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A 1-day simulation-based boot camp for incoming general surgery residents improves confidence and technical skills

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ABSTRACT

Background: For surgery residents, opportunities to systematically learn about surgical equipment are limited. Our facility holds a simulation-based boot camp for incoming, first-year general surgery residents. The aim of this study was to assess the effectiveness of this boot camp at increasing resident confidence and improving technical skills.

Methods: Boot camp for incoming surgery residents is held annually and provides hands-on simulation relating to endoscopy, laparoscopy, bronchoscopy, and abdominal access. Before the boot camp, participants completed a pretest, which includes self-confidence, experience, and a skills-assessment. Identical assessments of self-confidence and skills were completed after the boot camp as a posttest. Data was accrued from 2016 to 2018.

Results: A total of 26, first-year, general surgery residents participated in the boot camp. Most participants had never used an endoscopic simulator (61.5%), handled a colonoscope (57.7%), a gastroscope (80.8%), or gained operative access to the abdomen (76.9%). The assessments of self-confidence and skills demonstrated a mean increase in all 4 topics. All differentials demonstrated statistical significance ($P < .001$).

Conclusion: A 1-day, simulation-based boot camp for incoming surgery residents with a focus on endoscopy, laparoscopy, and abdominal access increases resident confidence as well as several basic aspects of technical skill.

Introduction

Surgery residents have to amass tremendous base of skills and knowledge during their training. At the beginning of residency, residents commonly do not possess the skills and knowledge that might be expected of an incoming resident in a surgery residency. Some studies have even shown increased mortality and decreased hospital-wide efficiency due to the annual changeover of junior residents.[1,2] To minimize patient risk and discomfort, incoming residents must possess a fundamental knowledge and set of skills at the very beginning of residency. Unfortunately, opportunities to systematically learn about surgical equipment and the basic use of that equipment are limited for incoming surgery residents. The need for programs that bridge the gap between undergraduate medical education and independent care of patients is an area of increasing interest.[3] Our facility holds a simulation-based boot camp for incoming first-year general surgery residents that provides early exposure to minimally invasive surgical equipment, specifically endoscopy, laparoscopy, bronchoscopy, and abdominal access for laparoscopic surgery. Many prior studies have demonstrated the effectiveness of a boot camp curriculum in preparing trainees for a surgery residency[4–11]; however, the content of these boot camps tends to focus on fundamental procedures, such as knot tying, suturing, wound closure, placement of a chest tube or central venous access, etc. Moreover, the timing of boot camp also varies between programs. There are few reports of boot camps at the beginning of residency specialized in gastrointestinal endoscopy and laparoscopy, which are more applicable to current surgical training. The aim of this study was to assess the effectiveness of our institutional boot camp to improve technical skills and increase confidence for incoming residents.

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Methods

Boot camp

The boot camp is held annually for incoming first-year, surgery residents of the Pritzker School of Medicine, University of Chicago, at the Grainger Center for Simulation and Innovation, NorthShore University HealthSystem. This 1-day curriculum focuses on commonly used minimally invasive surgical equipment providing hands-on simulation relating to endoscopy, laparoscopy, bronchoscopy, and abdominal access for laparoscopic surgery. In the endoscopy module, residents learn about the differences between an upper and lower endoscope, function of the buttons and dials on an endoscope, and assembly of an endoscopic tower. Additionally, they are required to perform real-time troubleshooting on the equipment. In the laparoscopy module, residents identify the components of a laparoscopic tower, setup a laparoscopic tower, assemble and white balance a laparoscope, and troubleshoot problems with a laparoscopic setup. During the bronchoscopy module, after learning about the nuances of the bronchoscope itself, residents get hands-on experience using the 3-dimensional simulator GI-BRONCH Mentor (3D Systems, Littleton, CO). Using this simulator, residents learn how to manipulate the tip of the bronchoscope, advance the scope to the carina and bifurcations of the major bronchi, while attempting to minimize wall contact. They also learn the anatomy of the tracheobronchial tree. In the abdominal access module, residents learn techniques to establish pneumoperitoneum including use of the Veress needle, Hasson cannula, and optical port entry. Residents practice entry using a silicone-based, abdominal wall mannequin. Attending surgeons of NorthShore University HealthSystem and University of Chicago or senior residents of the University of Chicago proctor each module and instruct residents in specific skills and knowledge pertaining to each topic. All faculty receive training on the modules and instruction on how to evaluate the residents prior to the curriculum. Residents rotate in all 4 modules every 30 min to complete the curriculum.

