Student Factors That Influence Clerkship Grades and Matching Into a Surgical Residency

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OBJECTIVE: Evaluate the relationship between medical school factors (including preclinical mentorship, order of clerkships, and clerkship grades) and matching into surgical specialties.

DESIGN: Clerkship information, match data, and data on structured preclinical research obtained from 2010 to 2015 for a single institution was obtained and analyzed using multivariate analysis.

SETTING: University of Michigan Medical School.

PARTICIPANTS: Seven hundred and forty-six students who took both the Internal Medicine and Surgery clerkships between 2010 and 2015 and have since participated in the match.

RESULTS: Among 740 students studied, 243 matched into a surgical field. Higher Shelf scores were associated with higher clerkship grades in Surgery and Internal Medicine. Honors or High Pass in Surgery were associated with matching into a surgical field. Structured preclinical research in Surgery and order of clerkship were not associated with matching into a surgical field.

CONCLUSIONS: Students who went into surgery were more likely to receive Honors or High Pass. Preclinical choices geared toward a surgical specialty (e.g., order of clerkship and structured research) were not associated with matching into a surgical field. These data may help guide school specific advice for students. (J Surg Ed 76:393–400. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: surgery education, grading, mentorship, residency match

COMPETENCIES: Interpersonal and Communication Skills, Professionalism

INTRODUCTION

Anecdotally, one of the top sources of medical student anxiety is centered around the pairing of students to their preferred residency programs in the match, and the way that the institution at which they train will influence their careers. Preclinical medical students often look for mentorship in their fields of interest, but many students change their career interest during their second and third years, as they begin to work in clinics, and experience anxiety that not having done research with a mentor in their new field will negatively impact their long-term success. Students often aim to strategically schedule their core clinical year to enhance their ability to succeed during their clerkship of interest.[1,2]

For preclinical students interested in Surgery, many struggle on when to take the Surgery clerkship and how to schedule other rotations, namely Internal Medicine, around this (i.e., before or after Surgery). It is unclear if and how the timing of when to take Surgery and Internal Medicine affects a student's grade in their Surgery rotation. In addition, neither students nor educators understand fully what aspects of a student's transcript affect their ability to match in their field and location of choice. A survey of program directors has shown that a student's United States Medical Licensing Exam Step 1 score is often one of the most important screening criterion for program directors in General Surgery, but the final selection of residents is also heavily influenced by the interview and letters of recommendation.[3] Further, the survey respondents in the same study also attested that previous research was a relatively unimportant factor in choosing an applicant. It is less clear how other factors specific to a

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medical student's core clinical rotations, including grades in the Surgery clerkship and timing of Surgery clerkship, can affect a student's competitiveness.

We hypothesized that preclinical research in surgery and timing of the Surgery clerkship would impact a student's grade, specifically that Surgery in the middle of the year and after Internal Medicine increases the chance of Honors. To evaluate for factors impacting grades, we evaluated how timing, shelf score, and preclinical research affected the clerkship grades and which factors (including preclinical research in a structured program, Surgery and Internal Medicine grades, shelf scores, and clerkship timing and order) are associated with choosing a career in surgery.

MATERIALS AND METHODS

We reviewed grading, residency placement, and mentorship data for all students who passed through the Surgery and Internal Medicine clerkships at a single allopathic medical school from May 2010 to April 2015. Students were excluded from the study if they had not participated in the residency match, failed without remediation, or had not yet graduated.

For each student, data collected included grade in the Surgery and Internal Medicine clerkships (Honors, High Pass, Pass, and Fail), shelf score in the clerkship, the time of year in which the clerkship was taken, the academic year in which the clerkship was taken, a history of mentorship by a member of the surgical faculty, and residency matriculation information. Grades in the Surgery clerkship were assigned based upon clinical performance (60%), shelf exam performance (25%), oral exam performance (10%), and completion of administrative tasks (5%). Grades in the Internal Medicine clerkship were assigned based on clinical performance (75%), shelf exam performance, and performance on 3 internal exams (25% for all exams). Institutional guidelines suggest that 25% to 30% of students receive a grade of Honors, 30% to 40% a grade of High Pass, and 30% to 40% a grade of Pass. The Surgery clerkship was 8 weeks long and offered 6 times per academic year. The Internal Medicine clerkship, at 12 weeks, is offered 4 times per year. At our institution, students are able to submit preferences for the order in which they take their core clerkships.

