

## **Reviewer's report**

**Title:** EVOTECH(R) Endoscope Cleaner and Reprocessor (ECR):  
Simultated-use and Clinical-use Evaluation of Cleaning Efficacy

**Version:** 1 **Date:** 7 January 2010

**Reviewer:** Lawrence Muscarella

### **Reviewer's report:**

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Initial comments:

1. This study of the effectiveness of the EVOTECH Endoscope Cleaner and Reprocessor (ECR), an automated reprocessing device referred to herein as the "Evotech," is timely and presents important data. This study's results suggest, for example, that the Evotech can clean the narrow elevator-wire channel of the side-viewing duodenoscope, an otherwise challenging endoscope and channel to reprocess. According to this manuscript, the Evotech achieves greater than a 4 log reduction of bioburden inside this narrow channel. These data would suggest a potential advancement in endoscope reprocessing.
2. This manuscript's methodology and focus are similar in many regards to a published article written by three of this manuscript's four authors (see this manuscript's reference #21: Alfa MJ, Olson N, DeGagne P. Automated washing with the Reliance Endoscope Processing System and its equivalence to optimal manual cleaning. Am J Infect Control. 2006 Nov;34(9):561-70). Therefore, this article published in 2006 was reviewed, as were several other published studies, to provide clarity and insight into the methodology, results, and conclusions of this current manuscript.

Discretionary revisions:

1. The authors might want to note that the Evotech has not merely "received FDA clearance for cleaning claims," but, rather, that the Evotech has received FDA clearance for the replacement of manual cleaning prior to automated high-level disinfection.
2. For the reader's clarity, please have the authors define and discriminate between their use of the terms: "bedside flushing" and "manual cleaning."
3. Please have the authors clarify for the reader that their term "harvesting" refers to the sampling or culturing of the endoscope's potentially-soiled surfaces and channels.

4. Please have the authors explain why the data showing validation of the harvesting method, which demonstrated a recovery of at least 95% “of the organic and bioburden” in the first round of harvesting (therefore not requiring additional sampling), are not included in the manuscript.

5. Note that the reference on p. 16 – “Alfa 2008” – should read “Alfa et al., 2006.”

6a. The authors may choose to revise the first sentence of the “discussion” section. In truth, the Evotech was originally cleared in 2005 requiring that endoscopes “be manually cleaned prior to placement in the EvoTech System.” A second and third 510(k) clearance were received for this device by its manufacturer in 2006 and 2008, respectively; these two latter clearances include the claim that manual cleaning of medical devices (endoscopes) is not required prior to their placement in and automated reprocessing by the EvoTech (when selecting those cycles that contain a wash stage).

6b. The authors may also consider clarifying for the reader that most currently marketed automated reprocessors, like the Evotech, are cleared for “cleaning” endoscopes. But, unlike that of the Evotech, the labeling of these other automated reprocessors (including the one manufactured by this reviewer’s employer) still require manual cleaning, including brushing of the endoscope’s working channel, prior to automated reprocessing.

7. This manuscript discusses biofilms. So as to avoid confusion, the authors are requested to note in this manuscript that, to date, no published studies have linked the embedded microorganisms of a biofilm, which might have formed or developed on the internal surfaces and channels of a flexible endoscope over time, to any cases of disease transmission, provided the endoscope was reprocessed, either manually or using an automated endoscope reprocessor (such as the Evotech device), in accordance with published guidelines.

8. Please have the authors explain the rationale for manually cleaning and high-level disinfecting the patient-used endoscopes after they had been already processed in the Evotech (which is 510[k]-cleared with labeling that does not require manual cleaning). Was this the facility’s “routine” process?

9. This manuscript states that: “The Evotech ECR cleaning for endoscope surfaces and channels is superior to optimal manual cleaning.” Similarly, three of the four authors of this manuscript previously wrote (see: Alfa et al. [2006]) that: “The efficacy of the (Steris) Reliance EPS washing phase for flexible endoscopes was equivalent to optimal manual cleaning for all the makes and models of flexible endoscopes tested.”

