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Cost Analysis of Medical Students Applying to Orthopaedic Surgery Residency: Implications for the 2020 to 2021 Application Cycle During COVID-19

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Introduction: Although studies have evaluated the economic burden to medical students desiring an orthopaedic residency broadly, no study has evaluated in detail the application costs, away rotation costs, interview costs, and total costs. Given that the Association of American Medical Colleges and the American Orthopaedic Association's Council of Orthopaedic Residency Directors have recommended orthopaedic surgery residency programs for the 2021 residency application cycle cancel away rotations and in-person interviews, our objective was to evaluate the cost savings to medical students applying during this time and the potential implications.

Methods: Using the 2019 to 2020 Texas STAR Dashboard database, we queried responses from applicants applying to orthopaedic surgery residency. The dashboard was queried to record the application costs, away rotation costs, interview costs, and total costs for medical school seniors applying to orthopaedic surgery residency. Demographic information for applicants was also recorded. Mean and median costs were reported with percentile distributions and geographic comparisons. A Kruskal-Wallis H test was used to determine whether there were statistically significant differences in mean costs by medical school region.

Results: The 2019 to 2020 Texas STAR Dashboard database had 473 responses from applicants to orthopaedic surgery residency. The mean application costs were \$1,990, away rotation costs were \$3,182, interview costs were \$3,129, and total costs were \$8,205. The mean total costs for applicants from Midwest schools were significantly less than Western schools (\$7,410/applicant vs. \$9,909/applicant) ($p = 0.008$). There was no significant difference between the mean application fees between regions. Away rotation costs for applicants from schools in the Midwest (\$2,413/applicant) were significantly less compared with Northeast (\$3,279/applicant), South (\$3,343/applicant), and West (\$3,913/applicant) (all $p < 0.002$). Interview costs for applicants from schools in the Northeast (\$2,891/applicant) were less than applicants from Western US schools (\$3,831/applicant) ($p = 0.038$).

continued

Disclosure: The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (<http://links.lww.com/JBJSOA/A255>).

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Conclusion: In the COVID-19 era, orthopaedic residency applicants could save on average \$6,311 through the use of virtual interviews and lack of away rotations. There are geographic implications, with applicants from Western US medical schools potentially saving most.

Orthopaedic surgery residency is one of the most competitive specialties for prospective residency applicants. In 2020, 1,192 applicants competed for 849 positions with a match rate of 81% for US seniors¹. Given that, prospective orthopaedic surgery applicants spend thousands of dollars rotating at away institutions, interviewing, and often times applying to many more programs than necessary. Within the past decade, the number of programs each US orthopaedic surgery residency applicant applies to has nearly doubled^{2,3}. Although studies have evaluated the economic burden of the application process to medical students desiring a residency in orthopaedics broadly⁴⁻⁶, no study has evaluated in detail the application costs, away rotation costs, interview costs, and total costs. In the calendar year 2020, the COVID-19 pandemic has added an unforeseen complexity to the orthopaedic residency match process⁷. Given that the Association of American Medical Colleges and Council of Orthopaedic Residency Directors have recommended orthopaedic surgery residency programs for the 2021 residency application cycle cancel away rotations and in-person interviews with the exception of select applicants^{8,9}, it would be useful to evaluate the cost savings to medical students applying during this unprecedented time and the potential implications.

Although previous studies have broadly evaluated the economic burden of applying to orthopaedic surgery residency, these studies were completed almost 5 years ago^{5,6}, and their relevance remains unknown. Although much of the application process remains unchanged including the importance of board examination scores, clinical grades, letters of recommendation, away rotation experiences, and interview performance, each year becomes more competitive^{2,10-16}. The number of orthopaedic surgery positions is far outpaced by the increased number of applications for these highly coveted positions^{2,17}. Completion of more away rotations and applying to more programs may increase an applicant's chance for match success, but it is not without significant cost, of which we attempt to evaluate.

The objective of this study is to report the itemized expenses of a US medical students applying to orthopaedic surgery residency and discuss the implications for the 2020 to 2021 application cycle. As a secondary aim, we sought to evaluate whether there was a difference in costs by geographic region. Based on previous studies⁶, we hypothesized that applicants would save upward of \$5,000 and medical school geographic region would affect the total and individual costs of applying to orthopaedic surgery residency.

