

Timing of Infectious Disease Clinical Rotation Is Associated With Infectious Disease Fellowship Application

Dana M. Blyth, Alice E. Barsoumian, and Heather C. Yun

Infectious Disease Service, Department of Medicine, Brooke Army Medical Center, Houston, Texas

Background. With declining interest in infectious disease (ID) noted among internal medicine (IM) residents, national attention has been directed at methods to recruit more prospective ID applicants. The factors driving the recent decline in ID fellowship applications have thus far only been evaluated in survey studies. Since 2008 at our institution, all IM interns were required to complete a 4-week inpatient ID rotation. We evaluated this rotation to determine if any experiential factors could be linked to future ID interest.

Methods. Categorical IM interns rotating on the mandatory ID rotation at our institution between July 1, 2008, and June 30, 2015, were included. Interns were grouped by eventual application to ID fellowship (IDA) and nonapplication (non-IDA). Consult numbers and types and characteristics of team members during the rotation were compared.

Results. Between July 2008 and June 2015, 143 IM interns met inclusion criteria. Ten (7%) were IDA. There was no difference in number of consults seen, intern, team member, faculty, or fellow characteristics among groups. However, 90% of IDA compared with 46% of non-IDA rotated during the first 6 months of internship ($P = .01$).

Conclusions. During a 7-year period, those interns randomly assigned to rotate on ID in the first 6 months of their intern year were more likely to become future ID applicants. This supports prior self-reported survey data that early exposure to the field may impact future career choice and suggests that incorporating ID early into the intern experience may increase recruitment.

Keywords. career decision-making; infectious disease fellowship; infectious disease recruitment; internal medicine residents.

Since 2009, there has been a 31% decline in applicants to infectious disease (ID) fellowship programs, and the number of adult ID programs filling all positions dropped by 41% [1, 2]. During 2016–2017, ID filled only 65% of positions offered, which is well below the percentage for all internal medicine (IM) specialties at 88%, and above only nephrology and geriatrics. These stark results have led to a call to action [1, 3, 4]. Factors previously identified as important in decision-making for IM residents include time with family, desire to provide a needed service, long-term relationships with patients, job opportunities after training, financial considerations, opportunities to do procedures, and the specialties of their mentors [5].

Given the recent decline in ID fellowship applications, a national survey was completed to further evaluate factors influencing IM resident specialty choice as pertains particularly to ID. Several important points can be drawn from this. The first is that most residents develop an interest in their

career before residency, the second that mentorship is important to career choice, and the last that salary was the most commonly cited factor dissuading residents from a career in infectious disease [3]. Thus far, research into the impact of medical training on ID workforce issues has been limited to self-reported survey data with some attendant controversies in findings, and there remains a need for further qualitative and quantitative study [3, 6–8].

Although self-reported initial interest develops before or during medical school for most, it is particularly notable that more than 55% of residents change career plans at least once during residency and that 70% of residents make their ultimate career choice during residency. This “second engagement phase” following medical school remains an incredibly important, though understudied, aspect of the issue [3, 5, 9–12]. During IM residency (the “second engagement phase”), residents have a greater exposure to systems-based practices and immersion into the field of ID compared with the more pedagogical exposure of medical school [3]. In this recent survey study, 96% of those who applied to ID, compared with 70% of those who did not, rotated on ID. The timing of this rotation varied but was largely during the first 2 years, without further details on the experience and factors that may have played a role in career decision-making [3].

At our institution, all IM interns were required to rotate on the ID inpatient consultation service during their first year. We

Received 14 May 2018; editorial decision 19 June 2018; accepted 30 July 2018.

Correspondence: D. M. Blyth, MD, Infectious Disease Service, Department of Medicine, Brooke Army Medical Center, 3551 Roger Brooke Drive, JBSA Fort Sam, Houston, TX 78234 (dana.m.blyth.mil@mail.mil).

