

# Verantwoording literatuuronderzoek

## Module Reinigingsdoeken

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### **Uitgangsvraag**

Wat is het verschil in effectiviteit tussen reinigen met microvezeldoeken en reinigen met andere (conventionele) reinigingsdoeken?

**Bijlage** bij Richtlijn SRI Reiniging en desinfectie van ruimten in de langdurige zorg ([www.richtlijnenlangdurigezorg.nl](http://www.richtlijnenlangdurigezorg.nl))

## Methode

### Onderzoeksvraag

A systematic review of the literature was performed to answer the following question: what is the difference in efficacy between a (reusable) microfiber cloth and other cleaning cloths?

<b>P</b>	Cleaning of patient-related surfaces and areas
<b>I</b>	Cleaning with a microfiber cloth
<b>C</b>	Cleaning with a different (non-microfiber/ready-to-use) cleaning cloth
<b>O</b>	Effectivity, visual clean

### Relevant outcome measures

The guideline development group considered effectivity and visually clean as a critical outcome measure for decision-making.

A priori, the working group did not define the outcome measures listed above but used the definitions used in the studies.

### Search and select (Methods)

The databases Medline (via OVID), Embase (via embase.com), Web of Science, and Cinahl, were searched with relevant search terms from 1 January 2000 until 21 March 2022. The detailed search strategy is available upon reasonable request via [info@sri-richtlijnen.nl](mailto:info@sri-richtlijnen.nl).

The systematic literature search resulted in 304 hits. Seventeen studies were initially selected based on title and abstract screening. After reading the full text, 12 studies were excluded (see the table with reasons for exclusion under the tab Methods), and 5 studies were included (Diab-Elschahawi, 2010; Hron, 2019; Tajtman, 2015; Wiemken, 2014; Wren, 2008). The summary of literature, results and evidence tables are included below under the tab Onderbouwing.

### Results

Five studies were included in the analysis of the literature. Important study characteristics and results are summarized in the evidence tables. The assessment of the risk of bias is summarized in the risk of bias tables. Results were obtained from boxplots by using an online data extraction tool (<https://automeris.io/WebPlotDigitizer>). Cotton cloths, general-purpose cloths, and conventional cloths were included as relevant cleaning cloths. Sponges and paper towels were excluded from this analysis.

## Samenvatting literatuur

### Description of studies

Diab-Elschahawi (2010) conducted an experiment to investigate the decontamination capacity of 4 different types of cleaning cloths (microfiber cleaning cloth, cotton cloth, sponge cloth, and disposable paper towels) in wet or dry conditions. Furthermore, all cloths were reprocessed 10 to 20 times and then analyzed for decontaminating abilities. Ceramic tiles (5x5cm) were contaminated with *Staphylococcus aureus* (ATCC 6538) and *Escherichia coli* (ATCC 8739) (5x10<sup>7</sup> colony-forming units (CFU) per ml; left to dry for 1 hour). All cloths were tested in dry and wet (with distilled water) conditions. Wiping was performed in a meander-like pattern,

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starting in the upper left corner, turning four times, and ending in the lower right corner. Reprocessing of the cloths was done in a washer disinfector and a laundry dryer (90°C for 5 minutes) up to 20 times. The test suspension remaining on the tiles was recovered from the tile surfaces by shaking the surfaces in Petri dishes filled with 10 mL casein-soya-lactose broth. Aliquots of this suspension were then plated on Tryptic Soy Agar and incubated for 48 hours at 35°C before CFUs were counted. Outcome measures were *S. aureus* and *E. coli* colony-forming units (CFUs) remaining on the tiles after wiping.

Hron (2019) conducted an experiment to investigate the cleaning efficacy of 11 different samples of cloths (single-use wipes (50% rayon/50% polyester), 100% rayon, 100% polyester, 100% greige cotton (6.8 MJ kg<sup>-1</sup>), 100% greige cotton (8.9 MJ kg<sup>-1</sup>), 100% greige cotton (10.1 MJ kg<sup>-1</sup>), 100% greige cotton scoured and bleached, 80% polyester/20% greige cotton, 20% polyester/80% greige cotton, 80% rayon/20% greige cotton, and 20% rayon/80% greige cotton) in dry or wet (1ml of ultrapure water) condition. Stainless-steel plates were contaminated with either a protein contaminant (500 µl of 5% fetal bovine serum in phosphate buffered saline, dried overnight) or a hydrophobic residue (paraffin wax bead 50 ± 2 mg, melted and dried for 30 min). Wiping was performed by a machine performing 16 movements (71.3r/min, 9 kPa for protein, and 12kPa for hydrophobic residue). The outcome measure for the protein contaminant was protein uptake (mg/ml) of wipes, measured by putting wipes in phosphate buffered saline. For hydrophobic residue, a scale was used to measure the weight of the plate after wiping.

