The potential for increased risk of infection due to the reuse of convective air-warming/cooling coverlets

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Background: The use of convective air warming and/or cooling for the prevention of hypothermia or to induce hypothermia is growing rapidly. To date, there is no information available as to the potential risks for infection associated with either the postsurgical reuse or the repositioning of coverlets closer to the wound. We hypothesized that use of coverlets either intra- or postoperatively leads to increased contamination.

Methods: The bacterial contamination of commercially available coverlets before (control group, n = 10) and after patient application (n = 18) was investigated. From 3 predetermined sites, 1 cm × 2 cm pieces of coverlet were removed and analyzed for bacterial contamination.

Results: Even prior to use, coverlet samplings provided identifiable contamination (3 out of 30 sites, 10%), but this could be within our study’s sampling error. Nevertheless, following clinical use the frequency of contamination was considerably increased; 17 out of 57 sampled sites (31.5%) elicited contamination (P < 0.05, Fisher’s exact test).

Conclusion: This study demonstrates that the use of the coverlets, intra- or postoperatively, can lead to significant bacterial contamination. It is concluded that it is not advisable to reuse coverlets for multiple clinical applications.

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Key words: Bacteria: alpha hemolytic streptococcus, staphylococcus, bacillus, micrococcus, corynebacterium, neisseria, enterococcus, gram negative bacilli; coverlets: reuse, wound infection risk, blankets, convective warming/cooling; infection: postoperative, wound.


CONVEXTIVE air warming for the prevention of hypothermia in surgical patients has become quite common and its use continues to grow rapidly. There are numerous advantages for the prevention of hypothermia, e.g., it has been shown to reduce the incidence of postoperative wound infection and shorten periods of hospitalization (1). Furthermore, convective air cooling might be used to induce hypothermia in neurosurgical patients or in patients with stroke (2, 3). However, in spite of the continuing growth of the use of convective air coverlets in the operating room, postoperative recovery room and the intensive care unit, little is known about the potential risks of infection associated with the use of the coverlets themselves.

Surgical wound infections are the second most frequent nosocomial infection type and are important causes of both morbidity and mortality (4). A wound infection rate of 4.7% was reported in a 10-year prospective study, ranging from 1.5% in clean wounds to 40% in dirty wounds (5). Such infections not only prolong recovery and hospital stay, but increase the cost of care. Postoperative wound infection can increase the patient’s hospital stay by up to 6 days (6).

In a previous study it was shown that a single use of a convective air-warming coverlet did not increase the potential for wound contamination (7). Yet, in some instances these coverlets may come in direct contact with the surgical site perioperatively and in some institutions covers are being reused on several different patients (which is not in accordance with use recommended by manufacturers).

To date, there is no information available as to the rate of contamination and potential infection risk associated with either the postsurgical reuse or the repositioning of coverlets nearer to the wound. The aims of our study were to determine the relative sterility of a commonly used coverlet for convective air therapy and determine, following actual patient application in various types of surgery, the potential for post-use contamination.
Methods

The study was performed in the operating rooms, the postanesthetic care unit and the intensive care unit at the University of Minnesota Hospital. Coverlets were removed after use from 18 patients (patient group). In all cases, Bair Hugger coverlets (Augustine Medical Inc., Minneapolis, MN) were used; 8 Full Body Bair Hugger coverlets (AMI) from the postanesthetic care unit, all after abdominal surgery and 1 from the intensive care unit following coronary artery bypass grafting surgery. Either Upper Body (n=7) or Lower Body (n=2) Bair Hugger coverlets were used intraoperatively. The Upper Body coverlets were used intraoperatively for patients having orthopedic (n=3), abdominal (n=3) and gynecological (n=1) surgery, and 2 patients were covered with Lower Body coverlets for kidney surgery. The duration of coverlet application was measured.

From the underside of the coverlets (facing the patient’s skin) 1 cm×2 cm pieces were removed from 3 predetermined sites using sterile technique: a sternum, abdomen and right of foot sample of the full body coverlets; a center top, center middle and right of foot sample of the Lower Body coverlets; and a sternum, right and left arm of Upper Body coverlets. In addition, samples were removed from 10 new Full Body coverlets (AMI), which were immediately removed from the manufacturer’s non-sterile packaging (control group) and samples were processed in the same way as described above. All coverlet samples were inserted in a sterile container and sent to the Department of Microbiology at our institution to be analyzed for bacterial contamination.