Open Forum Infectious Diseases®

Published by Oxford University Press on behalf of Infectious Diseases Society of America 2018. This work is written by (a) US Government employee(s) and is in the public domain in the US. DOI: 10.1093/ofid/ofy155

sought to evaluate which features of this experience were associated with application for ID fellowship. To our knowledge, this is the first study evaluating characteristics of an intern ID rotation as they relate to future application to the field.

METHODS

Subjects and Setting

We performed a retrospective study of characteristics of categorical IM interns, the staff and fellows they rotated with, and experiential factors of their rotation to determine which predicted future ID fellowship application. All categorical IM interns rotating at Brooke Army Medical Center between July 1, 2008, and June 30, 2015, were included. Exclusion criteria were preliminary intern status (noncategorical) and failure to graduate from IM residency. Scheduling of the ID intern inpatient rotation was assigned by the chief medical residents according to IM program needs and overall vacation requests placed by interns before start of residency. This was done with no knowledge of intern career interest. Brooke Army Medical Center is the highest census hospital in the Military Health System, with 425 inpatient beds and a level I trauma center, and is associated with the US Army Institute of Surgical Research Burn Center, an American Burn Association–credentialed burn center. The IM residents and fellows are all active duty US Air Force (USAF) or US Army (USA) physicians. It is the only site for USAF ID fellows who complete an active duty fellowship and 1 of 2 fellowship training locations for USA fellows, so it is unique in that it is a largely a closed training system.

The ID intern rotation encompassed a 4-week block of inpatient consults, during which the residents worked closely with the inpatient ID fellow on 1 of 2 consult teams with random distribution of patients between the teams. Each inpatient consult team was typically made up of 1–2 interns and an infectious disease fellow who rotated in 4-week blocks, with 1 infectious disease staff rotating every 1–2 weeks. A typical day would entail multidisciplinary rounds with the ID staff, fellow, interns, and—variably by rotation—medical students, a pharmacist, pharmacy students, and microbiologists. During this rotation, interns did not have weekend or holiday coverage and had minimal administrative and documentation burdens. The interns typically carried between 1 and 3 patients at a time but were present for multidisciplinary rounds and teaching on all patients. The interns were invited to ID teaching conferences, which were normally a minimum of 2 hours weekly, as well as various other ID teaching series, which varied during the time period.

Data Collection and Analysis

A review of schedules for the interns, faculty, and fellows was completed based on historical records from the fellow case logbook, residency online scheduling system (amion.com), residency evaluations completed by ID staff, and fellowship

scheduling records to match interns with the timing of their rotation, fellows, and faculty. Data on interns, fellow, and faculty sex, branch of military service, and years of experience were obtained from historical demographic data. Interns were grouped by eventual application to ID fellowship (IDA) and nonapplication (non-IDA), as determined by ID application before departure from military service (which is typically at least 3–4 years after completion of residency).

Consult types seen during the interns' rotations as tracked by mandatory fellow case logs were categorized into 19 topics by 2 ID staff. The information is traditionally input into the case log in real time and includes patient age, sex, and initial consult question. These consults were categorized into 19 types based on host type and infectious syndrome. Patients were considered immunosuppressed if this was indicated by the initial fellow recording the consult (as requested by program leadership) or inferred by clinical information noted (solid organ or hematopoietic stem cell transplant recipient, high-dose steroid administration, and HIV/AIDS). Antimicrobial approval was recorded if this was the only clinical information included for that consult; otherwise a more specific category was used. Antimicrobial approvals (for use of restricted antimicrobials) required a formal and complete consult as no "curbsides" are permitted by the fellowship. Cardiovascular infections included bacteremia and pericarditis, endocarditis, and endovascular infections. Orthopedic infections included osteomyelitis, septic arthritis, bursitis, and orthopedic device–related infections. Tropical diseases included consults related to returning travelers and deployed military personnel, tropical diseases, and parasitic infections. Ear, nose, and throat (ENT) infections were infections of the head and neck that were not better categorized elsewhere. Consult types that could not be included in 1 of the other 17 categories were considered miscellaneous. Up to 2 different categories could be coded for each consult (excluding miscellaneous and antimicrobial approval, which were only coded if no more specific topic was available).