Trajtman (2015) conducted an experiment to assess the removal of *Clostridium difficile* spores on surfaces cleaned by microfiber cloths compared with cotton cloths. The test surface consisted of ceramic tiles (2.2x2.2 cm) contaminated with *C. difficile* (2.3x10<sup>4</sup> spores/site (CFUs), dried overnight). Before assessing the outcome, tiles were sprayed with either phosphate buffer saline (PBS) or a hydrogen peroxide 0.01% cleaning agent. Transfer of *C. difficile* was also studied, by contaminating cloths directly with *C. difficile*. Wiping was performed by a machine. Each test cloth or ceramic carrier was placed in a 50 mL sterile conical tube containing 10 mL of sterile PBS. The tube was mixed by vortexing for 1 minute, sonicated 3 times for 5 seconds each time, followed by 1 minute of vortexing. The eluent was serially diluted 1:10 from 10<sup>-1</sup>-10<sup>-5</sup> in PBS with a pH of 7.5. One hundred mL of the 10<sup>-2</sup>-10<sup>-4</sup> dilutions were inoculated onto *Clostridium difficile* Monobactam Norfloxacin agar using the spread plate technique and incubated for 48 hours at 37°C. Outcome measures were *C. difficile* CFUs remaining on the ceramic tiles after wiping with microfiber cloths and cotton cloths, after wiping with cloths used twice, and after wiping with contaminated cloths.

Wiemken (2014) conducted an experiment to evaluate the compliance related to using ready-to-use (RTU) disinfectant wipes compared with the bucket method. The bucket method refers to the traditional use of cleaning cloths saturated with diluted sodium hypochlorite cleaner/disinfectant in a bucket. Timeliness and cost-savings were also investigated. Cleaning with a cleaning cloth and bucket with sodium hypochlorite cleaner/disinfectant solutions was compared with ready-to-use (RTU) wipes impregnated with sodium hypochlorite cleaner/disinfectant solutions on 6 pre-specified areas in a patient room. Employees with environmental service responsibilities were randomized to one of both wiping methods. The **Bijlage bij Richtlijn SRI Reiniging en desinfectie van ruimten in de langdurige zorg** ([www.richtlijnenlangdurigezorg.nl](http://www.richtlijnenlangdurigezorg.nl))

outcome was measured as compliance: 0 points for total miss of the area, 1 point for partial miss, and 2 points for completely removing the fluorescent marker.

Wren (2008) conducted an experiment comparing the ability to remove several types of organisms by ultramicrofiber (UMF)-woven cloths and conventional cloths moistened with water. UMF cloths were 80% polyamide and 20% polyester fiber. Five types of surfaces were used: 100 cm<sup>2</sup> of a rough tile, a smooth tile, laminated worktops (new and worn), and stainless-steel surfaces. Surfaces were each inoculated with four microorganisms separately: methicillin-resistant *Staphylococcus aureus* (MRSA), *Acinetobacter calcoaceticus* var. *baumannii* (ACCB), *Klebsiella oxytoca* (*K. oxytoca*) in logarithmic phase growth, or spores of *Clostridium difficile*. Bacterial suspensions were made in phosphate-buffered saline (PBS) with or without 7% BSA, and 100 µL was subsequently used to inoculate areas of each surface. Wiping was performed as described by the manufacturer. Outcome measures were microorganisms remaining on the wiped surfaces based on CFUs after incubation of contact-plates and biological residue based on adenosine triphosphate (ATP) measurements, expressed in RLUs. CFUs were counted by placing contact-plates on the test area after wiping, and then incubating the plates (48 hours, 37°C). The test surfaces were swapped immediately after wiping and the adenosine triphosphate (ATP) level on the swabs was expressed in RLUs.

### Results

Because of the heterogeneity in study designs and outcome measures, pooling of data was not possible. Where possible, independent sample t-tests were performed on the post-wiping results. For the purpose of this guideline, the results for different microorganisms were pooled to obtain an overall effect estimate.

