures as likely contami-
nant, possible contaminant, or true pathogen. If all 3 opinions were different, that of another infectious disease specialist was obtained. Final decisions were made by a majority rule.

Likely contaminants were common skin flora, including *Bacillus* species, coagulase-negative staphylococci, *Corynebacterium* species, *Enterococcus* species, *Micrococcus* species, *Propionibacterium* species, or viridans *Streptococcus*, without isolation of the identical organism with the same antibiotic susceptibility from another potentially infected site in a patient with incompatible clinical features and no attributable risks (13). True pathogens were defined as enteric gram-negative bacilli, *Pseudomonas* species, *S. pneumoniae*, *Bacteroides* species, and *Candida* species (14) or by obtaining an identical organism with the same antibiotic susceptibility from another potentially infected site and the organism could account for the clinical features of the patient. Possible contaminants were defined as isolates obtained from 1 set of blood cultures that did not meet the criteria for likely contaminants or true pathogens.

### Statistical Analysis

Our study was designed to determine whether routine sterile gloving during blood culture collection reduces blood culture contamination rates. The sample size necessary to detect a 2-fold decrease in the contamination rate was calculated. We assumed that the contamination rate in the study hospital would be 1%, resulting in 9400 blood cultures being required to detect a difference of this magnitude (power, 0.8; type I error, 5%). Therefore, 6 months was determined to be the study period on the basis of the usual frequency of blood cultures in the study hospital.

The difference in blood culture contamination rates was evaluated according to the original group assignment, regardless of the actual gloving methods, by using generalized mixed models with binary outcome. In each model, the patient and intern were included as random effects because of a possible clustering effect by these factors. Gloving method, hospitalization unit, and sequence of gloving methods (routine-to-optional or optional-to-routine) were included as fixed effects. The interaction between gloving method and hospitalization unit or between the sequence and hospitalization unit was not significant.

The differences in adherence to the assigned gloving methods and reporting rates for the actual gloving methods used were evaluated by using generalized mixed models with binary outcomes. In these models, the intern was included as a random effect and gloving method, hospitalization unit, and sequence of gloving methods were included as fixed effects. We used the chi-square test to compare the distribution of blood cultures according to hospitalization unit between routine and optional sterile gloving.

The statistical analyses using generalized mixed models were done by using SAS software, version 9.2 (SAS Institute, Cary, North Carolina). Other statistical analyses and randomization were done by using SPSS software, version 17.0 (SPSS, Chicago, Illinois). All tests were 2-tailed. A *P* value less than 0.05 was considered statistically significant. The institutional review board at Seoul National University Hospital approved the study protocol.

### Role of the Funding Source

No external funding supported this study.

### Results

#### Baseline Characteristics

Of the 64 interns placed in the medical wards during the study period participated. A total of 10,520 blood cultures from 1854 patients were analyzed, comprising 5265 blood cultures from the routine sterile gloving period and 5255 blood cultures from the optional sterile gloving period (Figure). The number of blood cultures from each hospital unit was 7027 (66.7%) from general wards, 2446 (23.2%) from hematology wards, and 1047 (9.9%) from the intensive care unit. No significant difference between the routine and optional sterile gloving groups was found in the distribution of blood cultures according to unit (*P* = 0.55) (Table 1). The mean number of blood cultures done by an individual intern was 164 (SD, 66; interquartile range, 116 to 193).

#### Blood Culture Contamination Rates

From 301 patients, we identified 673 positive blood cultures; 244 isolates from 216 single positive blood cultures (185 patients) were classified into 67 cases of (36.5%) likely contaminants, 22 (12.8%) possible contaminants, and 155 (50.7%) true pathogens (Table 2). The main organisms of likely or possible contaminants (89 cases [100%]) were coagulase-negative *Staphylococcus* (52 cases [58.4%]), *Bacillus* species (10 cases [11.2%]), and *Enterococcus* species (9 cases [10.1%]).

