






ORIGINAL RESEARCH

Impact of Virtual Interviewing on Geographic Placement for Cardiology Fellowship Recruitment

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BACKGROUND: Virtual interviewing for cardiology fellowship was instituted in the 2021 fellowship application cycle because of the COVID-19 pandemic and restricted travel. The impact on geographic patterns of fellow-training program matching is unknown. This study sought to determine if there was a difference in geographic placement of matched fellows for cardiology fellowship match after initiation of virtual interviews compared with in-person interviewing.

METHODS AND RESULTS: All US-based accredited cardiovascular disease fellowship programs that participated in the 2019 to 2021 fellowship match cycles and had publicly available data with fellowship and residency training locations and training year were included. Each fellow was categorized based on whether their fellowship and residency programs were in the same institution, same state, same US census region, or different census region. Categories were mutually exclusive. Of 236 eligible programs, 118 (50%) programs were identified, composed of 1787 matched fellows. Compared with the previrtual cohort (n=1178 matched fellows), there was no difference in the geographic placement during the 2021 virtual cycle (n=609 matched fellows) ($P=0.19$), including the proportion matched at the same program (30.6% versus 31.5%), same state but different program (13% versus 13.8%), same region but different state (24.2% versus 19.7%), or different region (35% versus 33.1%). There was also no difference when stratified by program size or geographic region.

CONCLUSIONS: The use of virtual interviewing in the 2021 cardiology fellowship application cycle showed no significant difference in the geographic placement of matched fellows compared with in-person interviewing. Further study is needed to evaluate the impact of virtual interviewing and optimize its use in fellowship recruitment.

Key Words: graduate ■ medical education ■ cardiovascular training ■ medical education

The application and recruitment process for general cardiology fellowship remains an integral part of career development for budding cardiologists and the future of cardiovascular disease care. In the 2022 fellowship match, 1620 physicians applied through the National Resident Matching Program for a position in general cardiovascular disease fellowship competing for 1120 spots.¹ In addition to navigating a competitive match process, applicants must also consider which program can facilitate their career aspirations and personal goals.² In the era of the Core Cardiovascular Training Statement, clinical training expectations have

been delineated and largely implemented in an impartial manner, making the ability to differentiate programs strictly by training content difficult.^{3,4} This long-standing challenge has become more complicated since the onset of the COVID-19 pandemic.

Owing to travel restrictions and public health policy, in 2020 the Coalition for Physician Accountability's Work Group on Medical Students in the Class of 2021 Moving Across Institutions for Post Graduate Training recommended conducting virtual interviews for residency and fellowship recruitment. This was echoed by the Alliance for Academic Internal Medicine and the

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CLINICAL PERSPECTIVE

What Is New?

- Implementation of virtual interviewing for cardiology fellowship recruitment has changed the way that applicants and programs have a chance to evaluate each other before making rank lists.
- Virtual interviewing allows applicants more flexibility with scheduling and significant cost reduction because of the lack of travel, while programs are likely more exposed to a diverse applicant pool.

What Are the Clinical Implications?

- Further studies are needed to evaluate the impact of virtual interviewing on the rank list at the program and individual applicant level.
- Ongoing investigation is imperative to truly understand what role virtual interviewing can serve best in cardiology fellowship recruitment.

American College of Cardiology for the 2021 cycle.^{5–7} Reza et al highlighted some of the challenges that applicants and programs faced with the implementation of virtual interviews, including decreased exposure to fellows, faculty, and facilities for applicants; meanwhile, programs attempted to find ways to recruit and orient faculty to a new model.⁸ These challenges and changes may have broad implications because the interview day has been recognized as one of the most important factors for trainees when determining their eventual rank list.⁹

As residency and fellowship programs adjusted to virtual recruitment strategies during the COVID-19 pandemic, some specialties such as ophthalmology, urology, and plastic surgery experienced a decline in matriculation of candidates from different geographic regions.^{10,11} The impact of virtual interviews on the placement of general cardiology fellows in the fellowship match remains unknown. Our aim was to evaluate the impact of virtual interviews on geographic trends and placement for applicants and programs based on program size and program geographic region compared with the previrtual period.

METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request. All US-based accredited cardiovascular disease fellowship programs that participated in the 2019 to 2021 (appointment year) fellowship match cycles were identified through the Electronic Residency

Application Service system. Once these programs were identified, a review was done to look for publicly available match data on each individual program website. Information including the number of fellows in each class and residency program was requisite to be included in this study. For programs that did not provide this information, an email request was sent to program coordinators with a follow-up email 2 weeks later if no response was received. As these data were publicly available, informed consent was not required.

