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Predicting success: What medical student measures predict resident performance in neurology?

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ABSTRACT

Objective: Many medical school metrics are used by residency programs to differentiate residency applicants. The importance of each metric in the field of neurology is unclear.

Materials and methods: This is a single-site retrospective evaluation of characteristics that predict resident quality. Several measures from all 57 adult neurology residents over 8 years were obtained including Step I scores, college and medical school rankings, in-service training examination scores, advanced degrees, and number of publications during residency. Two program directors, blinded to these data and each other's ratings, rated the quality of all residents at the end of the residency. The data were then anonymized for all analyses.

Results: There was no significant relationship between Step I scores and resident quality, though Step I scores correlated significantly with in-service training examination scores. Medical students with PhDs did not perform differently in terms of resident quality, number of publications in residency, or in-service training examination scores. Resident quality was correlated with the ranking of each applicant's undergraduate college, but not the ranking of their medical school.

Conclusions: While Step I is used by many residency programs in ranking potential residents, it does not correlate with overall resident quality, although Step I scores may predict success on future standardized medical examinations. Students with PhDs do not differ from other residents across several metrics. Applicants from highly selective colleges, though not highly selective medical schools, had significantly higher quality ratings. Further research is needed to determine characteristics of medical students that predict performance during neurology residency.

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1. Introduction

Predicting which medical students will make good residents is not a straightforward process. Selection committees consider a variety of factors to both select students for interviews and create rank lists, including medical school attended, class rank, clerkship and sub-internship performance, standardized test scores, membership in honor societies, personal statements, and letters of recommendation [1–9]. It is unclear which factors predict residency performance in neurology. One of the more common traditional benchmarks for medical student quality is the score on the United States Medical Licensing Examination (USMLE) Step I (formerly the National Board of Medical Examiners Part I), the first of four American licensing exams performed during medical school and residency. The USMLE Step I is a 1 day, 8 h exam of 322 multiple-choice items generally taken at the end of the second year of medical school which tests knowledge of the basic health sciences including anatomy, physiology, pathology, biochemistry, genetics, and the behavioral sciences. Scores range from 0 to 300, with 98% of test-takers obtaining a score between 165 and 265 with a median that is generally between 225 and 230 [10]. A passing score varies annually but is close to 190. Past studies from other specialties generally find no correlation between resident quality and scores on the USMLE Step I [11–14], with one study finding a negative association [15] and several a weakly positive association [16,17]. The perceived quality of the medical school attended was predictive of

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resident quality in one internal medicine study [16] but not another [9], and clerkship grades were predictive of resident quality in most studies [9,12,16,18], but not all [14].

Although optimal assessment of residency candidates ultimately requires both subjective and objective information [19,20], determining which objective measures are most likely to predict residency performance would be a helpful guide for selection committees. Studies evaluating predictors of resident quality have not been performed on neurology residents. We sought to determine which measures might predict resident quality based on the experience of our adult neurology residency program over an 8-year period. We were also interested in the predictive value of metrics that might indicate clinical strength during residency, such as performance on in-service training exams.

2. Materials and methods

The University of California, San Francisco (UCSF) adult neurology residency program matched 57 residents between 2006 and 2013, and all were included in the study. The following data were obtained from residency program records: (1) college attended, (2) medical school attended, (3) obtainment of a PhD, (4) USMLE Step I score, (5) position on rank list for the match (adjusted for number of slots available during that year) (6) American Academy of Neurology Residency In-Service Training Examination (RITE) score in post-graduate year 4 (PGY4), and (7) first position after residency (PGY5 position), such as fellowship or post-doctoral position. The RITE is a 1 day, 8 h exam of 425 questions taken four times during residency (the spring of the PGY 1, 2, 3, and 4 years) in the United States with content including clinical adult neurology, pediatric neurology, physiology, neuroimaging, neuroanatomy, neuropharmacology, and psychiatry [21]. Students receive scores as a percentile of performance compared with peers nationally, both overall and within year of training. Some of the seven factors above were then grouped for statistical analysis. College and medical schools were each grouped into three tiers based on the most recent U.S. News & World Report rankings [22–24]. For colleges, the first tier included the top 10 national and top 5 liberal arts schools in 2014, the second tier included national colleges 11–20 and liberal arts colleges 6–10, and the third tier included all others. For medical schools, the first tier included the top 5 research institutions in 2015, the second tier included institutions 6–15, and the third tier included all others. Immediately after residency all residents pursued either clinical or post-doctoral fellowships which we grouped into three categories: (1) inpatient fellowships (vascular neurology, neurocritical care, interventional neuroradiology, neurohospitalist medicine, palliative care), (2) outpatient fellowships (movement disorders, epilepsy, neuromuscular, behavioral neurology, multiple sclerosis/neuroimmunology, headache, neuro-oncology, spine, Center for Disease Control (CDC)), or (3) post-doctoral research fellowship.