The overall contamination rate was 0.9% (94 of 10,520 cultures) if possible contaminants were included and 0.7% (71 of 10,520 cultures) if only likely contaminants were included. The contamination rate based on hospital unit was 1.0% (69 of 7027 cultures) in general wards, 0.4% (11 of 2446 cultures) in hematology wards, and 1.3% (14 of 1047 cultures) in the intensive care unit if possible contaminants (*P* = 0.039) were included and 0.8% (56 of 7027 cultures) in general wards, 0.4% (9 of 2446 cultures) in hematology wards, and 0.6% (6 of 1047 cultures) in the intensive care unit if only likely contaminants were included (*P* = 0.107).

The contamination rate based on gloving method sequence was 1.0% (54 of 5397 cultures) in routine-to-optional sterile gloving and 0.8% (40 of 5123 cultures) in optional-to-routine sterile gloving if possible contaminants were included (*P* = 0.30). The contamination rate was 0.7% (40 of 5397 cultures) in routine-to-optional sterile gloving and 0.6% (31 of 5123 cultures) in optional-to-routine sterile gloving if only likely contaminants were in-
cluded ($P = 0.40$). The mean contamination rates by interns were 1.0% (SD, 1.0%; interquartile range, 0% to 1.5%) if possible contaminants were included and 1.0% (SD, 0.7%; interquartile range, 0% to 1.1%) if only likely contaminants were included.

Generalized mixed models demonstrated significant differences in contamination rates between routine and optional sterile gloving, regardless of the classification into contaminants or pathogens (Table 3). When possible contaminants were included, the contamination rate was 0.6% in routine sterile gloving and 1.1% in optional sterile gloving (adjusted odds ratio, 0.57 [95% CI, 0.37 to 0.87]; $P = 0.009$). If only likely contaminants were included, the contamination rate was 0.5% in routine sterile gloving and 0.9% in optional sterile gloving (adjusted odds ratio, 0.51 [CI, 0.31 to 0.83]; $P = 0.007$).

### Table 1. Baseline Characteristics of Cultures and Patients

| Characteristic                  | Total, n (%) | Routine Sterile Gloving, n (%) | Optional Sterile Gloving, n (%) |
|--------------------------------|-------------|--------------------------------|---------------------------------|
| Blood cultures                 |             |                                |                                 |
| Total                          | 10,520 (100)| 5265 (100)                     | 5255 (100)                     |
| Hospital unit                  |             |                                |                                 |
| General ward                   | 7027 (67)   | 3528 (67)                      | 3499 (67)                      |
| Hematology ward                | 2446 (23)   | 1203 (24)                      | 1243 (23)                      |
| Intensive care unit            | 1047 (10)   | 534 (10)                       | 513 (10)                       |
| Any positive cultures          | 673 (6)     | 329 (6)                        | 344 (7)                        |
| Single positive cultures       | 216 (2)     | 98 (2)                         | 118 (2)                        |

#### Patients

| With blood cultures            | 1854 (100)  | 1277 (100)                     | 1286 (100)                     |
| Total culture events*          |             |                                |                                 |
| 1                              | 879 (47)    | 706 (55)                       | 718 (57)                       |
| 2                              | 365 (20)    | 277 (22)                       | 269 (21)                       |
| 3                              | 181 (10)    | 131 (10)                       | 118 (9)                        |
| ≥4                             | 429 (23)    | 163 (13)                       | 163 (13)                       |
| With any positive culture      | 301 (16)    | 162 (13)                       | 177 (14)                       |
| With single positive cultures  | 185 (10)    | 89 (7)                         | 106 (8)                        |

* An event when a blood culture is needed.