### Effectivity

#### *CFUs*

Colony-forming units (CFUs) were reported in three studies (Diab-Elschahawi, 2010; Trajtman, 2015; Wren, 2008). CFUs are a quantitative unit of measurement to estimate the number of microorganisms present on a surface. The results for the percentage reduction in CFU counts are presented in Table 1.1. When used wet, microfiber cloths resulted in a statistically significant larger reduction of CFUs from surfaces compared to other cleaning cloths in all studies. When used dry, a smaller reduction was seen for microfiber cloths compared to other cleaning cloths; however, no independent sample t-tests could be performed to test for statistical significance.

#### *RLUs*

Relative light units (RLUs) were reported in one study (Wren, 2008). An RLU is a quantitative unit of measure that is used to express the amount of adenosine triphosphate (ATP), a molecule that is used as indicator for the presence of biological residues on surfaces. An overview of the calculated percentage reduction of RLUs is presented in Table 1.2. No t-tests could be performed due to lack of information on standard deviation.

#### *Other measures*

Hron (2019) measured the effectivity of the wipes by calculating the protein uptake (mg/mL) and the paraffin wax uptake (mg). They report that, when used in a dry state, the greige cotton 6.8 MJ/kg wipe removed the most protein and removed statistically significantly more protein than

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the 50% rayon/50% polyester single-use wipe. The polyester wipe, the greige cotton 8.9 MJ/kg wipe, the 80% polyester/20% greige cotton wipe, and the 80% rayon/20% greige cotton wipe had a significantly lower protein uptake compared to the single-use wipe when used in a dry state (data not shown). When used in a wet state, the polyester wipe, the greige cotton 6.8 MJ/kg wipe, the greige cotton 10.1 MJ/kg wipe, the 80% polyester/20% greige cotton wipe, and the 20% polyester/80% greige cotton wipe had significantly lower protein uptake when compared to the single-use wipe.

Regarding the paraffin wax experiment using dry wipes, Hron (2019) reported that the polyester wipe had a significantly lower paraffin wax uptake (mg) when compared to the single-use wipe. Furthermore, the greige cotton 6.8 MJ/kg wipe, the greige cotton 10.1 MJ/kg wipe, and the 20% polyester/80% greige cotton wipe had a significantly higher paraffin wax uptake when compared to the single-use wipe.

### Visual clean

Wiemken (2014) reported a visually clean outcome measure: compliance. The average compliance points for RTU wipes were: 10.6 (SD 1.3) versus the average for the bucket method: 8.1 (SD 2.4) (P=.017). This resulted in a statistically significant mean difference of 2.50 compliance points (95% CI 0.072 to 4.28) in favor of using RTU wipes.

**Tabel 1.1: Overview of the pooled percentage reduction of CFUs from test surfaces per included study**

Study	Test surface	Wet or dry		Microfiber cloth % mean difference (SD)	Other cleaning cloth % mean difference (SD)	p-value
<i>Diab-Elschahawi (2010)</i>	Ceramic tiles 5x5 cm	wet	n	8	8	
			% reduction	99.97	99.92	
		dry	n	8	8	
			% reduction	97.37	97.74	
<i>Traitman (2015)</i>	Ceramic tiles 2.2x2.2 cm	wet (desinfec tant)	n	6	6	
			% reduction	99.65	98.22	
<i>Wren (2008) - Microorganism in PBS alone</i>	New laminate high touch surface	wet (deionize d water)	n	9	9	
			% reduction	99.64 (0.50)	57.40 (43.11)	0.0096
	Old laminate high touch surface	wet (deionize d water)	n	9	9	
			% reduction	99.98 (1.27)	62.51 (27.85)	0.0011
	Steel tile	wet (deionize d water)	n	9	9	
			% reduction	99.27 (1.16)	71.02 (26.87)	0.0062
<i>Wren (2008) - Microorganism in PBS</i>	Smooth tile	wet (deionize d water)	n	18	18	

with 7% bovine serum albumin			% reduction	100.00 (0)	83.18 (13.95)	<0.0001
	Rough tile	wet (deionized water)	n	18	18	
			% reduction	99.85 (0.18)	88.31 (7.49)	<0.0001
	New laminate worktop	wet (deionized water)	n	18	18	
			% reduction	99.96 (0.10)	96.44 (5.44)	0.0097
	Steel tile	wet (deionized water)	n	18	18	
			% reduction	100.00 (0)	87.49 (7.39)	<0.0001

