



# New patient privacy curtains to provide passive infection prevention

Nicole M. Nelson<sup>a</sup>, Anna Aceto<sup>a</sup>, Gordon F. West<sup>a,\*</sup>

<sup>a</sup>Department of Nursing, Madigan Army Medical Center, Tacoma, WA, United States

## ARTICLE INFO

### Article history:

Received 1 February 2023

Accepted 5 June 2023

Available online 13 June 2023

### Keywords:

Curtains

Privacy curtain

Cross infection

Equipment contamination

Anti-bacterial agents

Linen



## SUMMARY

**Background:** Cloth privacy curtains represent a potentially overlooked high touch surface. Inconsistent cleaning schedules paired with frequent contact allow curtains to provide a surface for the transmission of healthcare associated pathogens. Privacy curtains integrated with antimicrobial and sporicidal agents are shown to reduce the number of bacteria found on the surface of the curtains. The purpose of this initiative is to utilize antimicrobial and sporicidal privacy curtains to mitigate the transmission of healthcare associated pathogens from curtains to patients.

**Methods:** The pre/post-test study design compared the bacterial and sporicidal burden of cloth curtains to the bacterial and sporicidal burden of Endurocide curtains following 20-weeks of use within the inpatient setting of a large military medical hospital. The Endurocide curtains were installed on two inpatient units in the organization. We also compared the overall costs associated with the two different types of curtains.

**Results:** The antimicrobial and sporicidal curtains had a significant reduction in bacterial contamination (32.6 CFUs vs 0.56 CFUs,  $P < 0.05$ ) after instillation on both units. There were no additional hospital associated infections during the study period. In addition, the direct cost savings of replacing the antimicrobial and sporicidal curtains is estimated to be \$20,079.38 annually with a reduction of 66.95 hours in environmental services workload.

**Conclusion:** These curtains represent a cost-effective intervention effective at reducing CFUs with the potential to mitigate the transmission of hospital associated pathogens to patients.

© 2023 The Authors. Published by Elsevier Ltd on behalf of The Healthcare Infection Society. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Despite years of work to reduce healthcare associated infections (HAIs), estimates suggest 1 out of 31 patients will develop an HAI while hospitalized [1]. Prevention efforts have

tended to focus on device-related and surgical site infection interventions. However, 67% of HAIs are not linked to these two main focus areas suggesting a need to explore additional interventions to reduce HAIs [2]. In a clinical environment, privacy curtains pose an unseen but serious risk to patients. Privacy curtains are a high touch surface frequently utilized preceding and immediately following the delivery of care. These curtains can easily harbor bacteria that can be transferred to patients increasing the risk for developing an HAI [3].

Healthcare workers are tasked with the overall responsibility of limiting the exposure of HAIs to those under their care.

\* Corresponding author. Address: Madigan Army Medical Center ATTN: MCHJ-ISI, CNSCI, Rm 1-57-7, Gordon West; 9040 Jackson Ave., Tacoma, WA, 98431, United States. Tel.: +1253 968 0981; fax: +1253 968 2559.

E-mail address: [gwest@plu.edu](mailto:gwest@plu.edu) (G.F. West).

Hand hygiene is the primary intervention healthcare workers utilize to reduce this risk. However, hand hygiene is variable with numerous studies identifying problems with the amount of product used, duration of hand hygiene, and overall compliance with consistently performing hand hygiene as indicated [4]. Typically, when entering a patient's room healthcare workers perform hand hygiene, don gloves and then as needed reposition curtains to provide patient care. These actions alone can place the patient at risk as studies have shown that there is a high risk of gloves transferring bacteria from curtains to patients [3]. Numerous studies have identified *methicillin-resistant Staphylococcus aureus*, *Vancomycin-resistant enterococci*, *Clostridium difficile* and many other nosocomial pathogens on hospital curtains [5–7]. Overall, these findings suggest privacy curtains are a potential vector for bacteria associated with HAIs that require additional interventions beyond simple hand hygiene.

Finally, hospital curtains are inconsistently changed between patient admissions. Some hospital protocols limit changing curtains to when they are visibly soiled or following the discharge of a patient on contact or droplet precautions occupying that room [8]. Visual inspection is inadequate to determine the presence of bacteria as it cannot be seen and bacteria are typically found on the majority of surfaces sampled within the healthcare environment [9]. Beyond traditional cloth privacy curtains, antimicrobial curtains are now available. These antimicrobial curtains have demonstrated the ability to effectively prevent as well as kill bacteria introduced onto the curtains over an extended amount of time [8]. As such, the objective of this project was to determine if there is a difference in bacterial colonization of antimicrobial and sporicidal privacy curtains compared to traditional cloth curtains over a 20-week period of use. The long-term goal of this project is to demonstrate the feasibility of antimicrobial and sporicidal privacy curtains with the goal of facility wide implementation to mitigate the transmission of pathogens from curtains to patients potentially reducing HAIs within the facility.