Data collection

Before the learning modules, participants completed a 2-part pretest. The first part acquired demographics and evaluated self-confidence pertaining to the 4 components of the boot camp. The second part was a faculty-scored, skills assessment, whereby residents are assessed on various aspects of the 4 modules without prior didactics or guidance. After participants completed the training modules, identical self-confidence and skills-assessments were completed as a posttest. Tests were scored using a 5-point rubric for each question with multiple questions in each topic. Rubric answers were as follows: 1 = not able to do, 3 = able to do with verbal cues, 5 = able to do independently. Self-confidence questions were phrased as, "How do you feel about your ability to…" and skills questions asked, "Was the resident able to…" Points were averaged across participants and summed for each topic. The maximum score of each module was as follows: 20 points for endoscopic tower self-confidence, 25 points for laparoscopic tower self-confidence, 30 points for bronchoscopy self-confidence, 45 points for abdominal access self-confidence, 25 points for endoscopic tower skills-assessment, 30 points for laparoscopic tower skills-assessment, 30 points for bronchoscopy skills-assessment, and 45 points for abdominal access skills-assessment. The questions asked in the self-confidence and skills-assessments were developed internally and performed well when tested for internal consistency with a Cronbach α of 0.943 and 0.958, respectively. Additionally, learner satisfaction was not used as a question in the self-confidence assessment in order to avoid confounding bias. Three years of data were collected from 2016 to 2018.

Table I
Participant characteristics

	N (%)
Total participants	26
Sex	
Female	7 (27)
Male	19 (73)
Have you ever…	
Used an endoscopic simulator?	10 (39)
Placed ports during lap surgery?	15 (57.79998)
Simulated	1
On a real person	14 (54)
Seen or participated in a colonoscopy?	19 (73)
Seen or participated in a gastroscopy?	18 (69)
Handled a colonoscope?	11 (42)
Handled a gastroscope?	5 (19)
Steered the scope during lap surgery?	24 (92)
Gained access for lap surgery?	6 (23)
Worked with lap instrument or devices?	24 (92)

Statistical analysis

Descriptive statistics are presented as mean and standard deviation or frequency and percentage. Comparisons of the scores of pre and post boot camp self-confidence and skills-assessment were made using the paired t test or the Wilcoxon signed-rank test. Because each module had a different amount of questions and thus a different amount of total points possible, mean percentage change in score was used to allow for fair comparison between modules. Percent change was calculated as the difference between pre and post boot camp scores, divided by the pre score for each of the 4 topics and overall total. Percent change in self-confidence scores as well as skills-assessment scores were compared between topics using the paired t test. All analysis was performed using SAS 9.3 (SAS Institute, Cary, NC).

Results

From 2016 to 2018, a total of 26 first-year general surgery residents participated in surgical boot camp. Most participants had never used an endoscopic simulator (61.5%), handled a colonoscope (57.7%), or a gastroscope (80.8%), or gained operative access to the abdomen (76.9%). In contrast, most residents did have experience steering the laparoscope (92.3%) and working with laparoscopic instruments and devices (92.3%; Table I). The before and after self-confidence assessments demonstrated a mean increase in all items in each of the 4 topics after boot camp, specifically endoscopy (pre 7.2 ± 3.2 vs post 18.3 ± 1.8), laparoscopy (pre 11.7 ± 4.8 vs post 24.0 ± 1.5), bronchoscopy (pre 12.3 ± 6.0 vs post 25.3 ± 2.9), and abdominal access (pre 17.8 ± 7.4 vs post 37.4 ± 5.6). This improvement was also present when totaled as a group (pre 49.0 ± 18.8 vs post 105.1 ± 8.9; Table II). The skills-assessments also showed a mean increase in scores, endoscopy (pre 13.3 ± 3.2 vs post 24.7 ± 0.6), laparoscopy (pre 26.0 ± 3.4 vs post 30.0 ± 0.2), bronchoscopy (pre 22.0 ± 3.5 vs post 27.5 1.7), and abdominal access (pre 18.3 ± 8.9 vs post 38.3 ± 7.1). Taken as a group, the overall mean skills-assessment score increased after boot camp (pre 79.6 ± 12.7 vs post 120.5 ± 7.0; Table III). All differences demonstrated statistical significance ($P <$ .001). Mean percent change in self-confidence scores was greater for endoscopic tower than either the laparoscopic tower, bronchoscopy, abdominal access, or overall (199 ± 22; vs 141 ± 20, $P = .015$; vs 149 ± 21, $P = .014$; vs 142 ± 19, $P = .015$; vs 142 ± 17, $P = 0.003$; Figure). Mean percent change in skills-assessment scores was greatest in the topics of abdominal

