



Factors Influencing a Medical Student's Decision to Pursue Surgery as a Career

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Abstract

Background Recent match trends from the National Resident Matching Program suggest that the number of allopathic medical students (MD) pursuing general surgery is declining. This decline may have profound consequences given the surgeon shortage predicted by the Association of American Medical Colleges. Early exposure to surgery opportunities may increase a student's desire to pursue the specialty as a career. The aim of this study was to evaluate the effect surgical activities have on promoting student interest in surgery.

Methods Medical students (years 1–3) at the University of Illinois at Rockford completed a two-component activity: a questionnaire and laparoscopic box activity. Differences in lifestyle factors, psychomotor aptitude, and future career interests were compared.

Results A total of 64 medical students completed the activity. 45.3% of students reported that the activity positively influenced their decision to pursue a career in surgery. Rating of the importance of living in a rural versus urban community was an important lifestyle factor ($p = 0.01$) for students without rather than with an interest in surgery, 3.95 and 3.19, respectively. No differences were observed in other lifestyle factors.

Conclusion Early exposure to surgical activities may foster interest in students who lacked previous intention to pursue the specialty.

Jarod Shelton, Michael Obregon, Jessica Luo, and Oren Feldman-Schultz have contributed equally to the project.

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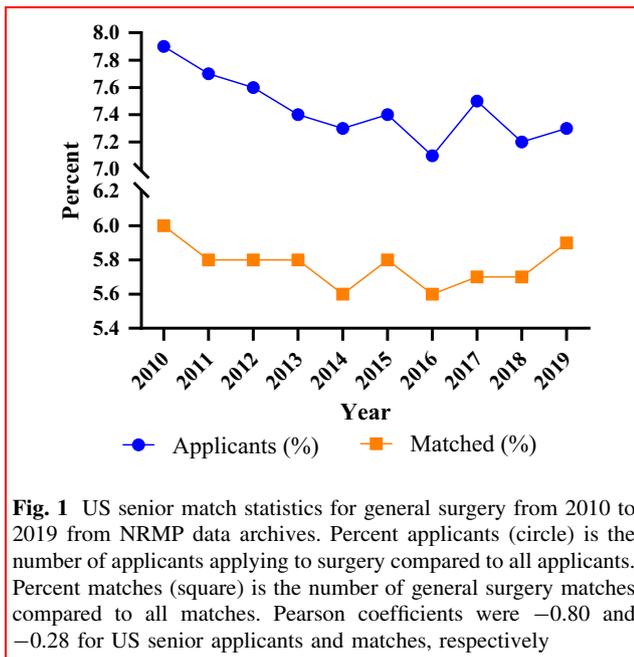
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Introduction

The number of US seniors applying and matching into general surgery has fluctuated since 1994. Overall, the match rate of all applicants (osteopathic, foreign international, and US international graduates) matriculating into general surgery has remained relatively consistent; however, recent 2019 Match Day statistics from the National Resident Matching Program (NRMP) [1] indicate that allopathic medical student interest in general surgery is declining (Fig. 1). Students reported, on average, a 5% decrease in surgery interest for every completed year of medical school [2, 3]. This growing disinterest in general surgery may have profound consequences given the predicted shortage of up to 29,000 surgeons by 2030 [4].



Several causes for diminished interest in general surgery have been proposed, including poor surgeon personality, lack of mentorship, hostile environment, and increased length of training [1, 5]. Other studies have shown that increased exposure to surgical specialties during the pre-clinical years positively correlates with a greater interest in general surgery [6]. Therefore, increasing a medical student's exposure to general surgery through positive mentorship, research opportunities, and activities that mimic surgical procedures may improve matriculation rates for US seniors pursuing general surgery [7].

There are several methods of exposing medical students to surgery. Longitudinal laparoscopic courses have shown varying results in cultivating surgery interest [8]. The aims of this investigation were twofold: explore the factors influencing a student's interest in surgery and, second, evaluate how exposure to a laparoscopic box activity influences a student's decision to pursue surgery as a career. The authors' hypothesis is that exposure to a surgery-related activity, i.e., laparoscopic box trainer, will positively influence a medical student's desire to pursue surgery as a career.

Materials and methods

Participants

Years 1–3 medical students (M1–M3) at the University of Illinois at Rockford (UI-Rockford) were asked to voluntarily complete the cross-sectional activity. UI-Rockford is one of four campuses within the University of Illinois

College of Medicine system and is home to the Rural Medical Education (RMED) program. The RMED [9] program provides a supplementary curriculum focusing on rural healthcare issues and represents approximately half of each class.