## Methods

This evidence-based practice initiative was conducted from July 2020 to February 2021 on an acute care and maternal child unit in a military treatment facility in the Pacific Northwest. This timeframe includes planning and executing the project. The sampling period included baseline sampling followed by repeat sampling 20 weeks later. A combined total of 13 single or multi-bed patient rooms and two control rooms were selected for this initiative; each room contained 2–9 cloth privacy curtains.

Within this facility, cloth privacy curtains are changed every six months or when visibly soiled, damaged or after the discharge or transfer of a patient on contact or droplet precautions. Prior to this project, all rooms had standard cloth curtains. To ensure the research team could communicate the change with nursing and housekeeping, a schematic of patient rooms was utilized to identify which rooms received the antimicrobial and sporicidal curtains as well as identifying the control curtains.

To determine the presence of contamination on the curtains, bacterial swabbing was performed at approximate waist

level extending roughly 30 centimeters above and below to sample the curtain surface with the most direct hand contact and 20 centimeters in for a total of 1,200cm<sup>2</sup>. Both sides of the curtain within this area were sampled as contact is made on both sides of the curtain when staff open and close the curtain. This contact occurs both before and after patient care. As each curtain has two edges, sampling was done on the leading edge defined as the edge staff use to open and close the curtain. Typically, the other edge has minimal contact as the edge borders the headwall of the patient bed preventing easy entry/exit. Bacterial swabbing was performed at baseline and once during the follow up period for a total of two swabs per curtain. BBL CultureSwab EZ were used and swabs transferred to lab for streaking once sampling was completed.

Utilizing standard microbiology techniques, swabs were streaked onto a 5% blood agar plate and incubated for approximately 24 hours. Each plate was manually counted and the total number of colonies annotated. The acceptable countable range of a plate is 0–250 colony forming units (CFUs). Anything above 250 CFUs was considered too many to count [10]. To ensure validity, two individuals performed counts on 50% of the pre/post plates. The total number of colonies were independently counted and then compared. To ensure validity of the counts, if the number of colonies varied by more than 10% on the respective plate the two individuals conducting the count were to review the plate collectively and agreed on the number of colonies present.

In collaboration with the environmental services department, the antimicrobial and sporicidal curtains were installed in designated patient rooms when the room was not occupied. The curtain installation date and the curtain change date were documented on each curtain label. Consistent with existing guidance with cloth curtains, these curtains were changed if they were visibly soiled or damaged. Cloth curtains continued to be changed if a patient on contact or droplet precautions utilized the room. However, the antimicrobial and sporicidal curtains were not changed if the room was utilized for a patient on contact or droplet precautions.

Bacterial growth was quantified as CFUs. The Shapiro-Wilk test was used to determine if the data was normally distributed. The Mann-Whitney U test was used to determine the significance of CFUs detected on the antimicrobial and sporicidal curtains. A *p*-value < .05 indicated a statistically significant difference. All analyses were performed using R version 4.0.4 software. Ethical approval was not necessary for this study.

Cost figures for this analysis were derived by consultation with the hospital logistics division. The logistics division provided the cost per each cloth curtain. Additionally, the logistics division provided a cost per pound for commercial laundering services at the facility and the curtain was weighted to determine the cost per curtain. The facility contracts housekeeping services and was able to provide us with a cost per hour for services. This rate was utilized to provide cost estimates for labor savings. We asked four different housekeepers how long it takes to change a privacy curtain and took the mean of these reported times to determine how long it takes to perform this task. Finally, we communicated with the facility infection control staff to monitor HAIs during this intervention period. No HAIs were reported at this facility during the intervention period.

## Results

Twenty-five curtains were installed in the acute care and maternal child units and two control rooms had the standard curtains. The mean CFU count prior to changing the curtains was 25 CFUs in the acute care unit and 55 CFUs in the maternal child unit. Disagreement beyond 10% did not occur on any of the plates. Post implementation on the new curtains the mean CFU count was less than 1 CFU on both units. Overall, antimicrobial and sporicidal curtains had a significant reduction in bacterial colonization (32.60 CFUs vs 0.56 CFUs,  $P < .05$ ) compared to the previously installed cloth curtains. The cloth privacy curtains in the control rooms as expected experienced an increase in bacteria over the study period but the difference was not statistically significant (32.25 CFUs vs. 67.25 CFUs,  $P = .15$ ) pre/post evaluation. None of the control room curtains were changed during the study period. Two antimicrobial and sporicidal curtain panels in the acute care unit were changed because they were visibly soiled; no curtains in the maternal child unit were changed. The infection control service did not identify any new hospital associated infections during the study. The COVID-19 pandemic occurred during data collection. The target units in this study did not provide care to COVID-19 positive patients. Workload was not specifically tracked over the study period but informal estimates suggest workload remained stable on the labor and delivery setting and increased slightly on the telemetry floor as the surgical unit these patients typically transition to was converted to a COVID-19 floor resulting in more patients staying on this unit until discharge.