Methods

This was a retrospective, cross-sectional study using the 2019 to 2020 Texas STAR Dashboard database. We queried responses from applicants applying to orthopaedic surgery residency. The Texas STAR Dashboard is a no-cost database available to US medical schools who agree to participate. The Texas STAR online dashboard database for 2019 to 2020 was derived from data from 115 US allopathic medical schools, with 7,265 students in total responding. Medical school participation is voluntary, and participation gives the medical school and its students access to privileged data as a reward for participation. Applicants respond anonymously to questionnaires involving demographic information such as medical school, step 1 scores, step 2 scores, number of publications, honors grades, etc. In addition, applicants respond to 3 questions regarding costs of applying to residency including away rotation, interview, and application costs. Application costs included total dollars of application fees from Electronic Residency Application Service. Away rotation costs included travel, food, parking, and living expenses for the month clerkship away from a home institution. Interview costs included any travelling expenses (gas and airline) and hotel/living expenses pertaining to the interview process. The database can be accessed and analyzed by specialty. More information regarding the database and data collection can be found on the website¹⁸. The dashboard was queried to record the application costs, away rotation costs, interview costs, and total costs for medical school seniors applying to orthopaedic surgery

TABLE I Geographic Representation of Student Affairs in the United States

Central Group on Student Affairs: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin
Northeast Group on Student Affairs: Connecticut, District of Columbia, Maine, Massachusetts, New Hampshire, New Jersey, Maryland, New York, Pennsylvania, Rhode Island, and Vermont
Southern Group on Student Affairs: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia
Western Group on Student Affairs: Arizona, California, Colorado, Hawaii, Nevada, New Mexico, Oregon, Utah, and Washington

TABLE II Orthopaedic Surgery Residency Applicant Demographics*

No. of applicants	473
No. of matched applicants	412
No. of applicants from CGSA	100
No. of applicants from NEGSA	117
No. of applicants from SGSA	199
No. of applicants from WGSA	43
No. of applicants unknown region	14
Mean step 1	248
Mean step 2	255
AOA (%)	44.6
Mean no. of applications	79
Mean no. of interview offers	16
Mean no. of interviews attended	12
Mean no. of clerkships "honored"	5
Mean no. of research experiences	5
Mean no. of publications	4
Mean no. of presentations	6
Mean no. of volunteer experiences	7
Mean no. of leadership positions	4

*AOA = American Orthopaedic Association; CGSA = Central Group on Student Affairs, NEGSA = Northeast Group on Student Affairs, SGSA = Southern Group on Student Affairs, and WGSA = Western Group on Student Affairs.

residency. Demographic information for applicants was also recorded including step 1 score, step 2 score, number of applications, number of interviews, and supporting applicant demographics including medical school region. The 4 medical school regions (Central Group on Student Affairs [CGSA], Northeast Group on Student Affairs [NEGSA], Southern Group on Student Affairs [SGSA], and Western Group on Student Affairs [WGSA]) and the states included are shown in Table I. The publicly available data are deidentified; therefore, this study did not require IRB approval.

Statistical Analysis

Mean and median costs were reported with percentile distributions for each type of cost incurred. A Kruskal-Wallis H test was used to determine whether there were statistically significant differences in mean costs by medical school region. A p value of <0.05 was considered statistically significant.

Results

Application Cohort

The 2019 to 2020 Texas STAR Dashboard database had 473 responses from applicants to orthopaedic surgery resi-

dency. Applicant demographics are presented in Table II. The match rate was 412/473 (87%). On average, applicants sent 79 applications, received 16 interview offers, and attended 12 interviews.

Cost Analysis

The mean application costs were \$1,990 (SD \$758), away rotation costs were \$3,182 (SD \$2,120), interview costs were \$3,129 (SD \$2,265), and total costs were \$8,205 (SD \$4,062) (Fig. 1). More than 50% of applicants spent more than \$1,750 solely on application fees, \$2,250 on interviews, \$2,750 on away rotation auditions, and \$7,250 in total costs. A comparison of the median total costs, application costs, away rotation costs, and interview costs with interquartile ranges is shown in Figure 2.