Number of research publications was calculated based on PubMed entries. Publications were defined as all research articles published during residency or the first year after residency (PGY1-5); we included the first year after residency since submitted articles may take several months to reach publication. We excluded editorials, commentaries, and "News and Views" articles, as well as research articles that were related to work prior to the residency.

Resident quality was rated separately by two program directors (JWE and SAJ). The quality of each resident at the end of the PGY-4 year was scored on a scale from 1 to 10 by each program director retrospectively, taking into consideration all aspects of clinical (not research) performance; these two ratings were then averaged. The two residency directors were blinded to each other's ratings and
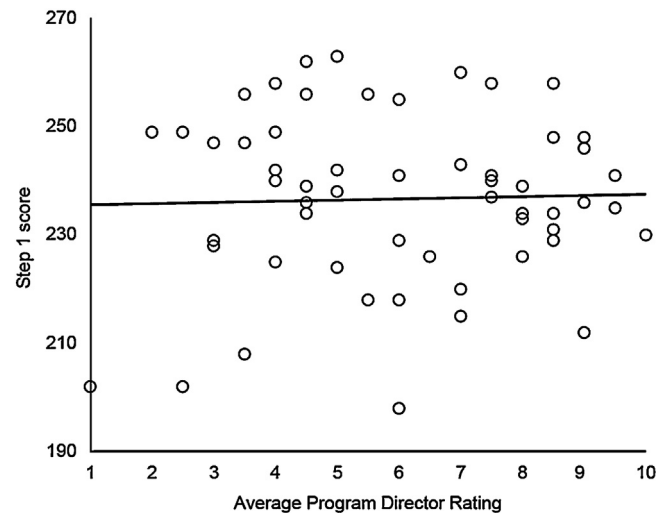

Fig. 1. Relationship between Step 1 scores and average program director rating. Each circle represents a single resident, $n = 57$; $p = 0.82$.

all other data in the study. The data were anonymized before being analyzed.

Statistical analyses were conducted using IBM SPSS Statistics for Macintosh, Version 22.0. Correlation coefficients were used to evaluate the relationship between average program director rating of each resident and step 1 score, rank list position, or PGY4 RITE percentile. Independent samples t-test was used to evaluate the relationship between average program director rating and PhD degree. The remainder of the measures, including ranking of college and medical school rank, publications, and post-graduate plans were categorized as described above. We used one-way analysis of variance to evaluate the relationship between program director rating and each of these measures.

USMLE Step II scores were not included in our analysis as they are currently required to be taken prior to the residency match, whereas at the time of our study they were not. Performance on Step II is presumably different when the results impact the residency application.

3. Results

All 57 residents were included in analysis (Table 1). For program director ratings of resident quality, the two raters had normally distributed ratings, average ratings of 5.8 and 6.3 on a scale of 1–10, and a difference of at most 3 of 10 points for any particular resident. They showed excellent inter-rater reliability (Spearman's $\rho = 0.868$). Our primary objective was to evaluate for objective measures which correlated significantly with program director ratings (Table 2). We had a secondary interest in measures which correlated with PGY4 RITE score (which could be considered an objective measure of resident performance in the medical knowledge domain) and in any relationship between program director rating and measures obtained after applicants joined the residency program (such as PGY4 RITE score, publications in PGY 1-5, and post-residency pursuits).

3.1. Do objective measures available at the time of residency application predict resident quality?

We evaluated whether Step 1 scores, rank of college or medical school attended by the applicant, or the completion of a PhD were correlated with resident quality rating. Step 1 scores were not significantly correlated with resident quality ($p = 0.82$) (Fig. 1). They