Procedure

A non-probability sampling method was used to send campus-wide emails to all 177 M1–M3 students requesting their voluntary participation. No incentive was offered for completion of the activity. The in-person activity was available to medical students between January 2019 and April 2019 for about 300 h in a common area on campus. On average, a student researcher was present with the activity for 20 h per week during the morning or afternoon. M1–M3 class schedules were reviewed, and emails were sent to students indicating when the box activity would be available. Students were also able to request additional time outside of the posted schedule if an obligation limited their ability to complete the activity during regular hours. Student researchers were present to answer questions while the activity was being completed; however, students were encouraged to complete the activity with minimal interjection. The activity was comprised of three phases: pre-activity questions, laparoscopic box activity, and post-activity questions.

Laparoscopic box trainer

Construction of the laparoscopic box trainer was based on designs by De Loose and Weyers [10]. A 10-ream copy paper box was modified to include a 400-cm² viewing area with two 6-mm trocar ports. A base was constructed using layered cardboard to secure the activity blocks and weights minimized horizontal movement of the box trainer. Maryland grasping forceps 5 mm × 330 mm and fenestrated grasping forceps 5 mm × 330 mm were purchased from an international distributor (Surgical Works) in India using eBay™. Real-life use of the laparoscopic box is shown in Fig. 2a.

First phase of activity

The 41-item survey (see “Online Appendix”) was split into three phases with the laparoscopic box activity being the second phase. The survey was hosted on an ASUS Chromebook using Google Forms. The first phase of the survey included demographic, amount of surgery exposure before and during medical school, prior laparoscopic instrument use, thoughts of pursuing surgery as a career, psychomotor aptitude, future specialty, and lifestyle expectation questions. Demographic, future specialty, and lifestyle expectation questions were based on the 2018

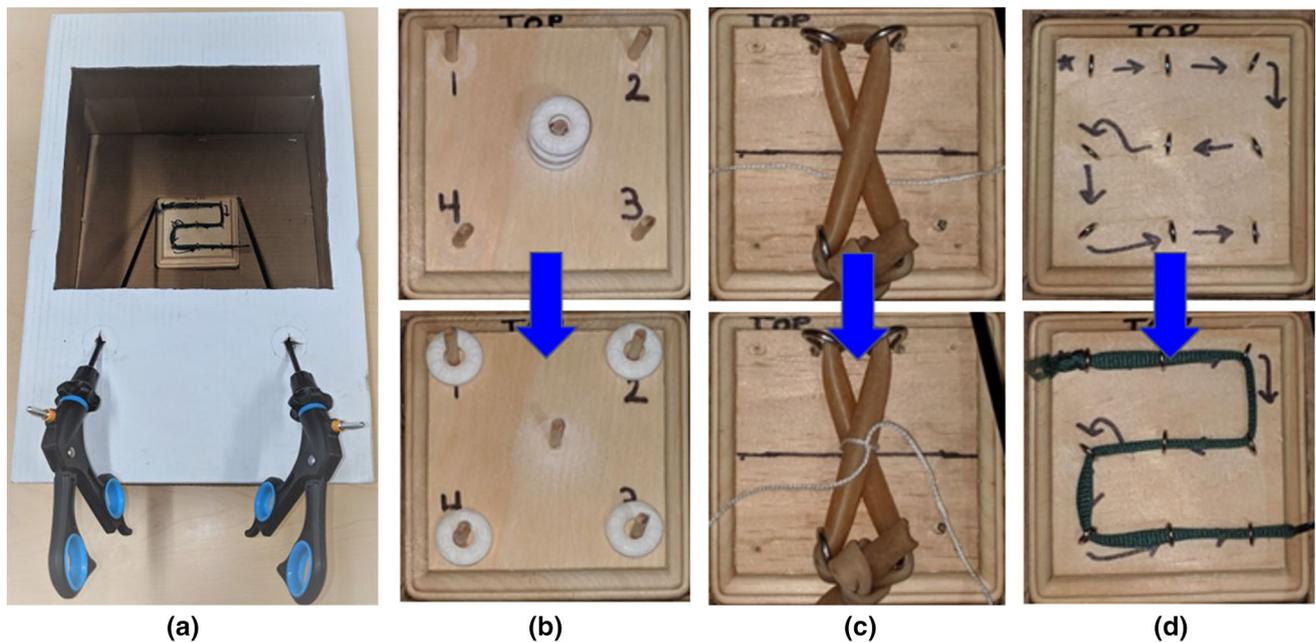


Fig. 2 Real-life example of laparoscopic box trainer use (a). Task 1 required the transfer of four mints from a central to peripheral dowels (b). Task 2 required the tying of a standard surgeon's knot (c). The final task, task 3, required the threading of a shoelace through eyelets (d)

