

# The Optimal Changing Frequency of Hospital Privacy Curtains Based on Contamination Rates: A Prospective Culture Study

**Chan Mi Lee**

Seoul National University College of Medicine

**Hye Yeon Goh**

Seoul National University Hospital

**Hyo Yeon Lee**

Seoul National University Hospital

**Young Rok Oh**

Seoul National University Hospital

**Wan Beom Park**

Seoul National University College of Medicine

**Nam Joong Kim** (✉ [molder@unitel.co.kr](mailto:molder@unitel.co.kr))

Seoul National University College of Medicine <https://orcid.org/0000-0001-6793-9467>

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**Short report**

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# Abstract

To estimate contamination rates over time, we obtained cultures from 34 hospital privacy curtains and two control curtains over 8 weeks. If cultures revealed microorganisms over 2.5 colony forming unit (CFU)/cm<sup>2</sup>, we defined the curtains as contaminated. The burden of microorganisms of control curtains remained under 0.2 CFU/cm<sup>2</sup> over the study period. The cumulative contamination rate of hospital privacy curtains increased over time (15.6% at week 2, 37.0% at week 4, and 55% at week 8). Contamination rates showed a tendency to increase as the number of beds in a room increased. We suggest that hospital curtains should be changed every 4 weeks, or less if the number of beds is high.

## Background

Hospital privacy curtains can be easily contaminated with microorganisms (1–3). Contaminated curtains are a potential source of infection and an important reservoir for dissemination (4, 5). Several studies have revealed that hospital privacy curtains become contaminated within a short period of time (6, 7). Considering hospital curtains as potential sources of outbreak, it would be reasonable to recommend a protocol for regular changing frequencies. Guidelines for environmental infection control from the Centers for Diseases Control and Prevention suggest that privacy curtains should be disinfected or changed more frequently than surfaces with minimal hand contact (8). The objective of this study was to estimate the contamination rates of hospital curtains over time and determine the optimal changing frequency for hospital curtains based on contamination rates.

## Methods

We collected 34 hospital privacy curtains from one intensive care unit (ICU) (five curtains) and six general wards (29 curtains). Of the 29 curtains from general wards, one was from a 2-bed room, four were from 4-bed rooms, five were from 5-bed rooms, 16 were from 6-bed rooms, and three were from 7-bed rooms. We also collected two control curtains from meeting rooms where no patients or caregivers had direct contact. New laundered curtains were put in place at the baseline of this study. They were sampled at baseline, and at weeks 1, 2, 3, 4, 6, and 8. During the study period, the curtains were changed as determined by the healthcare workers who were caring for patients. We recommended changing curtains prior to week 8 if they became visibly contaminated, if curtain cultures revealed vancomycin-resistant enterococcus (VRE) or methicillin-resistant *Staphylococcus aureus* (MRSA), or after being used by patients from whom VRE or MRSA were isolated.

The patients' side and leading edge of curtains were cultured using Rodac plates (Synergy Innovation, Seongnam, South Korea). For each sample, the plate was pressed against the curtain for 30 seconds. Curtain cultures taken on subsequent weeks were carried out at the same height but lateral to the previous sampling site to avoid contamination during the previous culture procedure. Contact plates were incubated at 36.5 °C for 48 hours and swab samples were streaked on blood agar plates (Synergy Innovation), C-VRE plates (Synergy Innovation) for VRE selection, and MRSA6 plates (Synergy Innovation)

for MRSA selection. Plates were incubated for 48 hours at 36.5 °C and colony forming units (CFUs) were counted. Contamination levels were determined by calculating CFU/cm<sup>2</sup> per plate. Previous research has suggested that bacteriologic standards for hospital surface hygiene based on standards used in the food industry (9). Because the United Kingdom uses < 2.5 CFU/cm<sup>2</sup> for cleaning efficacy, we defined our contamination threshold according to this standard. If cultures revealed a contamination level ≥ 2.5 CFU/cm<sup>2</sup>, the curtain was considered contaminated, regardless of further culture results.

## Results

Thirty-four hospital curtains and two control curtains were placed and cultured as described. A total of 14 hospital curtains were removed prior to week 8. Out of 14 hospital curtains, seven were removed following various changing schedules of each ward, three due to isolation of VRE from curtain cultures, two due to isolation of MRSA from admitted patients, and two due to isolation of VRE from admitted patients. None of the curtains were removed due to visible contamination.