**Tabel 1.2: Overview of the pooled percentage reduction of RLUs from test surfaces per included study**

Study	Test surface	Wet or dry		Microfiber cloth % mean difference	Other cleaning cloth % mean difference
Wren (2008) - Microorganism in PBS alone	Laminated worktop	wet (deionized water)	n	9	9
			% reduction	96.59	69.46
	Steel tile	wet (deionized water)	n	9	9
			% reduction	98.39	79.74
	Smooth tile	wet (deionized water)	n	9	9
			% reduction	98.92	86.54
	Rough tile	wet (deionized water)	n	9	9
			% reduction	98.47	78.45
Wren (2008) - Microorganism in PBS with 7% bovine serum albumin	Laminated worktop	wet (deionized water)	n	9	9
			% reduction	93.78	87.14
	Steel tile	wet (deionized water)	n	9	9
			% reduction	94.90	82.65
	Smooth tile	wet (deionized water)	n	9	9
			% reduction	92.52	87.32

	Rough tile	wet (deionized water)	n	9	9
			% reduction	83.48	77.35

### Leven of evidence of the literature

The level of evidence regarding the outcome measure effectivity started at low and was downgraded to very low because of the number of included experiments (imprecision; -1).

### Conclusions

#### Effectivity

<b>Very low GRADE</b>	<p>The evidence is very uncertain about the effectivity of microfiber cloths in removing microorganisms compared to cotton cloths, general-purpose cloths, and conventional cloths.</p> <p>Sources: Diab-Elschahawi (2010), Hron (2019), Trajtman (2015), Wiemken (2014), Wren (2008)</p>
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#### Visual clean

<b>Very low GRADE</b>	<p>The evidence is very uncertain about the effectivity of microfiber cloths compared to ready to use wipes and conventional cloths on the outcome measure visual clean.</p> <p>Sources: Wiemken (2014)</p>
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### Referenties

Diab-Elschahawi M, Assadian O, Blacky A, Stadler M, Pernicka E, Berger J, Resch H, Koller W. Evaluation of the decontamination efficacy of new and reprocessed microfiber cleaning cloth compared with other commonly used cleaning cloths in the hospital. *Am J Infect Control*. 2010 May;38(4):289-92. doi: 10.1016/j.ajic.2009.09.006. Epub 2010 Jan 31. PMID: 20123151.

Hron RJ, Hinchliffe DJ, Mattison CP, Condon BD. The effect of cotton fiber inclusion on the hard surface cleaning capacity of nonwoven substrates. *Journal of Engineered Fibers and Fabrics*. January 2019. doi:10.1177/1558925019889620

Trajtman AN, Manickam K, Alfa MJ. Microfiber cloths reduce the transfer of *Clostridium difficile* spores to environmental surfaces compared with cotton cloths. *Am J Infect Control*. 2015 Jul 1;43(7):686-9. doi: 10.1016/j.ajic.2015.03.002. Epub 2015 Apr 20. PMID: 25907782.

Wiemken TL, Curran DR, Pacholski EB, Kelley RR, Abdelfattah RR, Carrico RM, Ramirez JA. The value of ready-to-use disinfectant wipes: compliance, employee time, and costs. *Am J Infect Control*. 2014 Mar;42(3):329-30. doi: 10.1016/j.ajic.2013.09.031. PMID: 24581022.

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Wren MW, Rollins MS, Jeanes A, Hall TJ, Coën PG, Gant VA. Removing bacteria from hospital surfaces: a laboratory comparison of ultramicrofibre and standard cloths. *J Hosp Infect.* 2008 Nov;70(3):265-71. doi: 10.1016/j.jhin.2008.07.017. PMID: 18801594.

## Evidence-tabellen

### Evidence table for intervention studies (randomized controlled trials and non-randomized observational studies [cohort studies, case-control studies, case series])