To identify factors associated with IDA, chi-square analysis or the Fisher exact test for categorical variables and Mann-Whitney *U* for continuous variables were performed as appropriate. Statistical analyses were performed using SPSS software (IBM SPSS Statistics, version 22, Armonk, NY).

RESULTS

Over the course of the 7 academic years from 2008 to 2014, 143 categorical IM interns met inclusion criteria. Ten (7%) ultimately applied for ID fellowship (Table 1). All applicants applied before graduation from residency or completing a chief medical resident year. Of those completing an IM categorical residency during this time, between 5% and 9% applied for ID fellowship each year, with no significant difference across the study time period. Demographic factors of the interns rotating, such as sex, military branch of service, and year of rotation, did not affect

Table 1. Demographics of Interns who Ultimately Did and Did Not Apply for ID Fellowship

	ID Applicants (n = 10), No. (%)	Non-ID Applicants (n = 133), No. (%)	P Value
Male sex	5 (50)	97 (73)	.15
Service affiliation of resident			.32
USAF	8 (80)	81 (61)	
USA	2 (20)	52 (39)	
Timing of rotation			.01
July–December	9 (90)	61 (46)	
January–June	1 (10)	72 (54)	
PGY1 year			.97
2008	2 (20)	21 (16)	
2009	1 (10)	17 (13)	
2010	1 (10)	14 (11)	
2011	1 (10)	15 (11)	
2012	2 (20)	25 (19)	
2013	1 (10)	19 (14)	
2014	2 (20)	22 (17)	
No. of co-rotators, median (IQR)	2 (1–2)	2 (2–2)	.40

Abbreviations: ID, infectious disease; IQR, interquartile range; USA, United States Army; USAF, United States Air Force.

future fellowship application. The number of co-rotating trainees also did not affect future application. However, 90% of IDA compared with 46% of non-IDA rotated on ID within the first 6 months of starting internship ($P = .01$).

Of the 143 included interns, 1 IDA and 5 non-IDA rotated during a consult month without a fellow. The remaining 137 interns typically rotated with a single fellow. There was no effect of fellow sex, year of fellowship training, or branch of military service on future ID application (Table 2). Interns' rotations had a median of 2 staff throughout the month, without differences

in military branch of service, sex, or ID clinical experience of staff between IDA and non-IDA. A subanalysis failed to show that female interns were more likely to apply for ID fellowship after rotating with female ID staff (data not shown). Rotating with either the fellowship program director or associate program director was common, but not associated with fellowship application.

There was a median of 34 and 33 consults seen by each team during the rotation of IDA and non-IDA, respectively (Table 3). The most common types of consults seen during

Table 2. Characteristics of ID Fellows and Staff Working With IDA and Non-IDA During Their ID Rotation

	ID Applicants, No. (%)	Non-ID Applicants, No. (%)	P Value
Fellow ^a			
Sex			.62
Male	5 (56)	55 (43)	
Female	4 (44)	63 (49)	
Both male and female fellows	0 (0)	10 (8)	
No. of fellows, median (IQR)	1 (1–1)	1 (1–1)	.81
PGY status, median (IQR)	4 (4–5)	5 (4–5)	.12
Staff ^b			
Sex			.15
Male	6 (60)	44 (33)	
Female	2 (20)	22 (17)	
Both male and female staff	2 (20)	67 (50)	
No. of staff, median (IQR)	2 (2–2)	2 (2–2)	.11
Years of postfellowship ID practice, median (IQR)	6 (5–8)	5.5 (3–8.5)	.37
Rotated with Program Director/Associated Program Director	5 (50)	56 (42)	.63
Rotated with staff who won "Teacher of the Year"	1 (10)	5 (4)	.36
Rotated during a year when ID service won "Teaching Service of the Year"	6 (60)	77 (58)	1.0

Abbreviations: ID, infectious disease; IDA, application to ID fellowship; IQR, interquartile range; PGY, postgraduate year.

