The Impact of a Comprehensive Resident Curriculum and Required Participation in "This Week in SCORE" on General Surgery ABSITE Performance and Well-Being

Leah K. Winer, MD, Alex R. Cortez, MD, Al-Faraaz Kassam, MD, Ralph C. Quillin, MD, Michael D. Goodman, MD, Amy T. Makley, MD, Jeffrey J. Sussman, MD, and Joshua W. Kuethe, MD

Department of Surgery, Cincinnati Research on Education in Surgical Training (CREST), University of Cincinnati College of Medicine, Cincinnati, Ohio

OBJECTIVE: *This Week in SCORE* (TWIS) is a biennial, general surgery curriculum comprised of weekly online modules, readings, and multiple-choice quizzes. In this study, we examined the impact of required TWIS on American Board of Surgery In-Training Examination (ABSITE) scores and well-being among categorical general surgery residents.

DESIGN, SETTING, AND PARTICIPANTS: TWIS quiz completion became required in 2017. Residents attended weekly lectures, and ABSITE performance was incentivized with educational stipends. Surveys were distributed to assess study preferences, learning styles, burnout, and grit. Thirty-six categorical general surgery residents who took ABSITE in both 2017 and 2018 were evaluated in a paired-sample, retrospective analysis.

RESULTS: After requiring TWIS, median ABSITE percentile increased by 12% (65%−77%, $p = 0.001$). Weekly TWIS completion (59% vs 89%, $p < 0.001$) and quiz results (62% vs 69%, $p = 0.005$) also improved. During this time, emotional exhaustion and depersonalization declined significantly, yet overall burnout scores did not change. Of 21 survey respondents, 66.7% (n = 14) increased weekly study time by a median of 2.5 hours. However, less than half used Surgical Council on Resident Education as their primary study tool. Only 23.8% (n = 5) reported that mandatory TWIS modified their study behavior, while 90.4% (n = 19) felt the culture of education had improved.

CONCLUSIONS: After TWIS participation became required, ABSITE performances improved. Formalized curriculum with frequent assessment may foster accountability among residents, enhancing educational climate, well-being, and test performance. (J Surg Ed 76: e102−e109. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: ABSITE, SCORE curriculum, burnout, Culture, TWIS

COMPETENCIES: Medical Knowledge

INTRODUCTION

Each year, general surgery residents take the American Board of Surgery In-Training Examination (ABSITE), which identifies individuals who meet a defined standard of clinical judgment and surgical and scientific knowledge.[1] ABSITE scores help program directors determine which residents struggle academically and intervene appropriately to prepare them for the written qualifying and oral certifying exams (Qualifying Exam (QE) and Certifying Exam (CE)), and ultimately, safe independent practice.

Given the tremendous availability of text and digital resources, it is imperative that surgical educators distill large volumes of information down to high-yield principles. To this end, the Surgical Council on Resident Education (SCORE) was founded in 2004 to develop a standardized,

Presented at the 2019 Association of Program Directors in Surgery Annual Meeting/Surgical Education Week, April 23−27, 2019.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Correspondence: Inquiries to Joshua W. Kuethe, MD, Department of Surgery, Cincinnati Research on Education in Surgical Training, University of Cincinnati, 231 Albert Sabin Way, ML 0558, Cincinnati, OH 45267-0558; fax: (513) 558-3136; e-mail: kuetheja@ucmail.uc.edu

  1931-7204/$30.00
https://doi.org/10.1016/j.jsurg.2019.08.015

competency-based general surgery curriculum. Since 2015, SCORE's online portal has expanded to include a dedicated biennial curriculum called *This Week in Score* (TWIS), which features online readings, modules, and corresponding multiple choice quizzes for self-assessment and conference preparation.[2] Currently 97% of Accreditation Council for Graduate Medical Education residency programs subscribe to SCORE.[2]

Although the use of SCORE correlates with improved mean QE performance, there is a paucity of data exploring the direct association between TWIS and annual ABSITE performance.[3] In recent years, our program transitioned from a program-specific curriculum to the exclusive use of TWIS with the aim of enhancing participation, learning, and ultimately, ABSITE performance. In this study, we describe our experience with this transition and explore the impact of our program's comprehensive curriculum changes on ABSITE scores. We hypothesized that required participation in this curriculum would be associated with improved ABSITE performance and well-being among categorical general surgery residents at our program.