Study reference	Study characteristics	Patient characteristics	Intervention (I)	Comparison / control (C)	Outcome measures and effect size	Comments
Diab-Elsch ahawi (2010)	<p><u>Type of study:</u> experiment</p> <p><u>Funding and conflicts of interest:</u> "Supported by the research fund of the Division of Hospital Hygiene, Medical University of Vienna."</p>	<p><u>Test surface/area:</u> Standardized ceramic tiles measuring 5x5 cm</p> <p><u>Microorganism:</u> Staphylococcus aureus (ATCC 6538) and Escherichia coli (ATCC 8739), 5x10<sup>7</sup> colony-forming units (CFU) per ml, 0.1 ml per tile; left to dry for 1 hour</p>	<p><u>Describe intervention (treatment/procedure/test):</u></p> <p>Cleaning with 5x5 cm microfiber cleaning cloth, cotton cloth, sponge cloth</p> <p>Wiping: meander-like pattern, starting left upper corner, turning 4 times, ending right lower corner</p> <p>Dry and wet (with distilled water)</p> <p>Microfiber cloths, cotton cloths, and sponge cloths were reprocessed in a washer disinfectant and a laundry dryer (90°C for 5 minutes) up to 20 times</p>	<p><u>Describe control (treatment/procedure/test):</u></p> <p>Cleaning with disposable paper towels</p> <p>Wiping: meander-like pattern, starting left upper corner, turning 4 times, ending right lower corner</p> <p>Dry and wet (with distilled water)</p>	<p><u>Outcome measures and effect size (include 95%CI and p-value if available):</u></p> <p>CFUs: microbial load from a surface / decontamination: tested by shaking the tiles in a petri dish with glass pearls, and then incubated on agar.</p> <p>New microfiber better than new cotton (P=.0012; regression coefficient = 1.0766), new sponge (P=.001; regression coefficient = 1.0971), and disposable paper towels (P=.0001; regression coefficient = 1.5455).</p> <p>After processing, no difference between main effect of cloths. Cotton cloths better than microfiber cloths (S. aureus P=.0334; regression coefficient = 20.4332; E coli P=.0014; regression coefficient = 20.7847). Sponge better than microfiber (S. aureus P=.0263; regression Coefficient = 20.4531).</p>	<p>Conclusions: decontamination capacity higher when used wet versus dry (for all cloths)</p> <p>No difference in decontamination efficacy between cloths.</p>

Hron (2019)	Type of study: experiment	Test surface/area: Stainless steel plate	Describe intervention (treatment/procedure/test): Cleaning with 10 in-house nonwoven fabrics (energy of hydroentanglement 4.8 MJ/kg): 2. 100% rayon 3. 100% polyester 4. 100% greige cotton (6.8 MJ/kg) 5. 100% greige cotton (8.9 MJ/kg) 6. 100% greige cotton (10.1 MJ/kg) 7. 100% greige cotton scoured and bleached 8. 80% polyester/20% greige cotton 9. 20% polyester/80% greige cotton 10. 80% rayon/20% greige cotton 11. 20% rayon/80% greige cotton Protein contaminant: Dry and wet (1 mL of ultrapure water) Wiping: by machine, 16 movements, 71.3r/min, 9 kPa Hydrophobic residue: Dry	Describe control (treatment/procedure/test): Cleaning with 1. single use wipes (50% rayon/50% polyester) Protein contaminant: Dry and wet (1 mL of ultrapure water) Wiping: by machine, 16 movements, 71.3r/min, 9 kPa Hydrophobic residue: Dry Wiping: by machine, 16 movements, 71.3r/min, 12 kPa	Outcome measures and effect size (include 95%CI and p-value if available): Protein contamination: After wiping, wipes were put in saline and incubated. Then they performed protein analysis. Dry wipes Wipes 3, 5, 8, and 10 had significantly lower protein (mg/ml) uptake, compared to wipe 1 (single use wipes). Wipe 4 had significantly higher protein (mg/ml) uptake, compared to wipe 1. Wet wipes Wipes 3, 4, 6, 8, and 9 had significantly lower protein (mg/ml) uptake, compared to wipe 1 (single use wipes). Hydrophobic residue: Removal of wax was measured by placing the sample on a scale Dry wipes Wipe 3 had significantly lower paraffin (mg) uptake, compared to wipe 1. Wipes 4, 6, and 9 had significantly higher paraffin (mg) uptake, compared to wipe 1.	No numbers are given. Only descriptions of results and boxplots.
	<p><u>Funding and conflicts of interest:</u> "The author(s) received no financial support for the research, authorship, and/or publication of this article."</p>	<p><u>Microorganism:</u> 2 experiments: - protein contaminant: 500 µl of 5% fetal bovine serum in phosphate buffered saline, left to dry overnight - hydrophobic residue: paraffin wax bead 50 ± 2 mg, melted and dried for 30 min</p>				