^aOne hundred thirty-seven total interns included with 9 IDA.

^bOne hundred forty-three interns included with 10 IDA.

Table 3. Number and Type of Consults Seen During Rotations of Those who Did and Did Not Apply in ID

	ID Applicants (n = 9), ^a Median (IQR)	Non-ID Applicants (n = 133), Median (IQR)	P Value
Total No. of consults	34 (32–35)	33 (30–39)	.60
Orthopedic infections	8 (5–10)	8 (6–10)	.86
Skin and skin structure infections	8 (5–8)	5 (3–7)	.02
Cardiovascular infections	6 (6–10)	6 (3–8)	.08
Immunosuppressed	5 (2–7)	5 (3–6)	.83
Fever and infectious work-ups	4 (3–5)	3 (2–6)	.47
Pulmonary infections	4 (1–5)	3 (2–5)	.86
Urinary tract infections	2 (2–5)	2 (1–4)	.63
MDR organisms	3 (2–3)	3 (1–4)	.81
Central nervous system infections	2 (1–3)	1 (0–2)	.06
Fungal infections	2 (1–2)	1 (0–2)	.52
Intraabdominal infections	1 (1–2)	2 (1–4)	.24
Antimicrobial approval	1 (0–2)	1 (0–3)	.55
Tropical diseases	0 (0–1)	0 (0–1)	.44
Burn	0 (0–0)	0 (0–1)	.38
Viral infections	0 (0–0)	0 (0–1)	.17
Active or latent tuberculosis infection	0 (0–0)	0 (0–0)	.97
Sexually transmitted infections	0 (0–0)	0 (0–0)	.17
Ear, nose, and throat infections	0 (0–0)	0 (0–0)	1.00
Miscellaneous	0 (0–0)	0 (0–0)	.77
Total subtypes	43 (42–48)	43 (37–51)	.44

Abbreviations: ID, infectious disease; IDA, application to ID fellowship; IQR, interquartile range; MDR, multidrug-resistant.

^aOne IDA rotated on team without consult book completed by staff.

rotations by both IDA and non-IDA were orthopedic infections, skin and skin structure infections (SSSIs), cardiovascular infections (mainly bacteremia), consults related to patients with immunosuppression, fever and infectious work-ups, pulmonary infections, and consults for multidrug-resistant (MDR) organisms. There were significantly more SSSI consults and a trend toward more cardiovascular and central nervous system (CNS) infections seen during rotations with IDA compared with non-IDA. Otherwise, there was no difference in consult types seen during the rotations of IDA and non-IDA.

DISCUSSION

During a 7-year period, when all categorical IM interns were required to rotate on an inpatient ID rotation at our institution, rotating within the first 6 months of internship was associated with increased fellowship application to ID. It is well described that career choices for IM residents are unstable, with 20% undecided on residency entry and nearly two-thirds changing their career plans at some point during training [9–12]. With respect to ID interest, a recent landmark survey evaluating graduating US IM residents attempted to clarify the factors influencing career decision-making. Although it identified that most graduating IM residents developed their career interest before residency, it is notable that 32% of respondents considered an ID career but ultimately did not apply [3]. The plasticity of career decision-making during the residency years may offer an opportunity to target recruitment measures.

Self-reported surveys have shown conflicting results regarding the reasons that respondents ultimately did not choose careers in ID. Although the most common intervention selected to increase interest in ID by respondents was improved salary in these studies, these same respondents ultimately cited reasons other than salary dissuading them from ID [3, 13]. Additionally, it is notable that the most common specialties chosen for those previously interested in ID who ultimately did not apply are not high-compensation specialties [3]. This begs the question of insight of respondents and biases attendant to survey studies and argues strongly for attempts to be made toward more empiric analysis of factors contributing to career decision-making. This study is the first to look at factors that may contribute to resident decision-making regarding ultimate application to ID fellowship that are not subject to recall or social desirability bias [3, 8].

