Changes in Gender and Racial/Ethnic Diversity in US Residency Program Applications From 2018 to 2022

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ABSTRACT

Background Residency application patterns by gender and race/ethnicity offer important insights about diversity in residency recruitment. It is unknown how the COVID-19 pandemic and virtual interviewing affected these patterns.

Objective We hypothesized that the introduction of virtual interviews caused an increase in applications submitted per applicant and that there may be differences by gender and race/ethnicity.

Methods We extracted publicly reported Electronic Residency Application Service application data from 2018 to 2022 for 14 residency specialties with 1000 or more applicants in 2022 by self-reported gender and underrepresented in medicine (UIM) status. We compared patterns before and after virtual interviews were introduced in 2021.

Results Among 401 480 residency applicants, the average number of applications submitted per applicant increased for all specialties between 2018 and 2022 across gender and race/ethnicity. Across all years, women applied to more programs than men in 5 specialties (dermatology, neurology, obstetrics/gynecology, pediatrics, and surgery), whereas men applied to more programs than women in 3 (anesthesia, family medicine, and physical medicine and rehabilitation). Across all years, non-UIM applicants applied to more programs than UIM applicants in all 14 specialties. There were no clear changes in application patterns by gender and race/ethnicity during in-person versus virtual interview years.

Conclusions The average number of applications submitted per applicant increased over time across gender and race/ethnicity. In some specialties, women applied to more programs than men, and in others vice-versa, whereas non-UIM applicants applied to more programs than UIM applicants in all specialties. Virtual interviews did not change these patterns.

Introduction

Diversity in academic medicine training programs is critical to recruit and retain a diverse physician workforce. At the graduate medical education (GME) level, there is opportunity to increase diversity in specialties that have historically lacked diversity and from program to program. During the COVID-19 pandemic, residency interviews switched from an in-person to a virtual format, decreasing the time and costs associated with the interview process. With this change, some predicted that applicants may choose to interview at a wider range of programs, which may increase the quantity and diversity of applicants at many programs.[1] However, to our knowledge, residency application patterns by gender and race/ethnicity before and after the transition to virtual interviews have not been evaluated.

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Editor's Note: The online supplementary data contains further data from the study.

We hypothesized that the introduction of virtual interviews would cause an increase in the number of applications submitted per applicant, and that there may be differences by gender and race/ethnicity.

Methods

We extracted publicly reported US Electronic Residency Application Service (ERAS) application data from 2018 to 2022 for 14 residency specialties with 1000 or more applicants in 2022: anesthesia, dermatology, emergency medicine (EM), family medicine (FM), internal medicine, neurology, obstetrics and gynecology (OB/GYN), orthopedic surgery, pathology, pediatrics, physical medicine and rehabilitation (PM&R), psychiatry, radiology (diagnostic), and surgery.[2] In ERAS, application year refers to the applicant appointment year—so, for example, residency interviews conducted in fall and winter of 2021 to 2022 are considered part of the 2022 application year since residents are appointed in the summer of 2022.

For each residency program, we extracted the total number of applicants, as well as data for self-reported

gender and self-reported race/ethnicity from the ERAS database. ERAS reports self-reported gender with the following categories: "Men," "Women," and "Unknown"; applicants categorized as Unknown" were excluded from this analysis. ERAS reports self-identified race/ethnicity with the following categories: American Indian or Alaskan Native, Asian, Black or African American, Hispanic, Latino or of Spanish origin, Native Hawaiian or Other Pacific Islander, White, Other Race/Ethnicity, or Unknown Race/Ethnicity. We defined underrepresented in medicine (UIM) per the Association of American Medical Colleges definition, including applicants who self-identified as American Indian or Alaska Native; Black or African American; Hispanic, Latino, or of Spanish Origin; or Native Hawaiian or Other Pacific Islander.[3] Applicants who identified as White or Asian were considered non-UIM. Applicants categorized as "Other Race" or "Unknown Race" were excluded from this analysis. Of note, ERAS displays self-identified race/ethnicity alone or in combination with other races/ethnicities; therefore, an individual may be counted in multiple race/ethnicity categories. Prior to the 2020 ERAS application cycle, race/ethnicity data were displayed only for ERAS applicants who reported US citizenship or permanent resident status. Beginning with ERAS 2020, the race/ethnicity data also includes refugees and asylees.

We used line graphs and heat maps to display the patterns in average number of applications per applicant over time. The boxes in the heat maps are color-coded based on the percentage change over the stated time period, from <-10% (dark red) to 0% (yellow) to >+10% annual change (dark green). We used 10% change as a benchmark to describe more notable changes in the text as has been done previously[4]; raw numbers can also be found in the line graphs, heatmaps, and text. ERAS reports the number of applicants per specialty as well as the mean number of applications per applicant, but does not provide standard deviations; therefore, it is not possible to make statistical comparisons. Data were analyzed using Prism (GraphPad). This report follows the STROBE reporting guidelines for cross-sectional studies.