The presence of preclinical surgical research was defined by having a surgical faculty member as their mentor for a sponsored or funded research project in the summer between their first and second years of medical school. The research program is not required for students at our institution, but the majority of medical students apply for finding mentors from all medical fields. Students often view their choice of mentor for this program as having a significant impact on their future success in that mentor's field. The residency matriculation information on each student included the specialty into which the student matched and the specific residency program to which each student matched.

Surgical specialties included were General Surgery, Neurosurgery, Orthopedic Surgery, Otolaryngology, Plastic Surgery, Thoracic and Cardiac Surgery, Urology, and Vascular Surgery. All but General Surgery were considered surgical subspecialties. Ophthalmology, and Obstetrics and Gynecology were considered separately. In terms of Obstetrics and Gynecology, it was differentiated based upon the presence of its own core clerkship. Ophthalmology was differentiated due to its separation by our institution from other surgical specialties for advising purposes.

Categorical variables were compared using chi-square test and Fisher's exact, as appropriate, and continuous variables were compared using Student's t test and ANOVA. Multivariable logistic regression and ordered logistic regression were used to analyze the association between selected predictors and relevant outcomes. Data were analyzed by considering groups of students—groups included (1) students who matched into General Surgery, (2) students who matched into a surgical subspecialty (excluding Ophthalmology, and Obstetrics and Gynecology), (3) students who matched into any surgical field (including Ophthalmology, and Obstetrics and Gynecology), and (4) students who matched into any nonsurgical field. Analysis was performed using STATA13 (StataCorp, College Station, TX) and the level of significance was set at $\alpha < 0.05$.

This research has been deemed IRB exempt (local IRB number HUM 00117084).

RESULTS

Distribution of Students and Grades

Over the 5 years analyzed, 847 students went through the Surgery and Internal Medicine clerkships at our institution. Among these students, 746 met all inclusion criteria. The majority of those who did not meet inclusion criteria have taken time off of medical school to complete graduate degrees, but completed one or both of the Surgery and Internal Medicine clerkships before taking their leave of absence. Fifty-five students matched into General Surgery (7.4%), 98 (13.2%) into a surgical subspecialty not including Ophthalmology or Obstetrics and Gynecology, 28 (3.8%) into Ophthalmology, and 52 (7.0%) into Obstetrics and Gynecology. The remainder of the students (507, 68.5%) matched into a nonsurgical field.

Students who matched into each of the specialties listed above showed no statistically significant

differences in their distribution across the year in both clerkships (p = 0.68). When removing Ophthalmology and Obstetrics, there was still no statistically significant differences between when students who matched into a surgical field took their Surgery clerkship (p = 0.89). There was no statistically significant association between the time when a student rotated on Surgery or IM and their likelihood of going into Surgery or a Surgical subspecialty (Fig. 1, p = 0.28).

We evaluated the spread of grades across the year in each clerkship. Grades were not statistically different across the year in either the Surgery (p = 0.71) or Internal Medicine (p = 0.65) clerkships (Fig. 2). In the Surgery clerkship, 28% of students received a grade of Pass, 43% received High Pass, and 29% received Honors. For Internal Medicine, 44% of students received a grade of Pass, 35% received High Pass, and 21% received Honors.

Student Grades

Ordered logistic regression was used to consider what factors were correlated with a grade of Honors vs. High Pass or Pass in the Surgery and Internal Medicine clerkships (Table 1). For the Surgery clerkship grade, a higher Surgery shelf exam score and a higher Internal Medicine shelf exam score were both associated with a grade of Honors compared to the combined High Pass and Pass categories (Surgery shelf exam: odds ratio [OR] 1.14, 95% confidence interval [CI] 1.12-1.16, p < 0.0001; Internal Medicine shelf exam: OR 1.09, 95% CI 1.07-1.11, p < 0.0001). The order in which students took Surgery and Internal Medicine (i.e., if they took their Internal Medicine or Surgery clerkship first) had no statistically significant effect on the grade received in the Surgery clerkship (OR 1.07, 95% CI 0.82-1.40, p = 0.596). In addition, the presence of funded preclinical surgical research, as a surrogate for surgical mentorship, was not associated with a grade of Honors in the Surgery clerkship (OR 0.86, 95% CI 0.59-1.25, p = 0.436).