Association of American Medical Colleges' Medical School Graduation Questionnaire [11]. All other questions were developed by the investigators, and the survey was reviewed by two senior surgeons related to content and question format.

Second phase of activity

The second phase of the activity was the laparoscopic box. Three activities were developed to mimic common laparoscopic procedures, and two general surgeons tested the realism of each activity. Both surgeons reported that the activity mimicked laparoscopic surgery and that the level of difficulty was appropriate for a medical student.

Students were asked to watch an embedded instructional video prior to beginning each activity. The time to complete each activity was inputted by the student. Students were allowed to quit any task if perceived too difficult. The activities included: the transfer of four mints from a central dowel to four peripheral dowels in each corner (Fig. 2b); the tying of a standard surgeon's knot around 3 mm rubber latex tubing (Fig. 2c); and the threading of a shoelace through a series of 5-mm eyelets (Fig. 2d). The surgeon's knot required two throws for the initial knot, and the final, securing knot required one throw.

Third phase of activity

The third phase of the activity was a mix of post-activity questions that measured the functionality of the

laparoscopic box trainer and any change in a student's perception of surgery as a career. Students were encouraged to provide an open-ended response on anything that was not asked that may be important when considering a career in surgery.

Data collection and analysis

Data were transferred to Excel 365 (Microsoft Corporation, Redmond, WA) and analyzed for statistical significance using Prism v8 (GraphPad Software, San Diego, CA). Descriptive statistics were calculated for all data. Normal distribution of continuous variables was evaluated using the Shapiro–Wilk test. Significance between normally distributed groups was analyzed using the Student's *t* test, while significance between non-normally distributed groups was assessed using the Mann–Whitney *U* test. The Chi-square test was used to evaluate categorical variables. Pearson coefficients were used to investigate linear relationships. A *p* value of less than 0.05 was considered significant.

Results

A total of 64 M1–M3s completed the activity representing a response rate of 36.2%. Demographic characteristics of students are listed in Table 1.

Table 1 Student characteristics (*n* = 64)

	<i>N</i>	Response rate (%)
<i>Gender</i>		
Male	33	51.6
Female	31	48.4
<i>RMED participation</i>		
No	48	75
Yes	16	25
<i>Year of enrollment</i>		
M1/M2	41	64.1
M3	23	35.9
<i>Ethnicity</i>		
AA/Black	5	7.8
Asian	13	20.3
Hispanic	7	10.9
White	35	54.7
Other	4	6.3
<i>Age</i>		
≤25 y/o	38	59.4
>26 y/o	26	40.6

Response rate for survey and laparoscopic activity for medical students (*n* = 64). Responses were separated by gender, participation in RMED, enrollment year, ethnicity, and age

Interest in surgery

Prior to the laparoscopic activity phase, 32 (50%) students responded ‘Yes,’ 19 (29.7%) students responded ‘No,’ and 13 (20.3%) students responded ‘I don’t know’ when asked to report their desire to pursue surgery as a career. After completion of the activity, 29 (45.3%) students reported that the activity positively influenced their decision to pursue surgery. Of the students that initially reported either none or an undecided interest in surgery, 11 (35.3%) students responded that the activity positively influenced their decision to pursue surgery.

No statistical significance was identified in categorical variables between students with and without surgical interest (Table 2). Males (54.5%) and females (45.2%) reported a comparable interest in surgery. Participation in RMED (56.3%) did not influence surgery interest when compared to non-RMED (47.9%) students. Exposure to preclinical (M1/M2) or clinical year (M3) medicine did not affect student interest in surgery (46.3% vs 56.5%). Asian (61.5%), White (54.3%), AA or Black (40%), Hispanic (28.6%), and Other (25%) students reported comparable interest in surgery. Students > 26 y/o (57.7%) reported a similar interest in surgery to ≤ 25 y/o (44.7%) students.

