Best Study Strategy for the NBME Clinical Science Surgery Exam

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INTRODUCTION: Providing medical students with effective study strategies is paramount in fostering their success on the NBME Clinical Science Surgery exam. As of yet, there has not been a comprehensive inquiry into a study strategy for this exam. We aim to identify if the following are associated with higher NBME raw exam scores: (1) the use of popular study materials, (2) the number of study materials used, and (3) the amount of time spent studying throughout the clerkship.

METHODS: Over the period of 1 academic year, third-year medical students at our institution were administered a survey during their surgical clerkship inquiring about study materials used and hours spent studying per week. The data were then matched to students' raw NBME scores and then depersonalized. A total of 82 of 193 (42%) students responded with an overall average raw score of 76.74 on the NBME Clinical Science Surgery exam. By comparing our data to the NBME national average of 70 with a standard deviation of 8, a z test was used to compare the population mean to our sample means.

RESULTS: When investigating resources used, the combination of using an online question bank and a high yield review book yielded a high z score (6.23) and using 4 resources yielded the highest z score (6.28). Regarding study hours, the highest z scores were seen when students studied for 6 to 10 hours per week during the first half of the clerkship, and 11 to 15 hours per week during the second half of the clerkship (5.76 and 6.02, respectively).

CONCLUSIONS: In conclusion, higher NBME Clinical Science Surgery exam scores were correlated with the use of multiple and varied types of resources and increasing study time closer to the exam date. The resources and methods utilized by students achieving the highest exam scores can be recommended by surgical educators and employed by other medical students to foster academic success. (J Surg Ed 76:1539−1545. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: surgery, medical school, NBME, study strategy

COMPETENCIES: Medical Knowledge, Practice-Based Learning and Improvement, Systems-Based Practice

INTRODUCTION

The Liaison Committee on Medical Education has developed a standard curriculum to balance clinical experience, educational didactic sessions, and self-study during the medical school core clinical surgery rotation.[1] However, the varied nature of clinical services has placed a greater emphasis on examination scores in determining students' final clerkship grades.[1-5] Developing a successful study strategy to adequately prepare for the National Board of Medical Examiners (NBME) Clinical Science Surgery exam (Shelf exam) has proven to be a challenging endeavor. Demanding clinical rotations, time constraints, and the overwhelming amount of study resources available imparts a challenge in maintaining self-study schedules. In addition to textbooks, students now have access to audio, video, free and subscription-based internet resources, as well as institution provided simulation resources.[6,7]

Developing individual learning plans is of paramount importance to success on the NBME Surgery Shelf exam,[8] however, specific inquiry into the best study strategy has been limited. Previous evaluations investigating study resources and study habits have been limited to surgery residents or the usefulness of alternate teaching behaviors such as flipped classrooms, preceptor models, and simulation training.[9-13] Other studies have investigated changes in the surgery clerkship curriculum and the effect on examination scores; including adopting an innovative curriculum,[14] investigating clinical rotation order,[15] altering the length of clinical

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rotations,[16] and even delaying the USMLE Step 1 exam until after all clerkships have been completed.[17]

It is important for surgical educators to suggest to students a study strategy utilizing current schedules and available resources to help students succeed on the NBME Surgery Shelf exam. In order to determine the best study strategy, we aim to identify if the following are associated with higher NBME raw exam scores: (1) the use of popular study materials, (2) the number of study materials used, and (3) the amount of time spent studying throughout the clerkship.

METHODS

A prospective observational study was conducted at our institution over the course of 1 academic year, July 2016 through June 2017. The study was deemed exempt from approval by the institutional review board as participation was voluntary and the deidentified nature posed minimal risk to participants. A survey was administered to all third-year medical students during their surgery clerkship to investigate study habits. During the clinical 3-year medical student curriculum, all students rotate with the Department of Surgery for a total of 8 weeks. The rotation is divided into two 4-week long rotations, referred to as block 1 and block 2, respectively. Students are assigned to either a general surgery or surgical subspecialty service at locations throughout the greater New Orleans area or nearby cities having affiliation with our institution. Students may request rotation placements based on interests or are randomly placed at 2 of 16 possible rotations located at 13 different hospitals.

