## Title

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# Characteristics of the National Applicant Pool for Clinical Informatics Fellowships (2016-2017)

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**Abstract**

*We conducted a national study to assess the numbers and diversity of applicants for 2016 and 2017 clinical informatics fellowship positions. In each year, we collected data on the number of applications that programs received from candidates who were ultimately successful vs. unsuccessful. In 2017, we also conducted an anonymous applicant survey. Successful candidates applied to an average of 4.2 and 5.5 programs for 2016 and 2017, respectively. In the survey, unsuccessful candidates reported applying to fewer programs. Assuming unsuccessful candidates submitted between 2–5 applications each, the total applicant pool numbered 42–69 for 2016 (competing for 24 positions) and 52–85 for 2017 (competing for 30 positions). Among survey respondents (n=33), 24% were female, 1 was black and none were Hispanic. We conclude that greater efforts are needed to enhance interest in clinical informatics among medical students and residents, particularly among women and members of underrepresented minority groups.*

**Introduction**

In 2006, AMIA was elected to full membership in the Council of Medical Specialty Societies, in recognition of Clinical Informatics' importance as an emerging specialty area in healthcare.[1] In 2011, clinical informatics achieved recognition as a medical subspecialty in the U.S.,[2,3] and in 2014, the first four fellowship training programs received accreditation from the Accreditation Council for Graduate Medical Education (ACGME).[4] Despite significant financial challenges,[5] the number of accredited fellowship programs has grown to 26 as of February 2018.[6] These programs seek to train the next generation of leaders who will apply informatics and information technology to transform health care delivery. However, programs are more likely to produce highly effective graduates if they recruit candidates with sufficient aptitudes, knowledge, and motivation. To succeed, fellows need to acquire strong quantitative, interpersonal, technical and organizational skills. They also should represent a diverse array of gender, race-ethnicity, and specialty backgrounds to ensure that fellows are informed by a broad array of perspectives and that they understand the experiences of diverse patient populations. Building a pipeline of diverse and well-prepared candidates may be as important to the future of clinical informatics as the curriculum taught in our fellowships.

Although clinical informatics fellowship programs are proliferating, little is known about the pool of applicants for these programs. If the applicants are not sufficiently diverse or their numbers are not growing at pace with the available

positions, it would indicate a need to market the subspecialty more vigorously to diverse medical students and residents.

In this paper, we report the results of an effort aimed at estimating the characteristics of the national applicant pool for clinical informatics fellowship programs. Our research questions were: (1) *How many candidates applied for the available 2016 and 2017 clinical informatics fellowship positions,* (2) *What were the characteristics of the applicants, including their diversity and their level of preparation, and (3) What characteristics were associated with success in obtaining a position?*

## Methods

### Data Collection from Fellowship Program Directors

In January, 2016, we collected data from the 12 clinical informatics fellowship programs that participated in a common offer date for July, 2016 positions. The common offer date was an attempt by the participating programs to approximate a match process by making offers sequentially starting at an agreed-upon day and time. We asked program directors to report the total number of positions that their program filled, the total number of applications received, and of those applicants, the number who ultimately succeeded in obtaining a position at any program (based on comparing their applicant lists with the roster of candidates who had accepted positions at one of the programs participating in the common offer process). We collected only aggregate data in order to protect applicants' confidentiality. From December, 2016 to January, 2017 we repeated this data collection among the 18 programs that participated in the common offer date for July, 2017 positions. We excluded positions offered outside of the "match" process because they often involved an informal or off-cycle application process and they were difficult to identify. We estimate that less than 5 such positions were offered nationally each year.

### Online Survey of Applicants

We developed a 13-item anonymous survey of fellowship applicants. Respondents were asked to indicate each program where they applied. Other survey items asked applicants about their demographic characteristics, prior training, and, if they did not obtain an offer, their future career plans. It also asked for narrative feedback on the application process. The survey was implemented using SurveyMonkey®. Program directors invited all their applicants to take the survey by sending an email message to each applicant containing a link to the survey. The email instructed applicants to complete the survey only once, regardless of the number of invitations they received from different programs. Most programs sent two reminder messages asking all applicants to respond to the survey, with the last message focused particularly on encouraging responses from applicants who did not succeed in obtaining a fellowship position.