Table 2 Difference in attribute of students interested in pursuing a career in surgery (*n* = 32)

	<i>N</i>	Percentage (%)	Significance
<i>Male</i>			
<i>Gender</i>	18	54.5	0.78
Female	14	45.2	
<i>RMED participation</i>			
No	23	47.9	0.56
Yes	9	56.3	
<i>Year of enrollment</i>			
M1/M2	19	46.3	0.43
M3	13	56.5	
<i>Ethnicity</i>			
AA/black	2	40.0	0.49
Asian	8	61.5	
Hispanic	2	28.6	
White	19	54.3	
Other	1	25.0	
<i>Age</i>			
≤25 y/o	17	44.7	0.31
>26 y/o	15	57.7	

Percentage of students who reported a desire to pursue surgery as a career (*n* = 32). Percent of responses were separated by gender, participation in the rural program, enrollment year, ethnicity, and age. Chi-squared analysis demonstrated no significance between the groups

Psychomotor aptitude

No statistical significance was identified between completion times of students with and without surgical interest for each task (Fig. 3). Completion times for tasks 1, 2, and 3 for students interested in surgery were 64.3 ± 31.4 , 157 ± 103.2 , and 124.6 ± 37.5 s, respectively. In comparison, completion times for tasks 1, 2, and 3 for students with no surgical interest were 55.3 ± 41.7 , 188.4 ± 112.1 , and 133.2 ± 39.7 s, respectively. One student interested in surgery was unable to complete task 2. Four students and one additional student without surgical interest were unable to complete task 2 and task 3, separately. Most students reported that task 2 (75%) was the most difficult followed by task 3 (14.1%) and task 1 (10.9%).

Lifestyle factors influencing career choice

Lifestyle factors were ranked using a 5-point Likert scale (Table 3). All students valued ‘job satisfaction’ (4.72 ± 0.52) the highest followed by ‘enjoying the type of work in the specialty’ (4.55 ± 0.64) and ‘enjoying the work environment’ (4.54 ± 0.56). All students cared least

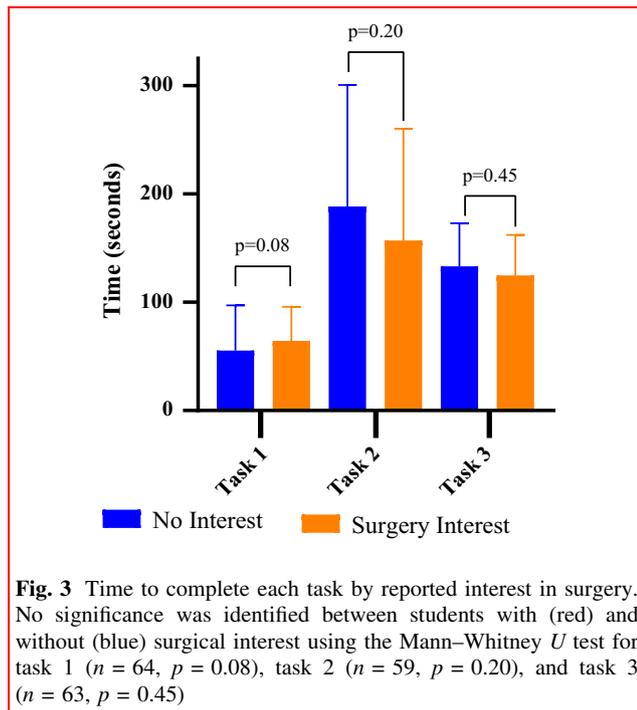


Fig. 3 Time to complete each task by reported interest in surgery. No significance was identified between students with (red) and without (blue) surgical interest using the Mann-Whitney *U* test for task 1 ($n = 64$, $p = 0.08$), task 2 ($n = 59$, $p = 0.20$), and task 3 ($n = 63$, $p = 0.45$)

about ‘research opportunities’ (2.18 ± 1.07) and ‘prestige’ (2.42 ± 1.05). Students without surgical interest were significantly ($p = 0.01$) more likely to report ‘location of future practice’ as an important lifestyle factor. When ranking the most important lifestyle factor, students ranked ‘enjoying type of work in specialty’ (52.3%) as the most important followed by ‘enjoying work environment’