Fellow-level data were collected in a deidentified manner. The 2019 and 2020 cycles were considered in aggregate as a previrtual cohort, and the 2021 fellowship application cycle was the virtual cohort. Each placement was organized into one of the following categories: same program (ie, they were matched to the fellowship program at the same institution that they completed residency, same state, same US census region, or different US census region).¹² These categories were exclusive (eg, if a fellow matched at the same fellowship program as their residency training program they were placed in the same program category but not the same state category). The decision to make these categories exclusive was intended to better highlight the differences in placement between the same program, the same state (outside of the applicant's residency training program), the same region (outside of the applicants' residency training program and state of training), and a placement in a different region. Program size was divided into small (1–10 fellows), medium (11–17 fellows), and large (≥ 18 fellows) similar to previous studies that have looked at cardiovascular disease fellowship programs.¹³

Statistical Analysis

We examined the primary outcome with the chi-square test for difference in proportions of fellows who matched into cardiology fellowship programs in the same institution, same state, same region, or different region before and after the start of the COVID-19 pandemic. We considered a $P < 0.05$ significant. We also performed an exploratory subgroup analysis by program size using the chi-square test; we did not adjust the P value for multiple testing. Statistical analysis was done using STATA 17.0 (College Station, TX). The University of Alabama at Birmingham Institutional Review Board in Birmingham, AL, approved this research.

RESULTS

Program Characteristics

We included 118 of 236 (50%) eligible programs with available data for all 3 years (2019–2021) (see [Table 1](#)). Programs were from 42 states and all 4 US census regions. The states with the most programs included

Table 1. Characteristics of the Responding Programs

Variable	Value N (%)
US region	
Northeast	37 (31.4%)
South	34 (28.8%)
Midwest	29 (24.6%)
West	18 (15.3%)
Program size	
Small, 1–10 fellows	35 (29.7%)
Medium, 11–17 fellows	36 (30.5%)
Large, ≥18 fellows	47 (39.8%)
Total	118 (100%)

were New York (n=12, 10.2%), Pennsylvania (n=11, 9.3%), California (n=9, 7.6%), Michigan (n=9, 7.6%), and Texas (n=8, 6.8%). Most programs were considered large (≥18 total fellows; n=47, 39.8%), followed by medium sized (11–17 fellows; n=36, 30.5%) and small programs (1–10 fellows; n=35, 29.7%) (see [Table 1](#)). The median number of fellows per program was 15 (interquartile range 9–19, range 5–42). There was a total of 1787 fellows across the 3 application cycles. Each year the total number of fellowship positions increased in the 118 programs included in this analysis: 584 fellows in the 2019 cycle, 594 fellows in 2020, and 609 fellows in 2021. The previrtual cohort (2019 and 2020 application cycles) included 1178 fellows compared with 609 fellows in the virtual (2021) cohort.

Approximately 60% of programs were from the Northeast and South. Only 15% of programs were from the West. Roughly 40% of programs are considered large fellowship programs (≥18 total general fellows) compared with 30.5% of programs being medium-sized programs (11–17 fellows) and 29.7% small programs (1–10 fellows).

Geographic Trends

We observed no difference in the geographic placement in the previrtual and virtual cohorts in terms of applicants matriculating at the same program, same state, same region, or different region from their residency training program ([Figure 1](#), $P=0.19$). [Table 2](#) shows the breakdown of geographic placement in the previrtual and virtual interviewing time frames. In the previrtual cohort, 361 out of 1178 individuals matched into fellowship at the same institution compared with 192 out of 609 in the virtual cohort (30.7% versus 31.5%). A smaller portion matched in a different program in the same state: 153 out of 1178 in the previrtual cohort compared with 84 out of 609 in the virtual cohort (13.0% versus 13.8%). A total of 285 out of 1178 applicants matched in the same region (outside of the same program/state as their original residency program) in

the previrtual cohort compared with 120 out of 609 in the virtual cohort (24.2% versus 19.7%). Nearly one-third (379 of 1178 previrtual versus 213 of 609 virtual, 32.1% versus 35.0%) of incoming fellows matched in a different geographic region in both cohorts.

During the total period of this study, the placements of 1787 matched fellows were reviewed. The review showed that 553 (30.9%) fellows matched into the same program as their residency training, 790 (44.2%) in a program within the same state, 1195 (66.9%) fellows matched into a program from the same geographic region, and 592 (33.1%) were placed in programs that were in a different geographic region.