Each of the blanket pieces was cut into 3 pieces using sterile scissors and “touchprinted” several times: 1 piece each to a MacConkey agar (isolation medium for recovery of aerobic gram-negative bacteria), a sheep blood agar (a nonspecific medium) and a colistin-nalidixic acid agar plate (a medium inhibitory to gram-negative bacteria). The culture plates were incubated at 35°C under aerobic conditions (ambient air) for 48 h.

The data were analyzed by using the Fisher’s exact test or the Mann-Whitney test as appropriate. A P-value <0.05 was considered statistically significant.

Results

Data from 28 coverlets were analyzed, 18 after patient use (patient group) and 10 previously unused coverlets served as controls (control group). From each blanket, 3 samples (sites) were analyzed; thus, total contamination data from 54 sites in the patient group and 30 sites in the control group were obtained.

The absolute number of bacterial colonies detected for each coverlet and site are shown in Table 1. Even prior to clinical use (control group), coverlet samplings provided identified contamination. Three out of 10 coverlets were contaminated (30%), corresponding to 3 sites out of 30 investigated (10%). It should be noted that the presence of a single bacterial colony in any of the cultures was considered as a positive reaction. However, the number of colonies did not exceed 2 and the manufacturer’s packaging for the coverlets are sold as non-sterile.

In the patient group, 11 out of 18 coverlets (61%) and 17 out of 54 sites were contaminated (31.5%). In 6 out of these 18 coverlets, the contamination exceeded 2 colonies.

| Control PACU & ICU Operating room Number of bacterial Number of bacterial Number of bacterial
| coverlets patients’ patients’ colonies colonies colonies |
|---|---|---|---|---|
| 1 F | F | 1 | 1 F | U | 5 strept, (−)-staph, micro strept, (−)-staph, micro |
| 2 F | F | 2 | 2 F | U | 11 (−)-staph sterility |
| 3 F | F | 3 | 3 F | F | 7 (−)-staph sterility |
| 4 F | F | 4 | 4 F | U | 2 coriy, neiss |
| 5 F | F | 5 | 5 F | F | 18 (−)-staph (16), bacill, gram-neg |
| 6 F | F | 6 | 6 F | F | 15 U |
| 7 F | F | 7 | 7 F | F | 18 U |
| 8 F | F | 8 | 8 F | F | 17 L |
| 9 F | F | 9 | 9 F | F | 18 L |
| 10 F | F | 2 (−)-staph, entero | 10 F | F | sterile |

F=Full Body Bair Hugger; U=Upper Body Bair Hugger; L=Lower Body Bair Hugger; strept=alpha-hemolytic streptococcus; (−)-staph=coagulase-negative staphylococcus; entero=enterococcus group D; micro=micococcus species; bacill=bacillus species; neiss=neisseria species; coriy=corynebacterium species; gram-neg=gram-negative bacilli.

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Although 61% (11/18) of the coverlets were contaminated, compared to 30% (3/10) in the control group, this was not statistically significant ($P=0.2365$) (see Table 2). However, when comparing the number of contaminated sites in the patient group (17/54, 31.5%) vs. the control group (3/30, 10%), there was a statistical difference ($P<0.05; 0.031$).

Pooling all data in this study, 63 bacterial colonies were found in all groups (100%), 4 in the control group and 59 in the patient group. Thus, the control group had 4 colonies (6.5%) out of 30 investigated sites, and the patient group 59 colonies (93.5%) out of 54 sites.

No pattern of contamination could be detected. Interestingly, 6 out of the 8 coverlets of the post-abdominal surgery patients were contaminated. The site of contamination varied from coverlet to coverlet, and all 3 investigated sites elicited contamination. Specifically, in 2 patient coverlets contamination was located in the right foot and sternum sites, in 3 others in the abdomen site, and in a single patient in all 3 sites (data not shown).

The following types of bacteria were identified in both control- and patient-sampled sites (see Table 2): Coagulase-negative staphylococci (79%, $n=50$), alpha-hemolytic streptococci (5%, $n=3$), bacillus species (5%, $n=3$), micrococcus species (5%, $n=3$), gram-negative bacilli (1.5%, $n=1$), corynebacterium species (1.5%, $n=1$), neisseria species (1.5%, $n=1$) and the enterococcus group D (1.5%, $n=1$).