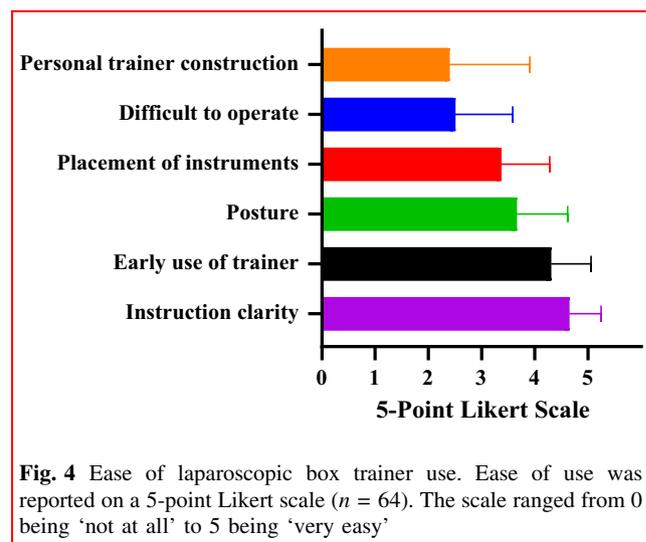


Fig. 4 Ease of laparoscopic box trainer use. Ease of use was reported on a 5-point Likert scale ($n = 64$). The scale ranged from 0 being ‘not at all’ to 5 being ‘very easy’

(27.7%), ‘control of work schedule’ (10.8%), ‘enjoying time off work’ (7.7%), and ‘financial compensation’ (1.5%).

Use of box trainer

Ease of box trainer use was ranked using a 5-point Likert scale (Fig. 4). Students reported that the box trainer was easy to use (4.31 ± 0.75), and the operating instructions were clear (4.64 ± 0.60). Students reported moderate interest (2.4 ± 1.51) in constructing a personal box trainer. The box was difficult to operate by some (2.51 ± 1.08);

Table 3 Variation in surgery interest by rating lifestyle attributes ($n = 64$)

Lifestyle factor (ranked from 1 to 5)	Surgery interest Mean ± SD	No interest Mean ± SD	<i>p</i> value
Financial compensation	3.25 ± 0.80	3.26 ± 0.87	0.96
Control of work schedule	3.72 ± 1.02	4.05 ± 0.97	0.26
Enough time off work	3.53 ± 1.02	3.84 ± 0.69	0.24
Enjoying work environment	4.53 ± 0.62	4.58 ± 0.51	0.78
Enjoying work involved in specialty	4.59 ± 0.56	4.58 ± 0.77	0.94
Prestige	2.38 ± 1.04	2.5 ± 1.15	0.70
Average salary reports	3.17 ± 0.88	3.21 ± 0.92	0.84
Research opportunities	2.06 ± 0.98	2.26 ± 1.24	0.53
Teaching opportunities	2.75 ± 1.02	3 ± 1.29	0.45
Location of practice ^a	3.19 ± 1.06	3.95 ± 0.85	0.01
Call frequency	3.59 ± 0.91	3.95 ± 0.78	0.16
Consistent work schedule	3.47 ± 1.08	3.79 ± 0.98	0.29
Job satisfaction	4.75 ± 0.51	4.74 ± 0.45	0.93

Comparison of lifestyle factors of students with and without surgical interest ($n = 64$). Mean ± standard deviation (SD) was reported for each lifestyle factor. Those without surgical interest reported a significantly greater interest ($p = 0.01$) in practice location

^aUsing the Student’s *t* test. No other significance was identified

however, most students found the placement of the instruments (3.37 ± 0.91) and their posture (3.66 ± 0.96) during use to be appropriate.

Discussion

Lifestyle factors

Lifestyle factors heavily influence a medical student's specialty choice. Previous studies found that controllable lifestyle factors, such as one's work schedule, are becoming more important when choosing a specialty [12–14]. In a web-based survey of 657 medical students, Rao et al. [15] found that quality of life, lifestyle attributes, and stress levels were major motivating factors when considering a specialty. Yen et al. [16] found a similar trend with fulfillment of daily work, work–life balance, and interest in the specialty subject matter in the 259 medical students and 47 radiology residents surveyed. Our results are similar to prior investigations with 'enjoying type of work in specialty' being the most important lifestyle factor influencing specialty choice.

Morra et al. [17] surveyed 560 M1–M4 students and found that financial compensation is one of the least important factors when considering different career options. In a national survey of educational debt's influence on specialty selection, Rosenblatt and Andrilla [18] reported that higher levels of debt had only a minimal effect of specialty selection. Students with higher levels of debt matriculated into lower-paying specialties at a negligible rate when controlling for other predictors of specialty choice. Our results align with prior investigations, finding that 'financial compensation' is one of the least important lifestyle factors influencing specialty selection.