Although residency serves as the “second engagement phase,” this phase may be extremely short based on our results, as those rotating in the first 6 months of their residency were most likely to apply for ID. This is unsurprising considering that while the fellowship match process has been more formalized and delayed, it still requires extensive preparation to be successful, including establishment of mentorship and research productivity [3, 13]. It is possible that this early experience can recruit trainees at a critical period during their career decision-making process and may offer support to advocate for early curricular time in IM residency programs.

It is notable that although early rotation was associated with ID application, the interns’ experience was similar regardless of

ultimate interest in ID. The median number of consults seen over the course of the block was similar between the 2 groups and stable over time. In terms of types of consults seen, there were more SSSIs and a trend toward more CNS and cardiovascular infections seen during rotations of IDA. Whether this represents an interest for interns (eg, related to those infections that they see commonly and can identify with), an anomaly related to our cohort, or small sample size remains to be validated in further studies. During this period, the ID service was recognized by the IM residency multiple times for teaching awards. It is possible that the largely manageable workload allowed ample time for fellow and faculty teaching. This experience may be viewed favorably by early or undecided interns for these reasons, and although potentially equally enjoyed by later rotating interns, it would have occurred after the trainee determined their career choice. Therefore, in addition to timing, a positive experience with a manageable workload and ample opportunities for teaching may be required to foster and maintain interest in a field. This is exemplified by a report of an inpatient hematology–oncology rotation’s association with decreased interest in oncology [11]. Alternatively, prior surveys have identified scholarly activity as important in career decision-making [3, 13]. It is possible that early interns were more likely to be offered scholarly activity, which could have fostered additional interest in the field. Late rotating interns may have already been approached with other non-ID opportunities. Regardless of the reason, we find it interesting that there seems to be a critical period for engagement.

Mentorship in particular has been suggested by survey data as impactful in career decision-making [3]. As such, we had posited that rotating with more experienced faculty members or ID fellowship program leadership may have impacted career choice, but we did not find any evidence to support this hypothesis. Of note, at our institution, the median years of experience post-training for faculty members during this time period was 5–6 years, which is typical given the patterns of military physician careers, with many leaving academic medicine through attrition from active duty or promotion to senior leadership at otherwise early to midcareer intervals.

ID fellowship applications at our institution were also notably stable over this period of time (ranging from 5% to 9%), in comparison with the decrease from 5.1% to 3.2% in national rates of ID fellowship applications over a similar period of time [2]. This anomaly may be independent of any 1 rotational experience or limited by a small sample size. However, as a whole, the US military ID fellowships have seemingly retained their applicant pathway [13]. This may be related to required ID exposure as there are data from other medicine subspecialties to argue that exposure during residency is key to recruitment [14, 15].

Limitations of this study include its retrospective nature at a single institution. This is an active duty military training program and has not seen a decline in interest in recent years in comparison

with national data, which may minimize generalizability [13]. On the other hand, this continual exposure and its associated stable rates of ID interest support the engagement hypothesis. During this time, there was also a consistent and disproportionately large ID staff presence on the inpatient general medicine service, a high number of mentored ID resident research projects resulting in national presentations and publications, and 1 of the 2 IM associate program directors was an infectious disease physician [16]. However, these additional ID exposures did not change during the study period. Because of the retrospective nature of this study, we tracked consults by rotation rather than individual consults seen by the interns. However, teaching is typically done during rounds to the entire team, so education would be based on consults seen by the service rather than by individual interns.

