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The Association Between Virtual Interviewing and Geographical Distribution of Matched Residency Programs for General Surgery Applicants

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OBJECTIVE: Due to the COVID-19 pandemic, the Coalition for Physician Accountability’s work group on Medical Students in the class of 2021 made the recommendation in May of 2020 that the upcoming residency recruitment cycle be conducted virtually. This flexibility may have allowed applicants to apply and interview at programs with less regard to geography, knowing that travel costs of interviewing would not be a factor. Alternatively, applicants who interviewed virtually could choose to remain in a close proximity to their home institutions where they likely have a greater comfort level and familiarity with the community both personally and professionally. We examine the distribution of applicants matched at general surgery residency programs in 2021 to those in 2020 to see if there was a change in geographic variability.

DESIGN: Retrospective review of general surgery residents

SETTING: United States general surgery residency programs

PARTICIPANTS: 2153 PGY1 categorical general surgery residents who were interviewed virtually and PGY2 categorical general surgery residents who interviewed in-person, who also attended residency programs and medical schools located in the continental United States with publicly accessible residency websites containing necessary biographical information.

RESULTS: A total of 2153 residents were included; 1124 in their PGY1 and 1029 in their PGY2. Average distance from attended medical school to matched program (634.2 vs 662.5), percentage of matched programs within 500 miles of attended medical school (57.3 vs 55.7), average price of flight, when available, from attended medical school to matched program (222.8 vs 230.4), and percentage of attended medical schools with non-stop flight to matched program (42.9 vs 42.9) did not significantly differ between PGY1 and PGY2 residents.

CONCLUSIONS: The decision to adopt virtual interviewing practices compared to previous in-person interviews did not significantly alter the geographical distribution of students’ matched programs. The distance from medical school to the matched program, flight availability, and flight pricing remained comparable between residents interviewed in-person and residents interviewed virtually. (J Surg Ed 80:194–199. © 2022 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: COVID-19, Internship and Residency, Virtual Interview, General Surgery

COMPETENCIES: Professionalism, Interpersonal and Communication Skills, Systems-Based Practice

INTRODUCTION

The COVID-19 pandemic introduced innumerable new concerns requiring changes to surgical practice and surgical education. These included many unexpected adjustments to the process of applying to a residency program in general surgery. Among these were the necessary travel restrictions imposed globally in order to stem the spread of
the COVID-19 virus. In response to these restrictions, and to general public health concerns, the Coalition for Physician Accountability’s work group on Medical Students in the class of 2021 made the recommendation in May of 2020 that the upcoming residency recruitment cycle be conducted virtually. They cited inadequate vaccination rates, geographic inequity in the impact of the pandemic, and the need for consistency across the wide field of applicants and programs in making this recommendation.1,2 These recommendations, and virtual residency interviews, persisted into the 2021-2022 residency cycle and may continue to persist indefinitely.5

Traditionally, the residency interview has played a vital role for program directors to evaluate candidates on their communication and interpersonal skills, and for candidates to interact with residents and faculty. Interactions with residents and perceptions of residents and faculty have previously been cited as some of the most important factors for applicants when making their rank list.3,4 Leading into the 2021 residency cycle, medical students indicated a preference for in-person interviews, noting the importance of visiting the location of the residency program and the importance of meeting the residency and staff.3,4

With this in mind, and travel to other institutions prohibited, applicants interviewed virtually could have chosen to remain in a close proximity to their home institutions where they likely have a greater comfort level and familiarity with the community both personally and professionally. Alternatively, applicants could have chosen to apply and interview more geographically broadly without the restrictions imposed by the cost of travel - the price of housing, food, and transportation all play a role in the decision to accept an interview for residency.6 With the average number of applications and interviews per applicant rising year after year, these costs continue to rise in tandem.6 We aim to investigate how the geographical distribution of the match actually changed with these possibilities in mind.

Data on the impact of virtual interviewing on the geographical distribution of applicant’s matched programs is still emerging. As travel restrictions continue to be lifted, this information will play an important role when deciding how interviews should be conducted in future residency cycles. We examined the distribution of applicants matched at general surgery residency programs in the 2020-2021 residency cycle to those in the 2019-2020 residency cycle to determine if there was an increase in geographic variability.