### Analysis

To estimate the size of the national applicant pool in each year, we first divided the total number of applications received from successful candidates across all programs by the total number of successful candidates to calculate the average number of applications submitted per successful candidate. Based on this statistic and on the average numbers of applications that successful vs. unsuccessful applicants reported submitting in the 2017 survey, we then postulated a plausible range for the average number of applications that each unsuccessful applicant submitted. Dividing the total number of applications that unsuccessful applicants submitted across all programs by lower and upper bounds of this postulated range, we then postulated lower and upper bounds for the national number of unsuccessful applicants. We compared response rates for and self-reported characteristics of successful vs. unsuccessful applicants for 2017 positions using Fisher's Exact Test, and we compared the mean number of applications submitted by successful vs. unsuccessful applicants using the Mann-Whitney U test.

Because survey subjects remained anonymous, the University of California Los Angeles IRB deemed the study exempt from IRB review.

## Results

### Fellowship Program Positions

We received aggregate data from all programs that participated in the common offer dates. For 2016, programs received an average of 15.9 applications. For 2017, the 11 continuing programs received an average of 17.2 applications and seven new programs received an average of 12.4 applications for an overall average of 15.3 applications per program. Programs accepted 10.9% of their applicants on average.

**Table 1** shows each step in estimating the total applicant pool size, as described in the methods. The total number of applications received from successful candidates increased from 191 to 276 (44%), due to increases in both the applications per applicant (4.2 to 5.5, a 31% increase), and in the number of positions filled (24 to 30, a 25% increase). The total number of applications that programs received in aggregate from unsuccessful candidates also increased, but only by half as much (90 to 110, a 22% increase). In the 2017 applicant survey, successful candidates reported applying to an average of 5.7 programs each, closely approximating the actual average determined from the program directors' responses. Unsuccessful candidates reported applying to an average of 2.5 programs ($p$=0.04 for comparison with successful candidates). Using 2 and 5 as postulated lower- and upper-bound estimates for the average number of applications submitted by unsuccessful applicants, we estimated plausible ranges for the total applicant pool size (Table 1). The midpoints of these ranges were 56 and 69, implying a growth rate of in the total applicant pool of about 23% from 2016 to 2017. Based upon these plausible range estimates for the total applicant pool size, we estimated that the competition for clinical informatics fellowship positions remained similar (from success rates of 35–57% for 2016 to 35–58% for 2017).

| | **2016** | **2017** | **1-year Δ** |
|---|---|---|---|
| Number of programs offering positions | 12 | 18 | +50% |
| Number of positions filled by all programs (=Number of successful candidates) | 24 | 30 | +25% |
| Total number of applications received by all programs | 191 | 276 | +44% |
| Total number of applications from successful candidates | 101 | 166 | +64% |
| Total number of applications from unsuccessful candidates | 90 | 110 | +22% |
| Average number of applications per successful candidate | 4.2 | 5.5 | +31% |
| Average number of applications per candidate reported by successful candidates in the anonymous online survey | | 5.7 | |
| Average number of applications per candidate reported by unsuccessful candidates in the anonymous online survey | | 2.5 | |
| Lower-bound estimate for number of unsuccessful candidates, assuming they submitted 5 applications each | 18 | 22 | +22% |
| Upper-bound estimate for number of unsuccessful candidates, assuming they submitted 2 applications each | 45 | 55 | +22% |
| Estimated total fellowship applicant pool | 42–69 | 52–85 | |
| Estimated proportion of applicants who succeeded | 35–57% | 35–58% | |

**Table 1**. Steps in estimating the applicant pool size for 2016 and 2017 clinical informatics fellowship positions

**Applicant Characteristics**

Thirty-three applicants responded to the anonymous online survey in 2017. Of these, 27 reported having succeeded in obtaining a fellowship position (representing 90% of successful applicants). Only six respondents reported having failed to succeed (representing 11% to 27% of the estimated unsuccessful applicants). Unsuccessful candidates were significantly less likely to complete the survey ($p$<0.0001 for both upper- and lower-bound estimates). **Table 2** shows

the applicants' self-reported characteristics. Of note, no applicants reported having Hispanic or Latino ethnicity and only one applicant reported having black or African American race. Twenty-four percent of applicants were women. The only characteristic that showed a statistically significant association with success in obtaining a fellowship position was the year of residency graduation — among successful applicants, 74% were applying to begin fellowship immediately following residency *vs.* only 17% of unsuccessful applicants.