Table II
Self confidence

	Pre mean ± SD	Post mean ± SD	Difference mean ± SD	*P* value
Endoscopic tower self-confidence				
How do you feel about your ability to distinguish between an upper and lower endoscope?	2.0 ± 1.0	4.7 ± 0.5	2.8 ± 1.0	<.0001
How do you feel about your ability to identify the function of the buttons and dials on an endoscope?	2.1 ± 1.1	4.6 ± 0.5	2.5 ± 1.0	<.0001
How do you feel about your ability to assemble an endoscopic tower?	1.6 ± 0.9	4.6 ± 0.5	3.0 ± 1.0	<.0001
How do you feel about your ability to troubleshoot problems with the endoscopic setup?	1.5 ± 0.8	4.4 ± 0.6	2.9 ± 1.0	<.0001
Endoscopic tower self-confidence total (4–20)	7.2 ± 3.2	18.3 ± 1.8	11.2 ± 3.2	<.0001
Laparoscopic tower self-confidence				
How do you feel about your ability to identify the components of laparoscopic tower?	2.3 ± 1.0	4.8 ± 0.4	2.5 ± 1.0	<.0001
How do you feel about your ability to set up a laparoscopic tower?	2.0 ± 1.0	4.8 ± 0.4	2.9 ± 1.1	<.0001
How do you feel about ability to assemble a scope?	2.4 ± 1.2	4.8 ± 0.4	2.4 ± 1.2	<.0001
How do you feel about your ability to white balance a scope?	3.2 ± 1.5	4.9 ± 0.3	1.7 ± 1.4	<.0001
How do you feel about your ability to troubleshoot problem with the laparoscopic setup?	1.8 ± 0.9	4.6 ± 0.5	2.8 ± 1.1	<.0001
Laparoscopic tower self-confidence total (5–25)	11.7 ± 4.8	24.0 ± 1.5	12.3 ± 4.6	<.0001
Bronchoscopy self-confidence				
How do you feel about your ability to identify a bronchoscope?	2.8 ± 1.2	4.7 ± 0.5	1.9 ± 1.2	<.0001
How do you feel about your ability to manipulate the tip of the bronchoscope?	2.2 ± 1.2	4.4 ± 0.6	2.2 ± 1.3	<.0001
How do you feel about your ability to advance the scope to the carina?	2.1 ± 1.2	4.5 ± 0.6	2.4 ± 1.3	<.0001
How do you feel about your ability to advance the scope to the right upper lobe and right middle lobe bifurcations?	1.8 ± 1.1	4.0 ± 0.6	2.2 ± 1.2	<.0001
How do you feel about your ability to advance the scope to the left lower lobe and left upper lobe bifurcations?	1.8 ± 1.1	4.0 ± 0.7	2.2 ± 1.1	<.0001
How do you feel about your ability to manipulate the scope with minimal wall contact?	2.2 ± 1.1	3.7 ± 0.7	2.2 ± 1.0	<.0001
Bronchoscopy self-confidence total (6–30)	12.3 ± 6.0	25.3 ± 2.9	13.0 ± 6.0	<.0001
Abdominal access self-confidence				
Veress				
How do you feel about your ability to insert a Veress needle?	2.0 ± 0.8	4.0 ± 0.8	2.0 ± 1.1	<.0001
How do you feel about your ability to verify placement of Veress needle?	2.0 ± 0.9	4.3 ± 0.6	2.3 ± 0.8	<.0001
How do you feel about your ability to establish pneumo-peritoneum once the Veress needle has been properly inserted?	2.4 ± 1.2	4.3 ± 0.6	1.9 ± 1.3	<.0001
Veress total	6.5 ± 2.7	12.7 ± 1.8	6.2 ± 2.8	<.0001
Hasson				
How do you feel about your ability to gain peritoneal access using the Hasson method?	2.0 ± 0.8	4.0 ± 0.8	2.0 ± 1.0	<.0001
How do you feel about your ability to anchor the Hasson port?	1.8 ± 0.8	4.1 ± 0.9	2.3 ± 0.9	<.0001
How do you feel about your ability to establish pneumo-peritoneum once the Hasson port is in place?	2.3 ± 1.2	4.3 ± 0.7	1.9 ± 1.1	<.0001
Hasson total	6.2 ± 2.6	12.3 ± 2.2	6.2 ± 2.6	<.0001
Optical port				
How do you feel about your ability to select appropriate supplies using the optical port?	1.6 ± 1.0	4.1 ± 0.8	2.5 ± 1.1	<.0001
How do you feel about your ability to gain peritoneal access using the optical port?	1.7 ± 1.1	4.0 ± 0.8	2.3 ± 1.1	<.0001
How do you feel about your ability to establish pneumoperitoneum using the optical port?	1.9 ± 1.2	4.2 ± 0.7	2.3 ± 1.1	<.0001
Optical port total	5.2 ± 3.2	12.3 ± 2.2	7.1 ± 3.0	<.0001
Abdominal access self-confidence total (9–45)	17.8 ± 7.4	37.4 ± 5.6	19.5 ± 7.3	<.0001
Overall confidence total (24–120)	49.0 ± 18.8	105.1 ± 8.9	56.0 ± 18.6	<.0001

Scoring: 1 = not able to do, 3 = able to do with verbal cues, 5 = able to do independently.

access (150 ± 21) and endoscopic tower (96 ± 9), and least in laparoscopic tower (17 ± 4). All pairwise comparisons of percentage change in skills-assessment scores were statistically significant ($P < .05$; Figure).