MATERIALS AND METHODS

Resident Education and Implementation of SCORE Curriculum

The University of Cincinnati Department of Surgery subscribed to SCORE in 2011 to provide an optional educational resource. At the beginning of the 2016 academic year, TWIS was incorporated into the educational curriculum, and weekly participation was encouraged, but not mandated. However, in July of 2017, a new policy was initiated: TWIS became required, and residents were expected to complete assigned readings and associated quizzes prior to a weekly, 1-hour educational lecture that paralleled the SCORE topic. Over this time, the lecture format did not change. Lecturers were provided with the TWIS outline in advance but could decide how to structure their presentation, allowing for the variable use of patient cases, video/images, small-group work, oral boards scenarios, and quiz review.

Resident participation in TWIS was closely monitored by the program director, and residents who failed to participate weekly or achieved less than a 70% average on the best 3 of 4 monthly quizzes were required to attend a supervised study session on a Friday evening. In total, 3 sessions were held before the 2018 ABSITE, each with between 6 and 12 resident attendees. In addition, an optional and informal weekly reading club was established in July of 2017. Led by the chief residents, reading topics varied with the postgraduate level and learning needs of participants. Weekly attendance ranged from 6 to 10 residents. Lastly, ABSITE scores were incentivized through various class and individual education stipends, funds that could be applied for academic purposes (i.e., textbooks or question banks, conference or meeting travel, board examinations, licensing, and surgical society membership; Fig. 1). The purpose of the class incentives was to encourage group studying. At our institution, ABSITE scores at or below the 30th percentile are considered high risk, so educational stipends are contingent on performing above this minimum standard, as well as maintaining greater than 80% attendance at weekly conference. This policy was the same for both 2016 to 2017 and 2017 to 2018 academic years. Funding for educational stipends is generated through and sustained by hospital revenue and the health care system; these funds are not dependent on industry, grants, or individual donors. Additional educational stipends in the 2017 to 2018 academic year amounted to an extra $285 per resident.

Study Design, Subject Inclusion, and Variables

To evaluate the association between mandatory TWIS participation and changes in ABSITE scores, we conducted a retrospective study of categorical general

	2017	2018
Curriculum	• Optional *This Week in SCORE®* • Weekly 1 hour curriculum conference	• Required *This Week in SCORE®* • Weekly 1 hour curriculum conference • Optional resident-run reading club
Incentives	$500 educational stipend if >30th percentile and >80% conference attendance	$500 educational stipend if >30th percentile and >80% conference attendance • + $250 if >70th percentile • + $250 if all class members score >30th percentile • + Extra day-off for highest class average
Disincentive	N/A	"Study hall" for residents who failed to complete all four *This Week in SCORE® quizzes* or achieve >70% average on three best quizzes of the month

FIGURE 1. Summary of curriculum changes between the 2016 to 2017 and 2017 to 2018 academic years. Beginning in July 2017, the general surgery residency curriculum was modified to include mandatory participation in weekly TWIS quizzes. Quiz completion and performance were monitored, and residents who were delinquent at meeting requirements attended an extra study session. Superb individual ABSITE performance was rewarded with a stipend that could be applied to educational materials or travel.

surgery residents between 2016 and 2018. Residents who did not take the ABSITE in both 2017 and 2018 (i.e., 2017 chief residents and 2018 interns) were excluded. The following demographic variables were collected: age, postgraduate year, sex, race, and average USMLE steps 1 and 2 scores. Conference attendance was obtained from official administrative records, and TWIS participation, TWIS multiple choice quiz scores, and ABSITE percentile scores were also tabulated for both 2016 to 2017 and 2017 to 2018 academic years. Resident data were deidentified prior to analysis, and this study was approved by the University of Cincinnati Institutional Review Board (protocol number 2018-2875).

