Associations between Cardiology Fellowship Applicants' Characteristics and Subsequent Clinical Performance during Fellowship Training

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Abstract

Background: Minimal research exists regarding valid methods for the important process of selecting cardiology fellows for subspecialty training.

Aim: We sought to determine associations between standard cardiology fellowship application variables and subsequent clinical performance.

Methods: This was a retrospective cohort study of cardiology fellows who started clinical training from 2007-2013 at the Mayo Clinic in Rochester, Minnesota. Independent variables from the cardiology fellowship application included strength of comparative statements in recommendation letters, AOA status, awards, volunteer activities, USMLE scores, advanced degrees, publications, and residency reputation, as determined by the 2015 residency rankings from US News &World Report. The outcome variable, which was supported by content and internal structure validity, was mean faculty-of-fellow evaluation scores over the first 2 years of clinical training (10 common items; scale 1-5). Calculations were performed using simple and multiple linear regression analysis.

Results: The study included 65 fellows (mean age 32 years; 41 [63%] male) from 18 different residency programs. Independent variables included: mean USMLE score 235, mean publications 14 (9 as first author), AOA designation 10 (15%), mean awards 3, mean volunteer activities 4, advanced degrees 8 (12%), and completed residency programs ranked in the top 6 nationally 43 (66%). Applications typically contained 4 letters of recommendation, including 1 from the residency program director. The overall mean evaluation score was 4.07±0.18. Internal consistency reliability for evaluation scores across all raters and items was excellent (Cronbach's alpha=0.98). Mean evaluation scores during fellowship training were significantly associated with AOA designation (β=0.13; p=0.03), completing a top ranked residency (β=0.13; p=0.004), and strength of comparative statements in letters of recommendation (β=0.08; p=0.02), particularly in the program director's letter (β=0.05; p=0.009 in model including only program director letters). Evaluation scores were not associated with research publications, USMLE scores, awards, volunteer activities, or an advanced degree.

Conclusions: Validated clinical performance scores during cardiology fellowship training are associated with residency reputation, AOA status, and favorable comparative statements in letters of recommendation, particularly the residency program director's letter. Cardiology fellowships should emphasize these factors when evaluating applications for their training programs.

Objectives

1. Identify evidence to guide the selection of cardiology fellows.
2. Determine associations between variables in the standard cardiology fellowship application and validated clinical performance measures during subsequent training.

Methods

- We conduced a retrospective study of 7 classes of cardiology fellows at the Mayo Clinic in Rochester, Minnesota beginning 2 years of core clinical training from July, 2007 to July, 2013.
- We reviewed the ERAS applications of study participants and extracted data on common variables fellowship programs use in the evaluation of candidates to their training programs (**Table 1**).
- We reviewed the letters in each subject's application to determine the academic rank of each letter's author (on a 5 point scale with 5 as the highest for full professor) and the strongest comparative statement for each letter (on a 3 point scale with 3 as the highest), defined as a phrase that directly compares a candidate to their peers.[1]
- The primary outcome in this study, supported by content and internal structure validity, was the aggregate faculty-of-fellow evaluation scores during the subject's 2 years of core clinical training on a 5-point ordinal scale (5 = highest).
- Statistical analyses were performed using simple and multiple linear regression analyses.

Results

- Of the 67 fellows who entered clinical training during the study period, 2 were excluded due to incomplete application data. The final study group included 65 fellows (mean age 32 years, 63% male) from 18 different residency programs.
- The mean strength of comparative statement was 1.0±1.2. Selected comparative statements in letters of recommendation were scored by multiple reviewers with good agreement (Kendall's W = 0.96).
- The overall mean evaluation score was 4.07±0.18 with excellent internal consistency reliability (Cronbach's alpha=0.98).

Table 1 – Variable definitions

Variable	Definition
Advanced degree	Presence of an additional degree (i.e. PhD, MPH, MBA, PharmD, JD, MS) beyond a traditional medical degree.
AOA status	Membership in the Alpha Omega Alpha (AOA) honor society.
Awards	Counts of awards listed in the ERAS application, excluding grades or performance in specific classes or rotations.
Volunteer activities	Counts of volunteer activities listed in the ERAS application.
Mean USMLE scores	Mean of USMLE Step 1, Step 2 Clinical Knowledge, and Step 3 scores listed in the ERAS application.
Publications	All publications and publications where the applicant was the first author, as listed in ERAS, excluding any listings "in progress" or "in preparation".
Top 6 residency	Completion of a residency ranked in the top 6 nationally by reputation in the 2015 Doximity / US News and World Report residency program rankings.

Table 2 – Subject characteristics

Variable	Value[*]
Age at beginning of clinical training (years)	32 ± 4
Male gender	41 (63)
Advanced degree	8 (12)
AOA status	
No	25 (39)
Yes	10 (15)
Not offered	30 (46)
Awards	3 ± 3
Volunteer activities	4 ± 4
Mean USMLE scores	235 ± 17
Publications	
Total	14 ± 12
First author	9 ± 6
Top 6 residency	43 (66)

[*]Values are presented as mean ± standard deviation or n (%) of the 65 total study subjects.