Discussion

The primary purpose of a boot camp curriculum is to bridge the gap between the knowledge gained during medical school and the necessary clinical and technical aptitude expected of incoming residents. This study suggests that our boot camp was effective at increasing both self-confidence and skills in multiple basic aspects of minimally invasive operations.

Our data demonstrated a few particularly noteworthy findings. The endoscopic tower module demonstrated the greatest increase in self-confidence when compared to the other modules. This observation was coupled with the second greatest increase in the skills-assessment category. These findings may suggest that

Table III
Rater-scored skills-assessment

	Pre mean ± SD	Post mean ± SD	Difference mean ± SD	*P* value
Endoscopic tower skills-assessment				
Was the intern able to distinguish between the upper and lower endoscopes?	4.3 ± 1.1	5.0 ± 0.0	0.7 ± 1.1	0.0043
Was the intern able to identify the function of each button or dial on the upper endoscope?	2.4 ± 1.0	4.9 ± 0.3	2.5 ± 0.9	<.0001
Was the intern able to identify the function of each button or dial on the lower endoscope?	2.3 ± 0.8	4.9 ± 0.8	2.6 ± 0.8	<.0001
Was the intern able to assemble the endoscopic tower correctly?	2.1 ± 1.0	5.0 ± 0.0	2.9 ± 1.0	<.0001
Was the intern able to troubleshoot the problem if you could not see anything on the screen when the light switch was turn off (without their knowledge)?	2.2 ± 1.2	4.8 ± 0.4	2.7 ± 1.2	<.0001
Endoscopic skills assessment total (2–25)	13.3 ± 3.2	24.7 ± 0.6	24.7 ± 0.6	<.0001
Laparoscopic tower skills-assessment				
Was the intern able to identify the light source on the tower?	4.5 ± 1.1	5.0 ± 0.2	0.5 ± 1.0	0.0204
Was the intern able to identify the insufflation on the tower?	4.6 ± 1.0	5.0 ± 0.0	0.4 ± 1.0	0.0384
Was the intern able to distinguish between a 0 and 30 degree scope?	4.7 ± 0.5	5.0 ± 0.0	0.3 ± 0.5	0.0164
Was the intern able to assemble the scope correctly?	4.2 ± 0.8	5.0 ± 0.0	0.8 ± 0.8	<.0001
Was the intern able to white balance the scope correctly?	4.0 ± 1.3	5.0 ± 0.0	1.0 ± 1.3	0.0006
Was the intern able to troubleshoot the problem if you could not see anything on the screen when the light switch was turned off (without their knowledge)?	4.1 ± 1.3	5.0 ± 0.0	0.9 ± 1.3	0.0010
Laparoscopic tower skills assessment total (6–30)	26.0 ± 3.4	30.0 ± 0.2	4.0 ± 3.4	<.0001
Bronchoscopy skills-assessment				
Was the resident able to identify the bronchoscope?	4.3 ± 0.9	5.0 ± 0.0	0.7 ± 0.9	0.0008
Was the resident able to manipulate the tip of the bronchoscope?	3.6 ± 0.9	4.9 ± 0.3	1.3 ± 0.9	<.0001
Was the resident able to advance the scope to the carina?	4.2 ± 0.6	4.9 ± 0.3	0.7 ± 0.7	<.0001
Was the resident able to advance the scope to the right upper lobe and right middle lobe bifurcations?	3.3 ± 0.7	4.2 ± 0.8	0.9 ± 1.1	0.0003
Was the resident able to advance the scope to the LL and UL bifurcations?	3.8 ± 1.0	4.6 ± 0.6	0.8 ± 0.9	0.0002
Was the resident able to manipulate the scope with minimal wall contact?	2.8 ± 0.8	3.8 ± 0.7	1.0 ± 0.7	<.0001
Bronchoscopy skill assessment total (6–30)	22.0 ± 3.5	27.5 ± 1.7	5.5 ± 2.7	<.0001
Abdominal access skills-assessment				
Veress				
Inserts Veress needle	2.0 ± 1.0	4.3 ± 0.8	2.3 ± 0.9	<.0001
Verifies placement prior to insufflation	1.8 ± 1.0	4.5 ± 0.7	2.7 ± 1.0	<.0001
Establishes pneumo-peritoneum	2.3 ± 1.4	4.4 ± 0.9	2.0 ± 1.3	<.0001
Veress needle technique total	6.2 ± 3.0	13.2 ± 2.3	7.0 ± 2.7	<.0001
Hasson				
Gains peritoneal access	2.0 ± 1.2	4.2 ± 0.7	2.2 ± 0.8	<.0001
Inserts and anchors Hasson trocar	1.9 ± 1.2	4.2 ± 1.2	2.3 ± 1.3	<.0001
Establishes pneumo-peritoneum	2.3 ± 1.3	4.3 ± 0.9	2.1 ± 1.1	<.0001
Open (Hasson) technique total	6.2 ± 3.6	12.7 ± 2.5	6.6 ± 2.7	<.0001
Optical port				
Selects appropriate supplies	2.1 ± 1.4	4.2 ± 1.2	2.0 ± 1.3	<.0001
Inserts optical trocar	1.7 ± 1.0	4.0 ± 1.1	2.4 ± 1.1	<.0001
Establishes pneumo-peritoneum	2.2 ± 1.3	4.2 ± 1.1	2.0 ± 1.2	<.0001
Optical technique total	6.0 ± 3.2	12.4 ± 2.9	6.4 ± 2.8	<.0001
Abdominal access skills-assessment total (9–45)	18.3 ± 8.9	38.3 ± 7.1	20.0 ± 6.5	<.0001
Overall skills assessment total (26–130)	79.6 ± 12.7	120.5 ± 7.0	40.8 ± 9.7	<.0001