Program Size

When stratified based on program size, there were 35 small, 36 medium, and 47 large fellowship programs. During the previrtual application cycles, 172 out of 1178 fellows matched into small programs. In small programs, most placements were from within the same region (114 fellows, 66.3%) compared with from a different region (58 fellows, 33.7%). Approximately 45% of placements were from residents within the same state and 26.2% were from the same program. In the virtual cohort, 91 fellows were from small programs, and similarly, most fellows (62, 68.1%) came from the same region.

In the medium-size programs, 343 fellows were identified in the previrtual cohort compared with 169 fellows in the virtual cohort. For both cohorts, nearly one-third came from the same institution: 107 (31.2%) previrtual versus 58 (34.3%) virtual. More fellows matched from the same region in the previrtual (255, 74.3%) compared with the virtual cohort (115, 68.0%), whereas fewer matched into different census regions previrtual (88, 25.7%) compared with virtual (54, 32%).

At large fellowship programs, nearly 40% of fellows matched from a different geographic region in both cohorts. The previrtual cohort comprised 663 fellows, of whom 233 (35.1%) were from a different region. The virtual cohort consisted of 349 fellows, of whom 130 (37.2%) were from a different region.

There was no significant difference seen in the geographic placement of fellows in small ($P=0.974$), medium ($P=0.112$), or large ($P=0.661$) programs when comparing previrtual to virtual cohorts. Medium programs did trend to statistical significance in comparison to small and large programs. The complete distribution of fellow placement is included in [Table 3](#).

Regions

The geographic regions were labeled as the South, Midwest, West, and Northeast as defined by the 2010 US Census.¹² Most programs were in the Northeast (37 programs, 31.4%), followed by the South (34 programs, 28.8%) and Midwest (29 programs, 24.6%). The

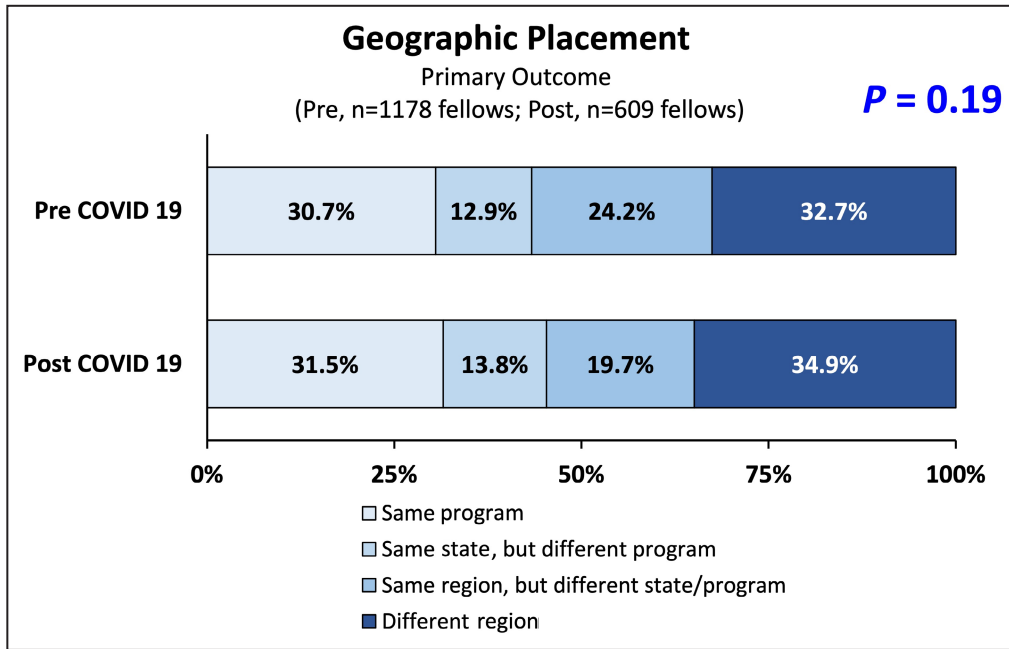


Figure. Geographic placement of matched cardiology fellows from the previrtual (2019 and 2020) cohort compared with virtual cohort (2021).

smallest cohort was from the West with 18 programs (15.3%). This was very similar to the national cohort in all 4 regions (Northeast 30.5%, South 32.6%, Midwest 24.2%, and West 12.2%).