Resident Personality Metrics and Survey Responses

To elicit information on study habits and perceptions, residents were asked to complete a 5-question voluntary, anonymous online survey (Survey Monkey, www.surveymonkey.com) at the end of the 2017 to 2018 academic year (Fig. 2). The survey also evaluated resident grit, learning styles, and burnout. Grit, defined as perseverance and passion for long-term goals, was assessed using the 12-item Grit Scale,[4] which rates grit from 1 (low) to 5 (high). Learning styles were evaluated with the Kolb Learning Style Inventory 3.1 (Hays Group, Boston, Massachusetts), which assesses how individuals perceive and interact with new information (i.e., individual-based vs team-based), and then process and solidify that information (i.e., through action vs observation) to create knowledge.[5]

Burnout was evaluated by the Maslach Burnout Inventory Human Services Survey,[6] which asks residents how frequently they identify particular emotions with responses on a 7-point Likert scale. This process generates 3 subscale numeric scores for emotional exhaustion (EE), depersonalization (DP), and personal achievement (PA), which are then converted to ordinal values of low, moderate or high based on previously reported normative data.[6] Ranges for each subscale are as follows: EE—low (0-16), moderate (16-26), and high (27+); DP—low (0-6), moderate (7-12), and high (13+); and PA—low (0-31), moderate (32-38), and high (39+). In this study, burnout was defined as having 2 of the following 3 criteria: high EE, high DP, or low PA.

Statistical Analysis

Statistical analyses were performed using JMP Pro Version 14.0 (SAS Institute, Cary, North Carolina). Descriptive statistics were reported as medians and interquartile ranges or means and standard deviations as appropriate. Wilcoxon signed-rank and McNemar paired *t* tests were used to compare resident metrics before and after TWIS participation was required. The p values <0.05 were considered statistically significant.

RESULTS

Thirty-six residents took the ABSITE in both 2017 and 2018. Of this cohort, 18 (50%) were women and 24 (66.7%) were white with an approximately equal distribution between individual and team-based learning

1) Did you study more in preparation for this year's ABSITE (2018) compared to last year (2017)?
   - YES or NO
2) If yes to #1, on average, how many additional hours per week did you study compared to last year?
3) Which of the following factored into your studying for ABSITE this year?
   - Mandatory TWIS quiz requirement
   - Following structure SCORE curriculum
   - Avoiding study hall
   - Increased educational stipend incentives
   - Obtaining increased clinical knowledge
   - Contributing to raising my class' average ABSITE score
   - Reading club
   - Desire to improve upon last year's performance
   - Other
4) Regarding weekly reading for SCORE/TWIS and curriculum conference, what was your regular practice?
   - I did not prepare or read on a regular basis
   - I read the assigned readings in SCORE
   - I read from my preferred text based on the SCORE topic
5) Compared to prior years, how was this year's culture and promotion of self-learning and education?
   - Unchanged
   - Improved
   - Worse

FIGURE 2. Survey questions distributed to general surgery residents who completed the ABSITE in both 2017 and 2018 academic years. Optional education-related surveys were distributed to all residents at the end of the 2017 to 2018 academic year. Questions sought to understand resident perceptions of study behavior, the curriculum, and educational climate for the preceding year. Answer choices were structured in multiple choice form in the order they appear.

TABLE 1. Demographics of Study Cohort

Surgical Resident Information	n (%)
Total residents	36 (100.0%)
Gender (female)	18 (50.0%)
Race	
White	24 (66.7%)
Asian	8 (22.2%)
Black	2 (5.6%)
Hispanic	2 (5.6%)
USMLE step 1, mean ± SD	236 ± 12
USMLE step 2, mean ± SD	248 ± 9
Learning style	
Accommodating	16 (44.4%)
Converging	16 (44.4%)
Diverging	3 (8.3%)
Assimilating	1 (2.8%)
Learning style (processing)	
Action learners	32 (88.9%)
Observation learners	4 (11.1%)
Learning style (perception)	
Individual learners	19 (52.8%)
Team learners	17 (47.2%)