			Wiping: by machine, 16 movements, 71.3r/min, 12 kPa			
Trajtman (2015)	<p><u>Type of study:</u> experiment</p> <p><u>Funding and conflicts of interest:</u> none to report</p>	<p><u>Test surface/area:</u></p> <p>On ceramic tiles (2.2x2.2 cm)</p> <p>On microfiber cloths</p> <p>On cotton cloths</p> <p><u>Microorganism:</u></p> <p>Clostridium difficile 765, 2.3x10<sup>6</sup> spores/mL; 100 mL/site to provide 2.3x10<sup>4</sup> spores/site (CFUs), dried overnight</p>	<p><u>Describe intervention (treatment/procedure/test):</u></p> <p>Cleaning with microfiber cloths (16 cm<sup>2</sup>)</p> <p>Wiping: done by machine: 1.5-1.77 N and 10 rotations</p> <p>Before assessing the outcome, tiles were sprayed with either phosphate buffer saline (PBS) or with a hydrogen peroxide 0.01% cleaning agent.</p>	<p><u>Describe control (treatment/procedure/test):</u></p> <p>Cleaning with cotton cloths (16 cm<sup>2</sup>)</p> <p>Wiping: done by machine: 1.5-1.77 N and 10 rotations</p> <p>Before assessing the outcome, tiles were sprayed with either phosphate buffer saline (PBS) or with a hydrogen peroxide 0.01% cleaning agent.</p>	<p><u>Outcome measures and effect size (include 95%CI and p-value if available):</u></p> <p>CFUs: tiles and wipes were placed in liquid, this was then incubated on agar. CFUs were counted, and expressed as log<sup>10</sup> (cfu/cm<sup>2</sup>)</p> <p>Cotton cloths transfer significantly more spores than microfiber cloths between wet ceramic surfaces regardless of using a detergent (P = .0261 and P = .0001).</p>	Trajtman used cleaning agents in the study with the purpose of disinfecting, leading to somewhat indirect results. However, due to the small contribution of the study to the final results, it was decided downgrading is not needed.
Wieken (2014)	<p><u>Type of study:</u> experiment</p> <p><u>Funding and conflicts of interest:</u> "Supported by Clorox Healthcare, which did not play a role in data collection,</p>	<p><u>Test surface/area:</u></p> <p>6 pre-specified areas in a patient room</p> <p><u>Microorganism:</u></p> <p>Fluorescent marker</p>	<p><u>Describe intervention (treatment/procedure/test):</u></p> <p>Cleaning with towel and bucket with sodium hypochlorite cleaner/disinfectant solutions</p> <p>Wiping: by randomized participant</p>	<p><u>Describe control (treatment/procedure/test):</u></p> <p>Cleaning with ready-to-use (RTU) wipes with sodium hypochlorite cleaner/disinfectant solutions</p>	<p><u>Outcome measures and effect size (include 95%CI and p-value if available):</u></p> <p>Compliance: residual fluorescent marker viewable under an ultraviolet light (0 point = complete miss of area; 1 point = partial miss; 2 points = completely removing fluorescent marker). A total of 12 points could be rewarded.</p> <p>Mean (SD) compliance, RTU versus bucket</p> <p>Sink countertop 1.8 (0.67) 1.1 (0.78)</p> <p>Bedside table 1.9 (0.33) 1.8 (0.44)</p>	

	<p>analysis, writing, or critical review of the study data or manuscript.</p> <p>Conflicts of interest: None to report.”</p>				<p>In-room dresser 2 (0)1.3 (0.71)</p> <p>Medicine cabinet 1.8 (0.67)1.6 (0.73)</p> <p>Wall-mounted cabinet 1.9 (0.33)1.3 (0.87)</p> <p>Toilet 1.2 (0.97)1 (0.87)</p> <p>Average compliance points:</p> <p>RTU: 10.6 (SD 1.3)</p> <p>Bucket 8.1 (SD 2.4)</p> <p>P =.017</p> <p>Time of cleaning and disinfecting:</p> <p>RTU: 178.1 seconds (SD 98.2)</p> <p>Bucket: 230.9 seconds (SD 96.0)</p> <p>P=0.003</p> <p>Time-related cost savings for using RTU wipes: (15 rooms per day, 20 min per room, \$10 per hour): \$38.58 (95%CI: \$34.07-\$41.08) per employee per day</p>	
Wren (2008)	<p>Type of study: experiment</p> <p>Funding and conflicts of interest:</p>	<p>Test surface/area:</p> <p>100 cm<sup>2</sup> of:</p> <ul style="list-style-type: none"> <li>- a rough tile</li> <li>- a smooth tile</li> <li>- laminated worktops (new and worn (aged &gt;10 years, taken from a ward in the closed Middlesex Hospital, London)</li> <li>- stainless steel surfaces</li> </ul>	<p>Describe intervention (treatment/procedure/test):</p> <p>Cleaning with ultramicrofibre (UMF)-woven cloths (80% polyamide/ 20% polyester fibre)</p> <p>Wet: deionized water</p> <p>Wiping: as prescribed by manufacturer.</p>	<p>Describe control (treatment/procedure/test):</p> <p>Cleaning with conventional cloths (JC)</p> <p>Wet: deionized water</p> <p>Wiping: as prescribed by manufacturer.</p>	<p>Outcome measures and effect size (include 95%CI and p-value if available):</p> <p>CFUs: contact plates on areas were incubated</p> <p>RLUs: by ATP swabbing of surface</p> <p>Laminated worktop (new): CFUs</p> <p>In 28 of 36 experiments, ultra-microfiber cloths were able to completely remove all bacteria of bacterial spores (MRSA, ACCB, K. oxytoca, and C. difficile) from surfaces (new and old laminated surfaces, and steel tiles). Whereas conventional cloths were only able to remove all bacteria of</p>	