Scoring: 1 = not able to do, 3 = able to do with verbal cues, 5 = able to do independently.

endoscopy is a particularly deficient topic for our incoming interns and thus is an ideal topic for boot camp. This contention is further supported by the low percentage of residents who had handled a colonoscope or gastroscope before boot camp. In addition to identifying an area that requires improvement, these data suggest that our boot camp was effective in increasing not just confidence, but actual knowledge about the endoscopic tower. Both the laparoscopic tower and bronchoscopy modules exhibited statistically significant changes in confidence but with only small changes in the category of skills-assessment. Considering that the pre-test skills-assessment scores in both of these categories were quite high, this seems to suggest that despite having low confidence on these topics, the residents exhibited relatively high skill to start and thus only improved a only a smaller relative amount. From this observation, one conclusion might be that our incoming residents already possess adequate skill and knowledge of these 2 topics, and thus, we should consider de-emphasizing these aspects in future boot camps. Another interpretation is that our skills-assessments for these categories need to be made more rigorous, thereby allowing residents more opportunity to demonstrate improvement or perhaps that assessment graders need to be more strict when awarding full credit.

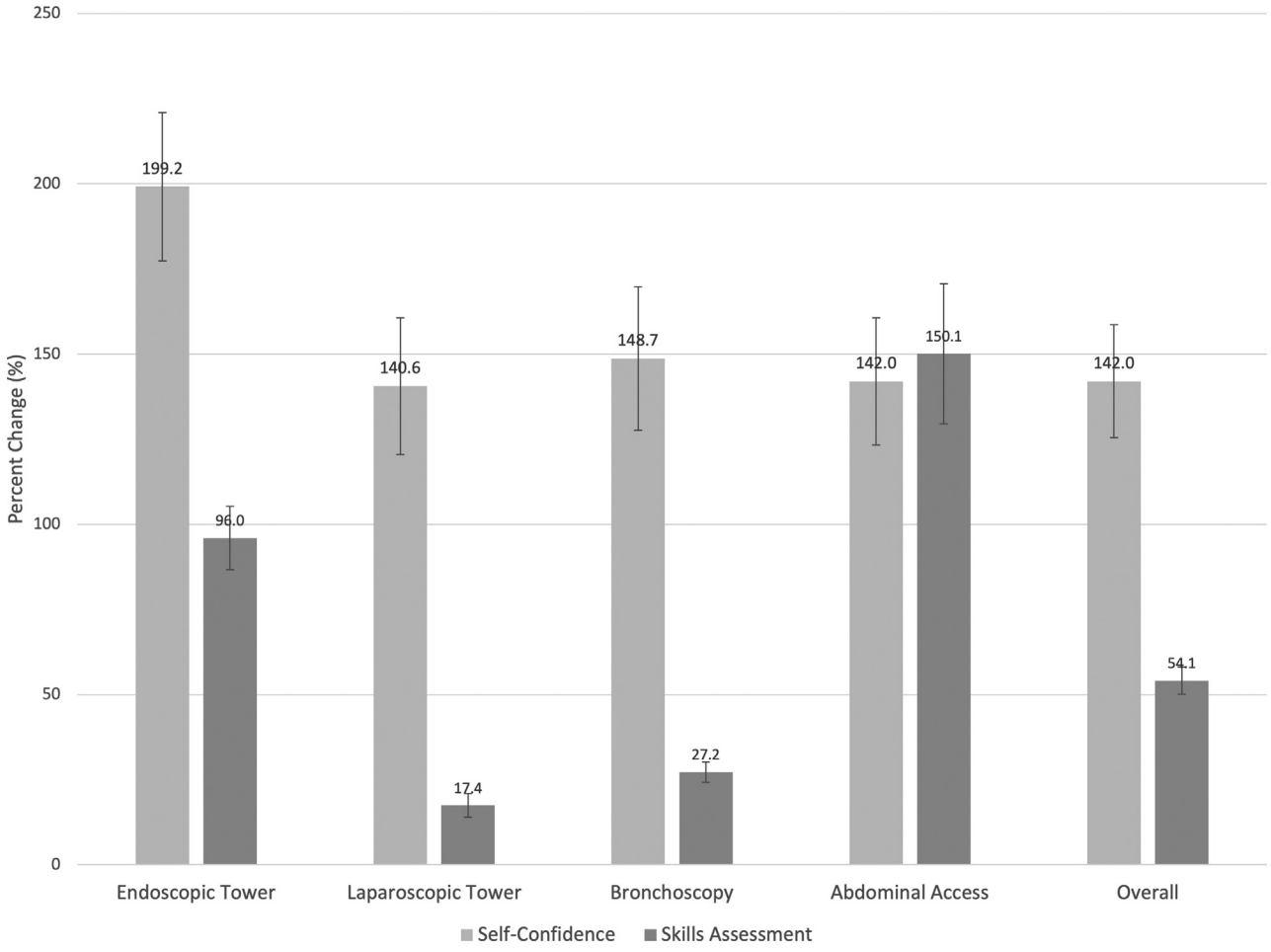

Figure. Percent change for scores of self-confidence and skills-assessment. To allow fair comparison between modules, mean percent change of total score was used. Mean percent change of the endoscopic module in self-confidence score was greater than the other modules (P <.015). Mean percent change in skills assessment score was greatest in the abdominal access module and endoscopic tower module, and least in laparoscopic tower module (P < .05).

We were most surprised by the results in the abdominal access module. This module demonstrated the greatest increase in skill and suggests that it was most effective at improving a deficient aspect of medical education. Even more interesting was that this module seemed to have one of the smallest changes in confidence. The findings may suggest either that our cohort was overly confident initially without the actual skills required to access the abdomen safely or that although resident skill increased drastically, their confidence in completing the task changed minimally. Generally low pretest confidence scores seem to support the later.

The gap of knowledge between medical school and residency can cause substantial stress for residents (and attendings) and may affect patient safety. With the increasing emphasis on safety and outcome in recent years, there is concern that the traditional model of resident education needs further refinement,[12] supported by some studies that report a 41% increased risk of mortality at the start of the year when compared to patients treated at the end of the year.