Before the start of clinical rotations, students receive a 2-day orientation consisting of information sessions, lectures, and hands on skill stations. The course-learning objectives are discussed and students are encouraged to use a surgical textbook to prepare for their NBME examination; however, there is no required text. Students may access various web-based surgical resources through the institution's library; however, additional resources not available must be purchased individually. Students are also provided with access to online educational modules covering surgical procedures and patient management.

Throughout the surgery clerkship, students meet with the clerkship director or other members of the surgery faculty at least once in the middle and once at the end of the clerkship. At the end of the clerkship, students were administered a voluntary nonvalidated survey designed by the surgery clerkship administrators to assess study habits and resources used throughout the clerkship. A link to complete an online survey was emailed to students during the last 2 weeks of the clerkship rotation. Students were additionally reminded and encouraged to complete the survey at their end of the clerkship meeting. Students privately completed one 5-question online survey (Fig. 1). The survey was made voluntary to further enforce that responses would in no way alter clerkship grades. The survey included free response questions regarding rotation assignments during block 1 and block 2, and the resources used to study throughout the clerkship. The survey also included multiple choice

Name: _____

1. Please list your *block 1* surgery rotation: _____

2. How many hours did you spend studying per week on average during *block 1*?

   Please select one of the following:
                   0-5 hrs.   6-10 hrs.   11-15 hrs.   16-20 hrs.   >20 hrs.

3. Please list your *block 2* surgery rotation: _____

4. How many hours did you spend studying per week on average during *block 2*?

   Please select one of the following:
                   0-5 hrs.   6-10 hrs.   11-15 hrs.   16-20 hrs.   >20 hrs.

5. Please list the resources (books, qbanks, apps, etc.) you used to prepare for the NBME shelf exam:
   _____

FIGURE 1. Example of survey questions.

questions inquiring about the estimated number of hours spent studying per week during each block (0-5, 6-10, 11-15, 16-20, or >20 hours). Surveys were processed by the clerkship coordinator and information was kept secure.

At the end of the clerkship clinical rotations, all students completed the NBME Clinical Science Surgery exam, a multiple-choice computer-based examination. Survey data were then matched to the students' raw NBME Surgery Shelf exam score, entered into a database, and depersonalized. The clerkship coordinator performed the data collection and student de-identification with no author involvement in this process.

Statistical analysis was performed to test for significance. A z test was used to evaluate for differences between the mean NBME Surgery Shelf exam scores between our study sample and the national average, serving as our population mean. A higher z score indicated a better outcome in our study sample compared to the national average. A statistical significance was set at a p value less than 0.05 corresponding to a confidence level of 95%. Average exam scores between groups were further compared using 2-sample t tests.

RESULTS

During the study period, 193 third-year medical students completed the surgery clerkship at our institution. The survey response rate was 42.49% with a total of 82 students completing the survey, serving as our study sample. The NBME Clinical Science Surgery exam average raw score for our study sample was 76.74% over the entire academic year (Fig. 2), while the national average NBME score during our study period was reported to be 70% with a standard deviation of 8 ($p < 0.0001$). Students that did not respond to the survey scored an
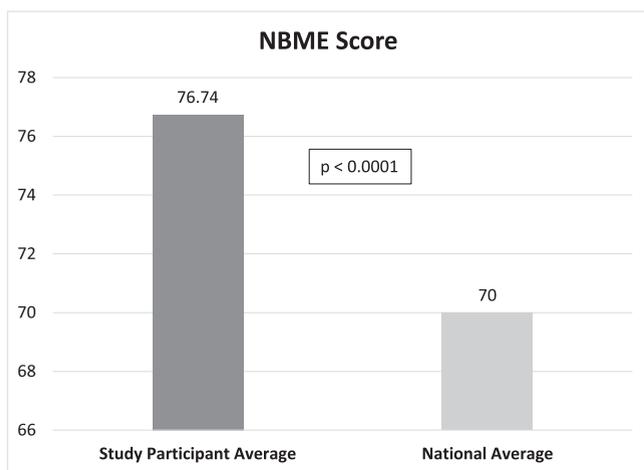
average of 73.65% over the entire academic year, which was lower than the average score for students responding to the survey ($p < 0.01$), but still higher than the national average ($p < 0.0001$). Of note, regarding the survey responders, the average NBME scores for students completing the exam during the first half of the academic year was 74.9%, increasing to an average score of 78.3% for students taking the exam during the second half of the academic year. This was found to be statistically significant ($p < 0.05$).