		<p><u>Microorganism:</u></p> <ul style="list-style-type: none"> <li>- meticillin-resistant Staphylococcus aureus (MRSA)</li> <li>- Acinetobacter calcoaceticus var. baumannii (ACCB)</li> <li>- Klebsiella oxytoca (K. oxytoca) in logarithmic phase growth</li> <li>- spores of Clostridium difficile</li> </ul> <p>All in PBS, 100 ul on area, dried for 2 hours</p>			<p>bacterial spores in two of 36 experiments. When bacteria (MRSA, ACCB, and K. oxytoca) were suspended in 7% bovine serum albumin, ultra-microfiber cloths were able to completely remove all bacteria 20 of 24 experiments, and conventional cloths were not able to remove all bacteria from surfaces (smooth tile, rough tile, new laminated worktop, steel tile)</p>	
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## Exclusietabel

Reference	Reason for exclusion
Cobbett CV. Are current cleaning methods effective against hazardous drugs?  J. Vasc. Access. 2020. NP49 - NP50. DOI: 10.1177/1129729820953.	Wrong type of publication (conference abstract)
DeJonge PM, Martin E, Hashikawa AN. Environmental Cleaning Strategies Used by Child Care Centers During Illness Outbreaks. Pediatrics, 2018; 142(1_MeetingAbstract), 784-784.	Wrong type of publication (conference abstract)
Lalla F, Dingle P, Cheong C. The antibacterial action of cloths and sanitizers and the use of environmental alternatives in food industries. J Environ Health. 2005 Dec;68(5):31-5. PMID: 16392629.	Wrong setting (the food industry)
Egert M, Späth K, Weik K, Kunzelmann H, Horn C, Kohl M, Blessing F. Bacteria on smartphone touchscreens in a German university setting and evaluation of two popular cleaning methods using commercially available cleaning products. Folia Microbiol (Praha). 2015 Mar;60(2):159-64. doi: 10.1007/s12223-014-0350-2. Epub 2014 Oct 11. PMID: 25305112.	About cleaning smartphones, not cleaning of surfaces/areas
Berendt AE, Turnbull L, Spady D, Rennie R, Forgie SE. Three swipes and you're out: how many swipes are needed to decontaminate plastic with disposable wipes? Am J Infect Control. 2011 Jun;39(5):442-443. doi: 10.1016/j.ajic.2010.08.014. Epub 2011 Feb 9. PMID: 21306797.	About cleaning plastics, not cleaning surfaces/areas
Bergen LK, Meyer M, Høg M, Rubenhagen B, Andersen LP. Spread of bacteria on surfaces when cleaning with microfibre cloths. J Hosp Infect. 2009 Feb;71(2):132-7. doi: 10.1016/j.jhin.2008.10.025. Epub 2008 Dec 23. PMID: 19108933.	No comparison
Dramowski A, Aucamp M, Bekker A, Pillay S, Moloto K, Whitelaw AC, Cotton MF, Coffin S. NeoCLEAN: a multimodal strategy to enhance environmental cleaning in a resource-limited neonatal unit. Antimicrob Resist Infect Control. 2021 Feb 12;10(1):35. doi: 10.1186/s13756-021-00905-y. PMID: 33579364; PMCID: PMC7881651.	About cleaning routines

