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

Carmel Malvar, BA,1,2 Tiffany Nguyen-Vu, BA,1,2 Amandeep Shergill, MS, MD,1,2 Yung Ka Chin, MD,3 Aruna Baniya, CNA,1 Michelle McAnanama, RN,1 Tonya Kaltenbach, MD,1,2,4 Roy Soetikno, MD1,4,5

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.1-3 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.1 Although attention to correcting deficiencies in reprocessing procedures is increasing, outbreaks due to contaminated endoscopes continue to be a source of growing international concern.2 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.3 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.4-6 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 (≥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
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 Competency in Manual Reprocessing and the Olympus Certification of Competency for adult colonoscope/pediatric colonoscope/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

---

**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\(^7\)                                                        |
| Reprocessing of the endoscope                                          | Reprocessing Guideline Task Force et al\(^8\)                                  |
| - Precleaning                                                          | ASGE Quality Assurance in Endoscopy Committee et al\(^9\)                     |
| - 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                                       |                                                                                |
| Standard precautions for prevention of endoscopic transmission of infection | Summary Poster of SFVAMC Basics of Infection Prevention and Control\(^0\)     |
| - Standard cleaning                                                   | Johnston et al\(^11\)                                                         |
| - Added precaution for patients with diarrhea                         |                                                                                |
| - Terminal cleaning                                                   |                                                                                |
| - Cleaning after patients with C-difficile and other infectious diseases|                                                                                |
| Morbidity and mortality from contaminated endoscopes                  | Goldschmidt\(^12\)                                                            |
|                                                                       | Murray\(^13\)                                                                |

SFVAMC, San Francisco Veterans Affairs Medical Center.
Figure 1. Applying flipped learning pedagogy to teach endoscope reprocessing and standard precaution in the endoscopy unit.

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. A survey conducted by the International Society of Antimicrobials and Chemotherapy found that although reprocessing personnel in high-income countries undergo a training program, only 70% of those in upper-middle-income countries and 67% of those in lower-income countries do. 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.

ACKNOWLEDGMENTS

We would like to thank the staff at the San Francisco Veterans Affairs Medical Center for their support. In particular, we would like to express our special gratitude to Ms Aruna Baniya and Ms Victoria Young for their technical expertise and assistance throughout the course and demonstrations. Funding for the Mastery Learning program used in this report was supported, in part, by a gift from The Asian Endoscopy Research Forum.

REFERENCES

1. Simecka JW, Fulda KG, Pulse M, et al. Primary care clinics can be a source of exposure to virulent Clostridium (now Clostridioides) difficile: an environmental screening study of hospitals and clinics in Dallas-Fort Worth region. PLoS One 2019;14:e0220646.
2. Ryu JK, Kim EY, Kwon KA, et al. Role of clinical endoscopy in emphasizing endoscope disinfection. Clin Endosc 2015;48:351-5.
3. Rutala WA, Weber DJ. Reprocessing endoscopes: United States perspective. J Hosp Infect 2004;56(Suppl 2):S27-39.
4. Kenter N, Tartari E, Hopman J, et al. Worldwide practices on flexible endoscope reprocessing. Antimicrob Resist Infect Control 2018;7:153.

5. Soetikno R, Kolb J, Nguyen-Vu T, et al. Evolving endoscopy teaching in the era of the millennial trainee. Gastrointest Endosc 2018;19:1056-62.

6. Baig MS, Mallu HS. Advances in medical education and practice: what Millennial medical students say about flipped learning. Adv Med Educ Pract 2017;8:681-2.

7. Kohli DR, Baillie J. How endoscopes work. In: Chandrasekhara V, Elmunzer BJ, Khashab MA, Muthusamy VR, editors. Clinical Gastrointestinal Endoscopy. 3rd ed. Amsterdam, the Netherlands: Elsevier; 2018. p. 24-31.e2.

8. Reprocessing Guideline Task Force; Petersen BT, Coehn J, et al. Multi-society guideline on reprocessing flexible GI endoscopes: 2016 update. Gastrointest Endosc 2017;85:282-94.e1.

9. ASGE Quality Assurance in Endoscopy Committee; Calderwood AH, Day LW, et al. ASGE Guideline for infection control during GI endoscopy. Gastrointest Endosc 2018;87:1167-79.

10. Summary Poster of SFVAMC Basics of Infection Prevention and Control. Adapted from Infection Control Manual and Guidelines. Available at: http://vawwn.visn21.portal.va.gov/sanfrancisco/ic/default.aspx. Accessed June 5, 2019.

11. Johnston ER, Habib-Bein N, Dueker JM, et al. Risk of bacterial exposure to the endoscopist’s face during endoscopy. Gastrointest Endosc 2019;89:818-24.

12. Goldschmidt D. Medical scopes still causing superbug infections and deaths, FDA says (with VIDEO). Available at: https://www.cnn.com/2019/04/12/health/medical-scopes-superbug-infections-fda-bn/index.html. Accessed June 5, 2019.

13. Murray P. Preventable tragedies: superbugs and how ineffective monitoring of medical device safety fails patients. Available at: https://www.help.senate.gov/imo/media/doc/Duodenoscope%20Investigation%20FINAL%20Report.pdf. Accessed June 5, 2019.

14. Bourdon L. Addressing the complexities of flexible endoscope reprocessing. AORN J 2015;101:97-9.

Section of Gastroenterology, San Francisco Veterans Affairs Medical Center, San Francisco, California (1); Department of Medicine, University of California, San Francisco, California (2); Department of Gastroenterology and Hepatology, Singapore General Hospital, Singapore (3); Advanced Gastrointestinal Endoscopy, Mountain View, California (4); Academy of Endoscopy, Woodside, California (5).

Copyright © 2020 American Society for Gastrointestinal Endoscopy. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

https://doi.org/10.1016/j.vgie.2020.02.011