In the previrtual cohort, a large portion of fellows in the Northeast came from the same residency training program, and there was no difference compared with the virtual cohort (31.2% versus 29.1%). In the Midwest, 33.1% of the previrtual cohort were from outside the region compared with the virtual cohort, which was 37.1%. Meanwhile, the virtual cohort in the Midwest had a notable 38.4% from the same institution. In the South and West regions, the majority of matched fellows came from the same region in both the previrtual and virtual cohorts. Stratifying based on geographic region of the program did not show a difference in the placement of fellows in the Northeast

($P=0.777$), Midwest ($P=0.082$), South ($P=0.650$), and West ($P=0.806$). Table 4 provides fellowship placement by US census region.

DISCUSSION

Our study of the geographic placement of matched cardiology fellows during the 2019 to 2021 application cycles found no associated differences in the geographic placement of applicants based on the implementation of virtual interviews. This held true after stratifying fellows based upon program size and geographic region. A similar, and the largest, proportion of fellows came from the same geographic region in both the previrtual and virtual cohorts indicating that the interview modality was not associated with a difference in geographic fellowship match placement. The second highest group included fellows who matched at their same institution. The least common placement was from those within the same state but from a different institution.

Our study is the first to examine the implications of virtual interviews on cardiology fellowship recruitment. Although our study did not find a difference, prior studies investigating other specialties during the COVID-19 pandemic have had mixed findings. Reviewing 36 021 medical graduates and their residency placement, Cotner et al found a small increase in the geographic placement of medical students in the same state of their institution during the 2021 match cycle, the first virtual interview season for residency placement, compared with 2018 to 2020 cycles.¹⁰ Similar findings were described in plastic surgery applicants for virtual versus

Table 2. Geographic Placement Trends From PreVirtual (2019) and Virtual (2020, 2021) Application Cycles

Geographic placement trends from 2019–2021 application cycles			
Application cycle	Previrtual	Virtual	Cumulative
From same program	361 (30.7)	192 (31.5)	553 (30.9)
Same state, but different region	153 (13)	84 (13.8)	237 (13.3)
Same region, but different state/program	285 (24.2)	120 (19.7)	405 (22.7)
Different region	379 (32.2)	213 (35)	592 (33.1)
Total number of fellows	1178 (100)	609 (100)	1787 (100)

*Percentages in parentheses as exclusive categories (ie, same state excluding same program). $P=0.186$.

Table 3. Geographic Placement of Matched Cardiology Fellows Based on Program Size With Total Number (%) as Exclusive Categories (ie, Same State Excluding Same Program)

Geographic trends based on program size						
	Program size					
	Small		Medium		Large	
Number of programs	35		36		47	
	Previrtual	Virtual	Previrtual	Virtual	Previrtual	Virtual
From same program	45 (26.2)	25 (27.5)	107 (31.2)	58 (34.3)	209 (31.5)	109 (31.2)
Same state, but different program	33 (19.2)	19 (20.9)	58 (16.9)	28 (16.6)	62 (9.4)	37 (10.6)
Same region, but different state/program	36 (20.9)	18 (19.8)	90 (26.2)	29 (17.2)	159 (24)	73 (20.9)
Different region	58 (33.7)	29 (31.9)	88 (25.7)	54 (32)	233 (35.1)	130 (37.2)
Total number of fellows	172 (100)	91 (100)	343 (100)	169 (100)	663 (100)	349 (100)
P value	0.974		0.112		0.661	

Small program=1–10 fellows, medium program=11–17 fellows, large program= \geq 18 fellows.

in-person cohorts based on program region or size, but this difference was seen in programs ranking outside the top 30 according to Doximity.¹¹ In these specialties, applicants are known to use away rotations, which were limited early in the COVID-19 pandemic. This may explain why a difference was observed compared with specialties that do not use away rotations as frequently such as the cardiology fellowship in our study.¹⁴ On the other hand, Gabrielson et al did not find a difference in the geographic diversity of successfully placed urology applicants.¹⁵

The extent of downstream changes from virtual interviewing remains unclear. Multiple studies have shown an increase in applications for residency and fellowship programs in some fields.^{16,17} Virtual interviews can create limitations in applicants and programs trying to evaluate the right fit, but it also allows applicants more flexibility and feasibility to attend interviews while avoiding costs of travel and strains placed upon other residents to provide coverage of clinical duties. Unlike medical students, who often

have more schedule flexibility during the fourth year of medical school, residency programs often struggle to cover clinical demands during fellowship interviews. Eliminating travel costs may help reduce any disparities in the application process and encourage applicants to apply and interview at programs that they may not have previously considered. This may, in part, explain why although there was no significant difference between the cohorts, there was a trend toward more matches from a different region. On the contrary, it may deter applicants from ranking programs in cities they have never visited higher because of unfamiliarity.¹⁸