In Table 1, the estimated direct and indirect costs of replacing the standard curtain with the antimicrobial and sporicidal curtains was calculated during this study period. The estimated total cost savings for this study period is \$7,722.84. Over 2 years this could provide additional savings to the organization for the purchase of new curtains, labor, and laundry cost.

The frequency of curtain changes for the organization is every six months unless the curtains are visibly soiled, damaged or discharge of a patient on contact or droplet precautions. The estimated time saved by environmental services for a curtain change in a contact or droplet precaution room after patient discharge is 26.25 hours.

## Discussion

Similar to other studies, the antimicrobial and sporicidal curtains demonstrated a significant decrease in the number of bacteria after installation [8,11]. No healthcare associated infections were directly linked to curtains within our study. Given the relatively low level of HAI in our facility, this was anticipated. Future work to directly link the source of HAI in patients is needed. However, this research will likely require prospective research enrolling high risk patients in studies sampling multiple surfaces and staff interacting with patients to determine the potential source of infection. Our small study suggests this intervention is very effective at eliminating the potential for curtains to pose a risk to our patients within the two different units with the findings supporting the expansion of these curtains to all inpatient areas.

Although direct observation of hand hygiene compliance was not conducted for this study, these antimicrobial and sporicidal curtains provide a strategy that organizations can utilize to mitigate the transmission of HAI pathogens to patients from the hands of healthcare workers. It is well established that hand hygiene is the best method to prevent HAIs. Despite this fact, hand hygiene rates tend to be under 50% allowing these privacy curtains to be potential danger hanging in plain site [12]. Efforts such as these new curtains could potentially decrease HAIs by significantly decreasing the number of bacteria on the curtain that healthcare providers can transfer to the patient [13]. Our findings found a mean of less than 1 CFU on the curtains suggesting the real potential to eliminate the potential for privacy curtains to serve as a vector for HAIs.

While the potential to decrease HAIs should outweigh cost issues, these new curtains have demonstrated consistent cost savings with our findings [14]. The additional time could potentially allow environmental services an opportunity to focus on other high priority sanitation efforts in the organization. In addition, the curtains provide a safety advantage because the environmental service team would not need to climb a ladder as often to change the curtains [14]. In addition, as these curtains continue to be used there is more opportunity or evaluation of a recycling program for these curtains since one of the selling points is that they can be recycled [15].

**Table 1**  
Cost comparison of antimicrobial and standard curtains

	Antimicrobial curtain	Standard curtain	Total savings
<b>Direct Costs Curtain Panels</b>	\$1,564.70	\$8, 432.14	\$6,867.44
<b>Indirect Costs</b>			
Curtain changes	2 <sup>a</sup>	105 (7 rooms x3 panels x 20 weeks) <sup>b</sup>	
Staff Cost	\$9.25	\$485.63	\$476.40
Laundering Cost <sup>c</sup>	\$0	\$379.05 (3.61 x 105)	\$379.05
<b>Annual Cost Savings</b>			<b>\$20,079.38</b>
Time to replace curtains	0.50 hours (15 min x2)	26.25 hours (15 min x105)	
<b>Annual Time Saved</b>			<b>66.95 hours</b>

<sup>a</sup> Combined number of curtains changed on the acute care and maternal units.

<sup>b</sup> Average number of contact or droplet precaution curtains changed on the units per month.

<sup>c</sup> Cost to launder standard curtain \$3.61 per panel.

The initiative was limited to two units in the organization, additional work is needed to determine the bacterial burden and associated patient risk within outpatient clinics and emergency room settings that utilize similar curtains for patient privacy. Future work could also extend the sampling time beyond 20 weeks to determine long-term effectiveness up to the manufacturer's 6-month claims.

## Conclusion

Privacy curtains are high touch surface areas that can harbor bacteria that can potentially be transmitted between patients and healthcare workers. The data demonstrates that antimicrobial and sporicidal curtains decrease bacterial count after installation on an acute care and maternal child units. These curtains provide a passive infection prevention method to mitigate the transmission of hospital associated pathogens during hospitalization. In addition, these curtains can provide additional cost-savings and safety advantages for the environmental services staff. Collectively, these findings suggest similar facilities should consider implementing these curtains as our results suggest the possibility to improve patient outcomes and decrease costs.

