



## The structure and delivery of a novel training course on endoscope reprocessing and standard precautions in the endoscopy unit

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The importance of knowing about endoscope reprocessing cannot be overemphasized. It is crucial to remember that keeping the endoscope disinfected and the endoscopy unit clean is everyone's responsibility; all staff members must understand the principles of endoscope reprocessing and standard precautions in the endoscopy unit. For precleaning, the process can be simplified and summarized as follows: wipe the outside and then wash and dry the inside. The specific length of time, typically ranging from 10 to 30 seconds, required to wash and dry the individual channels must be followed.

Inadequacies in endoscope reprocessing have been linked to disease outbreaks that are associated with morbidity and mortality.<sup>1-3</sup> Equally important is adherence to standard precautions; failure to do so may lead to contamination of the endoscopy unit, which can cause disease transmission in patients and healthcare providers.<sup>1</sup>

Although attention to correcting deficiencies in reprocessing procedures is increasing, outbreaks due to contaminated endoscopes continue to be a source of growing international concern.<sup>2</sup> In an International Society of Antimicrobials survey of over 160 reprocessing personnel (eg, physicians, nurses, sterilization managers) from 39 countries, 50% of the respondents identified the training of reprocessing practitioners as a main concern in improving patient safety.<sup>4</sup> Furthermore, there is significant variation in the observed practices for flexible endoscope reprocessing across different endoscopy units. The results of the aforementioned study, the persistence of outbreaks linked to reprocessing lapses, and the lack of formal reprocessing education highlight the need for a standardized training program to improve patient safety and prevent future reprocessing oversights.

Herein, we present our experiences with a flipped-learning course to train first-year fellows in the principles of endoscope reprocessing and standard precautions. We believe there is a major gap in the availability of such a course. In developing our course, we applied the principles of flipped learning, a pedagogical approach that reverses the traditional learning environment by delivering cognitive knowledge, usually through online platforms, outside of the classroom and optimizing in-classroom sessions for hands-on learning activities. Although flipped

learning has been adopted in higher education, including in medical schools, its use in endoscopy has rarely been explored.<sup>5,6</sup> Using flipped learning in endoscopy can potentially improve the efficiency and effectiveness of reprocessing training and can lead to the development of scalable standardized training programs.

### APPLYING FLIPPED LEARNING TO TEACH ENDOSCOPE REPROCESSING AND STANDARD PRECAUTIONS

We used flipped learning to create a standardized course on endoscope design, endoscope cleaning, and standard precautions in the endoscopy unit (Fig. 1). This course was conducted as a quality improvement effort and was deemed exempt from institutional review board approval by the San Francisco Veterans Affairs Medical Center.

We enrolled 7 trainees from the University of California, San Francisco; 2 trainees from California Pacific Medical Center; and 2 trainees from Singapore General Hospital. The in-unit sessions were conducted simultaneously at the San Francisco Veterans Affairs Medical Center and Singapore General Hospital. The sessions were facilitated by 2 attending physicians, 3 nurses, 3 reprocessing technicians, and an Olympus in-service personnel (Olympus, Center Valley, Pa, USA).

#### Self-paced learning

The trainees were given 2 days to complete online modules before their in-unit sessions. We used Canvas (Instructure, Inc, Salt Lake City, Utah, USA), a cloud-based learning management system, to share peer-reviewed articles, guidelines, and instructional videos. The syllabus covered the fundamental concepts of endoscope reprocessing and infection prevention (Table 1).

#### Required self-assessment

The trainees were required to complete an online assessment to demonstrate cognitive competency. They needed to receive a passing grade ( $\geq 8$  of 10 questions correct) to be eligible to move on to the in-unit sessions. They were allowed multiple attempts to complete the quiz but

**TABLE 1. Material covered in the online module of the endoscope reprocessing course**

Topics	Knowledge base
The design, parts, and newer modalities of the endoscope	Kohli and Baillie <sup>7</sup>
Reprocessing of the endoscope - Precleaning - Transporting a contaminated endoscope - Endoscope reprocessing room - Leak testing - Washing the endoscope - Washing the duodenoscope - Cleaning the elevator - Use of the automatic endoscope reprocessor - Washing endoscopes with leaks	Reprocessing Guideline Task Force et al <sup>8</sup> ASGE Quality Assurance in Endoscopy Committee et al <sup>9</sup>
Standard precautions for prevention of endoscopic transmission of infection - Standard cleaning - Added precaution for patients with diarrhea - Terminal cleaning - Cleaning after patients with C-difficile and other infectious diseases	Summary Poster of SFVAMC Basics of Infection Prevention and Control <sup>10</sup> Johnston et al <sup>11</sup>
Morbidity and mortality from contaminated endoscopes	Goldschmidt <sup>12</sup> Murray <sup>13</sup>

SFVAMC, San Francisco Veterans Affairs Medical Center.

were not given the correct answers until their final attempt. The assessment covered topics in endoscopy unit hygiene, endoscope operation, and reprocessing.

### Hands-on training

The instructors performed live demonstrations of the reprocessing procedure, conducted peer activities, facilitated small-group discussions, and provided personalized feedback for each fellow during the in-unit sessions. The trainees were divided into groups of 3 to 4 trainees with at least 2 instructors per group.

