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Brief Report

Comparing the microbial removal efficacy of new and reprocessed microfiber on health care surfaces

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The Centers for Disease Control and Prevention (CDC) suggests that microfiber is preferred for environmental cleaning and disinfection given its enhanced microbial removal. There has been controversy surrounding the sustained efficacy of reprocessed microfiber, though existing literature on the topic lacks standardized laundering parameters. The present study demonstrates that reprocessed microfiber cloths and pads, laundered according to CDC laundry parameters, achieve microbial removal from healthcare surfaces that is substantially equivalent to that of new microfiber.

Microfiber products are frequently viewed to be an important component of environmental cleaning and disinfection protocols, having demonstrated superior microbial removal compared to other cleaning textiles in some studies.[1-4] Microfiber is available as single-use (ie, monofilament, polyester) or durable and/or launderable (ie, bicomponent, polyester+polyamide); however, controversy exists over the efficacy of reprocessed microfiber.[5-8] Several studies evaluating this issue have demonstrated conflicting results, though without reporting laundry parameters consistent with CDC specifications.[5-8] The performance of these products is crucial given the widespread use of durable microfiber and the critical need to ensure effective microbial removal from healthcare surfaces.

This study was undertaken to determine whether the performance of new and reprocessed microfiber on hospital surfaces was significantly different or substantially equivalent.

METHODS

Setting and equipment

The study was conducted in a 414-bed acute care hospital in Denison, TX. The microfiber products (HYGEN Microfiber Cloths, SKU: FGQ62000BL00 (blue-new), FGQ62000GR00. (green-reprocessed), length: 16 inches, width: 16 inches, weight: 0.60 lb/0.27 kg; HYGEN Microfiber Wet Pad, SKU: FGQ41000BL00 (blue-new), FGQ41000GR00 (purple-reprocessed) length: 20.50 inches, width: 5.20 inches, weight: 2.90 lb/1.32 kg, Rubbermaid Commercial Products, Huntersville, NC) included new and re-processed cloths and mop pads (30 of each product category for a total of 60 cloths and 60 mop pads). The reprocessed microfiber was laundered by a third-party commercial laundry company according to the manufacturer's instructions which align with the 2003 CDC laundry guidelines: machine-washed at 160°F for 25 minutes with 50-150 ppm bleach; dried at low-heat setting of 130°F.[8] It is important to note that current CDC guidance does caution that chlorine-based disinfectants such as bleach can damage microfiber[1]; however, the manufacturer of these microfiber products indicate that bleach can be used "as necessary" for hot water laundering and is "required" for cold water laundering. Prior to use, each reprocessed product was laundered consecutively at these settings for the product's lifespan (ie, 200 launderings) according to the manufacturer. Products were color-coded according to laundering status. Cloths were tested on patient room sink counters and mop pads were tested on communal bathroom floors in the Emergency Department.

Sampling and data analysis

Each sampling surface was divided into three contiguous sections for the treatment type: control (ie, no cleaning), cleaning with new microfiber, and cleaning with reprocessed microfiber. Each section was further subdivided into pre- and/or post-cleaning sampling

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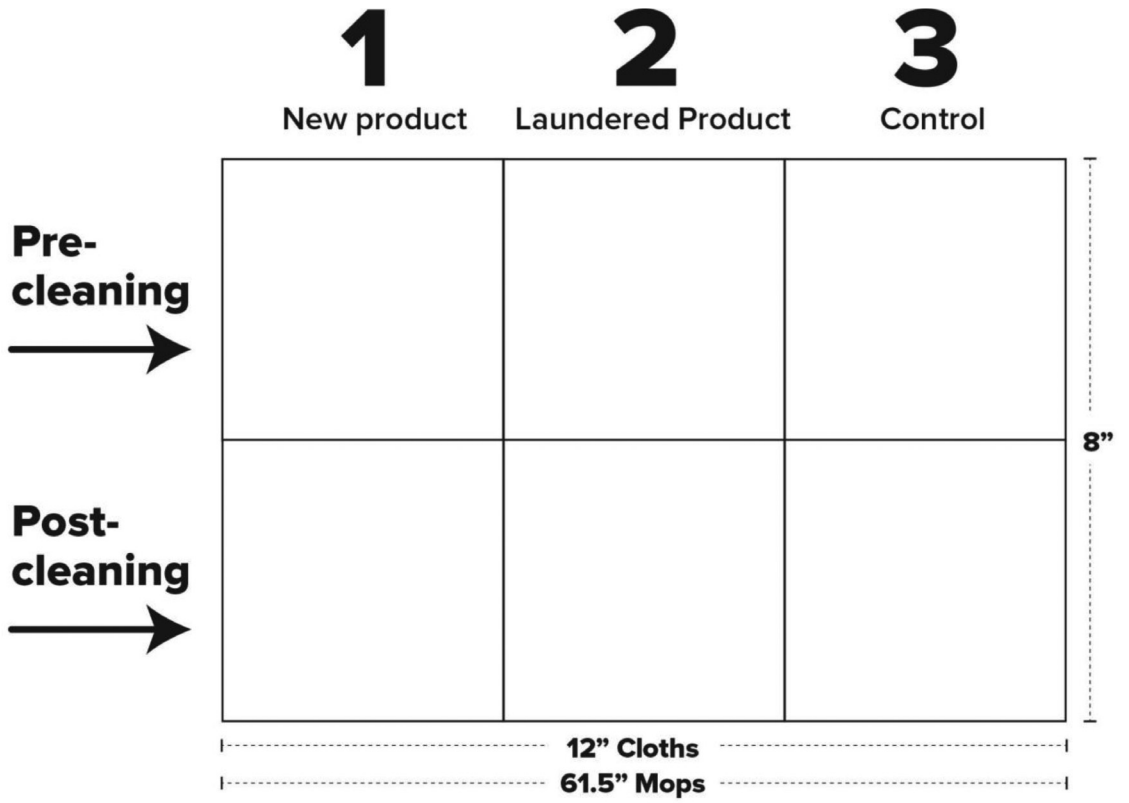