[2] In the more classic surgical training, residents are assigned immediately to clinical duties, with the assumption that they will obtain the necessary knowledge and skills while actively caring for patients. In the past, several articles have reported the effect of boot camps on the specific surgical skills and confidence of trainees for surgical residency.[4,6,7] Our results support the current literature that suggest incoming resident skills, knowledge, and self-confidence improve after boot camp. Admittedly, a surgical boot camp conducted over a single day is unlikely to provide residents with all of the necessary knowledge and skills required of them, but such an approach may be effective in providing a strong introduction to these critical skill sets and knowledge bases.

There are many limitations to our study that require mention. It is important to recognize that this is a 1-day boot camp for a small amount of surgery residents in a single program, and thus, extrapolating these results to other cohorts of surgery residents either within our institution or elsewhere or generalizing this approach should be done with caution. Additionally, although the confidence questions and skills-evaluations were chosen carefully, the components and assessments chosen and used may not be the most effective metric of confidence or skills. For example, if the components of a skills-assessment were overly advanced, residents would demonstrate only a small amount of improvement according to our test, which may overlook improvement in unmeasured skill. Refinement of these metrics should be attempted to ensure the most accurate evaluations possible. We acknowledge that we did not use goal-oriented training in this boot camp, which may have weakened the efficiency of our modules. The purpose of this boot camp was early exposure and experience using minimally invasive equipment, and thus, we were less focused on competency and more focused on general improvement and familiarity. With 3 years of data, the next step may be to determine a baseline for

incoming interns and develop reasonable benchmarks that can be used for goal-oriented training in the future. Lastly, our data does not address whether the effect of a 1-day boot camp is sustained over the long term. Yeh et al[12] reported that improvement of participants knowledge, skills, confidence, and clinical performance by simulation-based boot camp was durable at 6 months after the boot camp. A follow-up study of our cohort may yield interesting findings. Conversely, residents learn skills and knowledge pertaining to the introductory aspects of these topics; hopefully, this approach should serve as an early foundation for expansion, and thus re-evaluation of these same metrics may be unnecessary and actually may misrepresent the true value of boot camp. A relatable concept would be testing an attending surgeon a decade or more after completing an undergraduate biochemistry course. Most experts would agree that a surgeon's command over this once critical introductory aspect of medical learning is less important than the knowledge and expertise built on a strong foundation in biochemistry.

