

**Table 1.** World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), Public Health Ontario (PHO), and Proposed Hand Hygiene Practice Recommendations

WHO Five Moments for Hand Hygiene	CDC HICPAC Recommendations for Hand Hygiene in Healthcare Settings	PHO Your Four Moments for Hand Hygiene	Proposed Revisions
Before touching a patient	Immediately before touching a patient	Before initial patient or patient environment contact	Before patient or patient environment contact, including entering the patient's care area
Before clean/aseptic procedure	Before performing an aseptic task or handling invasive medical devices	Before aseptic procedure	Before clean or aseptic procedure and donning gloves
After body fluid exposure risk	Before moving from work on a soiled body site to a clean body site on the same patient	After body fluid exposure risk	After body fluid exposure risk and doffing gloves
After touching a patient	After touching a patient or the patient's immediate environment	After patient or patient environment contact	After patient or patient environment contact, including exiting the patient's care area
After touching patient surroundings	After contact with blood, body fluids, or contaminated surfaces		
	Immediately after glove removal		

infections. Additional benefits, such as improved patient satisfaction or perception, and alignment with existing auditing programs, may also result.

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## In vitro comparison of 3 different brushes for manual cleaning of endoscopes

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*To the Editor*—Flexible endoscopes may become heavily contaminated with blood, secretions, and microorganisms during use. Over the last several years an increasing number of cases have been

reported in which patients have been exposed to infectious microorganisms by contaminated gastrointestinal (GI) endoscopes.<sup>1</sup>

The complete and accurate reprocessing of flexible endoscopes is a multistep procedure involving manual cleaning followed by high-level disinfection (HLD) and active drying before storage.<sup>2</sup> Because almost all reported outbreaks are related to breaches in reprocessing techniques, it is crucial that endoscope cleaning, disinfection, and drying are performed according to a strict protocol.

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**Table 1.** Mean ATP Results and Culture Yield After Different Brushing Techniques Performed on an Endoscope Model<sup>a</sup>

Variable	Type of Brush			Controls		
	PULL TRHU	Push&Pull	DCB	Negative	Positive <sup>b</sup>	Positive <sup>c</sup>
Mean ATP value (RLU) ( $\pm$ SD) (range)	13.9 ( $\pm$ 13.7) (0–30)	1.0 ( $\pm$ 0.6) (0.5–2)	80.3 ( $\pm$ 89.9) (20–233)	0 (0–0)	3,274 (758–6,395)	65 (35–82)
Mean yield of culture (CFU/100 mL) ( $\pm$ SD) (range)	1.4 ( $\pm$ 1.7) (0–4)	0.6 ( $\pm$ 1.3) (0–3)	2 ( $\pm$ 1) (1–3)	0	175	12
Correlation coefficient (rs) and <i>P</i> value <sup>d</sup>	–0.872 ( <i>P</i> = .054)	–0.559 ( <i>P</i> = .327)	0.632 ( <i>P</i> = .252)	NA	NA	NA
Log10 reduction of ATP due to brushing ( $\pm$ SD) <sup>e</sup>	–2.75 ( $\pm$ 0.71)	–3.58 ( $\pm$ 0.23)	–1.81 ( $\pm$ 0.71)	NA	NA	NA
Recovery (%) CFU/100 mL relative to positive control	0.8	0.3	1.1	NA	NA	NA

Note. RLU, relative light units; SD, standard deviation; NA, not applicable.

<sup>a</sup>In a pairwise comparison of the ATP values (Kruskall-Wallis test *P* < .05 was considered statistically significant) only the difference between the Push&Pull and DCB subgroups was retained as statistically significant (*P* = .009).

<sup>b</sup>Two positive control tubes were not submerged in the water and not brushed.

<sup>c</sup>Two positive control tubes were submerged in water and flushed with water but not brushed.

<sup>d</sup>Correlation between mean ATP value and mean yield of culture (Spearman correlation coefficient)

<sup>e</sup>Log10 reduction of ATP caused by brushing was calculated as log10 reduction of mean ATP value of the brushed PTFE tubes to the positive controls not flushed with water and not brushed.

Manual cleaning is a critical reprocessing step, removing >99% of the bioburden from the endoscope prior to automated reprocessing.<sup>3</sup> Several different types of brushes are used as an essential accessory to routine manual cleaning, but very little is known about the differences in the performance of these brushes. Therefore, we compared the performance of different brushes widely used for manual cleaning of flexible endoscopes: (1) a PULL THRU brush (Medivators, Minneapolis, MN), (2) Push&Pull brush (with sweeper) (Endoss, The Netherlands), and (3) a double-cleaning brush (DCB; Nova LightSystems, France).

For the endoscope model, we used new polytetrafluoroethylene (PTFE) tubes soiled with a pool of 4 positive hemocultures. The method was based on the method described by Cattoir et al,<sup>4</sup> and detailed method description can be found in the Supplementary Material (online). Mean adenosine triphosphate (ATP) values and mean culture yield after 7 days (colony-forming units [CFU]/100 mL) obtained after using different brushing techniques on soiled PTFE tubes are presented in Table 1. To our knowledge, this is the first study to compare the effectiveness of different types of brushes in manual cleaning of surrogate endoscope channels by means of microbiological culture and ATP values.