styles (Table 1). Using a paired-sample approach, we then compared variables between residents before and after the curriculum policy change. After TWIS became required in 2017, weekly conference attendance remained stable, but online TWIS participation (59%-89%, $p < 0.001$) and median TWIS quiz scores (62%-69%, $p = 0.005$) improved significantly (Table 2). Between 2017 and 2018, the median ABSITE score increased by 12 percentile points, from the 65th percentile to the 77th percentile ($p < 0.001$), with 74.3% (n = 26) individual residents improving their performances. Next, we examined high-risk residents who scored beneath the 30th percentile by directly comparing score distributions in 2017 and 2018 (Fig. 3A). We observed that significantly fewer residents scored below the 30th percentile in 2018 compared with 2017 (n = 1 vs 8). All 8 residents who performed beneath the 30th percentile in 2017 markedly improved their scores in 2018 (median percentile 20.5 vs 60.5, $p = 0.008$; Fig. 3B).

Next, we evaluated grit and burnout before and after the TWIS requirement was implemented to determine if there were associated changes in individual-level characteristics and personality factors. Although overall changes in grit score and burnout rates were not significant, burnout subscale scores decreased markedly between 2017 and 2018 for both EE (20 to 13, $p = 0.04$) and DP (13 to 9, $p = 0.02$) among the 17 residents included in paired-sample analysis (Table 2).

Given improvements in resident burnout subscale scores, we then aimed to identify subjective factors that may have contributed to improved ABSITE performance, and survey results regarding educational perceptions and beliefs were analyzed (Table 3). Twenty-one residents completed the survey (58.3% response rate). Of this cohort, the majority were junior or mid-level residents. Fourteen respondents (66.7%) increased their weekly conference preparation by a median of 2.5 (2-4) hours. Only 9 residents (42.9%) reported that SCORE was their preferred weekly study modality. The most commonly cited factors influencing study behavior were desire for increased clinical knowledge and to improve the prior year's ABSITE score, class incentives, and attending the optional weekly reading club. The minority attributed their study habits to the mandatory TWIS or the SCORE curriculum. Finally, 19 residents (90.4%) reported an improved culture of education in 2018 compared with the previous academic year.

DISCUSSION

In this study, we evaluated whether comprehensive curriculum changes, including mandatory TWIS participation, were associated with improved categorical general

TABLE 2. Comparison of Personality Metrics and Academic Performance Before and After Required TWIS Participation, n = 36

	2017 n (%) Median (IQR)	2018 n (%) Median (IQR)	p
ABSITE percentile score	65 (41-83)	77 (63-87)	0.001*
% conference attendance	87 (79-95)	89 (81-95)	0.589
% TWIS completed	59 (38-78)	89 (82-98)	<0.001*
TWIS score	62 (58-68)	69 (62-78)	0.005*
Burnout score (n = 17)			
Emotional exhaustion (EE)	20 (14-32)	13 (9-26)	0.038*
Depersonalization (DP)	13 (8-17)	9 (5-14)	0.022*
Personal achievement (PA)	38 (32-41)	36 (30-44)	0.970
Burnout (n = 17)	8 (47.1%)	4 (23.5%)	0.103
Grit score (n = 17)	4.0 (3.7-4.2)	4.1 (3.8-4.3)	0.067

*$p < 0.05$ by Wilcoxon signed-rank and McNemar paired *t* tests.