Surgical Residency Match

Factors considered for as predictors for a match into a surgical residency included grade from Internal Medicine, grade from Surgery, the order of rotations, the presence of preclinical surgical research, and shelf scores in both Internal Medicine and Surgery. Table 2 shows information for students who matched into General Surgery, a surgical subspecialty (not including Ophthalmology or Obstetrics and Gynecology), and all surgical specialties (including General Surgery, Ophthalmology, and Obstetrics and Gynecology).

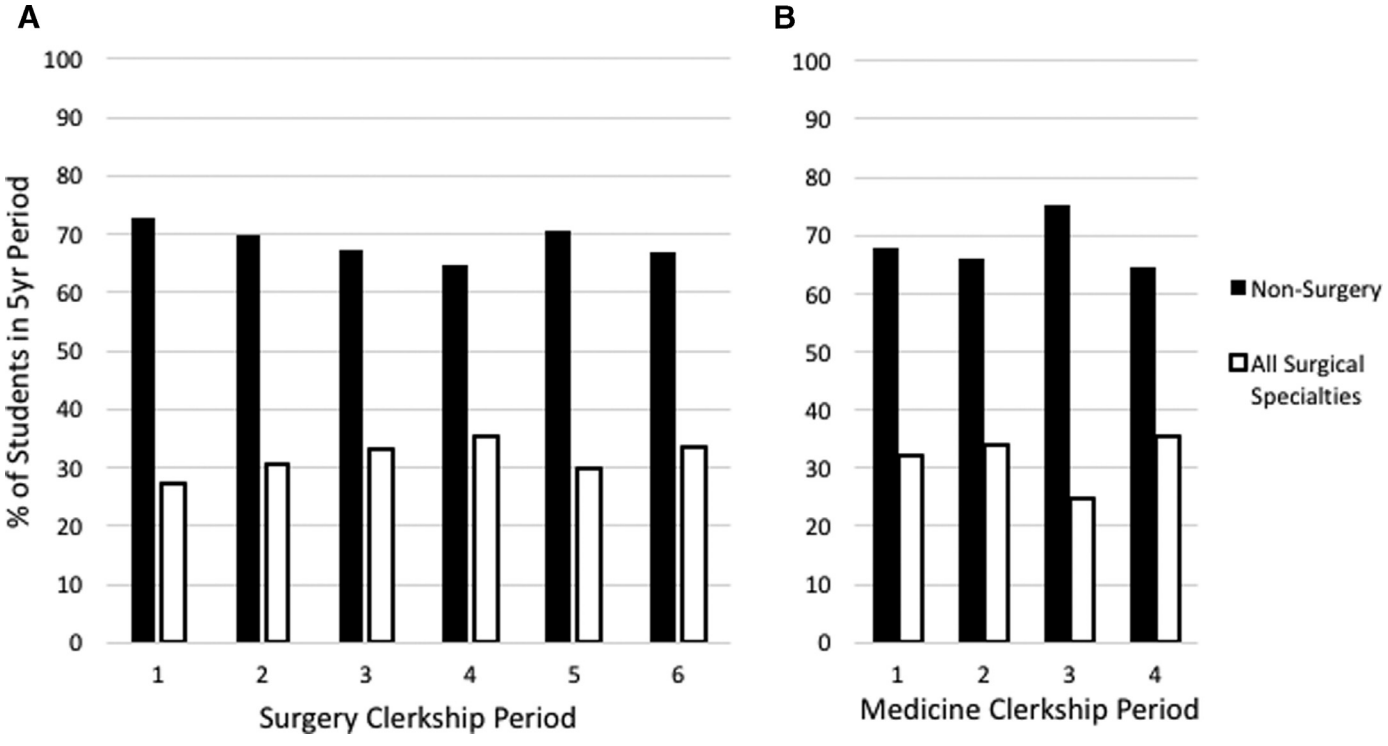

FIGURE 1. Distribution of students in Internal Medicine and Surgery clerkships by matched specialty. (A) There was no statistically significant difference in the percentage of students who matched into a surgical field based upon the period of Surgery clerkship (6 periods, 2 months each; p = 0.80). (B) There was no statistically significant difference in the percentage of students who matched into a surgical field based upon the period of Internal Medicine clerkship (4 periods, 3 months each; p = 0.268).