Region Cost Comparisons

There was a significant difference between the mean incurred total costs for applicants from schools in the Midwest (CGSA) (\$7,410/applicant) vs. West (WGSA) (\$9,909/applicant) (p = 0.008) (Fig. 3). There was no significant difference between the mean application fees between regions (Fig. 4). There were

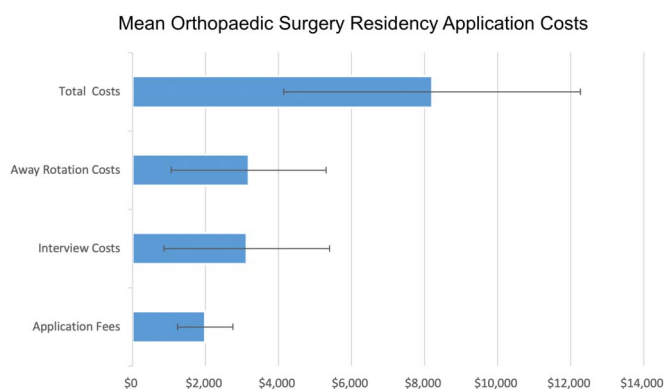


Fig. 1 The mean costs to students applying to orthopaedic surgery residency during 2019 to 2020. Error bars are SD of the mean.

significantly lower mean away rotation costs for applicants from schools in the Midwest (CGSA) region (\$2,413/applicant) compared with the Northeast (NEGSA) (\$3,279/applicant), South (SGSA) (\$3,343/applicant), and West (WGSA) (\$3,913/applicant) (all $p < 0.002$) (Fig. 4). There was a significant difference between the mean interview costs between applicants from schools in the Northeast (NEGSA) (\$2,891/applicant) vs. West (WGSA) (\$3,831/applicant) region ($p = 0.038$) (Fig. 4).

Discussion

Using a nationwide database, we evaluated the costs associated with applying to orthopaedic surgery residency in 2019 to 2020. This is the first and largest study to compare geographically the costs of applying to orthopaedic surgery residency. Across the nation, the mean application costs were \$1,990, the mean away rotation costs were \$3,129, the mean interview costs were \$3,129, and the mean total costs were \$8,205. In the COVID-19 era, orthopaedic residency applicants may save on average \$6,311 during the application cycle (larger savings from applicants that attend medical school in West [\$7,744] > South [\$6,400] > Northeast [\$6,170] > Midwest [\$5,573]), assuming the majority do not perform any away rotations and take part in exclusively virtual interviews. The implication of this cost saving is unknown and should be further evaluated.

Studies have previously evaluated the financial burden of applying to residency both for orthopaedic applicants and other specialties^{4-6,19}. In the context of previous cost analysis studies in 2015 by Camp et al.⁶, the mean total costs found in this study are 50% greater than evaluations 5 years earlier. Fogel et al.⁵ surveyed applicants in 2015 regarding cost estimates for interviewing, and 72% of the applicants borrowed additional money to finance the interview season and 28% cancelled at least 1 interview due to financial concerns. With the mean reported total application costs of \$8,205 and most orthopaedic surgery applicants saving an estimated \$6,311 during the 2020 to 2021 application cycle, it is unclear how this will impact the application process. One could hypothesize that students will apply to a greater number of orthopaedic surgery programs as they will have greater funds to do so.

Previous cost studies are limited in that they do not include geographic comparisons. We noted applicants from Midwest medical schools (CGSA region) on average spent the least when applying to orthopaedic residency. By contrast, applicants from the west coast (WGSA) had the greatest expenses. As expected, we found no significant difference between application costs between regions. The lower interview costs between applicants from schools in the northeast compared with the west could be explained by the density of programs and their closer proximity to one another. This may result in lower travel expenses. Finally, students from a medical school located in the Midwest (CGSA) reported lower away rotation expenses compared with Northeast (NEGSA), South (SGSA), and Western (WGSA) regions. One would expect the cost of living to be a primary driver of these cost differences. These findings could be valuable for prospective medical students who may be deciding between medical schools in different regions of the country.