**METHODS**

The list of general surgery residency programs available through the Association of Program Directors in Surgery was investigated for links to the websites for each residency program. The website provided for each program was searched for the medical school attended by each of the current PGY1 and PGY2 residents. PGY1 residents refers to those who matched during the 2019-2020 residency cycle with in-person interviews and PGY2 residents refers to those who matched during the 2020-2021 residency cycle when interviews were conducted virtually.

The distance between attended medical school and current general surgery residency was calculated using Google Maps.10 An arbitrary distance considered a “driving distance” was set at 500 miles or less for all applicants. Flight data was calculated using Google Flights between airports closest to the applicant’s respective medical school and surgical residency program.11 Flight data was not retroactively available for all flights and so calculations were based on the flight cost and availability at the time of data collection. Microsoft excel was the only software used for data storage and analysis. P-values were calculated using a two-tailed T-test for two independent means for all population means when comparing class years, and a two-tailed Z-score for two independent population proportions for all population proportions when comparing class years.

When determining whether applicants left their geographical region for residency, geographical regions were defined as those listed on the ERAS Supplemental Application (Table 1).12

Applicants who attended medical schools or residency programs not located in the continental United States were excluded. Only categorical residents were included. Other exclusion criteria included programs with websites that did not list current residents, websites that did not list the medical school attended for each current resident, and residency programs that had not updated their websites with biographical information regarding their PGY1 residents at the time of data collection. Applicants were not contacted as a means of

| Geographical Region        | States                          |
|----------------------------|---------------------------------|
| New England                | CT, ME, MA, NH, RI, VT         |
| Middle Atlantic            | NJ, NY, PA                      |
| South Atlantic             | DC, DE, FL, GA, MD, NC, PR, SC, VA, WV |
| East South Central         | AL, KY, MS, TN                  |
| West South Central         | AR, LA, OK, TX                  |
| East North Central         | IL, IN, MI, OH, WI             |
| West North Central         | IA, KS, MN, MO, NE, ND, SD     |
| Mountain                   | AZ, CO, ID, MT, NM, NV, UT, WY |
| Pacific                    | AK, CA, HI, OR, WA             |
data collection and no identifiable information beyond attended medical school and residency program was collected for each applicant. Institutional Review Board approval was not needed as all information collected is publicly available.

RESULTS

A total of 238 programs were reviewed, of which 189 programs met the requisite inclusion criteria. Programs were excluded because the attended medical schools of the current residents were not listed in 42 cases, because the information for the PGY1 class had not yet been updated in 5 cases, and because a website for the residency program was not able to be found in 2 cases.

From these included programs, a total of 2153 residents were evaluated; 1124 residents in their PGY1 and 1029 residents in their PGY2. The average distance in miles from attended medical school to matched program was 634.2 for PGY1 residents and 662.5 for PGY2 residents with no significant difference between the two years (p = 0.3732). The percentage of matched programs within 500 miles of attended medical school was 57.3% for PGY1 residents and 55.7% for PGY2 residents with no significant difference between the two years (p = 0.471).

The average price of flight in US dollars, when available, from attended medical school to matched program was $222.8 for PGY1 residents and $230.4 for PGY2 residents based on 2022 flight data estimates. The percentage of attended medical schools with non-stop flight to matched program was 42.9% for PGY1 residents and 42.9% for PGY2 residents, again based on 2022 flight data estimates. 178 PGY1 residents, or about 15.8% of included applicants, and 161 PGY2 residents, or about 15.6% of included applicants, matched to the surgical program associated with their medical school (Table 2).


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Applicants were then divided by the geographical region of their medical school and the geographical region of their residency program with complete results for PGY1 residents in Table 3 and complete results for PGY2 residents in Table 4. When comparing the percentage of PGY1 and PGY2 residents who matched within the same region as their medical school there was no significant difference for any of the 9 geographical regions (Table 5).

DISCUSSION

The transition from in-person interviews to a virtual format was a necessary one given the global impact of the COVID-19 pandemic. The impact of this transition on the residency application process is still unclear but remains an important area of study given the implications for applicants if virtual interviews remain the norm in future residency cycles.