Table 3 – Recommendation letters

	All letters (N=255)[*]	Program director letters (N=62)[*]	Non-program director letters (N=193)[*]
Academic rank of writer			
Not available	42 (16)	9 (14)	33 (17)
Instructor	1 (0)	0 (0)	1 (1)
Assistant professor	39 (15)	10 (16)	29 (15)
Associate professor	59 (23)	21 (34)	38 (20)
Full professor	114 (45)	22 (35)	92 (48)
Comparative statement			
Not available	131 (51)	28 (45)	103 (53)
Neutral enthusiasm	38 (15)	16 (26)	22 (11)
Moderate enthusiasm	42 (16)	6 (10)	36 (19)
Most enthusiasm	44 (17)	12 (19)	32 (17)

[*]Values are expressed as n (%) based on the total number of letters in each column.

Table 4 – Univariate analysis

Variable	β (95% CI)	p-value	R[2]
Advanced degree	-0.08 (-0.22, 0.06)	0.25	0.021
AOA status			0.126
No	Reference	-	
Yes	0.15 (0.02, 0.28)	0.02	
Not offered	0.13 (0.03, 0.22)	0.01	
Awards	0.01 (-0.003, 0.03)	0.12	0.039
Volunteer activities	0.002 (-0.01, 0.02)	0.72	0.002
Mean USMLE scores	0.001 (-0.002, 0.004)	0.41	0.011
Publications			
Total	0.003 (-0.0003, 0.007)	0.08	0.048
First author	0.007 (0.00001, 0.01)	0.05	0.058
Top 6 residency	0.13 (0.03, 0.22)	0.009	0.104
Mean comparative statement			
All letters	0.08 (0.01, 0.15)	0.04	0.067
Program director letters[*]	0.06 (0.03, 0.10)	<0.001	0.178
Non-program director letters	0.03 (-0.04, 0.10)	0.45	0.009
Mean academic rank			
All letters	0.0001 (-0.05, 0.05)	0.99	<0.001
Program director letters[*]	0.01 (-0.02, 0.04)	0.45	0.010
Non-program director letters	-0.01 (-0.05, 0.04)	0.73	0.002

[*]Three subjects were excluded from this analysis because their application did not contain a program director's letter.

Table 5 – Multivariable analysis

Variable	β (95% CI)	p-value	Model R[2]
All letters			0.285
AOA status			
No	Reference	-	
Yes	0.13 (0.01, 0.25)	0.03	
Not offered	0.11 (0.02, 0.20)	0.02	
Top 6 residency	0.13 (0.05, 0.21)	0.004	
Mean comparative statement (all letters)	0.08 (0.01, 0.15)	0.02	
Program director letters[*]			0.305
AOA status			
No	Reference	-	
Yes	0.12 (0.01, 0.23)	0.04	
Not offered	0.10 (0.01, 0.18)	0.02	
Top 6 residency	0.08 (-0.01, 0.16)	0.08	
Mean comparative statement (PD letters)	0.05 (0.01, 0.08)	0.009	
Non-program director letters			0.254
AOA status			
No	Reference	-	
Yes	0.13 (0.01, 0.26)	0.03	
Not offered	0.12 (0.03, 0.21)	0.008	
Top 6 residency	0.14 (0.05, 0.23)	0.003	
Mean comparative statement (non-PD letters)	0.06 (-0.01, 0.12)	0.10	

[*]Three subjects were excluded from this analysis because their application did not contain a program director's letter.

Summary of findings

- In univariate analysis, AOA status, completion of a top 6 residency, and mean strength of comparative statements in letters of recommendation were significantly associated with clinical evaluation scores (Table 4).
- The strength of association for comparative statement in the letters of recommendation was particularly strong when analyzing the letters from program directors (Table 4).
- Awards, volunteer activities, USMLE scores, research publications, and academic rank of letter writers were not associated with evaluation scores (Table 4).
- Multivariable analysis demonstrated that AOA status, completion of a top 6 residency, and the strength of comparative statements in letters of recommendation were all independently association with the evaluation scores (Table 5).
- The association of strength of comparative statement with the primary outcome remained significant when including only letters from program directors and was not significant when analyzing letters from non-program directors (Table 5).

Conclusions

- In a retrospective study of 65 cardiology fellows at Mayo Clinic, AOA membership, completion of a highly-ranked residency program, and favorable comparative statements in letters of recommendation, particularly letters from training program directors, were significantly associated with clinical performance during fellowship.
- Other variables that programs may traditionally emphasize in the evaluation of applicants, such as licensing exam scores and research publications, were not associated with clinical performance.
- Fellowship selection committees should emphasize AOA status, residency reputation, and comparative statements in letters of recommendation when evaluating candidates for their programs.

References

1. Cullen MW, Reed DA, Halvorsen AJ, Wittch CM, Kreuziger LM, Keddis MT, McDonald FS, Beckman TJ. Selection Criteria for Internal Medicine Residency Applicants and Professionalism Ratings During Internship. *Mayo Clinic Proceedings* 2011; 86(3): 197-202.