COVID-19 is a global pandemic that will impact all residency applicants. It is unknown at this time what the end effect of this will be on the match process. However, one thing that is certain are the financial savings to medical students. With medical school tuition increases, coupled with the growing financial debt after professional school, the 2020 to 2021 year may be a catalyst for considering future changes to the residency application process²⁰. Although saving money is desirable, studies have shown that completing a rotation at another program increased an applicant's chance of matching into that program by a factor of 1.5 (40% vs. 60%)⁶. Thus, the accrued costs of away rotations may be a worthwhile expense as they are used predominantly by students to identify a "good fit"²¹. Other studies have shown that evaluating current residents was the most valuable aspect of an in-person interview day for applicants²². Unfortunately, this vital component would not be available to most applicants during the current application season. And despite a reduction in financial spending, without in-person interviews and in-person away rotations, there may be a nonmonetary cost of reduced ability of applicants and programs to demonstrate their value to one another²³.

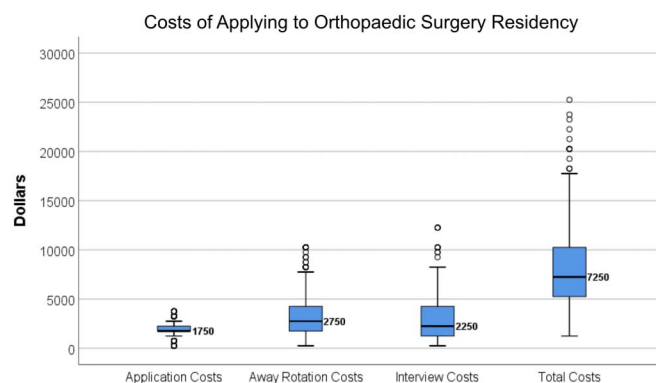


Fig. 2 Box plot of associated costs applying to orthopaedic surgery residency for all applicants from 2019 to 2020. Box plot resembles median value with quartiles.

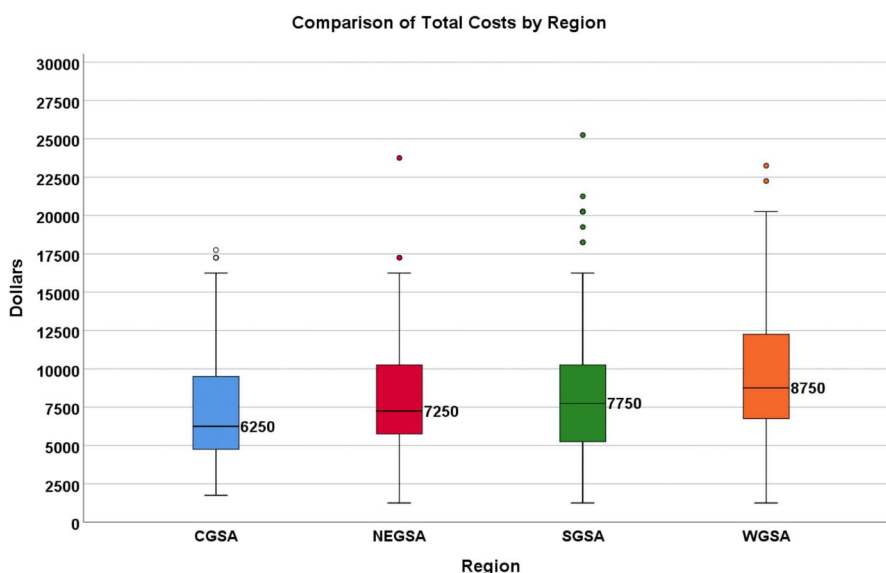


Fig. 3 Box plot of total costs applying to orthopaedic surgery residency from 2019 to 2020 by applicant geographic region (Central Group on Student Affairs [CGSA], Northeast Group on Student Affairs [NEGSA], Southern Group on Student Affairs [SGSA], and Western Group on Student Affairs [WGSA]). There was a statistically significant difference between the mean incurred total costs for applicants from schools in the CGSA region (\$7,410/applicant) vs. WGSA (\$9,909/applicant) ($p = 0.008$).