### Competency-based technical assessment

The trainees were required to demonstrate proficiency in precleaning the endoscope (Video 1, available online at [www.VideoGIE.org](http://www.VideoGIE.org)) and terminal cleaning the procedure room upon completion of the hands-on practice sessions (Video 2, available online at [www.VideoGIE.org](http://www.VideoGIE.org)). The trainees then were taught how to perform a leak test and were fully informed of the steps of manual cleaning before high-level disinfection (Video 3, available online at [www.VideoGIE.org](http://www.VideoGIE.org)) and the use of the automated endoscope reprocessor. In addition, they were required to demonstrate understanding of manual cleaning of the duodenoscope, specifically the distal part of the insertion tube and elevator (Video 4, available online at [www.VideoGIE.org](http://www.VideoGIE.org)). They were assessed for adherence to standard protocols and the completeness and quality of their work based on a sequential assessment checklist. Trainees were awarded the Veterans Affairs San Francisco Certification of Competence in Manual Reprocessing and the Olympus Certification of Competency for adult colonoscopy/pediatric colonoscopy/

gastroscope/single balloon enteroscope endoscopes upon successful demonstration of the endoscope reprocessing protocol (Olympus, Tokyo, Japan).

### Reflection and retention

To improve retention of information, we asked trainees to reflect on the materials covered at the end of the session. We then asked them to collaboratively create a document (video, PowerPoint [Microsoft, Redmond, Wash., USA], PDF) detailing the techniques and steps for proper endoscope reprocessing and highlighting the importance of learning these protocols. Instructors were available for questions after the course, and trainees were encouraged to bring up questions that they encountered in their own practice.

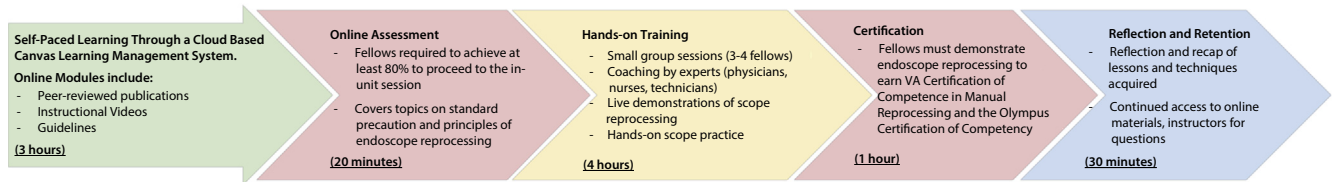
### Trainees' post-course feedback

The trainees completed an anonymous survey via Google Forms (Google LLC, Mountain View, Calif, USA) to rate the perceived usefulness of the online modules, satisfaction with the hands-on training, and helpfulness of the instructor and to give general comments and suggestions.

## RESULTS

The trainees received an average score of 85.2% ± 11% with an average of 2.7 attempts for the cognitive self-assessment. The online modules were completed in an average of 2.63 ± 0.08 hours. All trainees successfully demonstrated technical proficiency in precleaning and

## Applying Flipped Learning in Endoscopy



**Figure 1.** Applying flipped learning pedagogy to teach endoscope reprocessing and standard precaution in the endoscopy unit.

manual cleaning of the endoscope according to the standards set by the San Francisco Veterans Affairs Medical Center, the Singapore General Hospital, and the scope manufacturer (Olympus).

Seven of the 11 trainees (64%) completed the anonymous feedback survey. The course was rated highly by the trainees. When a Likert scale of 1 (not at all satisfied) to 5 (extremely satisfied) was used, the average satisfaction score for the online modules was  $4.0 \pm 0.57$ . The average satisfaction score for the hands-on training session was  $4.7 \pm 0.48$ . Furthermore, all of the trainees rated the course instructors as extremely helpful, giving them 5.0 out of 5.0 for their teaching performance during the in-unit session.

## DISCUSSION

We have described a framework to provide important information about endoscope reprocessing and standard precautions that can be used for training, certification, and recertification of trainees. Our described platform and the content therein were intensive and extensive. The trainees took approximately 8 hours in total to achieve cognitive and technical competence. Despite the duration and intensity of the course, it was unanimously well received by the trainees, as indicated by positive qualitative feedback and high satisfaction rates.

Given the persistence of outbreaks and infections resulting from lapses in the reprocessing procedure, it is important that a standardized, competency-based course be developed. Current problems in training include the lack of a formal reprocessing curriculum, the absence of in-service vendor representatives during training, and the limited availability of training in certain regions.<sup>4,14</sup> A survey conducted by the International Society of Antimicrobials and Chemotherapy found that although 85% of reprocessing personnel in high-income countries undergo a training program, only 70% of those in upper-middle-income countries and 67% of those in low-income countries do.<sup>4</sup> The availability of accessible online training packages, such as our Canvas modules (Instructure, Salt Lake City, Utah, USA), can help alleviate this disparity. In addition, providing the cognitive content online helps to ensure personnel across different centers receive standardized information. For example, the

trainees from the 2 participating countries in our cohort (United States and Singapore) received the same material and were subject to the same competency assessments.

Courses that are developed and distributed on a cloud-based learning management system are highly accessible. Such courses can be easily updated with current information from professional organizations and government agencies, rendering them useful for retraining and ensuring continued compliance with accreditation guidelines. We envision that similarly structured courses can be developed and applied to cover more advanced concepts in endoscopy. The positive results and feedback from our reprocessing course illustrate the promise of using flipped courses to enhance the current state of endoscopy training.

## DISCLOSURE

*All authors disclosed no financial relationships relevant to this publication.*

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