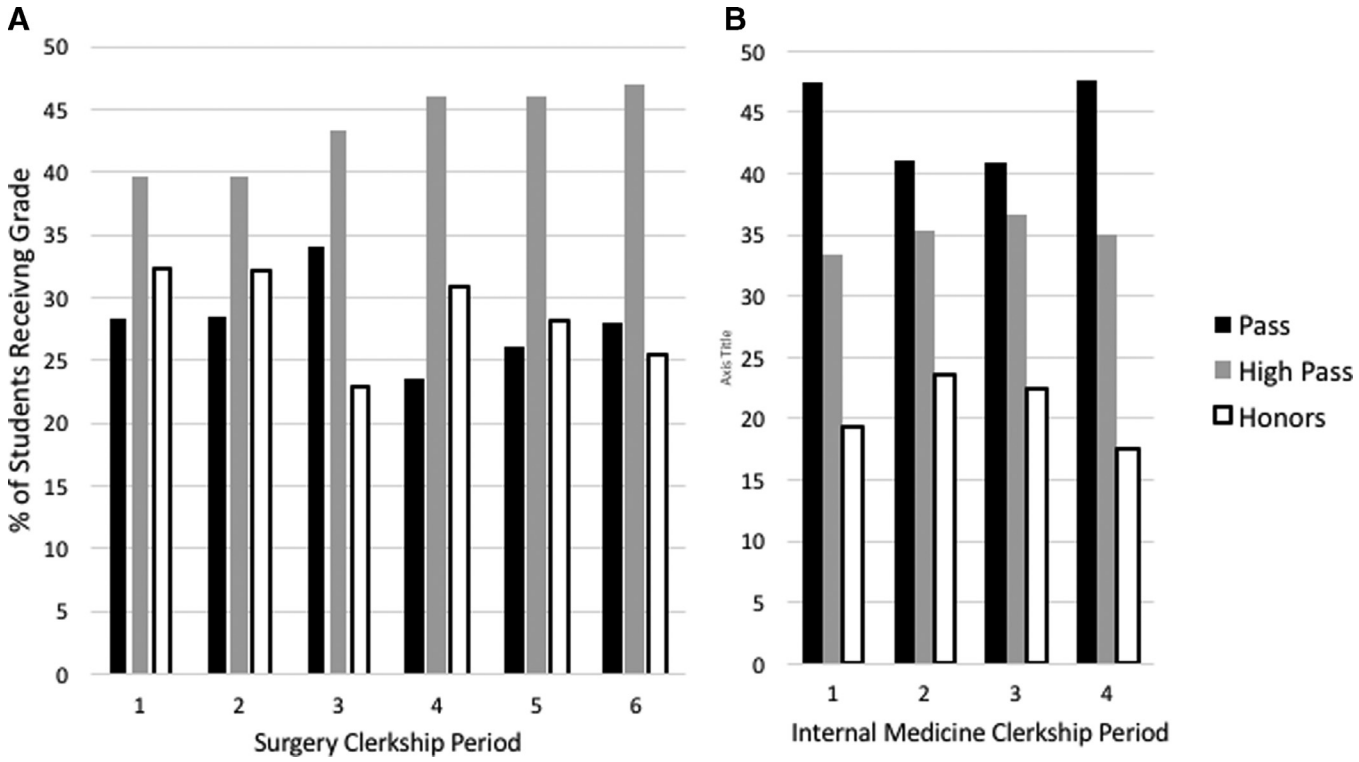

FIGURE 2. Distribution of grades in Internal Medicine and Surgery clerkships. There was no statistically significant difference in the distribution of grades (Honors, High Pass, and Pass) throughout the year in either the Surgery clerkship (A; p = 0.71) or in the Internal Medicine clerkship (B; p = 0.65).

The factor most strongly associated with matching into General Surgery was a grade of Honors in the Surgery clerkship when compared to Pass (OR 4.17, 95% CI 1.77-9.80, p = 0.001). A grade of High Pass in Internal Medicine was also associated with a match into General Surgery (OR 2.30, 95% CI 1.18-4.45, p = 0.013). Grades of High Pass in Surgery (OR 2.00, 95% CI 0.83-4.79, p = 0.12) or Honors in Internal Medicine were not associated with matching into General Surgery (OR 2.07, 95% CI 0.97-4.41, p = 0.058) Grades of High Pass and Honors in Surgery were associated with surgical subspecialty match (High Pass OR 2.3, 95% CI 1.13-4.67, p = 0.022; Honors OR 3.39, 95% CI 1.56-7.37, p = 0.002). The same factors held as the most significant associations when considering all students matching into a surgical residency (High Pass OR 1.93, 95% CI 1.24-2.24, p = 0.004; Honors OR 3.76, 95% CI 2.24-6.32, p < 0.001). The order of clerkships and presence of a structured research experience in surgery were not associated with a match into General Surgery, surgical subspecialties, or any other surgical field (all p > 0.05).