Among the six unsuccessful candidates, four reported that they planned to seek or continue employment that would allow them to be eligible for clinical informatics board certification via the Practice Pathway. Two also reported planning to seek or continue clinical employment, and one reported planning to seek or continue clinical informatics employment in government or the private sector. Only one candidate reported being "uncertain" of their plans. None reported planning to reapply for Clinical Informatics fellowship programs or to pursue other subspecialty training.

**Qualitative Findings**

Twelve survey respondents provided narrative feedback about the application process. Six respondents commented that application dates and interview timetables were inconsistent among programs, not clearly spelled out, or in some cases, changed unexpectedly during the course of the application season. A representative comment in this category was, "Many programs had application processes which were confusing, with incorrect dates (the worst of which was a program that listed its application closing date as its application opening date). Overall, it seemed that many CI fellowship programs had not reviewed their application processes and Web sites for clarity and usability."

Five respondents commented on inconsistent or confusing application forms among the programs. One representative comment in this category was, "A common application and a central source to deposit application materials would be very helpful in reducing the amount of work required to apply to programs." Another said, "Some programs reused existing applications (most commonly from a MS [degree program]) in a confusing, duplicative and sometimes contradictory fashion."

Four respondents commented that the telephone based-match process was stressful or unfair, or they called for an "official," third-party matching system. A sample comment was, "The match process was stressful and gave great advantage to programs."

Other comments included requests that programs (a) post clear guidance on whether they are open to J-1 visa holders, (b) collaborate in publishing the final match results so that applicants can see where others matched, and (c) move the application cycle earlier, to align with other fellowships and to allow those who are unsuccessful more time for a "plan B."

**Discussion and Conclusions**

This study documents robust growth in accredited clinical informatics fellowship programs and in the number of trainees who are applying to these programs, across two years in the early history of the subspecialty. Growth in the number of positions available was roughly on par with growth in the number of applicants. Despite the announcement in November, 2016, that the "practice pathway" to board eligibility in clinical informatics would be extended until 2022, allowing candidates to become board-eligible through work experience rather than fellowship training, aspiring practitioners of informatics seem to be placing faith in the accredited fellowship programs as an incubator for starting their careers.

By comparison with geriatrics, another relatively new subspecialty, clinical informatics remains a somewhat competitive subspecialty at this point in its evolution. In geriatrics, by contrast, only 176 of 387 fellowship positions offered nationally filled were filled in the match for 2018 positions.[7] We were not able to find data on the diversity of applicants in other new subspecialties.

Based on our applicant survey, those coming directly out of residency appear to have a substantial advantage in competing for the available positions compared with those who had finished residency earlier. We also found a trend toward greater prior training in programming or computer science among successful applicants, but it did not reach statistical significance and only a minority of successful candidates had this background. Other experience such as EHR committee service or prior work experience was not associated with success in finding a position. Also of note, we did not find a significant advantage or disadvantage for female applicants, though the proportion of women applicants (24%) was substantially lower than the proportion of women among all residents and fellows (46%).[8] Extremely few applicants self-identified as belonging to underrepresented minority groups. All of these conclusions must be tempered by the fact that only a small proportion of unsuccessful applicants respond to the survey.

| Characteristic | Value | Successful (n=27) | Unsuccessful (n=6) |
|---|---|---|---|
| Sex | Female | 7 (25%) | 1 (16%) |
| Race | Asian/Pacific Islander | 12 (44%) | 2 (33%) |
| | Black/African American | | 1 (17%) |
| | White/Caucasian | 15 (56%) | 3 (50%) |
| Specialty | Anesthesiology | 2 (7%) | 1 (17%) |
| | Emergency Medicine | 3 (11%) | |
| | Family Medicine | 4 (14%) | |
| | Internal Medicine | 8 (30%) | 3 (50%) |
| | OB/GYN | 1 (3.7%) | |
| | Ophthalmology | 1 (3.7%) | |
| | Pathology | 1 (3.7%) | |
| | Pediatrics | 6 (22%) | 1 (17%) |
| | Preventive Medicine | | 1 (17%) |
| | Surgery | 1 (3.7%) | |
| Citizenship | Non-U.S. | 7 (25%) | 2 (33%) |
| Medical School | Non-U.S. | 4 (15%) | 2 (33%) |
| Residency Graduation | 2017 | 20 (74%) | 1 (17%)* |
| Background or Training | Computer programming course or experience or CS degree | 12 (44%) | 1 (17%) |
| | Committee or other volunteer service related to EHRs | 11 (41%) | 3 (50%) |
| | Paid work experience in IT or CI before med school or residency | 6 (22%) | 1 (17%) |
| | Paid work experience in IT or CI after med school or residency | 0 | 1 (17%) |
| | Authored peer-reviewed pubs in CI or a related discipline | 5 (18.5%) | 0 |