From a program perspective, the resulting increase in applications will challenge the ability to holistically review each application in detail. Programs may require more time or updated strategies to select which candidates will be offered interviews. Programs may also consider interviewing more applicants to ensure that they fill their positions if applicants take more interviews. Ponterio et al. surveyed obstetrics and gynecology program directors finding that, although all

Table 4. Geographic Placement of Matched Fellows Based on Program Region With Total Number (%) as Exclusive Categories (ie, Same State Excluding Same Program)

Geographic trends based on program region								
	Program region							
	Northeast		Midwest		South		West	
Number of programs	37		29		34		18	
	Previrtual	Virtual	Previrtual	Virtual	Previrtual	Virtual	Previrtual	Virtual
Total number of fellows	378 (100)	189 (100)	302 (100)	159 (100)	317 (100)	168 (100)	181 (100)	93 (100)
From same program	118 (31.2)	55 (29.1)	93 (30.8)	61 (38.4)	95 (30.0)	50 (29.8)	55 (30.4)	26 (28.0)
Same state, but different program	68 (18.0)	39 (20.6)	33 (10.9)	13 (8.2)	27 (8.5)	15 (8.9)	25 (13.8)	17 (18.3)
Same region, but different state/program	105 (27.8)	48 (25.4)	76 (25.1)	26 (16.4)	81 (25.6)	35 (20.8)	23 (12.7)	11 (11.8)
Different region	87 (23.0)	47 (24.9)	100 (33.1)	59 (37.1)	114 (36.0)	68 (40.5)	78 (43.1)	39 (41.9)
P value	0.777		0.082		0.650		0.806	

responders agreed that there was a financial benefit in virtual interviewing for applicants, they also expressed concern about truly judging applicants' interest in their program.¹⁹ On a more encouraging note, if virtual interviews continue, it may allow program directors to see a more diverse pool of applicants, a goal the broad field of cardiology and the American College of Cardiology have emphasized remains a glaring deficit that needs to be addressed.^{20,21} Flexibility in interview scheduling may also limit interview cancellations especially owing to often unpredictable travel delays.

Our study suggests that virtual interviews may be a sustainable method to evaluate applicants without any significant impact on geographic match trends, though certainly further study in this subject will be imperative. When travel restrictions ease, fellowship programs will have a decision to make about returning to in-person interviewing.

Further areas of interest include the direct impact that virtual interviewing has on program recruitment including interviewer and applicant satisfaction, program and applicant impressions, and whether the pandemic itself has caused a shift in priorities to any degree for both programs and candidates. The way that each individual program and medical center adjusted to COVID surges, including imaging and procedural volume variation, may have played a role in how applicants perceived the programs they interviewed at for their desired training site.^{22,23}

Limitations

This study is a retrospective observational study that limits the ability to have true randomization or control of applicant characteristics. Participation was similar to some previous survey-based studies and could introduce selection bias given that half of fellowship programs were included and could be significantly different from their excluded counterparts. The included programs had enough of an online presence to have an updated roster of their general fellows, which may suggest that these programs had more information on their website in general. This could also have an impact on our study given more up-to-date program websites may create more interest in applicants applying to that program.²⁴ However, we provide a large sample of fellowship matches over several years to address this concern. Finally, the study cannot capture the individualized decision making that each applicant and program is faced with regarding their decision of where to train. These decisions are often rooted in very personalized factors and priorities. This study instead aimed to emphasize the trends and look for possible associations during the 2019 to 2021 application cycles but cannot provide explanations for the associations discovered.

CONCLUSIONS

Our study highlights the impact of transitioning to virtual interviews on geographic placement of matched general cardiology fellows. In the present study, the transition to virtual interviews resulted in no significant difference in geographic placement of matched fellows compared with in-person interviews, and no significant difference was observed when stratified by program size or geographic region.

Although initially established as a safety precaution during the COVID-19 pandemic, the use of virtual interviews may have a role in the future of fellowship recruitment. Much like the cutting-edge medical innovations in cardiovascular disease, virtual recruitment/interviewing must be studied further to find its optimized role in the fellowship application and beyond.

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