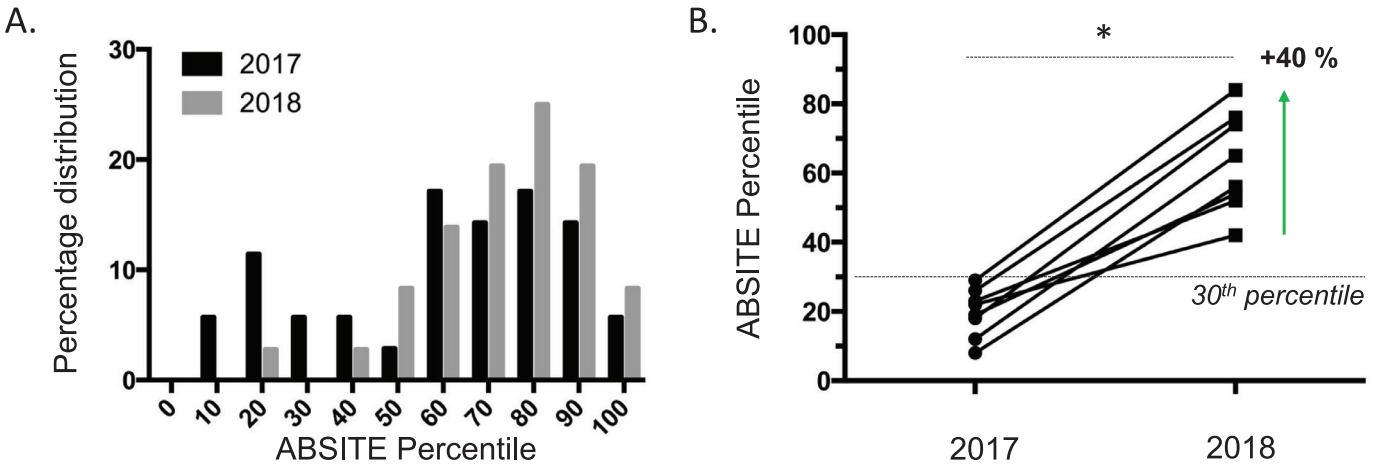

FIGURE 3. Improvement in high-risk ABSITE performers in 2018. (A) Score distributions from 2017 and 2018 were compared among residents included in the paired-sample analysis (n = 36). Twenty-two percent (n = 8) scored beneath the 30th percentile in 2017 compared to only 2.7% (n = 1) in 2018. (B) This subgroup of residents beneath the 30th percentile, all increased their scores significantly between 2017 and 2018 (median percentile 20.5-60.5, *p = 0.008 by Wilcoxon signed-rank test).

surgery resident ABSITE performance. We found that when weekly TWIS participation was required, completion rates and average scores subsequently improved, while conference attendance remained stable. More importantly, the median ABSITE percentile improved significantly after this intervention, with a substantial reduction in the number of low-performing residents. Over the same time frame, EE and DP metrics also improved, and residents reported an enhanced culture of education.

TABLE 3. Survey Responses of Residents Who Took the ABSITE in Both 2017 and 2018, n = 21

Survey Responses	n (%)
Total residents	21 (58.3%)
Gender (female)	11 (52.3%)
Training year	
PGY2	5 (23.1%)
PGY3	3 (14.3%)
PGY4	3 (14.3%)
PGY5	2 (9.5%)
Laboratory	8 (38.1%)
Increased preparation for weekly conference?	14 (66.7%)
Hours increased weekly study (median, IQR)	2.5 (2-4)
Preferred weekly study material	
SCORE	9 (42.9%)
Other preferred text	5 (23.8%)
Did not prepare for conference	7 (33.3%)
Factors influencing study behavior	
Intrinsic motivators:	
Increasing clinical knowledge	17 (81.0%)
Desire to improve performance	11 (52.4%)
Attending reading club	7 (33.3%)
Extrinsic motivators:	
Class ABSITE incentives	8 (38.1%)
Educational stipend incentive	5 (23.8%)
Mandatory TWIS	5 (23.8%)
Avoiding study hall	3 (14.3%)
Following SCORE curriculum	3 (14.3%)
Improved culture of education?	19 (90.4%)

Since its inception in 1975, the ABSITE has been a tool to evaluate general surgery resident fund of knowledge and clinical problem-solving ability.[7,8] Exam performance is scaled nationally by postgraduate level, allowing program directors to monitor residents' progress relative to their peer group.[9] Although not explicitly required for board certification, stronger ABSITE performance, particularly in the chief resident year, predicts QE pass rates.[10-13] In addition to serving as a benchmark for QE preparedness, ABSITE scores are often used to make "high-stakes" decisions about general surgery resident promotion, remediation, and suspension, as well as for fellowship match.[14] Given the implications of a poor ABSITE performance and the surgery ethos of lifelong scholarship, it is incumbent on surgical educators, program directors, and residents to maximize test preparation.