Survey data were analyzed to identify educational resources used by students participating in our study to prepare for the Surgery Shelf exam. The most common resources used included an online question bank, a high yield review book, and a case-based review textbook (Fig. 3). Additional resources used included question books, practice exams, additional case-based books, rapid fire question and answer books, online resources, and textbooks.

When the average exam scores were analyzed based on the resources used to study during the clerkship, the combination of using the online question bank and the high yield review book yielded the highest z score (z score = 6.23; Table 1). This was followed by the combinations of using the online question bank, the high yield review book, and 1 additional resource (z score = 6.02); the online question bank, the high yield review book, and 2 additional resources (z score = 5.17); the online question bank, the high yield review book, and the case-based review textbook (z score = 4.75); and the online question bank, the high yield review book, the case-based review textbook, and 1 additional resource (z score = 3.19).

When average exam scores were analyzed based on the total number of resources used to study during the clerkship, using 4 resources yielded the highest z score within this analysis and of any condition across the study overall (z score = 6.28; Table 2). This was followed by the use of 3 resources (z score = 3.28), 2 resources (z score = 3.16), and 5 resources (z score = 2.70), respectively.

When average exam scores were analyzed based on the number of hours spent studying per week during block 1 of the clerkship, students spending 6 to 10 hours studying per week had the highest z score (5.76; Table 3). The following z scores were also obtained: students studying 11 to 15 hours per week (z score = 3.44), students studying 16 to 20 hours per week (z score = 3.03), and students studying 0 to 5 hours per week (z score = 2.90). Investigating time spent studying during the second half of the clerkship, block 2, studying 11 to 15 hours per week had the highest z score (6.02). This was followed by students studying 16 to 20 hours per week (z score = 3.97), students studying 6 to
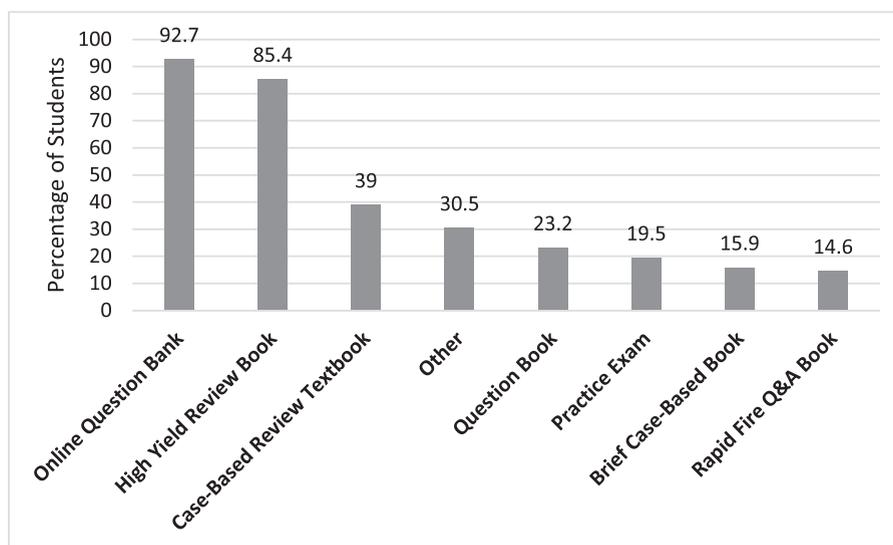

FIGURE 2. NBME Clinical Science Surgery exam average raw scores.