This study was deemed exempt from review by the University of California, San Francisco Institutional Review Board.

KEY POINTS

What Is Known
Since the COVID-19 pandemic, most residency programs have transitioned to a virtual interview format. However, it is unknown how the introduction of virtual interviews has impacted application patterns by gender and race/ethnicity.

What Is New
This analysis of Electronic Residency Application Service data from 2018 to 2022 demonstrates an increase in the number of applications submitted per applicant over time across gender and race/ethnicity, though there was no change in patterns since the introduction of virtual interviews in 2021.

Bottom Line
Programs looking to optimize gender and race/ethnicity diversity in their applicant pool may need to look to other strategies beyond continuing to offer virtual interviews.

Results

Average Number of Applications Submitted per Applicant by Residency Specialty

We evaluated 401 480 residency applicants across 14 specialties from 2018 to 2022. The average number of applications submitted per applicant increased in all specialties during this period, with some year-to-year variation (FIGURE). There were especially marked increases in the number of applications submitted per applicant between 2021 and 2022 (online supplementary data FIGURE 1).

Average Number of Applications Submitted per Applicant by Gender

Of the 401 480 applicants who applied from 2018 to 2022, 216 903 self-identified as men (54%) and

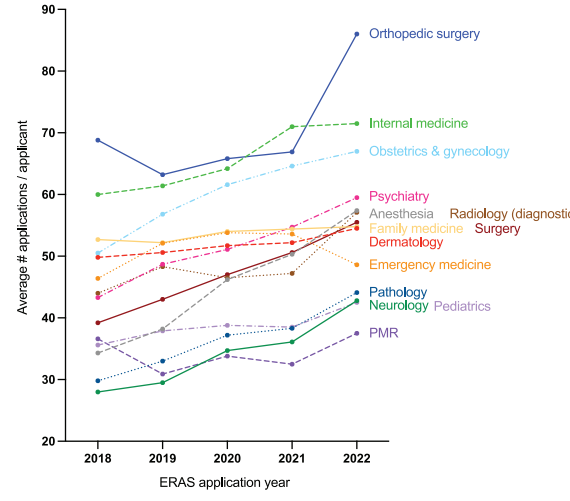

FIGURE
Patterns in the Average Number of Applications Submitted per Applicant for Residency Programs During the 2018-2022 ERAS Submission Cycles

Note: Average number of applications submitted per applicant to residency programs during the 2018-2022 ERAS application cycles. The ERAS application year is the year the applicant starts residency.
Abbreviations: ERAS, Electronic Residency Application Service; PM&R, physical medicine and rehabilitation.

184 577 self-identified as women (46%); 199 applicants had unknown gender <0.05%) and were excluded. The average number of applications submitted per applicant increased from 2018 to 2022 for men and women across all specialties except for men in dermatology, with some year-to-year variation (online supplementary data FIGURE 2). Across all years, women applied to more programs than men at each timepoint in 5 specialties (dermatology, neurology, OB/GYN, pediatrics, and surgery); men applied to more programs than women at all time points in 3 specialties (anesthesia, FM, and PM&R). In 4 specialties, women applied to at least 10% more programs than men in 2022: dermatology (64.5 vs 43.7), OB/GYN (70.7 vs 50.7), pediatrics (45.0 vs 36.8), and surgery (60.0 vs 52.3). In contrast, there were no specialties in which men applied to at least 10% more programs than women in 2022.

Average Number of Applications Submitted per Applicant by UIM Status

Between 2018 and 2022, there were 69 465 UIM applicants and 247 654 non-UIM applicants; 16 057 applicants who identified as "other race/ethnicity" and 16 576 applicants with "unknown race/ethnicity" were excluded. The average number of applicants submitted per applicant increased from 2018 to 2022 for both UIM and non-UIM applicants across all specialties except for UIM applicants in PM&R, with some year-to-year variation (online supplementary data FIGURE 3). Across all years, non-UIM applicants applied to more programs than UIM applicants in all specialties except pediatrics in 2019 and 2021 and surgery in 2020. Non-UIM applicants applied to at least 10% more programs than UIM applicants in 2022 in 7 specialties: anesthesia (59.1 vs 52.7), dermatology (59.2 vs 45.9), EM (52.3 vs 46.8), FM (56.3 vs 49.6), neurology (41.2 vs 34.4), PM&R (40.6 vs 33.7), and psychiatry (62.5 vs 51.3). In contrast, there were no specialties in which UIM applicants applied to at least 10% more programs than non-UIM applicants in 2022.