### Adherence to Gloving Methods

The interns reported the actual gloving methods for 8082 (76.8%) of 10,520 blood cultures. The reporting rate for the actual gloving methods used was 76.3% (5363 of 7027 cultures) in general wards, 80.5% (1968 of 2446 cultures) in hematology wards, and 71.7% (751 of 1047 cultures) in the intensive care unit ($P = 0.133$). The reporting rate was 76.8% (4045 of 5265 cultures) in routine sterile gloving and 76.8% (4037 of 5255 cultures) in optional sterile gloving ($P = 0.54$). No statistically significant difference was found in contamination rates between blood cultures obtained with or without known gloving methods.
During routine sterile gloving, 3791 (93.7%) of 4045 blood cultures were done wearing sterile gloves, whereas in optional sterile gloving, 296 (7.3%) of 4037 blood cultures were carried out with sterile gloving. The adherence rate to sterile gloving during the routine gloving period was 92.3% (2183 of 2350) in the routine-to-optional sterile gloving group and 95.3% (2191 of 2308) in the optional-to-routine sterile gloving group (P = 0.68). In optional sterile gloving, sterile gloves were worn for 2.8% of blood draws (55 of 1977) in the routine-to-optional sterile gloving group and 11.7% (241 of 2060) in the optional-to-routine sterile gloving group (P < 0.001).

In routine sterile gloving, the adherence rate to sterile gloving was 93.9% (2685 of 2685) in general wards, 92.8% (997 of 1082) in hematology wards, and 95.3% (363 of 381) in the intensive care unit (P = 0.006). In optional sterile gloving, sterile gloves were worn for 7.8% (265 of 3360) of blood draws in general wards, 8.0% (971 of 1213) in hematology wards, and 2.3% (388 of 1705) in the intensive care unit (P < 0.001).

Table 2. Microorganisms Classified as Likely or Probable Contaminants or as True Pathogens in Single Positive Blood Cultures

| Microorganism                          | Routine Sterile Gloving, n (%) | Optional Sterile Gloving, n (%) | Total, n (%) |
|----------------------------------------|--------------------------------|---------------------------------|--------------|
|                                        | Likely Contaminant | Possible Contaminant | True Pathogen | Likely Contaminant | Possible Contaminant | True Pathogen |              |
| Staphylococcus, coagulase-negative     | 16 (67)           | 0                  | 9 (12)        | 30 (70)           | 6 (46)              | 10 (13)        | 71 (29)      |
| Enterococcus spp.                      | 0                 | 5 (56)             | 7 (9)         | 2 (5)             | 2 (15)              | 11 (14)        | 27 (11)      |
| Staphylococcus aureus                  | 0                 | 1 (11)             | 12 (16)       | 0                 | 1 (8)               | 12 (15)        | 26 (11)      |
| Escherichia coli                       | 0                 | 12 (16)            | 0             | 0                 | 0                   | 11 (14)        | 23 (9)       |
| Candida spp.                           | 0                 | 11 (15)            | 0             | 0                 | 0                   | 6 (8)          | 17 (7)       |
| Streptococcus spp.                     | 0                 | 2 (22)             | 3 (4)         | 3 (7)             | 3 (23)              | 2 (3)          | 13 (5)       |
| Bacillus spp.                          | 6 (25)            | 0                  | 1 (1)         | 4 (9)             | 0                   | 0              | 11 (5)       |
| Klebsiella spp.                        | 0                 | 0                  | 3 (4)         | 0                 | 0                   | 7 (9)          | 10 (4)       |
| Enterobacter spp.                      | 0                 | 4 (5)              | 0             | 0                 | 0                   | 3 (4)          | 7 (3)        |
| Micrococcus spp.                       | 1 (4)             | 0                  | 1 (1)         | 2 (5)             | 0                   | 1 (1)          | 5 (2)        |
| Pseudomonas aeruginosa                 | 0                 | 3 (4)              | 0             | 0                 | 0                   | 3 (4)          | 4 (2)        |
| Acinetobacter baumannii                | 0                 | 1 (1)              | 0             | 0                 | 0                   | 3 (4)          | 3 (1)        |
| Salmonella spp.                        | 0                 | 0                  | 0             | 0                 | 0                   | 3 (4)          | 3 (1)        |
| Stenotrophomonas maltophilia           | 0                 | 1 (1)              | 0             | 0                 | 0                   | 2 (3)          | 3 (1)        |
| Clostridium spp.                       | 0                 | 1 (1)              | 0             | 1 (8)             | 1 (1)               | 3 (1)          | 3 (1)        |
| Sphingomonas paucimobilis              | 0                 | 1 (1)              | 1 (2)         | 0                 | 0                   | 2 (1)          |              |
| Aeromonas hydrophila                   | 0                 | 1 (1)              | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Anaerobic gram-positive cocci          | 0                 | 0                  | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Arcanobacterium haemolyticum           | 0                 | 0                  | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Bacteroides spp.                       | 0                 | 0                  | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Brevundimonas vesicularis              | 0                 | 1 (1)              | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Burkholderia cepacia                   | 0                 | 1 (1)              | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Capnocytophaga spp.                    | 0                 | 1 (1)              | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Haemophilus influenzae                 | 0                 | 0                  | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Lactobacillus spp.                     | 1 (4)             | 0                  | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Leuconostoc spp.                       | 0                 | 1 (11)             | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Morganella morganii                    | 0                 | 0                  | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Neisseria sicca                        | 0                 | 1 (1)              | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Pedicoccus spp.                        | 0                 | 0                  | 1 (2)         | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Raoultella planticola                  | 0                 | 1 (1)              | 0             | 0                 | 0                   | 1 (1)          | 1 (0)        |
| Total                                 | 24 (100)          | 9 (100)            | 75 (100)      | 43 (100)          | 13 (100)           | 80 (100)       | 244 (100)    |