Finally, the results of this study should be considered by orthopaedic surgery societies. National orthopaedic societies should carefully consider becoming involved in the match process and developing alternatives that may even be kept permanently to curb the financial burden of the conventional application process. Instituting its own application system would be 1 change worth considering (similar to the subspecialties of urology and ophthalmology). Along the lines of

urology and ophthalmology where the match process is governed by the respective specialties and they have input on evolving the match process, the orthopaedic surgery community should consider becoming involved at a similar level. If an orthopaedic surgery governing body (American Orthopaedic Association) takes the process under its own wing, they could lower application costs by not having to rely on a third party as currently constructed. By having its own application, the

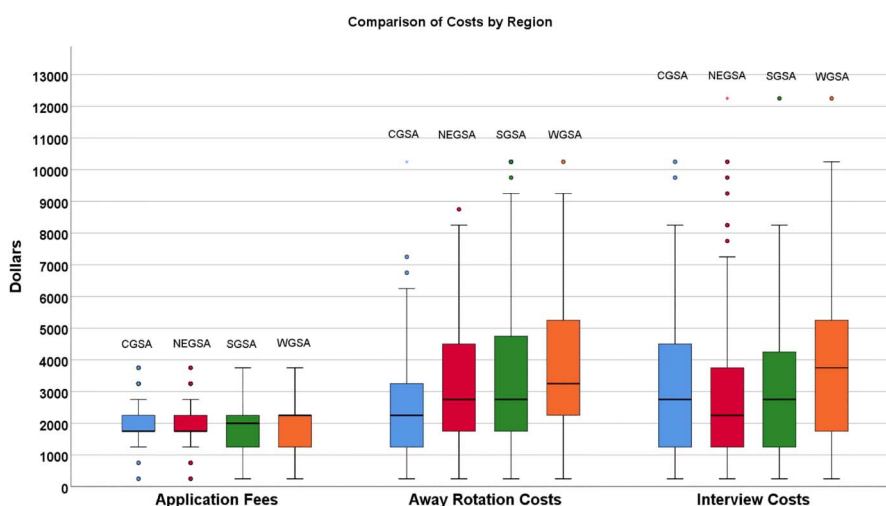


Fig. 4 Box plot of associated costs applying to orthopaedic surgery residency from 2019 to 2020 by applicant geographic region. There was no significant difference between the mean application fees between regions. There were statistically significantly less mean away rotation costs for applicants from schools in the CGSA region compared with NEGSA, SGSA, and WGSA (all $p < 0.002$). There was a significant difference between the mean interview costs between applicants from schools in the NEGSA vs. WGSA region ($p = 0.038$). CGSA = Central Group on Student Affairs, NEGSA = Northeast Group on Student Affairs, SGSA = Southern Group on Student Affairs, and WGSA = Western Group on Student Affairs.

orthopaedic community could have more control to evolve the application process over time if needed. Another topic of discussion is the potential benefit to having application caps²⁴. The implication of this would be to limit financial burden to students and time burden for residencies to review applications. Rather than the “shotgun approach” currently in place where applicants send 80+ applications, a more targeted approach or an application cap would ensure programs are getting applicants who are truly interested in their program.

This study has limitations. We were only able to report the mean and percentile distributions of application costs, away rotation costs, interview costs, and total costs of US allopathic applicants. Using a national database prevented us from reporting more granular information with regards to expenses which would improve the usefulness of the study. Unfortunately, we could not correlate costs to applicant demographics or match success. The response rate is also a limitation as the cohort represents only a fraction of the applicant pool. The Texas STAR Dashboard does not report data from international medical graduates or osteopathic applicants which contribute to a portion of the applicant pool. In addition, the data are dependent on their medical school participating and the applicant actually filling out the survey. For this reason, we cannot determine the total possible responses from this database to calculate a response rate. Of the surveyed sample, responses from Western medical schools were lower than other geographic regions which may have led to higher costs in that region. Despite the limitations, this is the largest cost analysis of applicants applying to orthopaedic

surgery residency and the results show a continued increased financial burden to applicants in comparison with previous reports. In addition, this is the first study to incorporate away rotation costs and geographic cost variability.

Conclusions

In the COVID-19 era, orthopaedic residency applicants may save on average \$6,311 during the application cycle through the use of virtual interviews and lack of away rotations. There are significant geographic implications, with applicants from Western US medical schools having the most cost savings. Further evaluation regarding the implication of cost savings to medical students should be performed. ■

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