Application Changes During the 2021 and 2022 Virtual Interview Application Years

We evaluated application changes in 2021 and 2022, the first 2 virtual interview seasons during the COVID-19 pandemic, compared to prior interview years, which were largely conducted in-person. The average number of applications submitted per applicant increased across all specialties in 2021 and 2022 compared to prior years, except for pediatrics from 2020 to 2021 (-0.8%), PM&R from 2020 to 2021 (-3.9%), and EM from both 2020 to 2021 and 2021to 2022 (-0.4% and -9.3% respectively) (online supplementary data FIGURE 1). Seven specialties had at least a 10% increase in applicants from 2021 to 2022, which represented the highest rate of annual change between 2018 and 2022 in 6 specialties: neurology (+18.6%), orthopedic surgery (+28.6%), pathology (+15.1%), pediatrics (+10.4%), PM&R (+15.4%), and radiology (+21.0%).

We also evaluated application patterns by gender and race/ethnicity in 2021 and 2022 compared to prior years. The average number of applications submitted per applicant increased for men and women, as well as for non-UIM, and UIM applicants in almost all programs in 2021 and 2022 and generally had similar rates of change across each of these demographic groups (online supplementary data FIGURE 2B, 3B). By gender, there were 2 specialties with a ≥10% differential annual change during this time period: neurology from 2020 to 2021 (+9.8% men, -2.1% women) and radiology from 2021 to 2022 (+24.7% men, +12.3% women). By race/ethnicity, there were 2 specialties with a ≥10% differential annual change during this time period: psychiatry from 2020 to 2021 (+6.0% non-UIM, +21.7% UIM), pediatrics from 2020 to 2021 (-5.1% non-UIM, +4.9% UIM), and radiology from 2021 to 2022 (+20.2% non-UIM, +41.1% UIM). Otherwise, changes were similar between demographic groups across programs and across time periods (online supplementary data FIGURE 2B, 3B).

Discussion

The average number of applications submitted per residency applicant has been increasing from 2018 to 2022 across all specialties for men and women, as well as for non-UIM and UIM applicants. While women applied to more programs than men in some specialties and vice versa, surprisingly we found that non-UIM applicants applied to more programs than UIM applicants in all 14 specialties. There were no clear changes in application findings by gender and race/ethnicity during in-person versus virtual interview years.

The observation that non-UIM applicants applied to more programs than UIM applicants in all 14 specialties across nearly all timepoints was a pronounced finding. Further research is needed to explore the underlying reasons for these differences (eg, geographic or financial restrictions, mentorship, etc) and, importantly, the downstream effects in the application process (eg, impact on number of interviews and the ranking process).

Some predicted that the introduction of virtual interviews in 2021 may increase the diversity of the applicant pool by reducing time/costs associated with

in-person interviews and thus potentially allowing UIM applicants to apply to more programs.[1] Therefore, we hypothesized that there may be differences in application patterns by gender and race/ethnicity due to this change. However, we did not observe a change in application patterns with the introduction of virtual interviews, and instead all applicants (both UIM and non-UIM) applied to more programs. While this may not change the diversity of the applicant pool overall, it may have increased the diversity of the applicant pool at specific programs—for example it is possible that applicants were more likely to apply to programs farther from their home institution in the virtual era. One analysis of cardiology fellowships found that there was no difference in match location based on geography in the previrtual versus virtual interview era,[5] although this analysis did not consider race/ethnicity and was only for a single fellowship. ERAS does not provide data on geographic location of applicants or programs, so this could not be assessed in our study.

This study is limited by the use of ERAS data, which omits comprehensive sexual orientation and gender identity, as well as multiple intersecting identities. In addition, ERAS provides information only on US citizens and green card holders prior to 2020, which excludes many international medical graduates from analysis. Applications may not accurately reflect interviews offered or accomplished: this data was not available using ERAS or National Resident Matching Program application data, and thus was not assessed in this analysis.

In the future, when building upon these findings, additional studies are needed to determine the factors driving changes in application patterns, the resulting impact on applicants and programs, and whether countermeasures, such as application caps, are warranted. Any interventions should acknowledge the different patterns across gender and race/ethnicity and center equity in their approach.

Conclusions

The average number of applications submitted per residency applicant increased for all specialties from 2018 to 2022, with increases for men and women, as well as non-UIM and UIM applicants in most specialties. Non-UIM applicants applied to more programs than UIM applicants across specialties at nearly all timepoints. There were no clear changes in application patterns by gender or race/ethnicity with the introduction of virtual interviews in 2021.

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