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Preparing for the American Board of Surgery Flexible Endoscopy Curriculum: Development of multi-institutional proficiency-based training standards and pilot testing of a simulation-based mastery learning curriculum for the Endoscopy Training System

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ABSTRACT

Background: The Fundamentals of Endoscopic Surgery (FES) exam is required for American Board of Surgery certification. The purpose of this study was to develop performance standards for a simulation-based mastery learning (SBML) curriculum for the FES performance exam using the Endoscopy Training System (ETS).

Methods: Experienced endoscopists from multiple institutions and specialties performed each ETS task (scope manipulation (SM), tool targeting (TT), retroflexion (RF), loop management (LM), and mucosal inspection (MI)) with scores used to develop performance standards for a SBML training curriculum. Trainees completed the curriculum to determine feasibility, and effect on FES performance.

Results: Task specific training standards were determined (SM-121sec, TT-243sec, RF-159sec, LM-261sec, MI-180-480sec, 7 polyps). Trainees required 29.5 ± 3.7 training trials over 2.75 ± 0.5 training sessions to complete the SBML curriculum. Despite high baseline FES performance, scores improved (pre 73.4 ± 7, post 78.1 ± 5.2; effect size = 0.76, $p > 0.1$), but this was not statistically discernable.

Conclusions: This SBML curriculum was feasible and improved FES scores in a group of high performers. This curriculum should be applied to novice endoscopists to determine effectiveness for FES exam preparation.

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1. Introduction

Endoscopy is a large component of many general and colorectal surgeons' practices, and the need for proficiency continues to increase in more rural general surgery practices.[1,2] Standardized training and assessment for endoscopy is in its early stages, and only recently was the Fundamentals of Endoscopic Surgery (FES) exam developed as a way to identify individuals with a level of competency required to safely perform basic endoscopy.[3–5] The need to ensure that surgeons are proficient in basic endoscopic skills prior to entering independent practice has been recognized by the American Board of Surgery, who will now require FES certification for board eligibility starting with the graduating residents of 2018 as part of the Flexible Endoscopy Curriculum.[6]

Abbreviations: FES, Fundamentals of Endoscopic Surgery; FLS, Fundamentals of Laparoscopic Surgery; SAGES, Society of American Gastrointestinal and Endoscopic Surgeons; USU, Uniformed Services University of the Health Sciences; SBML, Simulation Based Mastery Learning; VR, Virtual Reality; ETS, Endoscopy Training System; SD, Standard Deviation; MIS, Foregut Minimally Invasive Surgery; CR, Colorectal Surgery; GI, Gastroenterology; GAGES, Gastrointestinal Global Assessment of Gastrointestinal Endoscopic Skills.

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Similar to the Fundamentals of Laparoscopic Surgery (FLS), the FES program was developed by members of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), and is comprised of three parts—an online curriculum, a knowledge exam, and a technical skills exam. Expert endoscopists developed the specific tasks of the technical skills portion of the FES exam to represent the core skills required for gastrointestinal endoscopy. For consistency, predictability and objectivity of scoring, the FES skills test uses a virtual reality (VR) platform that has been shown to have considerable validity evidence.[5]

While the online curriculum prepares trainees for the knowledge portion of the exam, to date no optimal curriculum exists to prepare individuals to pass the technical skills exam. Recent studies have also shown that relying on completion of the endoscopy case requirements for a general surgery residency results in a 25% first time fail rate on the FES skills exam.[7] Similarly, a group of residency graduates who pursued fellowship in minimally invasive surgery demonstrated a skills exam failure rate of 40%.[8] An ideal endoscopic training curriculum would not only promote first-time pass rates for the FES skills test, but would also translate into improved performance in the clinical environment. There are few VR modules to train for the FES exam, and the cost of the available modules, like the VR system itself, can be prohibitive[9]; therefore, practicing for the FES skills exam on a VR system is often not possible or feasible. As a whole, VR simulators also have other training drawbacks including lack of haptic feedback, technical failure, high maintenance cost and suboptimal durability. An affordable and easy to use physical simulator can overcome many of these drawbacks with improved haptic feedback, lower cost, and less technical failures.