DISCUSSION

Our study shows that students who matched into surgical fields did disproportionately well in their Surgery clerkship, and that the strongest measureable factor-affecting

TABLE 1. Factors Associated With Clerkship Grade

	Surgery			Internal Medicine		
Factor	**OR**	**95% CI**	**p Value**	**OR**	**95% CI**	**p Value**
Surgery shelf score	1.14	1.12-1.16	<0.0001	1.00	0.98-1.02	0.997
IM shelf score	1.09	1.07-1.11	<0.0001	1.08	1.05-1.10	<0.0001
Surgeryafter Internal Medicine	1.07	0.82-1.40	0.596	0.97	0.74-1.27	0.843
Presence of surgery research	0.86	0.59-1.25	0.436	0.85	0.59-1.23	0.388

Points above the mean for the Surgery shelf score and Internal Medicine shelf score were both statistically significantly associated with higher grades in Surgery (p < 0.0001). The Internal Medicine grade was only associated with Internal Medicine shelf score (p < 0.0001). The order of clerkships and preclinical surgery research were not associated with higher Surgery or Internal Medicine grades.

TABLE 2. Factors Associated With Matching Into a Surgical Specialty

Factor	General Surgery			Surgical Subspecialty			All Surgical Specialties		
	OR	95% CI	p Value	OR	95% CI	p Value	OR	95% CI	p Value
Internal Medicine grade									
Pass	1			1			1		
High Pass	2.3	1.19-4.45	0.013	1.14	0.69-1.91	0.598	1.08	0.75-1.57	0.665
Honors	2.07	0.97-4.41	0.058	1.15	0.63-2.08	0.642	1.14	0.73-1.78	0.552
Surgery grade									
Pass	1			1			1		
High Pass	2	0.83-4.79	0.12	2.3	1.13-4.67	0.022	1.93	1.24-2.24	0.004
Honors	4.17	1.77-9.80	0.001	3.39	1.56-7.37	0.002	3.76	2.24-6.32	<0.001
Surgery after IM	0.85	0.49-1.49	0.59	1.34	0.86-2.09	0.191	1.13	0.82-1.55	0.466
Surgery research	1.02	0.48-2.15	0.953	1.46	0.83-2.55	0.189	1.11	0.72-1.71	0.629
IM shelf score	1	0.96-1.04	0.942	1	0.97-1.03	0.901	0.98	0.95-1.00	0.096
Surgery shelf score	1.02	0.99-1.06	0.143	1.02	0.99-1.05	0.158	1.01	0.99-1.04	0.408

High Pass in Internal Medicine ($p = 0.013$) and Honors in Surgery ($p = 0.001$) were associated with a match into General Surgery. Matches into a surgical subspecialty or all surgical specialties (including Obstetrics and Gynecology, and Ophthalmology) were associated with High Pass or Honors in Surgery ($p < 0.022$ or lower). The order of clerkships, preclinical research, and points above the mean on shelf scores were not associated with a match into a surgical field.

grade in Surgery and Internal Medicine clerkship was shelf score. Students interested in Surgery and surgical subspecialties did not have a statistically significant distribution difference across the year, and there was no significant variance in grades in Surgery or Internal Medicine based on timing of clerkship.

For students interested in General Surgery and surgical subspecialties, previous authors have identified factors such as early mentorship, increased time in the operating room, relationships with residents and faculty, and personality type as associated with the choice of a surgical career.[4-11] Survey data from 1 group demonstrated that nearly half of the students who chose surgery did so directly based upon their experience in their Surgery rotation.[7] There was also a correlation in 1 study between the quality of resident teaching, as evaluated by medical students, and the percentage of students who chose to pursue a career in surgery.[12] In contrast, from the perspective of those who select applicants for residency programs, the most important factors in General Surgery were shown by 1 study to be performed during the interview, Step 1 score, and Step 2 score, while research was comparatively unimportant.[1]

While scores and the interview are clearly important during the match, students consider other factors when considering how to maximize their chances of matching in their specialty of choice. These include the timing of their clerkship and the choice of mentors in a related field earlier in their medical education. Our study is unique in its focus on answering these questions. While surgical mentorship is clearly important, as shown by Day et al., the choice to perform research with a mentor in the Department of Surgery through our institutional student research program (which occurs during the summer after the first year) showed no correlation with a career in a surgical specialty, suggesting that many students find mentorship by other methods, and that this structured program alone is not critical to finding a mentor. Over the time period studied, there appeared to be no relationship between the timing of the Surgery clerkship in relation to the Internal Medicine clerkship and the grade of Honors in Surgery at our institution. In addition, there was not significant variance in the number of students in the Surgery clerkship at any given time of year who pursue a surgical career. This suggests that specialty of choice is not a factor students need to consider when choosing clerkship order.