The average time coverlets were on the patient was 170 min (range 35–405 min). The coverlets were used for a significantly shorter time on the postoperative patients than on the intraoperative patients: an average of 64 (35–95) min postoperatively, compared to 242 (120–405) min intraoperatively ($P<0.002$, Mann-Whitney two-sample test). Yet, there was no correlation between contamination and length of coverlet application (data not shown). Finally, there was no significant difference of contamination per site comparing the intraoperative vs. the postoperative patient coverlets ($P=0.5587$).

### Table 2

<table>
<thead>
<tr>
<th>Contamination per site (%)</th>
<th>Contamination per coverlet (%)</th>
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</thead>
<tbody>
<tr>
<td><strong>Control group</strong></td>
<td></td>
</tr>
<tr>
<td>3/30 (10%)</td>
<td>3/10 (30%)</td>
</tr>
<tr>
<td><strong>Patient group</strong></td>
<td></td>
</tr>
<tr>
<td>17/54 (31.5%)</td>
<td>11/18 (61%)</td>
</tr>
<tr>
<td>$P$ value (Fisher’s exact test, two-tailed)</td>
<td>$P&lt;0.05$ (0.031) NS</td>
</tr>
</tbody>
</table>

### Discussion

Since the use of convective air-warming and/or cooling coverlets is growing rapidly and the potential beneficial effects have been recognized, it is of interest to investigate potential negative effects of this form of therapy, such as infection. Previous studies have indicated that factors that influence infection rate are dose of bacterial contamination, virulence and resistance of the host (5). Obviously, the higher the contamination of the wound, the virulence of the microorganism and the lower the resistance of the host, the higher is the likelihood of infection. For example, elderly patients or patients with compromised immune system (e.g., AIDS, immunosuppression) are more susceptible to wound infections, even with microorganisms not usually virulent (5). It is generally accepted that the most common source of organisms in surgical infections is the patient or those around him. The most common time of contamination is during the surgical procedure itself (8). Skin bacteria at the incision site were found to make a substantial contribution to the wound flora (9). However, outbreaks of hospital wound infections have been reported due to infected mattresses and ECG electrode bulbs (10, 11). In another report, contaminated reusable pressure transducers were the source of bacteremias in an intensive care unit (12).

It was previously reported that a singular use of warming coverlets does not increase the potential for airborne bacterial wound infection (7). Nevertheless in some institutions convective air coverlets are being reused, although not recommended by any of the manufacturers.

Previous studies have shown that improved operating room practices can reduce the incidence of these complications (13). Consistent with these findings, we have shown here that reuse of convective air coverlets is not recommended due to the potential for increased contamination.

It was shown that 3 out of 30 control sites were contaminated with a maximum count of 2 colonies per site. However, in the patient group, 17 out of 54 sites were contaminated, which was significantly higher than in the control group. The number of colonies in the control group was 4, and 59 in the patient group. In 6 out of the 18 patient’s coverlets, the contamination exceeded 2 colonies per coverlet. The duration of coverlet application was not correlated with the number of colonies.

The bacteria species most commonly detected in this study were coagulase-negative staphylococci (79%). Coagulase-negative staphylococci are typical skin bacteria, and are considered one of the leading
causes of postoperative wound infections, especially in cardiac surgery (14). More severe infections can be caused by *Staphylococcus aureus*, which was not detected in our study.

One possible shortcoming of our study design could be considered as the potential for sampling error. While contamination during taking the samples should have been avoided by using an aseptic technique, the choice of the location of the sampling sites might have influenced the result. It could be speculated that investigating more samples from other locations after use in the same patients might have resulted in even greater detection of contamination, either quantitatively (e.g., number of colonies) or qualitatively (e.g., bacteria species). The source of contamination of the coverlets is a further matter of speculation. Most likely, the patient might have been the source. However, also handling of coverlets by health care professionals may have contaminated either the patient’s skin or the coverlets. For example, staphylococcus, streptococcus, bacillus, micrococcus and neisseria species all have been isolated from hospital personnel cultures (15).

Although a positive culture result (presence of bacteria) does not necessarily indicate subsequent wound infection, reuse of contaminated coverlets increases the potential of such occurrences; this may lead to wound infection and eventually cross-infection.

It is also important to note that not all pathogens were likely detected by our methodological approach, yet contamination of coverlets with the most common bacteria species found in wound infection was demonstrated.

We conclude that multiple use of a coverlet could lead to significant contamination and thus it is not advisable to reuse coverlets after single use.

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**References**


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