Results from comparing PGY1, interviewed virtually, and PGY2 residents, interviewed in-person, across 189 general surgery residency programs indicated that there were no significant differences related to geographical distribution of the Match between the two years. Our data found that applicants matched to programs a similar distance from their medical schools across both years. For those with a flight available, there was no significant difference in flight prices or in the percentage of non-

| TABLE 2. Geographic Differences in Distribution of Matched Programs for PGY1 and PGY2 Residents |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Average Distance Between Medical School and Residency Program (miles) | PGY1 | PGY2 | p-value |
| 634.2 | 662.5 | 0.373 |
| Percent of Applicants within Driving Distance | 57.3% | 55.7% | 0.471 |
| Percentage of Applicants Matched to Home institution | 15.8% | 15.6% | 0.920 |

| TABLE 3. Number of PGY 1 Residents Moving from Each Geographical Region for Residency |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Residency Region | NE | MA | SA | ESC | WSC | ENC | WNC | Mount. | Pac. | SUM |
| Medical School Region | 33 | 23 | 14 | 2 | 6 | 12 | 5 | 3 | 7 | 105 |
| NE | 17 | 86 | 29 | 2 | 9 | 18 | 4 | 2 | 4 | 171 |
| MA | 5 | 36 | 106 | 19 | 14 | 17 | 11 | 3 | 8 | 219 |
| SA | 2 | 21 | 22 | 11 | 10 | 5 | 2 | 2 | 77 |
| ESC | 3 | 22 | 12 | 50 | 3 | 7 | 3 | 3 | 105 |
| WSC | 7 | 20 | 28 | 10 | 9 | 105 | 8 | 8 | 7 | 202 |
| ENC | 1 | 3 | 4 | 7 | 8 | 18 | 39 | 3 | 5 | 88 |
| WNC | 1 | 2 | 7 | 2 | 3 | 15 | 7 | 18 | 7 | 62 |
| Mount. | 6 | 15 | 11 | 1 | 2 | 15 | 4 | 10 | 31 | 95 |
| Pac. | 75 | 189 | 242 | 77 | 112 | 213 | 90 | 52 | 74 | 1124 |
stop flights between attended medical schools and matched residency programs between PGY1 and PGY2 residents.

When students were divided based on the geographical region of their medical school, there was no significant difference in the percentage who remained in the same region for residency versus traveling to a different region between PGY1 and PGY2 residents. Similar studies comparing Urology and Plastic Surgery applicants in the 2020-2021 application cycle to previous cycles also found that virtual interviewing did not significantly alter applicant’s ability to match at programs outside their geographic region, excluding those who matched at their home institution in the case of Plastic Surgery applicants.13,14 One study which analyzed close to half of NMRP residency matches between 2018 and 2021 found a small difference (1.6%) in the percentage of medical students matching to residency programs in the same state as their medical schools in 2021 vs 2018-2020.15 These findings may differ from ours and those of the studies in Urology and Plastic Surgery due to the inclusion of applicants across all specialties and the consideration of only movement between states rather than geographical regions.

Geography has often been a driving factor for applicants when determining which programs to apply to and how they finalize their rank lists.16 Students may prefer to match in areas with close proximity to where they attended medical school. They may have built greater networks of friends, colleagues, and mentors in these regions, and they may have more comfort with the culture of their resident locale. From the residency program’s perspective, applicants with geographical connections to their institution can be more favorable, with the assumption that these applicants may be more likely to remain in the area.4,17

Alternatively, students may use residency as an opportunity to explore new locations with the understanding that upon completing residency they have the option to move again as part of the employment search. Without the travel costs associated with interviews, and the limitations that these costs impose, students could now interview more broadly. One study of United States allopathic students participating in the match found that 64% of respondents spent at least $2500 on interview related costs, while 13% spent $7500 or more.18 Another estimate places the median cost for an individual applicant at around $4000.19 These costs include air travel, ground travel, hotel/lodging, meals, and professional attire.19 This becomes especially relevant when considering that debt from medical school disproportionally impacts students who belong to groups underrepresented in medicine.19,20

However, our data indicates that a move to virtual interviewing had no impact on the geographical distribution of applicants’ matched programs. This may provide evidence that continuing with virtual interviews in future residency cycles will not restrict students from interviewing at locations that they have not had the opportunity to visit in person, while simultaneously removing the costs associated with travel during the interview season.