Data show that students who perform better in a clerkship, as evaluated by clinical skills or clerkship grade, tend to go into that field, including surgery.[13,14] The factors that have the largest impact on the grades include clinical performance and shelf exam scores. In our study, the Surgery and the Internal Medicine shelf scores appeared to correlate with higher grades in Surgery. This may reflect a higher level of medical knowledge, and it

would be interesting to understand the correlation with board scores. Unfortunately, due to anonymity concerns, this data was unavailable. Others have shown that students who do well on standardized tests before their clerkships tend to continue to do so in their National Board of Medical Examiners (NBME) exams.[15-17] Further, multiple studies to date have found that taking the Internal Medicine clerkship first increases shelf exam score in Surgery and other clerkships, including Family Medicine, Obstetrics and Gynecology, and Psychiatry.[18,19] We did not analyze changes in shelf score over the course of the year. However, our data show that the percentage of the students assigned each clinical grade does not vary over the course of the academic year. To understand this, we must consider that students are graded alongside those who are taking the clerkship at the same time as them—i.e., most students have had similar previous experiences to those with whom they are being graded.

Studies have also sought to find what factors are associated with changes in clinical performance. Important factors have included clinical mentoring in the preclinical years and the timing of the clerkship—i.e., students did better clinically during later clerkships.[20-23] While students may do better clinically later into the year, the order and combination of clerkships taken earlier in the year do not seem to affect clinical performance on standardized examinations.[22-25] As mentioned above, our study found that students' clerkship grades do not vary over the course of the year, although this cannot fully reflect improvements in clinical performance that students may have as a group as they progress through their core clinical clerkships.

Given the study design, there are significant limitations in our ability to understand which students will be successful in pursuing a career in a surgical subspecialty. The largest limitation to the dataset is the lack of information on clinical evaluations. These data were not included in this study due to wide variations in evaluation by different faculty and difficulty in deidentifying the data. Another factor we are unable to measure is personality, which many authors have previously shown as having a major association with a student's choice of a surgical career.[6,11] Due to anonymity concerns, we also did not analyze demographic factors like gender, age, or ethnicity, which have been shown to be predictors of clerkship grades.[26]

In terms of mentorship, we do not have specific data on mentors outside of our preclinical summer research program, and therefore cannot measure informal or formal mentorship relationships students may have with faculty before or after their Surgery clerkship. In addition, data on the effects of physician relatives and academic connections, which have been shown to be a factor in the selection of residents in Urology, were not included in this study.[27] New directions to address these limitations might include a survey-based study to determine what other mentorship sources students had access to and the ways in which that access changed during their Surgery clerkship and determining what other factors, such as undergraduate institution, undergraduate major, and previous work experience, may affect clinical performance. In addition, analyzing data from other institutions within our current paradigm would allow us to understand which findings from this study would be confirmed at other medical schools.

CONCLUSION

This study has shown that students are more likely to match into General Surgery or a surgical subspecialty if they receive higher grades in Surgery and Internal Medicine. The only individual factor that we examined that was associated with higher grade was shelf score. Order of clerkship and presence of structured preclinical research were not associated with higher grades or with a higher chance of matching into General Surgery or another surgical field. While mentorship may often guide students toward a surgical career, this study indicates that formal mentorship through structured preclinical research is not necessarily required to match into a surgical field. In addition, students often worry over the order of their clerkships—these data show that, when considering Internal Medicine and Surgery grades, the order in which clerkships are taken does not significantly affect the grade received. Overall, this study demonstrates that students who do well in Surgery and Internal Medicine are competitive candidates for the match in surgical specialties, and students are not fixed along their career path based on their preclinical decision-making or mentorship. Understanding a school's individual grading patterns will help to advise their students on how to succeed in matching into a surgical field.

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SUPPLEMENTARY INFORMATION

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.jsurg.2018.08.023.