Numerous studies have demonstrated that structured reading programs with multiple choice assessments are effective for improving ABSITE performance.[1,8,15,16] However, previously evaluated curricula were program specific, limiting their generalizability. In addition, the majority of studies were published prior to 2014, when the ABSITE was consolidated from separate exams for junior and senior residents to a single exam involving a wider scope of material. To this end, the SCORE curriculum is highly standardized and covers all ABSITE subject matter. Associated with improved mean QE performance and already used nationally, SCORE may offer a solution

for programs in search of more structured ABSITE preparation.[3]

In this study, we found that a residency curriculum, including mandatory TWIS participation, was associated with considerably higher median ABSITE scores in a paired-sample analysis. Upon closer evaluation of score distribution, significantly fewer residents scored below the 30th percentile in 2018 compared with 2017. Although there is no defined standard of ABSITE failure, we use the 30th percentile because this score, or multiple performances under the 35th percentile, is associated with QE and CE failure.[1,17] A previous study by Decoteau et al. found that residents who scored below the 30th percentile benefited from focused remediation involving assigned SCORE modules and questions. After this intervention, remediated resident scores improved from the 17th to the 68th percentile, and no participating resident remained in the high-risk range.[17] Similarly, we found that after the curriculum change, residents beneath the 30th percentile in 2017 improved significantly in 2018, their median performance increasing by 40 points. Thus, required participation in SCORE/TWIS may be particularly beneficial for a subset of lower-performing residents.

A review of our program's recent experience demonstrated that mandatory SCORE was also associated with better weekly TWIS compliance and quiz scores. Completing test questions is a form of knowledge "retrieval practice." This strategy has been linked to enhanced long-term retention compared with repeat studying, regardless of whether questions are interspersed throughout or at the end of studying.[18-20] In addition, question attempts are as beneficial as correct attempts as long as feedback is provided after an incorrect answer.[21] Among general surgery residents, practice questions are a popular and effective method of ABSITE study. Chang et al. found that for every 1000 practice questions completed, scores increased by 31 percentile points among first time ABSITE takers.[22] Thus, it is possible that requiring residents to complete 40 additional SCORE questions per month aided learning, retention, and eventual ABSITE performance. For the aforementioned subgroup beneath the 30th percentile, ABSITE improvement was directly correlated with TWIS quiz compliance, but not the proportion of correctly answered questions (data not shown). Providing correct answers through both the SCORE platform and in-person during lecture are forms of feedback that may explain the discrepancy between lower TWIS quiz scores and relatively higher ABSITE performance months later.

Burnout denotes an individual's experience of stress in relation to his or her occupational environment and is characterized by feelings of emotional fatigue and cynicism.[23,24] Previous studies show that EE and stress are directly proportional, whereas the data regarding DP and stress are more equivocal.[25,26] In our study, the proportion of residents with burnout did not change significantly between 2017 and 2018, but both EE and DP subscores improved markedly. These trends parallel the belief held by greater than 90% of survey respondents that the culture of education improved in 2018. While it is not possible to ascertain whether individual-level traits led to a culture change or vice versa, these data along with the substantial improvement in ABSITE performance reflect enhancement of the overall educational climate after TWIS participation became required.[27]

Motivation is essential to both learning and academic performance, but data within the field of surgical training is limited.[28] Intrinsic motivation is based on individual interest and sense of purpose and is believed to produce more robust outcomes in learning and performance.[28,29] On the other hand, extrinsic motivation is based on obtaining rewards or avoiding losses. Prior studies show that use of rewards and/or punishment may actually diminish intrinsic motivation with variable, perhaps even negative, effects on workplace performance.[30-32] However, inferences from psychological and economic fieldwork may lack generalizability to residency training programs, which are not predicated on a "baseline rewards" system, such as the competitive salary or bonuses inherent to other demanding fields.[32] In our study, less than half of respondents attributed study behavior to class or individual incentives. Furthermore, the threat of remediation did not appear to have negative consequences as evidenced by the decrease in EE and perception of enhanced educational culture. In fact, Kim et al. suggest that tracking weekly reading and quiz performance is effective because it signifies program director investment in education that may lead to habit formation.[8] The structure of SCORE and use of incentives may also foster greater individual and collective responsibility among residents.[29] It is outside the scope of the current study to untangle exactly how motivation, especially the use of financial incentives, impacted ABSITE improvement, but future studies are needed to understand these factors within the unique setting of surgical training.