FIGURE 3. Study resources used.

10 hours per week (z score = 2.41), students studying over 20 hours per week (z score = 2.21), and students studying 0 to 5 hours per week (z score = 1.01).

DISCUSSION

The goal of our study was to determine the relationship between the study habits of third-year medical students during their surgery clerkship rotation and their performance on the NBME Surgery Shelf exam. We investigated the specific resources used by students, the number of resources used, and the amount of time spent studying during the surgery clerkship. By comparing students' scores with the national NBME average, we were able to determine which factors led to a higher exam score. Our results provide surgical educators with data regarding the most effective strategies to prepare for the clerkship NBME exam, which can be used to help students succeed.

Results of our study showed that higher NBME scores were attributed to the use of 4 different study resources, using an online question bank along with a high yield review book, studying 6 to 10 hours per week the first half of the clerkship, and studying 11 to 15 hours per week the second half of the clerkship. Using 4 resources yielded the highest z score. Interestingly, using 3 and 2 resources produced a higher z score than using 5 resources. A possible explanation for this may be that by using too many resources students often get lost in the breadth of information. They may also be completing a portion of each resource and do not complete a comprehensive review of the entire subject. It is however important to incorporate different resources and study techniques.

Our study revealed that by using the online question bank along with a high yield review book, students obtained higher exam scores. A study by Taylor et al. also investigated resources used for the NBME Surgery Shelf exam. The authors concluded that the most common study materials used were review books and

TABLE 1. Results of Resources Used

Resources Used	n	Exam Average	p Value	z Score
Online question bank + high yield review book	65	76.18	<0.0001	6.23
Online question bank + high yield review book + 1 additional resource	53	76.62	<0.0001	6.02
Online question bank + high yield review book + 2 additional resources	26	78.11	<0.0001	5.17
Online question bank + high yield review book + case-based review textbook	24	77.75	<0.0001	4.75
Online question bank + high yield review book + case-based review textbook + 1 additional resource	13	77.08	<0.001	3.19

TABLE 2. Number of Study Resources Used

# of Resources Used	n	Exam Average	p Value	z Score
2	16	76.31	<0.001	3.16
3	34	74.50	<0.001	3.28
4	25	80.04	<0.0001	6.28
5	6	78.83	<0.01	2.70
6	1	77.00	>0.05	0.88

Internet sources. This was then followed by textbooks, journals, and personal notes.[7] The results of this study compare to our survey responses suggesting that there is a trend to abandon traditional study methods as new resources become available, without a compromise in student performance. Surgery clerkship educators and faculty members at our institution now encourage students to utilize different resource types when studying for their Shelf exam, specifically an online question bank and a high yield review book.

When analyzing time spent studying, during the first half of the clerkship, block 1, studying 6 to 10 hours per week yielded higher exam scores. This group scored higher than those who reported studying for a longer duration. An explanation for this may be that students initially focused more time on clinical duties, obtaining education through their faculty, residents, and patients. A study by Myers et al. revealed that medical students who participated in less self-directed studying and had greater clinical experience achieved higher academic performances.[1] In our study, during the second half of the rotation, block 2, students that reported studying 11 to 15 hours per week obtained higher exam scores. This may also be explained by the fact that as the exam approaches, more time is required for self-directed learning to cover gaps in knowledge that was not obtained