Laparoscopic tasks and surgical interest

Prior investigations have demonstrated a positive correlation between surgical skill and psychomotor aptitude [19–22]. In these investigations, students with a strong interest in surgery tended to have a greater psychomotor aptitude. For example, in a study of 68 fifth-year Belgium medical students, Sisk et al. [23] found that psychomotor aptitude and motivated practice equally influenced final box trainer performance. In our study, no difference was noted in psychomotor aptitude after measuring cross-sectional performance of one laparoscopic activity. Longitudinal use of the laparoscopic trainer in our population may demonstrate greater improvements in psychomotor aptitude in students with an interest in surgery compared to those without interest [19].

Interestingly, five students without an interest in surgery prematurely quit one of the tasks without finishing. In contrast, only one student with surgery interest was unable to complete a task. Cortez et al. [24] surveyed 62 third-year students at a single institution after the completion of their surgery clerkship. A student's grit, i.e., one's perseverance and passion for long-term goals, was measured and found to be greater in students with an interest in surgery. Burkhart et al. [25] and Salles et al. [26] found that higher levels of grit were negatively correlated with surgery resident attrition. Moreover, the amount of grit identified in surgical residents increased each year of residency with the highest levels noted in senior attendings. Therefore, the lack of perseverance noted in the five students who prematurely stopped one of the tasks may be explained by lower levels of grit exhibited in non-surgical students.

Early surgical exposure for generation of students for surgery

Use of laparoscopic trainers during the clinical years of medical school has been shown to increase student interest in surgery [27–29]. Additionally, low-cost or homemade laparoscopic trainers allow students to practice and increase their exposure to different surgical techniques [30–32]. These homemade trainers can be modified to best-fit the type of laparoscopic surgery the student wants to practice by incorporating low-cost online resources and/or electronic devices to simulate a two-dimensional environment. The current study found 45.3% of all students and 35.3% of those that initially reported none or an undetermined interest in surgery that the laparoscopic activity positively influenced their decision to pursue surgery. Incorporating surgical activities that expose students to surgery during the early years of medical school may be sufficient to generate more students for surgery.

Prior literature has demonstrated that medical student interest in surgery can be piqued by increasing a student's clinical involvement [33]. The expectations of a clinical year medical student are to gain as much experience as possible in each core clerkship. Even when a clinical student is eager for experience, their medical supervisor may not be capable of providing them with adequate educational opportunities. Patel et al. [34] reported that medical student interest in surgery was increased from 42 to 88% following educational events that focused on teaching basic surgical skills. In a similar study, Seo et al. [35] found that exposure to a surgical skills training weekend increased medical student interest in surgery from 56 to 81.3%. Other investigations showed that robust, intra-operative teaching increased student satisfaction during the clerkship and increased student interest in surgery as a career.

Engaging in research opportunities has been shown to foster interest in the associated specialty. Research during medical school increases a student's ability to translate medical research into clinical practice [36]. Healy et al. [37] indicated that increased interest is not only dependent on surgical opportunities, but surgeon mentors who can advise on productive, publishable research. Students who identified a positive surgeon mentor were more likely to retain a positive view of surgery and pursue it as a career. Surprisingly, Zuccato and Kulkarni [38] found that medical student interest in neurosurgery decreased from 25 to 10% following a 2-week comprehensive, focused surgical experience that introduced students to different components of surgery, including research. At the completion of the experience, those still pursuing neurosurgery had a greater interest and were exploring additional educational opportunities that involved research. Thus, involvement in surgery-related research may be used to not only foster student interest, but to solidify a student's intention of surgery as a career.

Limitations

The study design was cross sectional in nature. The relationships observed are associations that only suggest potential causal relationships [39] related to interest in surgery as a specialty choice at one point during a student's medical education. Response rate was another limitation. A larger sample size may increase the significance of the findings. Personality types and other intrinsic characteristics were not examined. Some personalities may be inherently drawn to surgery, and this requires further investigation. Lastly, the use of a binary categorical variable for measuring student interest in surgery may not be ideal during the early phases of their undergraduate medical education. Although not ideal, the use of a binary categorical variable allowed students to clearly declare their surgical interest prior to and following the completion of the activity.

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Compliance with ethical standards

Conflicts of interest Nothing to disclose.

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