The contamination level of control curtains remained under 0.2 CFU/cm<sup>2</sup> over the study period. Eleven hospital curtains exceeded the contamination threshold of 2.5 CFU/cm<sup>2</sup> before week 8. The cumulative rate of contaminated curtains increased during the study period (15.6% at week 2, 37.0% at week 4, and 55% at week 8; Table 1). MRSA was isolated from neither control nor hospital curtains during the study period. VRE was not isolated from control curtains, but was isolated from 11.8% (4/34) of hospital curtains during the study period (two at week 2, one at week 4, and one at week 6).

Table 1  
Cumulative contamination rates of hospital privacy curtains

	Baseline	Week 1	Week 2	Week 3	Week 4	Week 6	Week 8
No. of curtains evaluated	34	34	32	31	27	22	20
No. of contaminated curtains	0	3	5	9	10	11	11
Cumulative contamination rate (%)	0	8.8	15.6	29.0	37.0	50.0	55.0

Among the five curtains in the ICU, none were contaminated above a threshold of 2.5 CFU/cm<sup>2</sup>. In contrast, out of 29 curtains in general wards, eleven (37.9%) were contaminated. The contamination rates of curtains from 2-, 4-, 5-, 6-, and 7-bed rooms were 0% (0/1), 0% (0/4), 20% (1/5), 43.8% (7/16), and 100% (3/3), respectively.

## Discussion

Our study revealed that the cumulative contamination rate of hospital privacy curtains increased over time compared with control curtains. Contamination rates showed tendency to increase as the number of

beds in a room increased. Considering that contamination of hospital curtains is likely due to direct contact with patients, caregivers, and healthcare workers, the higher number of beds might have contributed to more contact and contamination.

Although there is no definite cutoff value for contamination levels in hospital environments, previous studies have used 2.5 CFU/cm<sup>2</sup> to define a surface in a hospital environment as clean (10–12), and this value has also been used as a surface standard in healthcare and food sectors (13). Because previous research used < 2.5 CFU/cm<sup>2</sup> as the hygiene criteria (14, 15), we also used this value for the contamination threshold. Contamination level thresholds for hospital privacy curtains, which are associated with an increase in the transmission of microorganisms to patients, are currently not well established. Further studies are required to determine thresholds for contamination levels.

There are currently no standards in place for the changing or cleaning frequencies of hospital curtains (8). We suggest that hospital curtains need to be changed or cleaned every 4 weeks because the cumulative contamination rate was more than 30%, and almost 10% of hospital curtains tested positive for VRE at week 4. Based on the tendency for contamination rates to increase as the number of beds in a room increased, we also suggest that hospital curtains in rooms where the number of beds is high are changed or cleaned at least every 4 weeks.

This study had some limitations. First, seven curtains were removed prior to week 8 following various regular changing schedules in hospital wards. This was an observational study, and we did not intervene in the routine changing practices of hospital curtains. Second, we could not determine whether the contamination was directly from a colonized patient because we did not perform molecular analysis of contaminating microorganisms. Third, the number of hospital curtains investigated was too small to make definitive recommendations for changing frequency.

## Conclusion

Hospital privacy curtains could be easily contaminated and are a potential source of healthcare-associated infections. We found that the contamination rate of hospital curtains increased over time and showed tendency to increase as the number of beds in a room increased. We suggest that hospital curtains need to be changed or cleaned at least every 4 weeks.

## Abbreviations

CFU

colony forming unit; ICU:intensive care unit; VRE:vancomycin-resistant Enterococcus; MRSA:meticillin-resistant Staphylococcus aureus

## Declarations

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### **Authors' contributions**

NJK, HYG and CML designed the study and wrote the manuscript. HYG, YRO and HYL collected the data. WBP analyzed and interpreted the data. All authors read and approved the final manuscript.

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### **Availability of data and materials**

All data generated or analyzed during this study are included in this published article.

### **Ethics approval and consent to participate**

This study was approved by the Institutional Review Board of Seoul National University Hospital (IRB no. H-2009-073-1157).

### **Consent for publication**

Not applicable.

### **Competing interests**

The authors have no competing interests.

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