There are several limitations to the present study. First, the retrospective study design and small sample size prevent conclusions about causation between variables and limit our ability to identify the exact policies and/or incentives that had the greatest independent impact on performance. Although required TWIS was clearly associated with increased participation and weekly quiz performance, the source of improved program-wide ABSITE performance is likely multifactorial and could be related to TWIS, intrinsic factors, financial incentives, or a combination of all of these variables. The

paired-sample design further restricts the already limited sample size by eliminating individuals who did not take the ABSITE, Maslach Burnout Inventory, or 12-item Grit Scale in both 2017 and 2018. In so doing, this statistical approach may skew the sample distribution away from programmatic trends by removing either particularly high- or low-performing individuals. Second, the use of survey data introduces both recall and selection biases because it was collected at the end of the academic year with less than a 60% response rate. However, the median ABSITE percentile among survey respondents was 76%, comparable to that of the larger sample, minimizing concern that this group was exceptionally biased. Given these caveats, further studies are needed to evaluate the persistence of our institutional experience over time. More important, additional research is needed to determine whether changes to resident education and curriculum merely "teach to the test" or actually improve clinical performance and advance patient care.

CONCLUSION

Modification of resident curriculum, including adoption of required weekly TWIS participation, was associated with improved ABSITE performance among categorical general surgery residents. Concurrently, EE and DP metrics decreased, and 90% of residents believed the culture of education had improved. Moreover, residents indicated that study patterns and test performance were motivated by more intrinsic, rather than extrinsic, factors. We propose that a formalized weekly curriculum with frequent assessment may foster accountability and self-reliance among residents, enhancing educational climate, well-being, and test performance, particularly for lower performing residents.

ACKNOWLEDGMENTS

We would like to thank Gilda Young and Debbie Browne for their hard work in entering and collating resident data for this study.

REFERENCES

1. de Virgilio C, Chan T, Kaji A, Miller K. Weekly assigned reading and examinations during residency, ABSITE performance, and improved pass rates on the American Board of Surgery Examinations. *J Surg Educ*. 2008;65:499–503.
2. Joshi ART, Salami A, Hickey M, Barrett KB, Klingensmith ME, Malangoni MA. What can SCORE web portal usage analytics tell us about how surgical residents learn? *J Surg Educ*. 2017;74:e133–e137.
3. Klingensmith ME, Jones AT, Smiley W, Biester TW, Malangoni MA. Subscription to the Surgical Council on Resident Education web portal and qualifying examination performance. *J Am Coll Surg*. 2014;218:566–570.
4. Duckworth AL, Peterson C, Matthews MD, Kelly DR. Grit: perseverance and passion for long-term goals. *J Pers Soc Psychol*. 2007;92:1087–1101.
5. Quillin RC 3rd, Pritts TA, Hanseman DJ, Edwards MJ, Davis BR. How residents learn predicts success in surgical residency. *J Surg Educ*. 2013;70:725–730.
6. Maslach C, Jackson S. Maslach Burnout Inventory: Manual. 2nd ed. Consulting Psychologists Press; 1986.
7. Borman KR. Does academic intervention impact ABS qualifying examination results? *Curr Surg*. 2006;63:367–372.
8. Kim JJ, Gifford ED, Moazzez A, et al. Program factors that influence American Board of Surgery In-Training Examination performance: a multi-institutional study. *J Surg Educ*. 2015;72:e236–e242.
9. ABS In-Training Examination. Available at: http://www.absurgery.org/default.jsp?certabsite. Accessed 2 March, 2019.
10. Jones AT, Biester TW, Buyske J, Lewis FR, Malangoni MA. Using the American Board of Surgery In-Training Examination to predict board certification: a cautionary study. *J Surg Educ*. 2014;71:e144–e148.
11. Biester TW. The American Board of Surgery In-Training Examination as a predictor of success on the qualifying examination. *Curr Surg*. 1987;44:194–198.
12. de Virgilio C, Yaghoubian A, Kaji A, et al. Predicting performance on the American Board of Surgery qualifying and certifying examinations: a multi-institutional study. *Arch Surg*. 2010;145:852–856.
13. Malangoni MA, Jones AT, Rubright J, Biester TW, Buyske J, Lewis FR Jr. Delay in taking the American Board of Surgery qualifying examination affects examination performance. *Surgery*. 2012;152:738–743. discussion 743-736.
14. Taggarshe D, Mittal V. The utility of the ABS In-Training Examination (ABSITE) score forms: percent correct and percentile score in the assessment of surgical residents. *J Surg Educ*. 2012;69:554–558.
15. Kelly DM, London DA, Siperstein A, Fung JJ, Walsh MR. A structured educational curriculum including

