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Cost Comparison of Fundamentals of Laparoscopic Surgery Training Completed With Standard Fundamentals of Laparoscopic Surgery Equipment versus Low-Cost Equipment ☆

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OBJECTIVE: Training for the Fundamentals of Laparoscopic Surgery (FLS) skills test can be expensive. Previous work demonstrated that training on an ergonomically different, low-cost platform does not affect FLS skills test outcomes. This study compares the average training cost with standard FLS equipment and medical-grade consumables versus training on a lower cost platform with non–medical-grade consumables.

DESIGN: Subjects were prospectively randomized to either the standard FLS training platform ($n = 19$) with medical-grade consumables (S-FLS), or the low-cost platform ($n = 20$) with training-grade products (LC-FLS). Both groups trained to proficiency using previously established mastery learning standards on the 5 FLS tasks. The fixed and consumable cost differences were compared.

SETTING: Training occurred in a surgical simulation center.

PARTICIPANTS: Laparoscopic novice medical student and resident physician health care professionals who had not completed the national FLS proficiency curriculum and who had performed less than 10 laparoscopic cases.

RESULTS: The fixed cost of the platform was considerably higher in the S-FLS group (S-FLS, $3360; LC-FLS, $879), and the average consumable training cost was significantly higher for the S-FLS group (S-FLS, $1384.52; LC-FLS, $153.79; $p < 0.001$). The LC-FLS group had a statistically discernable cost reduction for each consumable (Gauze $9.24 vs. $0.39, $p = 0.002$; EndoLoop $540.00 vs. $40.60, $p < 0.001$; extracorporeal suture $216.45 vs. $25.20, $p < 0.001$; intracorporeal suture $618.83 vs. $87.60, $p < 0.001$). The annual fixed and consumable cost to train 5 residents is $10,282.60 in the S-FLS group versus $1647.95 in the LC-FLS group.

CONCLUSIONS: This study shows that the average cost to train a single trainee to proficiency using a lower fixed-cost platform and non–medical-grade equipment results in significant financial savings. A 5-resident program will save approximately $8500 annually. Residency programs should consider adopting this strategy to reduce the cost of FLS training. (J Surg Ed ▮:▮▮▮-▮▮▮. Published by Elsevier Inc on behalf of the Association of Program Directors in Surgery)

KEY WORDS: laparoscopy, simulation training, mastery learning, proficiency-based curriculum, fundamentals of laparoscopic surgery, cost analysis

COMPETENCY: Practice-Based Learning and Improvement

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INTRODUCTION

With advances in surgical technology, laparoscopy continues to advance and is becoming the standard of care for numerous general surgery operations. This push toward minimally invasive surgery has been met with increases in laparoscopic resident case requirements as well as in the formation of minimally invasive surgery fellowships. Residents are now required to become proficient in laparoscopy and open skills in the era of decreased operative opportunities due to work-hour restrictions as well as public and ethical concerns for more training before operating on real patients.[1,2]

The skill set required for laparoscopic surgery is unique and open skills do not transfer to the minimally invasive arena.[3] This created a need for simulated laparoscopic training. In addition, the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) refined the McGill Inanimate System for Training and Evaluation of Laparoscopic Skills (MISTELS) and developed the Fundamentals of Laparoscopic Surgery (FLS) skills examination.[4] Since 2008, FLS has been a requirement for general surgery board eligibility.[5,6]

A proficiency-based simulation skills curriculum was developed to train for the FLS examination, and it resulted in 100% pass rates on the FLS skills examination, robust skill retention, and improved intraoperative performance.[7-10] Despite minor longitudinal skill degradation, short refresher training quickly reestablishes proficiency.[11] This durability has been appreciated when applying these same mastery principles to other forms of simulation training.[12]

Unfortunately, incorporating FLS training into simulation centers can be met with hesitancy because of the high cost of personnel, equipment, and supplies.[13] Virtual reality (VR) simulators have been shown to improve intraoperative performance, but these are very expensive, prone to technical failure, and lack haptic feedback.[14] The traditional FLS physical platform is less expensive than a VR simulator; however, still has significant cost when considering the platform and medical-grade consumables required for proficiency training to promote resident first time pass rates on the FLS skills examination.[7] Many groups have developed lower cost physical training platforms and consumables in an attempt to decrease the cost of training for the FLS skills examination.[13,15-19]

Placek et al.[20] showed that training to proficiency using a lower cost and ergonomically different platform showed no difference in outcomes when compared with the standard FLS platform (S-FLS). Currently, no one has evaluated the potential cost reduction to train residents using both a lower cost platform in concert with more economic consumables. Our study aimed to compare the average cost of proficiency training on the S-FLS using medical-grade consumables to training using a lower cost FLS platform (LC-FLS) with training-grade, nonsterile consumables.

MATERIALS AND METHODS

Study Design and Overview

This study was a prospective randomized trial. All subjects underwent a diagnostic FLS skills examination pretest with a trained proctor on the S-FLS. Subsequently, subjects were randomized to the S-FLS or LC-FLS group to complete the proficiency-based training curriculum. After completion of training, subjects underwent a repeat FLS skills examination posttest on the S-FLS. A representative of the FLS program generated the test scores using a proprietary scoring algorithm. This study was deemed exempt by the Uniformed Services University of the Health Sciences Institutional Review Board.

Subjects and Randomization

All subjects were novices who had neither previous experience with an FLS curriculum, nor been involved in greater than 10 laparoscopic cases. To meet inclusion criteria, subjects had to be a health professional adult who was at least 18 years of age, never completed a proficiency FLS-based curriculum, and had participated in less than 10 laparoscopic cases of any kind. Subjects were excluded if they did not meet all of the inclusion criteria.

Equipment and Materials

The S-FLS group trained using the traditional box trainer (Fig. 1) that was originally developed by Venture Technologies Inc. (Reading, MA). Limbs and Things (Savannah, GA) now has a commercially available FLS box for laparoscopic simulation training that serves as a replacement for the original model.[21] The price for the Limbs and Things box was used for cost calculations. The complete platform consisted of the FLS trainer box with a video camera and accessories (light strip, power cable, and simulated skin), 19-in LED monitor, and Mobile SimCart. Consumables used by this group matched those used in the official FLS skills examination. They included prestamped, commercially available circle gauze (Limbs and Things, Savannah, GA), sterile 0-Vicryl EndoLoop ligatures, and sterile 48-in, 2-0 silk suture with a V-20 taper needle. Pricing for each item was obtained from our representative for each respective company and represents standard base pricing for each item. Cost to individual institutions may vary.

The LC-FLS group trained using the 3-Dmed Lap Tab Trainer (Franklin, OH).[22] After ergonomic analysis, the trainer required minor modification within the working space to reduce the differences with the standard FLS box trainer. This required only a single additional piece of plastic that is secured in place with plastic hooks and Velcro backing at a 25° angle (Fig. 2). An Apple iPad Air 2 was