Having written about the cleaning effectiveness of both the Steris Reliance EPS and the Evotech ECR, the authors are asked to consider briefly discussing and comparing in the manuscript the cleaning effectiveness of these two competing devices (and of any other automated reprocessors for which there are data suggesting that the device’s automated cleaning cycle is comparable, if not superior, to manual cleaning). For example, might one be expected to be more

effective than the other?

Minor essential revisions:

1. Please have the authors clarify for the reader clarify whether the Evotech can only be used with Cidezyme-GI detergent, or whether another type of detergent can also be used by the Evotech. If the latter, please clarify whether this manuscript's results would apply only to the use of Cidezyme-GI detergent.

2. Please also clarify whether the Evotech can operate at a water temperature that is below 35o C. If it can, would similar cleaning results be expected if water used by the Evotech were at a lower temperature?

3. Please have the authors clarify in the manuscript whether this study's evaluation of the Evotech's automated cleaning phase was performed (as typically required by the FDA) under "worst-case" controlled conditions. If true, please list each of the relevant worst-case conditions.

4a. The validity of the values of the cleaning "benchmarks" (e.g., < 1.8 micrograms/cm<sup>2</sup>) presented in and used during this study is not clearly explained in this manuscript. Please clarify from where the values for these "benchmarks" originate.

4b. Please clarify that the indicated benchmarks for cleaning effectiveness are the amounts that remain on the endoscope's surfaces after cleaning.

5. For this study's "phase 1" testing, please clarify for the reader the amount of time that elapsed between the clinical use of the endoscopes during non-emergency procedures and their placement in and reprocessing by the Evotech ECR.

6. Please clarify which GI endoscopes (double-channel colonoscopes? ultrasound GI endoscopes?) and other types and models of flexible endoscopes are contraindicated for processing in the Evotech device. Due to the potential for injury to patients with a history of bladder cancer, the use of ortho-phthalaldehyde (a use dilution of 0.55% or more) is contraindicated for reprocessing cystoscopes.

7. The authors describe the use of a patented organic challenge (U.S. Patent # 6,447,990; "Artificial test soil"; date: September 10, 2002; Inventor: Alfa MJ). Please have the authors disclose in this manuscript's relevant section (e.g., the competing interest section) that one of this study's authors (MJ Alfa) owns this patent. The editor of this journal may also elect to have this patent listed in this manuscript's reference section.

8. The authors conclude that "not all AER cleaning cycles are equivalent." Please have the authors cite at least one study to substantiate the validity of this conclusion, having compared and evaluated the cleaning effectiveness of two or more automated endoscope reprocessors.

Major compulsory revisions:

1. The manuscript states that in 2007 the ASGE and SGNA sent out an alert to users regarding the Evotech. As acknowledged in this alert and this manuscript, these two organizations expressed concern about the Evotech's labeling, which does not require manual cleaning of the endoscope prior to automated reprocessing. This manuscript notes that its data are the first to address these organizations' concern that "no independent confirmatory data are currently available to show that automated reproprocessors are able to provide cleaning of endoscopes that is comparable to that of manual washing and brushing."

Whether this manuscript's data prove to be an example of the "confirmatory data" that ASGE and SGNA have sought remains to be determined. But, the authors are asked to clarify in the manuscript whether in every clinical circumstance, including worst-case clinical conditions, the Evotech is effective and does not require manually washing and brushing the endoscope before placement in the Evotech.

Which is to ask, for the sake of the reader's correct understanding, that the authors clarify whether the results of this study indicate that no manual cleaning would be necessary if, for example, a side-viewing duodenoscope with an elevator-wire channel and both a suction and an air/water valve were to have been used during an "emergency procedure" in the early morning hours and remained soiled and un-cleaned for several hours or a day or two prior to its processing in the Evotech.