There are many reports evaluating boot camps, but most of them emphasize fundamental procedures, such as knot tying, suturing, and nasogastric tube insertion.[4,6–8] Our 1-day boot camp focused on endoscopy, bronchoscopy, laparoscopy, and abdominal access for laparoscopic surgery. We selected these modules for many reasons. First, the American Board of Surgery requires all surgery residents to pass the fundamentals of laparoscopic surgery and the fundamentals of endoscopic surgery during their residency.[13] Second, the course directors identified historically deficient areas of resident skill and knowledge, such as abdominal access, and selected logical benchmarks of improvement for each module. Some of these areas are institution-specific such as the bronchoscopy module; the interns at our institution are expected to perform bronchoscopies on all operative thoracic patients while the attending and senior resident prep and drape. Additionally, basic surgical skills are covered in other simulation curricula at our institution and thus a minimally invasive focus was chosen. A formal needs-assessment was not used to select modules, although the data accrued in these initial boot camps can be used to create a needs-assessment for future boot camps. There is no consensus on which topics in surgical boot camp are most important to offer, but the topics should be based on the skills and knowledge required at each individual institution.

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Conflict of interest/Disclosure

None of the authors have personal conflicts of interest.

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Discussion

Dr Jose Velasco (Chicago, IL): I would like to congratulate the authors on an important topic in surgical education: pre-surgical training boot camp. While there are questions regarding the value of simulation or performance-based curricula, it's most likely to remain an important part of surgical education for the next generation of trainees.

In 2014, American stakeholders (ABS/ACS/APDS/ASE) published a consensus statement advising that all medical schools adopt a surgical pre-residency program to address clinical and technical skills as well as to diminish variability in skills sets among future surgical residents. Further, many training programs have instituted boot camps for incoming interns mainly addressing knowledge and basic surgical skills. Unfortunately, there is no agreement or uniformity regarding the content, timing, and duration of such programs. Simulation has been shown to be an excellent educational intervention to enhance students' satisfaction with the learning experience, increase students' self-confidence, and enhance students' perception of increased skill performance.

The authors instituted a 1-day simulation-based boot camp to assess and improve performance skills and resident confidence in operating surgical equipment. They concluded that this boot camp resulted in improved self-confidence scores and performance skills.

The first question pertains to needs assessment. The authors designed the curriculum based on required FLS and FES testing as well as their institutional needs. Some of the results, specifically those related to the laparoscopic module seem to indicate a participants' higher grade of knowledge and skill. Indeed, most

residents had driven the camera previously. The outcomes pertaining to the bronchoscopy module are difficult to analyze since no data was given regarding prior use. They performed at a higher level than one would expect. Did you run a formal needs assessment to establish a gap in knowledge prior to the course? If so, could you share the assessment with us?

Second question pertains to the training and performance sessions. Did you establish performance goals? Your group has emphasized in the past, the value of goals in achieving learner's proficiency. Did you observe any difference between those learners who had prior experience through medical school or pre-residency boot camp and those who didn't? How many of the learners had attended a preparatory boot camp in medical school? It would have been interesting to see retention rates after 6 months.

Finally, the authors noticed a discrepancy between self-confidence scores and performance, particularly concerning the bronchoscopy and the abdominal access modules scores. Confidence based learning measures a learner's knowledge quality by determining both the correctness of the user knowledge and confidence in that knowledge. However, it is questionable whether confidence can be used as a performance measure. If a learner correctly answers a question, but reports low confidence, he is indicating doubt and hesitation. The opposite would indicate mistakes and dangerous misinformation. Measuring confidence should avoid including measures of learner satisfaction since the latter does not have an impact on outcomes. Did you use a validated instrument to measure self-confidence such as the self-confidence in learning instrument which has been shown to have good internal consistency with reported Cronbach's α of 0.87. If not, what was the internal consistency of the instrument used? Did you take into account learner satisfaction as a possible confounding factor in your posttest analysis?

Dr Tetsuya Nakazato: Thank you for the interesting questions. With regard to the question about the needs assessment, we did not perform a needs assessment beyond the information gathered in the demographics questionnaire. This is a very interesting suggestion that we could incorporate into future boot camps.