During a 7-year period when all interns were required to rotate on ID, there were minimal differences in experiences during the rotation of those who ultimately applied for ID fellowship and those who did not. However, those assigned to rotate on ID in the first 6 months of their intern year without regard to career interest were more likely to become future ID applicants. This supports prior self-reported survey studies that early exposure during residency to the broad field of ID may impact future career choice and further defines a critical period of exposure in the effort to increase ID recruitment. ID program directors and physicians should consider methods to integrate ID early into the academic year for categorical IM interns to promote more interest in ID.

Acknowledgments

Disclaimer. The view(s) expressed herein are those of the author(s) and do not reflect the official policy or position of Brooke Army Medical Center, Uniformed Services University, the U.S. Army Medical Department, the U.S. Army Office of the Surgeon General, the Department of the Army, the Department of the Air Force and Department of Defense or the U.S. Government.

Potential conflicts of interest. All authors: no reported conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

References

1. Walensky RP, Del Rio C, Armstrong WS. Charting the future of infectious disease: anticipating and addressing the supply and demand mismatch. *Clin Infect Dis* 2017; 64:1299–301.d
2. George Washington University Health Workforce Institute. *Analysis of the NRMP-SMS Match for Infectious Disease for 2016–2017 Appointment Year and Trends Over-Time*. Washington, DC: George Washington University Health Workforce Institute. 2016. http://www.idsociety.org/uploadedFiles/IDSA/Careers_and_Training/Program_Director_Resources/Match/Infectious%20Disease%20Match%20Results%20and%20Trends%20Report.pdf. Accessed January 2018.
3. Bonura EM, Lee ES, Ramsey K, Armstrong WS. Factors influencing internal medicine resident choice of infectious diseases or other specialties: a national cross-sectional study. *Clin Infect Dis* 2016; 63:155–63.
4. Chandrasekar P, Havlichek D, Johnson LB. Infectious diseases subspecialty: declining demand challenges and opportunities. *Clin Infect Dis* 2014; 59:1593–8.
5. West CP, Drefahl MM, Popkave C, Kolars JC. Internal medicine resident self-report of factors associated with career decisions. *J Gen Intern Med* 2009; 24:946–9.

6. Sullivan T. Declining interest in infectious diseases: an economic problem that requires economic solutions. *Clin Infect Dis* **2016**; 63:1677.
7. Bonura EM, Ramsey K, Armstrong WS. Reply to Sullivan. *Clin Infect Dis* **2016**; 63:1677–8.
8. Chida N, Melia MT, Ghanem KG. Editorial commentary: recruiting the next generation of infectious diseases physicians: how do we reignite the passion? *Clin Infect Dis* **2016**; 63:169–71.
9. West CP, Dupras DM. General medicine vs subspecialty career plans among internal medicine residents. *JAMA* **2012**; 308:2241–7.
10. West CP, Popkave C, Schultz HJ, et al. Changes in career decisions of internal medicine residents during training. *Ann Intern Med* **2006**; 145:774–9.
11. Reynolds EE. Influencing career choice during residency. *J Gen Intern Med* **1999**; 14:512–3.
12. Adams M, Rathore SS, Mitchell SR, Eisenberg JM. Residency application statements can predict postresidency training. *J Gen Intern Med* **1999**; 14:488–90.
13. Barsoumian AE HJ, Bonura EM, Ressler RA, Whitman TJ, Yun HC. Factors impacting selection of infectious disease training for military internal medicine residents. *Clin Infect Dis*. **2018** Apr 18. [Epub ahead of print]. doi:10.1093/cid/ciy322.
14. Santhosh L, Babik J, Looney MR, Hollander H. Whither the pulmonary ward attending? Preserving subspecialty exposure in United States internal medicine residency training. *Ann Am Thorac Soc* **2017**; 14:565–8.
15. McMahon GM, Thomas L, Tucker JK, Lin J. Factors in career choice among US nephrologists. *Clin J Am Soc Nephrol* **2012**; 7:1786–92.
16. Manian FA. A call for more involvement of infectious disease clinicians in the medical education of the next generation of physicians. *Clin Infect Dis* **2017**; 65:1598.