Isiyel E, Soydan S. Comparison Of Two Cleaning Methods Intaking Urine Culture Samples In Children. Flora. 2019, 107 - 112 DOI: 10.5578/flora.67606	Article in Turkish
Robertson A, Barrell M, Maillard JY. Combining detergent/disinfectant with microfibre material provides a better control of microbial contaminants on surfaces than the use of water alone. J Hosp Infect. 2019 Sep;103(1):e101-e104. doi: 10.1016/j.jhin.2019.05.005. Epub 2019 May 18. PMID: 31112729.	Wrong comparison
Soubieux A, Palamini M, Tanguay C, Bussi�eres JF. Evaluation of decontamination strategies for cyclophosphamide. J Oncol Pharm Pract. 2020 Mar;26(2):413-422. doi: 10.1177/1078155219865931. Epub 2019 Aug 1. PMID: 31370747.	About effectivity of wipes for cyclophosphamide removal
Tojo K, Nakamura K, Sato E, Hayami S, Fujii M, Miyaji K. Effectiveness of microfiber cleaning cloth used for medical equipment. Ther. Res. 2013; 399-407.	Article in Japanese
Moore G, Griffith C. A laboratory evaluation of the decontamination properties of microfibre cloths. J Hosp Infect. 2006 Dec;64(4):379-85. doi: 10.1016/j.jhin.2006.08.006. Epub 2006 Oct 19. PMID: 17055112.	Unclear which cloths were compared

#### Risk of bias-tabel

Author, year	Selection of participants	Exposure	Outcome of interest	Confounding-assessment	Confounding-analysis	Assessment of outcome	Follow up	Co-interventions	Overall Risk of bias
	Was selection of exposed and non-exposed cohorts drawn from the same population?	Can we be confident in the assessment of exposure?	Can we be confident that the outcome of interest was not present at start of study?	Can we be confident in the assessment of confounding factors?	Did the study match exposed and unexposed for all variables that are associated with the outcome of interest or did the statistical analysis adjust for	Can we be confident in the assessment of outcome?	Was the follow up of cohorts adequate? In particular, was outcome data complete or imputed?	Were co-interventions similar between groups?	

					these confounding variables?				
	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Low, Some concerns, High
Diab-Elshahawi (2010)	Definitely yes Reason: similar test areas were used for intervention and control.	Definitely yes Reason: Microorganisms were applied similar on all test areas.	Definitely yes Reason: similar quantities of microorganism were applied on test areas.	Definitely yes Reason: wiping was performed similar in all experiments.	Not applicable	Definitely yes Reason: quantitative outcome measures were used.	Not applicable	Not applicable	Low
Hron (2019)	Definitely yes Reason: similar test areas were used for intervention and control.	Definitely yes Reason: Microorganisms and hydrophobic residue were applied similar on all test areas.	Definitely yes Reason: similar quantities of microorganism and hydrophobic residue were applied on test areas.	Definitely yes Reason: wiping was performed similar in all experiments.	Not applicable	Definitely yes Reason: quantitative outcome measures were used.	Not applicable	Not applicable	Low
Trajtman (2015)	Definitely yes Reason: similar test areas were used for	Definitely yes Reason: Microorganisms were applied	Definitely yes Reason: similar quantities of microorganism	Definitely yes Reason: wiping was performed	Not applicable	Definitely yes Reason: quantitative outcome	Not applicable	Not applicable	Low

	intervention and control.	similar on all test areas.	nism were applied on test areas.	similar in all experiments.		measurements were used.			
Wiemken (2014)	<i>Definitely yes</i> Reason: similar test areas were used for intervention and control.	<i>Definitely yes</i> Reason: Microorganisms were applied similar on all test areas.	<i>Definitely yes</i> Reason: similar quantities of microorganisms were applied on test areas.	<i>Definitely yes</i> Reason: wiping was performed similar in all experiments.	<i>Not applicable</i>	<i>Definitely yes</i> Reason: quantitative outcome measurements were used.	<i>Not applicable</i>	<i>Not applicable</i>	<b>Low</b>
Wren (2008)	<i>Definitely yes</i> Reason: similar test areas were used for intervention and control.	<i>Definitely yes</i> Reason: Microorganisms were applied similar on all test areas.	<i>Definitely yes</i> Reason: similar quantities of microorganisms were applied on test areas.	<i>Definitely yes</i> Reason: wiping was performed similar in all experiments.	<i>Not applicable</i>	<i>Definitely yes</i> Reason: quantitative outcome measurements were used.	<i>Not applicable</i>	<i>Not applicable</i>	<b>Low</b>