We agree with the discussant that the performance on the bronchoscopy module was surprising considering so few incoming interns have experience in this procedure. We suspect it was a result of the module itself being too simple and pertaining mostly to anatomic identification. We believe that if the skills assessment were made more difficult, a greater skill disparity between residents would emerge and subsequently residents would be more able to demonstrate improvement.

In response to the question about goal-oriented training, this point is well taken. The purpose of this boot camp is early exposure and experience using minimally invasive equipment. We aren't necessarily poised to accomplish or measure competency in a single day. Rather we are focused on improvement. We have been collecting data for 3 years and thus maybe the next step is to try to determine a baseline of incoming interns and develop reasonable goals that can be used as goal-oriented training in the future. We did not routinely collect information on medical school boot camps but this would be interesting to look at.

Lastly, in reference to the type of tool used we did not use the "self confidence learning instrument" as suggested by the discussant. However, we did perform internal consistency testing on our self-confidence assessment, which showed a Cronbach α ratio of 0.943 suggesting excellent internal consistently.

Dr L. Michael Brunt (St. Louis, Mo): Thank you very much. I enjoyed the presentation. I was wondering if you could tell us a little bit about where this component of the boot camp fits into maybe other things that you do for your incoming interns and what you put them through.

I look at these skills. Certainly some of them you'll get some exposure to perhaps during internship, but compared to basic suturing and knot-tying skills and maybe fundamental use of the electrosurgical Bovie, PGY1s may not get a lot more experience with the others. If you could address that, number one.

Number 2, did you look at how often the PGY1s actually got to utilize any of these skills during their first year of training? Because if you have a one-time skills training session and you don't get to utilize those skills, your skills are going to degrade pretty quickly. I think that's an important consideration here.

Dr Michael Ujiki: I think one of the things that we knew that people would ask is how did you choose these modules. We have a simulation curriculum that goes all year round. We have been very fortunate that the residency director, Kevin Roggin, has been incredibly supportive of our simulation curriculum. We have blocked time during the day and on every rotation that allow people to come for their simulation activities. We have 2 to 4 hours a week where residents turn off their pagers, come to the laboratory, and they have modules set up for them. Basic skills, such as knot-tying, suturing, and laparoscopic camera-driving, are taught throughout intern year.

So we chose these 4 because, number one, we participate in the FEC. So we want endoscopic training from year 1 to start. In year 2, they get intensive training for 2 weeks on using the endoscope and manipulating and reducing loops. But we wanted to try to get the basic tower stuff out of the way. The same thing with laparoscopy. We chose bronchoscopy because the interns are actually the ones that do bronchoscopy on all the thoracic cases. They are called into the room and they are doing the bronchoscopy while surgeons and higher level residents are doing the cases. So they needed to know the anatomy.

One of the reasons that they did well on pre and post test, in answer to Dr Velasco's questions, we use a validated thoracic bronchoscopy assessment tool. It's kind of easy. It's basically identifying anatomy. It's not much more than that. I think they all did relatively well on that.

So that's how we chose these. We haven't formally looked at how many cases that they are doing. That's a good question and probably something we need to know. We know they are doing a lot of bronchoscopies. I don't think they are touching the endoscope much in their intern year but they are later. That's something we could look at. Obviously, they are doing more laparoscopic surgery than anything else. But that is a good question.

Dr Gerald Fried (Montreal, Qc): Thank you, Dr Nakazato, for the excellent presentation. There are a few points I would like to make.

It is very important to instill in surgeons and surgical trainees an ownership of the technology that we use, and not to rely on the nurses or other people in the operating room to manage and troubleshoot the technology that we use. So, having a culture where this responsibility is part of the education is very valuable.

The challenge is that, at least in our institutions, we don't just have one vendor in terms of the technology. We have much more uniformity with our flexible endoscopes, but we have a lot of diversity with our rigid scopes, particularly between different hospitals that our residents rotate through.

In your curriculum, did you have an opportunity to expose residents to more than one vendor's technology?

You presented your data as percent change, for the most part. What I would be more interested in is the percentage of people that achieved a level of competence, ie, that achieved a score that demonstrates that they learned what you wanted them to know. If

they already had it when they came in, then that may reflect that your curriculum is either unnecessary or the test was too easy. Percent change is not all that meaningful to me, and I would just urge you to maybe think about presenting your data in a different fashion.

Finally, because it was a 1-day course, and there may be a period of time where they won't be using this information, there is need to show that there is retention of this information.

Dr Michael Ujiki: You gave us wonderful ideas. I'm going to go talk to one of the vendors and see if they will donate some other towers to us, because we only have one vendor. That is a good point. We need to do that. I think retention is our next project. That's coming.

And your second question, we need to do that, and something we can easily do, and we'll put that in the manuscript. That is a great idea, too.