Previous work has developed a Simulated Colonoscopy Objective Performance Evaluation which is a physical endoscopy training platform based on the Kyoto Kagaku colonoscopy model.[10] With the development of a task for retroflexion, the platform was renamed as the Endoscopy Training System (ETS) (Limbs and Things and Kyoto Kagaku). The ETS platform consists of two separate models encompassing five tasks: scope manipulation, tool targeting, retroflexion, loop management and mucosal inspection (Figs. 1 and 2). Previous work has shown validity evidence for four of these tasks, with a new retroflexed tool-targeting task added to wholly represent the domain of flexible gastrointestinal endoscopic skills.[11]

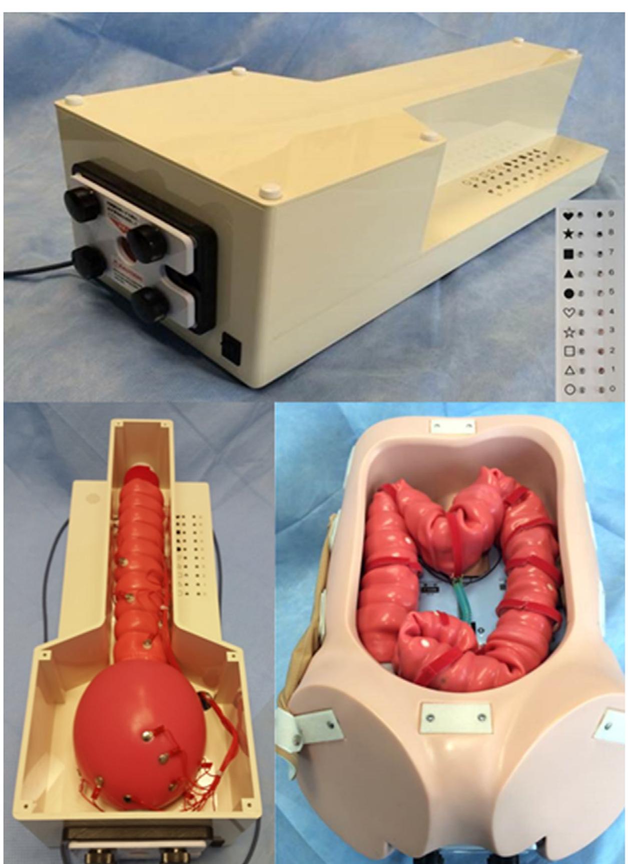

Fig. 1. Endoscopy training system platform; straight and body model.

In addition to the platform itself, an ideal curriculum for trainees must take into account the varying levels of endoscopic experience and skill. Employing mastery learning principles using an expert performance based standard is appealing because the total time required for training is dependent on the underlying skill and performance of the trainee.[12–15] This strategy has been used for many different simulation based training curricula, including FLS, with extraordinary results.[16–21]

The objective of this study was to conduct multi-institutional standard setting using experienced endoscopists to develop performance standards for a mastery learning, proficiency-based endoscopic training curriculum using the ETS training platform, and to pilot test the standards for feasibility on a small group of surgical trainees.

2. Methods

2.1. *ETS training platform*

The ETS has been developed over the last 4 years through a Collaborative Research and Development Agreement between the Henry Jackson Foundation for the Advancement of Military Medicine, the Department of Surgery at the Uniformed Services University of the Health Sciences (USU), Limbs & Things Inc. (Bristol, UK), and Kyoto Kagaku Co, LTD (Kyoto, Japan).

The ETS contains 5 training tasks housed in two tabletop units (Figs. 1 and 2). All tasks are performed using a standard endoscope and tower unit, which is not provided with the system. The first unit is linear and contains the Scope Manipulation (1), Tool Targeting (2) and Retroflexion (3) tasks. This unit is equipped with a simplistic endoscopic tool and uses basic circuitry to allow for both auditory and visual feedback for tasks 2 & 3. Task 1 requires a transparent screen overlay that is provided as part of the ETS. The second tabletop unit is a stylized body form, and is a modified version of Kyoto's previous colonoscopy trainer. The Loop Management (4) and Mucosal Inspection (5) tasks are performed in the second unit. Tasks 4 and 5 require setup by a trainer to ensure proper lubrication and orientation of the rubber colon. Instructions for this setup are standardized and require less than 5 min to complete. Tasks 4 and 5 also require use of suction, insufflation, and the lens cleaning function of the endoscope, thus requiring a fully functional endoscopy setup. Brief descriptions of the 5 ETS tasks are shown here:

2.2. *Task 1: scope manipulation*

The purpose of this task is to perform basic endoscope navigation using tip deflection and torque of the scope. The task is to align the white numbered triangle presented in the colonic lumen within the two black triangle outlines on the overlay that is placed onto the display monitor. The edges of the white triangle must be positioned upright and completely within the two black triangles of the overlay. Alignment must be held long enough to freeze and unfreeze the image on the screen. There are a total of 10 shapes and

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