Fig 1. Examples of sink counter and floor demarcation for sampling.

subsections, as seen in Figure 1, in order to mitigate the possibility that pre-cleaning sampling itself might remove bioburden from the surface before cleaning. Treatment type and sampling sections were randomized prior to testing. Wiping and/or mopping was performed by the same researchers for each trial, with the microfiber product dampened with water and wiped and/or mopped over the testing surface once left to right. The floor sampling surfaces for the mop pad tests, as seen in Figure 1, were divided in a manner consistent with the cloths, though the dimensions were different to accommodate the size of the mop pad (length 20.5 inches, width 8 inches).

Microbial sampling was performed using HiCap neutralization swabs sent overnight to a third-party lab (US MicroSolutions, Latrobe, PA) which were inoculated on TSA, incubated for 5 days at 20°C-25°C followed by enumeration as total colony forming units (CFU). A total of 360 samples, 180 for cloths and 180 for mop pads, were collected.

CFU values for each sample were logarithmically transformed, and a series of multivariate regression models were created to identify any statistically significant differences in microbial load after treatment with the different types of cloths and mops. Models simultaneously controlled for sample date and location to minimize the impact these covariates would have on the analysis.

RESULTS

As expected, the microbial counts yielded by samples treated with new and laundered cloths and mop pads were significantly lower than those yielded by the corresponding untreated controls (New Cloth: $P = .003$; Laundered Cloth and both New and Laundered Mops: $P \leq .001$). Conversely, there was no statistically significant difference in the microbial counts yielded by samples treated with new cloths and samples treated with laundered cloths ($P = .270$) as seen in Figure 2. Additionally, samples treated with new mop pads yielded counts that were not significantly different than counts yielded by samples treated with laundered mop pads ($P = .669$). The lack of a statistically significant difference in performance of new and laundered cloths and mop pads indicates that the new and laundered products were substantially equivalent in terms of microbial removal efficacy in a healthcare setting.

Treatment Category	Referent Category	Coefficient	Test Statistic	p-value
New Cloths	Control	-0.297	-3.03	0.003
Laundered Cloths	Control	-0.396	-4.04	<0.0001
New Mop Pads	Control	-0.622	-4.76	<0.0001
Laundered Mop Pads	Control	-0.570	-4.36	<0.0001
Laundered Cloths	New Cloths	-0.099	-1.11	0.270
Laundered Mop Pads	New Mop Pads	0.052	0.43	0.669

Fig 2. Table of regression model coefficients.

DISCUSSION

Manual cleaning of environmental surfaces is a critical component of HAI risk reduction.[1-9]

Microfiber has been shown to enhance microbial removal,[2-4] but it is vital that it maintains sustained efficacy throughout its purported lifespan. This is especially important when supply chains are disrupted, as seen during the pandemic, and durable products must be relied upon to be effective after multiple reprocessings.[8-10] This study demonstrates that the microbial removal efficacy of the tested microfiber product is substantially equivalent at the beginning and end of its lifespan.

Existing literature on the sustained efficacy of reprocessed microfiber yields mixed results, but notably does not report laundry parameters consistent with CDC recommendations.[5-8] Theories for the different outcomes range from the laundering process causing irreversible damage to the microfibers, thereby reducing efficacy, to it enhancing efficacy by rendering the fibers increasingly finer.[6,7]

Diab-Elschahawi et al. reported that, compared to cotton and sponge cloths, the decontamination efficacy of one microfiber product was reduced after 10 and 20 washings.[5] These cloths were washed at 90°C(194°F) for 5 minutes without bleach, dried in a dryer, with no specification of detergent additive or drying temperature. A 2021 critical review of reprocessed healthcare textiles studies posits that Diab-Elschahawi's conclusions warrant scrutiny given non-transparent statistical analyses.[8] The review further points to the study's findings that while new microfiber outperformed reprocessed for *Staphylococcus aureus* removal from ceramic tiles, the opposite was true for *E.coli* removal.[8]

Smith et al. evaluated nine different microfiber cloths washed 1, 50, 75, 100, and 150 times with a microfiber-recommended detergent but without bleach, using a temperature of 71°C (160°F) for 3 minutes and air-dried.[6] They found that microbial removal efficacy improved after repeated washings (up to 150) compared to after a single washing.[6]

Wiencek reported that ATP removal from floors was less effective with reprocessed versus disposable microfiber mop pads, but did not quantify results or provide laundering parameters and/or number of laundering cycles.[7] Unlike previously published studies, the present study reprocessed microfiber according to CDC laundering parameters, providing an evaluation more standardized to current healthcare practice.

As only one microfiber product line was evaluated, results cannot necessarily be extrapolated to microfiber products from other manufacturers given product construct and design differences. Because the laundry process is most often implicated as the source of damage to microfiber, this study evaluated microfiber after 200 launderings only and not 200 launderings and 'uses.'[7] Finally, the authors acknowledge the real-world challenge inherent in tracking the number of launderings a product has undergone.

In conclusion, this study found new and laundered microfiber cloths and mop pads achieve similar microbial removal efficacies in a clinical setting. This suggests that, when laundered according to CDC parameters, the microbial removal efficacy of the microfiber products tested is sustained throughout its claimed lifespan, a finding with important infection prevention and control implications. Future studies are needed to assess the sustained efficacy of other microfiber products.

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