

From the New England Society for Vascular Surgery

Increasing the number of integrated vascular surgery residency positions is important to address the impending shortage of vascular surgeons in the United States



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ABSTRACT

Objective: The demand for vascular surgeons is expected to far exceed the current supply. In an attempt to decrease the training duration and to address the impending shortage, integrated vascular surgery residencies were approved and have expanded nationally. Meanwhile, vascular fellowships have continued to matriculate approximately 120 trainees annually. We sought to evaluate the supply and demand for integrated vascular residency positions as well as changes in the quality of applicants.

Methods: We conducted a retrospective review of national data compiled by the Association of American Medical Colleges and the National Resident Matching Program regarding integrated vascular surgery residency programs (2008-2015) and fellowships (2007-2016). Variables reviewed included the total number of applicants, sex, U.S. vs international medical school enrollment, applications per program, and applicants per position. In addition, we conducted a retrospective review of applicants to the University of Massachusetts Medical School integrated vascular surgery residency program from 2008 to 2015 to examine these variables and United States Medical Licensing Examination Step 1 and Step 2 CK scores over time.

Results: The number of vascular surgery integrated residency positions increased from 4 in 2008 to 56 in 2015. Concurrently, the number of integrated residency applicants grew from 112 in 2008 to 434 in 2015. This increase has been predominantly driven by a 575% increase in U.S. graduate applicants and a 170% increase in women applicants. The percentage of international medical graduates has decreased by 17% during the study period. The total number of applicants per residency position increased from 5.9 to 7.8. Meanwhile, the number of vascular surgery fellowship positions remained stable with an applicant to position ratio near 1:1. At the University of Massachusetts Medical School, the mean United States Medical Licensing Examination Step 1 (226 to 235) and Step 2 CK (237 to 243) scores among integrated residency applicants have improved annually and typically exceed the national average among U.S. applicants who have matched in their preferred specialty.

Conclusions: Since the approval of a primary certificate in vascular surgery and the subsequent rollout of integrated vascular residency programs, the number of residency programs and the quality of residency applicants have continued to increase. Demand from medical school applicants vastly outweighs the current supply of training positions by eightfold. In contrast, demand from fellowship applicants matches the supply of fellowship positions. The matriculation of additional trainees must be met with continued expansion of the integrated vascular surgery residency pathway to manage future public health needs. (*J Vasc Surg* 2018;67:1618-25.)

The nation's first vascular fellow was appointed in 1962 at the University of California, San Francisco. This training paradigm has persisted ever since, with 120 accredited fellowship positions in the United States in 2016. The need for vascular surgeons has been expanding within the United States and internationally.^{1,2} With an aging population and a longer life expectancy, the demand for vascular surgeons is expected to dramatically

increase in the next 20 years.³ In 2003, it was predicted that 160 vascular surgeons would need to enter practice every year to avoid a critical shortage.⁴ Vascular surgery fellowships continue to train a portion of the 70% of graduates who seek subspecialty training on completion of their general surgery training.⁵ Concurrent with the predicted shortage of 399 vascular surgeons in the United States by 2030,¹ the Vascular Surgery Board of

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the American Board of Surgery proposed the creation of an integrated vascular surgery residency pathway as an additional, alternative training pathway to the traditional fellowships.⁶ From 2009 to 2016, other specialties, including cardiology (18.5%) and interventional radiology (28.6%), have expanded their workforce to enter the field of treating vascular disease.⁷

In March 2006, the Accreditation Council for Graduate Medical Education (ACGME) approved the vascular surgery primary certificate and eliminated the requirement to complete a general surgery residency before training in vascular surgery.⁸ The first integrated (0 + 5) vascular surgery residencies were approved shortly thereafter. During the past 10 years, the number of programs has expanded from 4 to 48. Despite initial concerns about this shortened training structure, studies have demonstrated equivalent case volumes and job opportunities for integrated vascular residents and vascular fellows at the completion of their training.^{9,10} Training programs continue to monitor the educational program for these increased trainees through the Vascular Surgery In-Training Examination, national educational curricula, simulation courses, and institutional reviews.

As integrated vascular surgery graduates have begun to enter the workforce, we sought to evaluate the changes in supply and demand for integrated vascular residency positions, the changes in the quality of applicants, and the total number of vascular surgeons being trained per year.

METHODS

National integrated vascular residency program review. The Association of American Medical Colleges (AAMC) was petitioned for data on applicants to integrated vascular surgery residencies from 2008 through 2015.¹¹ Variables requested included total number of applicants, sex, U.S. medical school enrollment status, international medical school graduate (IMG) status, applications per program, number of applicants per position, number of publications, and Alpha Omega Alpha (AOA) status. Test scores for the United States Medical Licensing Examination (USMLE) were requested but were not made available because of confidentiality agreements precluding the release of these data. Publicly available match data from 2008 through 2015 were queried on the National Resident Matching Program (NRMP) website.⁷ Deidentified national average USMLE Step 1 and Step 2 CK scores among applicants who have matched in their preferred specialty were obtained through the NRMP *Charting Outcomes in the Match*.⁷ Data regarding the number of ACGME-accredited programs and the number of applicants to those programs were obtained from the AAMC. All applications received through the Electronic Residency Application Service (ERAS) are processed for residency matriculation the following year (ie, ERAS 2008 data are processed for matriculation in 2009). Applicants were defined by the

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective review of prospectively collected data from the Association of American Medical Colleges and the National Resident Matching Program databases
- **Take Home Message:** Whereas the number of integrated vascular surgery residency positions has increased from 4 in 2008 to 56 in 2015, the number and quality of applicants have increased exponentially such that the applicant to position ratio is 7.8:1. There was a 575% increase in U.S. graduate applicants and a 170% increase in women applicants.
- **Recommendation:** This study suggests that the number of integrated vascular surgery residency positions should be increased to meet vascular workforce challenges and public health needs.

NRMP and AAMC as student/graduate from a U.S. allopathic or osteopathic medical school, student/graduate from a Canadian medical school, or student/graduate of an IMG who have ranked at least one integrated vascular surgery residency program through the match.

National vascular fellowship program review. National vascular fellowship match and program information is available through the NRMP specialty matching services website.¹² Available information included the number of ACGME-approved programs and positions, total number of applicants, applicant to program ratio, sex, U.S. vs international medical school enrollment, and AOA honor society membership status.

University of Massachusetts integrated vascular residency program review. All applications received at the University of Massachusetts Medical School integrated vascular surgery residency were reviewed from the 2009 through 2016 matriculation. All data were reviewed by two blinded data abstractors (Ed.J.A., D.R.J.). Variables examined included total applicant number, sex, U.S. vs international medical school enrollment, number of publications, AOA honor society membership status, and USMLE Step 1 and USMLE Step 2 CK scores. The University of Massachusetts Medical School Institutional Review Board reviewed the study protocol and approved an exemption from further review. As all data were blinded, institutional and national informed consent was not obtained for this review.

RESULTS

National integrated vascular residency program review. From 2006 to 2015, the number of integrated vascular residency programs and positions has increased from 4 to 48 programs (increase of 1200%) and 4 to 56 positions (increase of 1400%; Fig 1). Similarly, the demand for

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