online training positively impacts American Board of Surgery In-Training Examination scores. *J Surg Educ*. 2015;72:811–817.

16. Kim RH, Tan TW. Interventions that affect resident performance on the American Board of Surgery In-Training Examination: a systematic review. *J Surg Educ*. 2015;72:418–429.

17. Decoteau MA, Rivera L, Umali K, Chan AD, Soballe P, Ignacio RC. A multimodal approach improves American Board of Surgery In-Training Examination scores. *Am J Surg*. 2018;215:315–321.

18. Weinstein Y, Nunes LD, Karpicke JD. On the placement of practice questions during study. *J Exp Psychol Appl*. 2016;22:72–84.

19. Smith MA, Karpicke JD. Retrieval practice with short-answer, multiple-choice, and hybrid tests. *Memory*. 2014;22:784–802.

20. Weinstein Y, Madan CR, Sumeracki MA. Teaching the science of learning. *Cogn Res Princ Implic*. 2018;3:2.

21. Kornell N, Klein PJ, Rawson KA. Retrieval attempts enhance learning, but retrieval success (versus failure) does not matter. *J Exp Psychol Learn Mem Cogn*. 2015;41:283–294.

22. Chang D, Kenel-Pierre S, Basa J, et al. Study habits centered on completing review questions result in quantitatively higher American Board of Surgery In-Training Exam scores. *J Surg Educ*. 2014;71:e127–e131.

23. Elmore LC, Jeffe DB, Jin L, Awad MM, Turnbull IR. National survey of burnout among US general surgery residents. *J Am Coll Surg*. 2016;223:440–451.

24. Maslach C, Schaufeli WB, Leiter MP. Job burnout. *Annu Rev Psychol*. 2001;52:397–422.

25. McManus IC, Winder BC, Gordon D. The causal links between stress and burnout in a longitudinal study of UK doctors. *Lancet*. 2002;359:2089–2090.

26. Lebares CC, Guvva EV, Ascher NL, O'Sullivan PS, Harris HW, Epel ES. Burnout and stress among US surgery residents: psychological distress and resilience. *J Am Coll Surg*. 2018;226:80–90.

27. Buckley EJ, Markwell S, Farr D, Sanfey H, Mellinger J. Improving resident performance on standardized assessments of medical knowledge: a retrospective analysis of interventions correlated to American Board of Surgery In-Service Training Examination performance. *Am J Surg*. 2015;210:734–738.

28. Kusurkar RA, Ten Cate TJ, van Asperen M, Croiset G. Motivation as an independent and a dependent variable in medical education: a review of the literature. *Med Teach*. 2011;33:e242–e262.

29. Dath D, Hoogenes J, Matsumoto ED, Szalay DA. Exploring how surgeon teachers motivate residents in the operating room. *Am J Surg*. 2013;205:151–155.

30. Cook DA, Artino AR Jr. Motivation to learn: an overview of contemporary theories. *Med Educ*. 2016;50:997–1014.

31. Deci EL, Koestner R, Ryan RM. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychol Bull*. 1999;125:627–668. discussion 692-700.

32. Pink DH. Drive: The Surprising Truth About What Motivates Us. Penguin; 2011.

SUPPLEMENTARY INFORMATION

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jsurg.2019.08.015.