**Table 2**. Self-Reported Characteristics of Applicants for 2017 Clinical Informatics Fellowship Positions.
*: $P = 0.02$, Fisher's exact test

Feedback from applicants on the application process primarily centered on issues that will be mitigated through adoption of the AAMC's Electronic Residency Application System (ERAS) and that would be mitigated by using the National Residency Match Program (NRMP). Clinical informatics fellowship programs began using ERAS for the 2018 application cycle, and the AMIA Community of Clinical Informatics Program Directors (CIPD) is considering adoption of the NRMP in the future but not for the 2019 application cycle.

A major limitation of this study was the low survey response rate from applicants who were unsuccessful in obtaining a fellowship position. This leaves a wide plausible range for estimates of unsuccessful applicants' characteristics, including their race/ethnicity, gender, prior experience, as well as the average number of programs to which they applied. This uncertainty translated into an estimated range for the size of the applicant pool that is relatively wide but

still useful in gauging the national level of interest in clinical informatics. We also cannot conclude whether women or members of underrepresented minority groups were successful less often in competing for fellowship positions. Nonetheless, the data show that black and Hispanic trainees are virtually absent among clinical informatics fellowship applicants and that women are substantially underrepresented.

Our study demonstrates that robust policies and processes are needed to enhance interest in clinical informatics careers among medical students and residents, with a particular emphasis on women and members of underrepresented minorities. These efforts should include including providing curricular opportunities to medical students and residents that could enhance their interest in and preparation for clinical informatics. In future years, we will be able to monitor our success in growing the pipeline of diverse and well-prepared applicants through data from ERAS and potentially from the NRMP. When this data is available, the current study will serve as a baseline for comparison.

Perhaps the most important avenue for attracting women applicants, and stronger applicants in general, may be to promote the opportunities that careers in clinical informatics afford for team leadership and for effecting health system transformation. Clinical informatics fellowships are generally preparing trainees for leadership in either health care operations, e.g. in a Chief Medical Information Officer (CMIO) role, in academic medicine, or in the health IT industry, but applying technology is a common thread. However, it is common knowledge that girls often lose interest in science, technology, engineering and math (STEM) fields as they progress through secondary education and college. In a multi-year national survey, the most prominent explanatory variables for the decline in women choosing computer science as a college major were lower self-rated math abilities and greater commitment to social activism, which was negatively associated with the choice of computer science as a major.[9] Among medical students and residents, however, gender differences in career choice have been driven primarily by concerns about lifestyle and expected family demands[10] (although the gender gap in these concerns has narrowed over time[11]). Accounting for these findings, efforts to market clinical informatics as a subspecialty choice might focus on the team leadership opportunities, the pro-social benefits that informaticists provide for patients and colleagues, and on the controllable lifestyles of informatics professionals.

Recent surveys have also found that women in health IT receive 20% less overall annual compensation than men in similar positions,[12] and that women are more under-represented in senior managerial or executive leadership HIT roles, with less than 15% of Chief Medical Information Officers being women.[13] Thus, to provide aspiring female medical students and residents with adequate role models, it may be necessary to address the pay gap and to promote more visible female leaders in health IT.

From 2013 to 2016, 300 to 450 individuals per year achieved board certification in clinical informatics,[14] but in 2017 the number of new diplomates fell to 207.[15] The national need for clinical informatics subspecialists is not yet defined, but even if the number of fellowship positions continues to grow by 25% per year, we would expect only 73 positions nationally in 2021, when the first fellows will be enrolling who will be ineligible for the practice pathway. Considering the need for a robust pipeline of clinical informaticians, we need to accelerate the growth of our programs and we also need to focus vigorous efforts on growing the diversity and strength of our applicant pool.

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