TABLE 3. Time Spent Studying During the Surgery Clerkship

Study Hours	n	Exam Average	p Value	z Score
Block 1				
0-5 h	15	76.00	<0.01	2.90
6-10 h	29	78.55	<0.001	5.76
11-15 hrs.	20	76.15	<0.001	3.44
16-20 h	16	76.06	<0.01	3.03
>20 h	2	67.50	>0.05	-0.44
Block 2				
0-5 h	3	74.67	>0.05	1.01
6-10 h	19	74.42	<0.01	2.41
11-15 h	31	78.65	<0.0001	6.02
16-20 h	20	77.10	<0.0001	3.97
>20 h	8	76.25	<0.05	2.21

through clinical exposure. Allowing more time to cover areas of weakness will undoubtfully lead to higher exam scores. A study by Monrad et al. evaluated examination scores after a 25% reduction in the length of the surgery clerkship. No change was observed in students' exam scores by decreasing the rotation length.[16] Students may have studied for longer weekly time intervals throughout the entirety of the clerkship, or devoted more time to clinical responsibilities to compensate for a shorter clerkship duration. Undeniably, multiple variables contribute to student success and with the right balance of clinical, didactic and self-learning, students may achieve a high level of academic performance.

A factor that may have also played a part in students' success on the surgery clerkship NBME Shelf exam was the order in which students completed their core clerkship rotations. All medical students are required to complete clinical rotations in surgery, family medicine, internal medicine, psychiatry, obstetrics and gynecology, and pediatrics. Several studies have investigated the timing of these core rotations and students' success on the Surgery NBME Shelf exam. It has been shown that students who completed the core internal medicine clerkship before the surgery rotation scored higher on the Surgery NBME Shelf exam.[18,19] NBME performance also tends to improve throughout the academic year.[3] In fact, in our study population, the average NBME scores increased from 74.9% for students completing the exam during the first half of the academic year, to 78.3% for students completing the exam during the second half of the academic year. This improvement in exam scores was noted to be statistically significant ($p < 0.05$). An overlap of information on the clerkship exams and an increased familiarity of the exam style and format may contribute to improved performance.

The strength of our study comes from the prospective nature, and the multiple factors investigated. We do however recognize several limitations. Our study was conducted at a single institution over the course of 1 academic year. Our institution's clerkship faculty encourage students to use a surgical text to prepare for their exam, however, students may be more prone to using resources recommended by other faculty members, residents, or other students; therefore, there is limited variability in the specific resources used. Future studies should further inquire how students heard about or chose the resources they used. Recall bias may have existed, as students may not have accurately remembered how much time they spent studying during the rotation. Response bias may have also been seen; students may have felt obligated to answer a certain way, as responses would be seen by the clerkship administration. Our study also had a low response rate of 42% posing a risk of selection bias. Students that scored higher or felt more prepared for the

exam may have been more willing to participate in the study. Students responding to the survey did indeed score slightly higher compared to the nonresponders, which was found to be statistically significant ($p < 0.01$). However, both groups still received a significantly higher average score compared to the national average ($p < 0.0001$). Additional factors involved in medical student education were also not directly investigated; including which specific rotation each student was assigned to. Certain services may allow for more educational opportunities. Student's career interests were also not evaluated. Students who aim to pursue a career in surgery are more likely to have a higher level of motivation to seek out self-directing learning opportunities. Future multi-institutional studies will increase the sample size and expand the variability in the resources identified providing further insight into the most effective study strategies.

CONCLUSIONS

With an increasing emphasis on clerkship directors to incorporate medical students' scores on the NBME Clinical Science Surgery exam into final clerkship grades, it must be understood how students' can best succeed. By understanding which resources and study techniques lead to a higher performance on the exam, educators can suggest study strategies to their students. This study revealed that higher NBME Clinical Science Surgery exam scores were correlated with the use of multiple and varied types of resources and increasing study time closer to the exam date. The resources and methods utilized by students achieving the highest exam scores can be recommended by surgical educators and employed by other medical students to foster academic success.

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SUPPLEMENTARY INFORMATION

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