2. The authors used vegetative bacteria, in part, to evaluate "cleanliness," although this manuscript's data show that *Pseudomonas aeruginosa* was "affected by exposure to the enzymatic detergent and the net effect was a 1.6 Log<sub>10</sub> reduction in viability." Moreover, Alfa et al. (2006) wrote: "If the detergent being evaluated kills the vegetative test organism, then use of spores would be warranted." Please have the authors explain why they used vegetative bacteria, in lieu of more rigorous bacterial endospores (which are often used as "indicators" to evaluate cleaning effectiveness), to evaluate cleaning effectiveness of the Evotech during this manuscript's simulated in-use testing.

3. Three of this manuscript's four authors published a study in 2006 (see: Alfa et al., 2006) that similarly evaluated the cleaning effectiveness of another automated reproprocessor, the Steris Reliance EPS. As these authors discuss in this paper from 2006, the Steris Reliance EPS (which competes in the marketplace with the Evotech) uses a "control handle boot." According to these authors, the Steris Reliance EPS's use of this "boot" provides for the use of "a minimal number of connections to the endoscope channels," a technology that these authors conclude is "much less prone to connection errors than the traditional process of using only tubing connectors to attach specific ports/openings on the (endo)scope to an AER." These authors add that: "This new technology (this boot) virtually eliminates the possibility of user error when connecting the flexible endoscope to the Reliance EPS."

The Evotech is one of these “traditional processes” that would, therefore, presumably be prone to user error and a potential increase in the risk of disease transmission. As detailed in this manuscript under review, the authors write that the Evotech “uses direct channel connection” to deliver flow to each of the endoscope’s internal channels (in lieu of this aforementioned “boot” technology). Please have the authors comment, first, on the Evotech’s use of multiple channel connectors to deliver flow, which Alfa et al. (2006) appear to consider a potentially significant disadvantage; and, second, on how the Evotech’s design might compensate for this apparent limitation.

4. This manuscript employs an important “multi-site” (as opposed to a “single-site”) paradigm to evaluate the effectiveness of the Evotech ECR’s automated cleaning phase on each one of the endoscope’s several inoculated sites (see, for example, Table 1). This is the correct paradigm to employ, because the single-site paradigm, as the authors are aware, is prone to false-negative results and conclusions.

For consistency and completeness, among other considerations, please have the authors disclose (and reference) in the manuscript that the specific “multi-site” method employed by these authors to evaluate the effectiveness of the Evotech’s automated cleaning cycle has been patented (see: US Patent 6,428,746 - “Method for determining the efficacy of a decontamination procedure”; date: August 6, 2002; inventors: Muscarella, Lawrence F.; and Weber, Frank E.J.). This reviewer of this manuscript discloses that he is one of this latter patent’s two inventors.

5. Previously, the primary author of this manuscript wrote that “a wide range of microorganisms” reside in biofilms with a “significantly more rapid outgrowth” associated with build-up biofilms that may form inside the endoscope’s channels as opposed to “traditional biofilms” (see: Alfa M, Howie R. Modeling microbial survival in buildup biofilm for complex medical devices. *BMC Infect Dis* 2009;9:56).

These two authors (Alfa and Howie, 2009) add that, first, this rapid outgrowth of build-up biofilms “is most pronounced” when using an aldehyde-based disinfectant (i.e., glutaraldehyde) compared to an oxidizing disinfectant (namely, a hydrogen peroxide-based disinfectant); second, that “cross-linking agents,” such as glutaraldehyde, “are not as effective when” build-up biofilm is present inside an endoscope; and, third, “the data ... suggest that for flexible endoscopes that are repeatedly used and reprocessed, the assurance of effective high-level disinfection may decrease if (build-up biofilm) develops within the channels.”

Further, this manuscript’s primary author has previously published that oxidizing agents, such as peracetic acid, may break down encrustations of protein that may build up inside the endoscope’s internal channels, due to the use of aldehyde-based products, namely glutaraldehyde, to high-level disinfect the endoscope (see: Alfa M. System 1 sterile processing system: liquid chemical sterilization anthology; March 2004).