### TABLE 4. Number of PGY 2 Residents Moving from Each Geographical Region for Residency

| Residency Region | NE  | MA  | SA  | ESC | WSC | ENC | WNC | Mount. | Pac. | SUM |
|------------------|-----|-----|-----|-----|-----|-----|-----|-------|------|-----|
| Medical School Region |     |     |     |     |     |     |     |       |      |     |
| NE               | 42  | 22  | 18  | 1   | 5   | 6   | 4   | 1     | 1    | 100 |
| MA               | 15  | 82  | 25  | 3   | 6   | 16  | 4   | 2     | 4    | 157 |
| SA               | 8   | 24  | 88  | 17  | 7   | 21  | 2   | 10    | 8    | 185 |
| ESC              | 1   | 4   | 15  | 26  | 12  | 6   | 3   | 1     | 1    | 69  |
| WSC              | 1   | 6   | 19  | 10  | 51  | 7   | 5   | 2     | 2    | 103 |
| ENC              | 7   | 14  | 22  | 8   | 13  | 99  | 19  | 1     | 6    | 189 |
| WNC              | 1   | 1   | 9   | 1   | 8   | 15  | 28  | 5     | 11   | 79  |
| Mount.           | 4   | 4   | 5   | 5   | 2   | 9   | 4   | 14    | 5    | 52  |
| Pac.             | 8   | 13  | 8   | 1   | 9   | 19  | 7   | 4     | 26   | 95  |
| SUM              | 87  | 170 | 209 | 72  | 113 | 198 | 76  | 40    | 64   | 1029|

ENC = East North Central, ESC = East South Central, MA = Middle Atlantic, Mount. = Mountain, NE = New England, Pac. = Pacific, SA = South Atlantic, WNC = West North Central, WSC = West South Central.

### TABLE 5. Percentage of PGY1 and PGY2 Residents Matching Within Same Geographical Region

| Geographical Region | PGY1  | PGY2  | p-Value  |
|---------------------|-------|-------|----------|
| East North Central  | 49.3% | 50.0% | 0.779    |
| East South Central  | 28.6% | 36.1% | 0.327    |
| Middle Atlantic     | 43.5% | 48.2% | 0.610    |
| Mountain            | 34.6% | 35.0% | 0.968    |
| New England         | 44.0% | 48.3% | 0.582    |
| Pacific             | 41.9% | 40.6% | 0.881    |
| South Atlantic      | 43.8% | 42.1% | 0.719    |
| West North Central  | 43.3% | 36.8% | 0.395    |
| West South Central  | 44.6% | 45.1% | 0.936    |

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This study is limited by the lack of data concerning the location of each program on applicant’s rank lists. If this same data was able to be calculated for each program on each applicant’s rank list, a much more complete picture would be created of how the geographical distribution of interviews changed between residency cycles, with virtual interviews being the most notable change between cycles. Additionally, applicants may have connections to certain geographic locations beyond their attended medical school and so further biographical information could further elucidate the decision-making process behind applying to certain programs. However, this information is not readily available for many applicants. Any data regarding flights is limited by our inability to retrospectively calculate flight availability and costs for the years that the applicants applied in, forcing us to make rough estimates based on the same flights at the time of data collection. Another limitation is the potential for residents to transfer between programs. This is felt to be a small number of residents, but as the exact data proved too difficult to find, we cannot say that their inclusion did not skew results. Despite these limitations, we feel that this represents a convincing finding that virtual interviewing does not limit applicants’ ability to match geographically broadly, which deserves considering in future debates over virtual versus in-person interviewing for general surgery residency programs.

CONCLUSION

The changes in recruitment practices between the two years, primarily virtual interviewing, is not associated with a difference in the geographical distribution of students’ matched programs as measured either by average distance from medical school to residency program, or by the percentage of students remaining within their geographical region for residency.

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