DISCUSSION

In this cluster randomized crossover trial, routine sterile gloving just before venipuncture reduced blood culture contamination rates by approximately 50%. To the best of our knowledge, our study is the first to evaluate the influence of sterile gloving on blood culture contamination rates. Although sterile gloving is a basic aspect of aseptic technique, most previous studies did not consider the gloving method when they evaluated blood culture contamination rates (5, 6, 15, 16).

To minimize confounding caused by a difference in phlebotomy skills and the consequential contamination risk for individual interns, we used a crossover design and included a random effect of interns for the statistical model. Previous studies found that trained phlebotomy teams decrease blood culture contamination rates compared with resident physicians or nurses (9, 17). These findings suggest that personal phlebotomy skills influence blood culture contamination rates. Our data also showed that the contamination rates were diverse according to individual interns.

Although blood culture was done by interns rather than dedicated phlebotomists in this study, the baseline...
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Table 3. Blood Culture Contamination Rates With Routine and Optional Sterile Gloving

| Variable            | Blood Culture, n | Probability of Contamination | Contamination Rate, % (n/n) | Adjusted Odds Ratio (95% CI) | P Value |
|---------------------|------------------|-------------------------------|----------------------------|-----------------------------|---------|
|                     |                  |                               | Routine Sterile Gloving     | Optional Sterile Gloving    |         |
| Hospital unit       |                  |                               |                            |                             |         |
| General wards       | 7027             | Likely or possible             | 0.8 (27/3528)              | 1.2 (42/3499)               | 0.64 (0.39–1.04) 0.073 |
|                     |                  | Likely only                    | 0.6 (20/3528)              | 1.0 (36/3499)               | 0.55 (0.32–0.96) 0.036 |
| Hematology wards    | 2446             | Likely or possible             | 0.4 (5/1203)               | 0.5 (6/1243)                | 0.85 (0.26–2.81) 0.79 |
|                     |                  | Likely only                    | 0.2 (3/1203)               | 0.5 (6/1243)                | 0.52 (0.13–2.07) 0.35 |
| Intensive care unit | 1047             | Likely or possible             | 0.4 (2/534)                | 2.3 (12/513)                | 0.18 (0.04–0.80) 0.025 |
|                     |                  | Likely only                    | 0.2 (1/534)                | 1.0 (5/513)                 | 0.19 (0.02–1.66) 0.134 |
| Randomization group |                  |                               |                            |                             |         |
| Routine-to-optimal  | 5397             | Likely or possible             | 0.7 (20/2729)              | 1.3 (34/2668)               | 0.59 (0.34–1.05) 0.071 |
| Sterile gloving     |                  | Likely only                    | 0.5 (14/2729)              | 1.0 (26/2668)               | 0.54 (0.28–1.04) 0.067 |
| Optional-to-routine | 5123             | Likely or possible             | 0.6 (14/2536)              | 1.0 (26/2587)               | 0.55 (0.29–1.05) 0.071 |
| Sterile gloving     |                  | Likely only                    | 0.4 (10/2536)              | 0.8 (21/2587)               | 0.48 (0.23–1.03) 0.059 |
| Overall             | 10 520           | Likely or possible             | 0.6 (34/5265)              | 1.1 (60/5255)               | 0.57 (0.37–0.87) 0.009 |
|                     |                  | Likely only                    | 0.5 (24/5265)              | 0.9 (47/5255)               | 0.51 (0.31–0.83) 0.007 |