## Credit author statement

Manuscript: New patient privacy curtains to provide passive infection prevention.

Nicole M. Nelson DNP, ACCNS-AG, CCRN: writing-review& editing; validation; investigation; data curation; writing – original draft; funding acquisition; project administration.

Anna Aceto, BSN: writing-review& editing; validation; investigation; data curation; writing – original draft.

Gordon F. West PhD, MHA, BSN, FACHE, AMB-BC: visualization, writing-review& editing; methodology; conceptualization; investigation; resources; data curation; writing – original draft.

## Funding

We received funding from grant N2011 NelsonMEB from the Triservice Nursing Research Program.

## Conflict of interest

The authors declare no conflicts of interest.

The authors state that views expressed in this abstract/manuscript are those of the author (s) and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the US Government.

## References

- [1] Current HAI Progress Report | HAI | CDC 2022. <https://www.cdc.gov/hai/data/portal/progress-report.html> (accessed May 8, 2023).
- [2] Koipa M, Wałaszek M, Róžańska A, Wolak Z, Wójkowska-Mach J. Epidemiology of Surgical Site Infections and Non-Surgical Infections in Neurosurgical Polish Patients—Substantial Changes in 2003–2017. *Int J Environ Res Public Health* 2019;16:911. <https://doi.org/10.3390/ijerph16060911>.
- [3] Larocque M, Carver S, Bertrand A, McGeer A, McLeod S, Borgundvaag B. Acquisition of bacteria on health care workers' hands after contact with patient privacy curtains. *Am J Infect Control* 2016;44:1385–6. <https://doi.org/10.1016/j.ajic.2016.04.227>.
- [4] World Health Organization, Safety WP. WHO guidelines on hand hygiene in health care : a summary. World Health Organization; 2009.
- [5] Klakus J, Vaughan NL, Boswell TC. Meticillin-resistant Staphylococcus aureus contamination of hospital curtains. *J Hosp Infect* 2008;68:189–90. <https://doi.org/10.1016/j.jhin.2007.11.015>.
- [6] Schweizer M, Graham M, Ohl M, Heilmann K, Boyken L, Diekema D. Novel hospital curtains with antimicrobial properties: a randomized, controlled trial. *Infect Control Hosp Epidemiol* 2012;33:1081–5. <https://doi.org/10.1086/668022>.
- [7] Shek K, Patidar R, Kohja Z, Liu S, Gawaziuk JP, Gawthrop M, et al. Rate of contamination of hospital privacy curtains on a burns and plastic surgery ward: a cross-sectional study. *J Hosp Infect* 2017;96:54–8. <https://doi.org/10.1016/j.jhin.2017.03.012>.
- [8] Luk S, Chow VCY, Yu KCH, Hsu EK, Tsang NC, Chuang VWM, et al. Effectiveness of antimicrobial hospital curtains on reducing bacterial contamination-A multicenter study. *Infect Control Hosp Epidemiol* 2019;40:164–70. <https://doi.org/10.1017/ice.2018.315>.
- [9] Bonadonna L, Briancesco R, Coccia AM. Analysis of Microorganisms in Hospital Environments and Potential Risks. *Indoor Air Qual Healthc Facil* 2017;53–62. [https://doi.org/10.1007/978-3-319-49160-8\\_5](https://doi.org/10.1007/978-3-319-49160-8_5).
- [10] Sutton S. *Pharmaceutical Microbiology Forum Newsletter* 2006;2–5.
- [11] Widsten P, Salo S, Niemelä K, Helin H, Salonen M, Alakomi H-L. Tannin-Based Microbicidal Coatings for Hospital Privacy Curtains. *J Funct Biomater* 2023;14:187. <https://doi.org/10.3390/jfb14040187>.
- [12] Pfoh E, Dy S, Engineer C. Interventions to improve hand hygiene compliance: brief update review. Agency for Healthcare Research and Quality (US); 2013.
- [13] Smith SJ, Young V, Robertson C, Dancer SJ. Where do hands go? An audit of sequential hand-touch events on a hospital ward. *J Hosp Infect* 2012;80:206–11. <https://doi.org/10.1016/j.jhin.2011.12.007>.
- [14] Kotsanas D, Gillespie E. Disposable antimicrobial and sporicidal privacy curtains: Cost benefit of hanging longer. *Am J Infect Control* 2016;44:854–5. <https://doi.org/10.1016/j.ajic.2016.01.009>.
- [15] Carikas K, Matthews S. Hospital Privacy Curtains -What's hanging around? *Dissector J Perioper Nurses Coll N Z Nurses Organ* 2019;47:20–3.