Because the Evotech does not use an oxidizing disinfectant, such as hydrogen peroxide or peracetic acid, please have the authors discuss in the manuscript whether the Evotech – which uses an aldehyde-based chemistry (namely, ortho-phthalaldehyde) to high-level disinfect endoscopes – may, therefore, be more prone to the potential transmission of infectious biofilms that may build up on the internal channels of flexible endoscopes (compared to an automated reprocessing device that uses instead an oxidizing disinfectant, such as hydrogen peroxide or peracetic acid). The authors are also asked to comment on how the Evotech compensates for its use of an aldehyde-based chemistry, which Alfa and Howie (2009) and Alfa (2004) suggest is a disadvantage.

6. Three of this manuscript's four authors have previously written that: "on the basis of the concerns regarding antibiotic-resistant organisms and the need to ensure consistent standards for all patients, the ability to .... sterilize flexible endoscopes (as opposed to high-level disinfecting them) ... would provide a definite advantage for health care facilities" (see: Alfa MA, DeGagne P, Olson N, Hizon R. Comparison of liquid chemical sterilization with peracetic acid and ethylene oxide sterilization for long narrow lumens. *Am J Infect Control* 1998;26:469-77).

The Evotech device does not sterilize endoscopes, but rather only high-level disinfects them (in addition to cleaning them). The authors are therefore asked to discuss in this manuscript this apparent disadvantage of the Evotech and how, if at all, the Evotech compensates for only achieving high-level disinfection (and not sterilization).

7. The manuscript states that: "the data from the current study demonstrated that for patient-used flexible endoscopes the residuals for protein, hemoglobin and bioburden in the suction channel (L1) after the Evotech ECR cleaning are substantially better (99.7% met all benchmarks) compared to manual cleaning."

The manuscript adds, under the heading "Reprocessing of simulated-use endoscopes," that: "... all endoscopes were leak tested ... and ... were then fully manually cleaned (following the manufacturer's instructions)." Whereas such details were included in Alfa et al.'s (2006) study, the specific set of manual cleaning steps prescribed by the endoscope's manufacturer and employed in sequence during this study's simulated in-use tests is not described in this manuscript.

Nor could this manuscript's reviewer (LFM) identify in this manuscript the data that show either the effectiveness of this study's employed manual cleaning protocol or the amount of bioburden that remained on the endoscope's surfaces after manual cleaning. References are made in the manuscript to other studies vis-à-vis the manual cleaning data and to "benchmarks" for cleaning, but the specific data collected during this study's manual cleaning procedure could not be identified. These manual cleaning data are important to display in this manuscript, because of the manuscript's focus – to address SGNA's and ASGE's concerns that "no independent confirmatory data are currently available to show

that automated reprocessors are able to provide cleaning of endoscopes that is comparable to that of manual washing and brushing” – and its conclusion stating that: “the Evotech ECR cleaning for endoscope surfaces and channels is superior to optimal manual cleaning.”

For the reader’s clarity, please have the authors include in this manuscript (or explain why these data are not included) the manual cleaning steps employed during this study (which include the use of a suction pump and flushing pump) and the data that show the effectiveness of the study’s employed manual cleaning steps.

8. Since only Olympus endoscopes were tested during this study’s simulated in-use and clinical in-use testing, the authors are requested to comment on whether or not the collected data are applicable, too, to Fujinon and Pentax endoscopes.

**Level of interest:** An article of importance in its field

**Quality of written English:** Needs some language corrections before being published

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I am employed by Custom Ultrasonics, Inc. a company that manufactures an automated endoscope reprocessor potentially in competition with the device (Evotech) that is the focus of this manuscript. As you will see in my review, however, my comments are scientific, thorough, detailed, and without bias. Also, please refer to the comments I provide in my review of this manuscript.