contamination rate was relatively low, even when possible contaminants were included; although the baseline contamination rates reported by previous randomized, controlled trials were 3% to 9% (5, 8, 15, 16), our contamination rate was roughly 1% during optional sterile gloving. The exclusion of the emergency department and pediatric ward may partly explain our low contamination rates because contamination rates tend to be higher in these areas than elsewhere (6, 8, 15). In addition, comprehensive education on the standard protocol for specimen collection might have contributed to the low contamination rates (18). Furthermore, an awareness of the research might increase intern adherence to the standard protocol. Our data imply that adherence to current guidelines can reduce blood culture contamination rates to approximately 1%, as shown in our control period.

The lower blood culture contamination rates associated with routine sterile gloving may indicate the possibility of contamination of the nonsterile gloves worn by the interns (19). An outbreak of contaminated blood cultures caused by nonsterile gloves contaminated by Bacillus species was reported (20). However, in our study, the contaminants during optional sterile gloving were diverse and were mainly skin flora, which suggests that an outbreak due to collective contamination of nonsterile gloves was less likely.

The difference in blood culture contamination rates between the routine and optional sterile gloving groups was highest in the intensive care unit, in which relatively higher contamination rates during optional sterile gloving may be explained by phlebotomy difficulties due to the poor vascular condition of patients with chronic or severe illness, as well as by the less common use of sterile gloving as self-reported by the interns. A heavy workload in the busy intensive care unit might make optional sterile gloving by interns less common. Some previous studies also reported higher contamination rates in intensive care units than in general wards (21, 22), although data comparing the contamination rates of intensive care units and other hospitalization units are limited. These findings collectively suggest that sterile gloving may be preferable to use of clean (nonsterile) gloves for blood culture collection, especially in an intensive care unit.

Sterile gloving was self-reported to be used during the optional gloving period in approximately 7% of blood draws. Although this rate seems low, it might reflect actual practice guided by the current guidelines. The increased use of sterile gloving during the optional gloving period when the optional period was first may be explained as follows. First, the initial pressure of the research might make the interns stricter in their use of sterile gloving during the optional gloving period. In addition, some interns who were exhausted by sterile gloving during the routine sterile gloving period might have been reluctant to use sterile gloving during the optional period.

In this study, an approximate 50% reduction in rates of blood culture contamination due to the routine use of sterile gloving suggests that it can prevent 1 contaminated blood culture among 100 patients who need 2 sets of blood cultures. The effect of sterile gloving may be larger in a hospital with higher rates of blood culture contamination.

Our study has limitations. First, the interns could not be blinded to their gloving methods. Although information on which gloving method is preferred by investigators was not given to the interns, this inevitable nonblinding may have introduced bias. Second, we did not consider the site of peripheral venipuncture or the skin condition of the patients, such as dermatitis, which could influence contamination rates; however, we think the effect of these factors were minimized by the stratified randomization and crossover study design. Finally, we did not include blood cultures from the emergency department, surgical wards, and...
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pediatric wards, which may preclude generalization of our study results.

In conclusion, routine sterile gloving before venipuncture statistically significantly reduced blood culture contamination rates. The use of sterile gloving when collecting blood may reduce contamination rates in blood cultures.

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