Our *in vitro* experiments revealed that, for soiled PTFE tubes, ATP values of samples cleaned with the Push&Pull brush were significantly lower than those cleaned with the DCB and lower (but not significantly) than those cleaned with a PULL THRU brush. A literature search showed that there is no confirmed threshold for ATP value, so difficulties remain in interpreting this parameter.

There was no correlation between ATP measurements and culture results (Table 1). This result corresponds to the findings of Batailler et al,<sup>5</sup> who concluded that ATP cannot be used as an alternative to microbiological tests for monitoring endoscope reprocessing. The Aquasnap Total test (Hygiena, Camarillo, CA) detects ATP from bacteria in addition to all other biological sources (organic residues) of ATP. Because CFU and relative light unit (RLU) values are determined using different test methods and measure different substances, we expect that RLU values do not consistently correlate with CFUs.

Culture results showed that mean yield from soiled PTFE tubes was lowest when the tube was cleaned with the Push&Pull brush.

However, differences in mean CFU count did not reach statistical significance. The difference in CFU count can be presumed to not be clinically relevant either. Recovery in CFU/100 mL was calculated from the mean yield per brush type relative to the positive control, which did not undergo any reprocessing. These results are consistent with previous findings in literature that manual cleaning removes >99% of the bioburden from the endoscope.<sup>3</sup> Our study confirms the paramount importance of manual cleaning.

A fourth type of brush is a simple brush (Olympus). The design of the simple brush is basically a half DCB (with the brush part only on 1 side). Because the DCB had already showed inferior results to the 2 other brushes, we did not think it would be useful to include these in a further comparison.

In 2007, Charlton also compared the cleaning efficacy of different brushes. Efficacy was tested by applying a simulated blood soil to a lumen and comparing the weight difference before and after cleaning. In contrast to our study, which examined microbiological growth, Charlton concluded that the PULL THRU device was found to offer a consistently significant improvement in soil removal.<sup>6</sup> He hypothesized this is because the wiper element design of the PULL THRU device provides a complete circumferential seal in the lumen channel.<sup>6</sup>

In Belgium, the authorities have issued guidelines for endoscope reprocessing.<sup>2</sup> The guidelines state that the brushes used for manual cleaning are preferably single use, without other specifications. The European guidelines recommend brushing of all accessible channels using flexible, purpose-designed brushes. The size and type of cleaning brush must be matched appropriately to the size and type of endoscope channels to ensure contact with channel walls. In our study, PTFE tubes close to the actual size of endoscope channels were used. To ensure maximum effectiveness of cleaning and to avoid tissue carryover, the European Society of Gastrointestinal Endoscopy (ESGE) and the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) recommend the use of single-use brushes because they have undamaged bristles without any tissue remnants from previous examinations.<sup>7</sup> In the United States, the guidelines state to flush and brush all accessible channels with a brush appropriate for the size of the endoscope channel to remove all organic (eg, blood, tissue)

and other residues. They also recommend that cleaning items should be disposable or thoroughly cleaned and disinfected or sterilized between uses.<sup>8</sup>

This study has several limitations. Our manually soiled PTFE tubes did not contain a biofilm in the sense of Michelle Alfa's definition.<sup>9</sup> The "buildup biofilm" in endoscopes develops as a result of cyclical exposure to wet and dry phases during use and reprocessing. Because certain cleaning devices may compound the accretion of residual soil by causing surface abrasion or grooving of the lumen wall, additional research to address this issue could yield helpful insights.<sup>7</sup> Furthermore, the conclusion of our study is not necessarily generalizable for several reasons. Experiments were only performed at a single hospital site by 1 person, and only endoscope models were used. A future larger study could include different types of endoscopes from different manufacturers in a real-life hospital setting.

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## Evaluation of *Escherichia coli* resistance to fluoroquinolones in men undergoing prostate procedures: Is it time to change preoperative prophylaxis?

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*To the Editor*—Urinary tract infections and prostatitis account for most postoperative infectious complications following prostate procedures, by direct inoculation of bacteria from skin or rectal mucosa into the prostate or urinary tract. *Escherichia coli* is the most common pathogen in 75%–90% of cases.<sup>1</sup> Rates of sepsis from a urinary source are also rising, which may be secondary to increasing prevalence of antibiotic resistant uropathogens.<sup>2</sup> Although the mechanisms leading to antibiotic resistance are complex, inappropriate utilization of antibiotics, particularly fluoroquinolones (FQs), has been shown to correlate with postprocedural infection risk due to ease of bacterial acquisition of resistance

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gene mutations.<sup>3</sup> The Infectious Diseases Society of America (IDSA) now recommends avoiding empiric FQ use in genitourinary infections unless regional antibiogram data shows <20% FQ resistance to *E. coli*.

Previous studies have demonstrated an increasing prevalence of FQ-resistant *E. coli* in the rectal vault of men undergoing transrectal ultrasound-guided prostate biopsy (TRUS-PBx).<sup>4</sup> Despite these trends, the most current American Urological Association (AUA) best-practice statement, last amended in 2014, still recommends FQs as primary antimicrobial agents for preoperative prophylaxis for TRUS-PBx and transurethral procedures.<sup>5</sup>

Fluoroquinolone resistance to *E. coli* has reached 50% in some regions of the United States.<sup>6</sup> As of 2018, our institution had been using ciprofloxacin preoperatively due to a lack of data supporting alternative agents. Our institution-wide antibiogram reports ~30% FQ resistance to *E. coli*, but we were unsure of the generalizability to men undergoing prostate procedures. We aimed to evaluate FQ