Clostridium difficile Cross Contamination in the Textile Laundering Process: The Importance of Selecting an Appropriate Hard Surface Disinfectant Henry L. Carbone II, BS MS; Lisa A. Hellickson, BA; Anita L. Thomasser, BS; Loan K. Vu, BA; Ecolab Research and Development, Eagan, MN

BACKGROUND/OBJECTIVE:

Clostridium difficile infections are a major concern in healthcare settings and are becoming more frequent, more severe, and more difficult to treat. Estimates of up to \$3 billion annually are spent in the United States managing cases of C. difficile infection.¹ The hospital environment has been identified as a source of transmission and numerous cleaning interventions have been recommended.^{2,3,4,5} The US Environmental Protection Agency has approved products with efficacy claims against C. difficile spores, however, many healthcare facilities continue to remediate contaminated surfaces through meticulous cleaning with reusable wipers saturated with non-sporicidal disinfectants, as has been recommended for non-outbreak situations.⁵

It is hypothesized that when C. difficile contaminated surfaces are cleaned in this manner, although the spores may be physically removed by the wiper, they remain viable in the wiper and can contaminate other co-mingled items in the laundry process. Past work has demonstrated the risk of C. difficile spore cross contamination in the laundry process associated with contaminated bed linens.⁶

This study was conducted to evaluate the relative risk of C. difficile cross contamination in the laundry process associated with cleaning contaminated surfaces with reusable wipers saturated in either sporicidal or non-sporicidal hard surface disinfectants.

METHODS:





1: Saturate 5 Blue microfiber cloths in 1000 mL of each of four treatments

- Sporicidal Disinfectant 1
- Sporicidal Disinfectant 2
- Non-Sporicidal Disinfectant
- Cold softened tap water

2: Clean inoculated stainless steel coupons with saturated microfiber

- ~1x10⁵ C. difficle (ATCC 700792) spores per coupon
- Coupons wiped with sampling swab 10 minutes after cleaning
- Swab incubated and tested for presence of C. difficile to assess cleaning/disinfection

3: Launder 5 used Blue microfiber cloths with 20 new Yellow microfiber cloths

- Laundered using a typical commercial wash formula for microfiber textiles
- No disinfectant or bleach added as part of the wash process
- Blue cloths discarded after wash cycle
- Yellow cloths reserved for further testing after wash cycle
- Washer cleaned between cycles by operating empty for 10 minutes with 1000 ppm chlorine bleach followed by two water-only rinses







4. Swab washer with sampling swab after bleach step

Swabs incubated and tested for presence of residual C. difficile in the washer

5: Manually agitate Yellow cloths to dislodge any transferred spores

- Each cloth agitated for 1 minute in 200mL Letheen broth
- Serially diluted eluent from one cloth for both Non-Sporicidal Disinfectant and water treatments to more accurately estimate the number of transferred spores

Vacuum filter eluent

~200 mL eluent from each cloth split evenly into two 0.45 µm membrane filters

/: Plate resultant filter

- Filters plated, incubated and tested for presence of C. difficle
- Filters positive for presence of C. difficile were further evaluated for enumeration

RESULTS:

Spore Removal/Inactivation from Stainless Coupon

Coupons cleaned with microfiber cloths saturated in sporicidal disinfectants showed 0 of 5 coupons retained viable C. difficile spores. 1 of 5 coupons cleaned with cloths saturated in non sporicidal disinfectant and 2 of 5 coupons cleaned with cloths saturated in water retained viable C. difficile spores. (Figure 1)

Cleaning Cloth Cross Contamination from Wash Process

As shown in Figure 2, saturating cleaning cloths in a sporicidal disinfectant yielded a statistically significant reduction in the proportion of cleaning cloths that were cross contaminated from the laundry process, as compared to saturating cleaning cloths in either non-sporicidal disinfectant or water. Additionally, the number of C. difficile spores recovered from cross contaminated cloths was significantly reduced when cloths were saturated in sporicidal disinfectants vs. when saturated in either a nonsporicidal disinfectant or water (Figure 3). These results were independent of the type of sporicidal disinfectant used.

Presence of Spores Remaining the Washer

The washer was swabbed after each wash cycle as described. Viable C. difficile spores were not identified in any post wash cycle swabs.

TEST FOR STATISTICAL DIFFERENCE BETWEEN PROPORTIONS

Multiple Comparisons for Proportions

Ho: There is not a significant difference between proportions H1: There is a significant difference between proportions

R	OW	COMPARE	DIFF	SE	Q	q(.05)	CONCLUSION
	1	Cold Soft Tap Water vs. Sporicidal Disinfectant 1	54.619	6.327	8.632	3.630	Significant Difference
	2	Cold Soft Tap Water vs. Sporicidal Disinfectant 2	50.668	6.327	8.008	3.630	Significant Difference
	3	Cold Soft Tap Water vs. Non-Sporicidal Disinfectant	8.752	6.327	1.383	3.630	No Difference
	4	Non-Sporicidal Disinfectant vs. Sporicidal Disinfectant 1	45.866	6.327	7.249	3.630	Significant Difference
	5	Non-Sporicidal Disinfectant vs. Sporicidal Disinfectant 2	41.916	6.327	6.625	3.630	Significant Difference
	6	Sporicidal Disinfectant 2 vs. Sporicidal Disinfectant 1	3.951	6.327	0.624	3.630	No Difference

CONCLUSIONS:

Microfiber wipers can remove C. difficile spores from surfaces and removal/inactivation is improved when the cloths are saturated in a sporicidal disinfectant. However, if a non-sporicidal disinfectant or liquid is used in the cleaning process, the removed spores remain viable in the wiper creating a vector for cross contamination to other textiles via the laundry process.

Saturating wipers with a sporicidal disinfectant before cleaning does not entirely eliminate the possibility of cross contamination to other textiles in the laundry process, but it does significantly reduce both the number of cloths cross contaminated and the number of spores recovered from cross contaminated cloths.

The reduction in the number of cloths exhibiting cross contamination and the reduction in the number of spores recovered from the cloths was independent of the type of sporicidal disinfectant used in this study.

References:

¹ Dubberke ER, Wertheimer, AI. Review of Current Literature on the Economic Burden of Clostridium difficile Infection. Infect Control Hosp Epidemiol 2009; 30:57-66.

⁴ Dubberke ER, Gerding DN, Classen D, et al. Strategies to prevent Clostridium difficile infections in acute care hospitals. Infect Control Hosp Epidemiol 2008; 29:S81-S92.

⁵ Carrico RM, Archibald LK, Bryant K, et al. Guide to the Elimination of Clostridium difficile in Healthcare Settings. Washington, DC: Association for Professionals in Infection Control and Epidemiology, Inc.; 2008.

⁶ Hellickson, LA, Owens KL. Cross-Contamination of Clostridium difficile Spores on Bed Linen During Laundering. American Journal of Infection Control. 2008; Vol. 36(5), E24-25.





Figure 1. Spore removal/inactivation from stainless coupons (N=5)

³ Abbett SK, Yokoe, DS, Lipsitz SD, et al. Proposed Checklist of Hospital Interventions to Decrease the Incidence of Healthcare-Associated Clostridium difficile Infection. Infect Control Hosp Epidemiol 2009; 30:1062-1069.

² Rutala WA, Weber, DJ, et al. Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008 Nov. Available from: http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf.