Impact of provider characteristics on use of endovenous ablation procedures in Medicare beneficiaries

John T. Baber Jr, MD, MBA,[a] Jialin Mao, MD, MS,[a] Art Sedrakyan, MD, PhD,[a] Peter H. Connolly, MD,[a] *and* Andrew J. Meltzer, MD,[b] *New York, NY; and Scottsdale, Ariz*

CME Activity

Purpose or Statement of Need The purpose of this journal-based CME activity is to enhance the vascular specialist's ability to diagnose and care for patients with the entire spectrum of circulatory disease through a comprehensive review of contemporary vascular surgical and endovascular literature.

Learning Objectives

- Determine the appropriate number of ablation procedures likely to be needed per patient
- Know the specialties that are trained in venous disease

Target Audience This activity is designed for vascular surgeons and individuals in related specialties.

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ABSTRACT

Objective: The objective of this study was to assess the association between provider characteristics and intensity of endovenous therapy (EVT) utilization in the Medicare population.

Methods: The Medicare Provider Utilization and Payment Data Public Use Files (2012-2014) were queried to construct a database of providers performing EVT using laser or radiofrequency ablation techniques for treatment of lower extremity venous reflux. A utilization index (UI; EVT procedure per patient treated per year) was calculated for each provider, and median services per county were determined. Provider specialty, geographic region, and site of service (facility vs outpatient) were determined for each patient. Multivariate regression analysis was used to identify provider characteristics associated with a UI above the 75th percentile.

Results: There were 6599 providers who performed EVT in 405,232 Medicare beneficiaries during the study period. Intensity of EVT use by providers was assessed by the calculated UI, the average number of EVT procedures performed in treated patients per year (range, 1-4). Vascular surgeons had the lowest UI among all provider specialties (1.32). By multivariate analysis, the likelihood of a provider's UI being >1.8 (top 25%) was associated with provider training in a field

From the NewYork-Presbyterian Hospital/Weill Cornell Medical Center, New York[a]; and the Mayo Clinic, Scottsdale.[b]

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Correspondence: John T. Baber Jr, MD, MBA, Department of Surgery, Weill-Cornell Medical College, 525 E 68th St, F-08-035, New York, NY 10065 (e-mail: jtb9008@nyp.org).

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other than surgery, cardiology, or radiology (odds ratio [OR], 3.35; 2.74-4.09); services performed in an outpatient setting (OR, 2.62; 1.97-3.47); and providers who perform high annual volume of EVT (OR, 8.68; 7.59-9.91). A high annual volume provider was defined as one whose EVT volume was ≥75th percentile nationally.

Conclusions: There is great variation in intensity of vein ablation procedures performed on Medicare beneficiaries by geographic location and provider specialty. High-volume providers and those with a specialty not traditionally associated with the management of lower extremity chronic venous disease are more likely to perform more EVT procedures per patient. (J Vasc Surg: Venous and Lym Dis 2019;7:203-9.)

Keywords: Vein ablation; Venous reflux; Medicare

Venous disease is more prevalent in the United States than coronary artery disease, peripheral artery disease, congestive heart failure, and stroke combined.[1] A significant portion of patients who are affected by venous disease suffer from the sequelae of superficial venous insufficiency, with resulting deterioration in quality of life.[2] Although conservative measures including compression therapy are the first-line treatment of venous insufficiency, there is a long-standing history of surgical intervention for superficial venous insufficiency. Accounts of surgical treatment of varicose veins by various methods date as far back as ancient Greece.[3] The initial use of an internal stripping device for removal of the great saphenous vein after ligation of the saphenofemoral junction was first reported by Keller[4] in 1905, followed by the development of the flexible internal vein stripper by Babcock[5] in 1907. The stripping device and procedure described by Babcock differ very little from the methods used in modern practice.

Whereas the technique of ligation and stripping of the great saphenous vein has been established as the "gold standard" of treatment, it remains relatively invasive and typically requires a formal operating room and general anesthesia to be performed. The advent of minimally invasive techniques for treatment of venous reflux addressed these weaknesses, allowing venous reflux to be addressed in an outpatient setting, with reduced risk to the patient and equivalent or superior outcomes compared with open surgical techniques.[6]

The ability to treat lower extremity venous reflux by minimally invasive methods and in an outpatient setting has led to a dramatic proliferation in the number of patients undergoing procedures for venous disease.[7,8] This is likely due to both an increase in patients' demand for treatment and an increased willingness of physicians to provide it. Furthermore, the evolution of venous treatment and the shift toward minimally invasive, catheter-based techniques have resulted in physicians from multiple different specialties treating a historically surgical disease.

Although traditional surgical ligation and stripping procedures were in the surgeon's domain, endovenous ablation procedures are increasingly performed by physicians from a number of training backgrounds, including cardiology and interventional radiology as well as more disparate training backgrounds, such as dermatology, pathology, and ophthalmology,[8] among others. Presumably, this relatively newfound interest in venous disease is a result of the comparatively high reimbursement relative to effort for outpatient venous procedures. Concurrently, reports of fraud and abuse have been highlighted in the lay press with increasing frequency.[7,9-11] In light of these disturbing trends, it is worthwhile to evaluate the impact of variation in provider specialties, practice settings, and clinical indications on utilization and treatment intensity.

The purpose of this study was to explore the current landscape of endovenous thermal ablation in U.S. Medicare beneficiaries and to assess variation in treatment intensity based on provider specialty, site of service, and geographic region.

METHODS

The Medicare Provider Utilization and Payment Data Public Use Files (2012-2014) were queried to construct a database of providers who performed endovenous therapy (EVT) using laser or radiofrequency ablation techniques for treatment of lower extremity venous reflux and submitted a billing request to Medicare during the study period. Records related to EVT were selected using *Current Procedural Terminology* codes 36475 and 36478. For each provider, the number of patients treated with EVT and the number of EVT procedures performed within a particular calendar year were obtained. We additionally obtained the geographic location where each EVT procedure was performed, the service location (outpatient vs inpatient facility), and the reported specialty of the performing provider. This study was performed under an Institutional Review Board approval for research involving deidentified administrative data without patient consent.

Our primary outcome of interest was the utilization index (UI), a new measure we developed to evaluate treatment intensity at the provider level. This was calculated as the average number of EVT procedures performed per patient per year. For example, a provider with a UI of 2 could be considered to routinely perform bilateral great saphenous vein ablation within the same year, as either a single procedure or two separate occurrences, whereas a provider with a UI of 1 would, on average, perform one ablation per patient in a given year. The UI accounted for the average number of ablations performed in a patient in a given year and

did not account for whether procedures were staged or performed concurrently. One could also consider the UI an indicator of "the likelihood that a provider will perform multiple EVT procedures on a patient within a given calendar year." Covariates examined were the year the procedure was performed, provider specialty, service location, Medicare region (Northeast, Midwest, South, and West), and average number of EVT services per year. To aid in statistical analysis, provider specialties were grouped into the following categories: vascular surgery, cardiology, general surgery, radiology, other surgical specialty, and other specialty.

Descriptive analyses were performed to summarize total number and characteristics of providers performing EVT procedures and EVT services. Geographic analysis was performed using provider ZIP code, with regional analysis based on the four established Medicare regions. Site of service refers to inpatient vs outpatient treatment locale. Medians of UI and average number of EVT services performed per year were calculated by ZIP code, and choropleth density maps were constructed to demonstrate the national variation in these metrics.

A multivariate logistic regression analysis was performed to identify provider characteristics associated with a UI above the 75th percentile (1.8 EVT procedures per patient per year). Variables included in the model were year, provider specialty, service location, region, and average number of EVT services per year (categorized into above and below 75th percentile). Analyses were performed using SAS 9.3 software (SAS Institute, Cary, NC) and R 3.3.1 (R Foundation for Statistical Computing, Vienna, Austria).

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective analysis of data of the Medicare Provider Utilization and Payment Data Public Use Files
- **Key Findings:** From 2012 to 2014, vascular surgeons were the most common specialty (22.6%) performing endovenous therapy (EVT), but other nonsurgical specialties or those generally not associated with vascular procedures made up the largest fraction of providers (29.7%). Characteristics associated with utilization of EVT were outpatient procedures (odds ratio [OR], 2.62; 95% confidence interval [CI], 1.97-3.47); training in fields other than surgery, cardiology, or radiology (OR, 3.35; 95% CI, 2.74-4.09); and high volume of procedures (OR, 8.68; 95% CI, 7.59-9.91).
- **Take Home Message:** The study indicates that high-volume providers and those not traditionally associated with management of lower extremity chronic venous disease are more likely to perform more EVT procedures per patient and raises the question of financially driven, potentially inappropriate utilization of EVT.

RESULTS

During the study period, 2828 providers who performed a total of 405,232 EVT procedures were identified (Table I). The annual number of procedures performed increased during the study period (118,585 in 2012; 137,545 in 2013; 149,102 in 2014). The largest fraction of both providers (44.1%) and procedures (51.2%) was localized to the South (Table I).

When providers were segmented on the basis of their training background, vascular surgeons were found to be the most common specialty (22.6%) performing EVT, closely followed by cardiologists (19.3%), general surgeons (13.5%), radiologists (9.3%), and other surgical specialties (7.7%), the remaining specialties that are typically associated with the performance of vascular procedures. Interestingly, specialties that are neither surgical in training nor typically associated with vascular procedures (deemed "other" for the purpose of this analysis) made up the largest overall fraction of providers (29.7%) and accounted for the largest fraction of procedures performed (26.4%). The majority of procedures (94%) were performed in an outpatient setting rather than in an inpatient facility (6%). A complete list of all provider types included in the study and the number of procedures performed by each provider type during the study period can be found in the Supplementary Fig (online only).

When procedure volume was evaluated on a per-county basis, a wide variation in the median annual number of EVT procedures was observed (Fig, *A*), with most counties reporting <60 cases annually and a small number of counties reporting >150 cases annually. These variations in EVT volume did not necessarily correlate with county Medicare patient population. UI was subsequently evaluated on a county-by-county basis as a way of negating variation in Medicare patient density. This demonstrated a wide variation in the median number of procedures performed per treated patient, ranging between one and four EVT procedures per treated patient annually (Fig, *B*).

To determine whether patient-independent factors were associated with the observed variation in UI, multivariate regression analysis was performed to identify provider characteristics associated with a UI above the 75th percentile of all providers (UI >1.8). This analysis revealed several factors strongly associated with UI >1.8, including delivery of service in an outpatient setting (odds ratio [OR], 2.62; 1.97-3.47) and training in a field other than surgery, cardiology, or radiology (OR, 3.35; 2.74-4.09). The factor that most strongly correlated with a high UI was the performance of a high annual volume of EVT (OR, 8.68; 7.59-9.91), defined as a provider whose EVT volume was above the 75th percentile for all providers. These results are summarized in Table II.

Table I. Provider and procedure data

	Providers (n = 2828), No. (%)	Services (n = 405,232), No. (%)
By year[a]		
2012	1993 (70.5)	118,585 (29.3)
2013	2250 (79.6)	137,545 (33.9)
2014	2356 (83.3)	149,102 (36.8)
By region[a]		
Northeast	449 (15.9)	44,198 (10.9)
Midwest	576 (20.4)	69,309 (17.1)
South	1247 (44.1)	207,419 (51.2)
West	565 (20.0)	84,306 (20.8)
By provider specialty[a]		
Vascular surgery	640 (22.6)	81,658 (20.2)
Cardiology	547 (19.3)	79,681 (19.7)
General surgery	383 (13.5)	69,984 (17.3)
Radiology	262 (9.3)	32,544 (8.0)
Other surgical specialty	217 (7.7)	33,197 (8.2)
Other specialty	840 (29.7)	108,168 (26.7)
Service location[a]		
Facility	423 (15.0)	24,306 (6.0)
Outpatient	2472 (87.4)	380,926 (94.0)

[a]Sums of percentages for providers are >100% as providers can practice in multiple years and different regions and locations and be registered with different specialties.

DISCUSSION

Endovenous ablation has become a commonly performed office-based procedure in the United States because of the prevalence of venous reflux disease, the relative ease with which the procedure can be performed, and the financially lucrative reimbursements providers receive for the procedure. The lack of significant oversight when these procedures are performed in an outpatient setting in combination with the rapid increase in the number of procedures performed nationally has led some to suggest that a portion of these procedures may be performed inappropriately.[7,8,12,13]

In this study, we have demonstrated that there is a great variation in intensity of vein ablation procedures performed on Medicare beneficiaries that cannot readily be explained by clinical factors alone. This is demonstrated by the development of the UI, a novel measure of treatment intensity at the provider level that facilitates direct comparisons. The likelihood that a provider will perform multiple EVT procedures on a patient within a given calendar year is predictable on the basis of the provider's geographic location, site of service, and annual EVT volume. Of particular note is the association between increased intensity of EVT utilization and providers not traditionally associated with the management of venous disorders, specifically those other than vascular surgeons, cardiologists, radiologists, and other surgical specialists. Nearly one-third of all endovenous ablation procedures in Medicare beneficiaries are performed by providers whose specialty is not traditionally associated with the management of vascular disease. Furthermore, these providers treat venous disease with a greater intensity, with an average UI that is significantly higher. In light of the comparatively high reimbursements for endovenous procedures, it would be naive to attribute this variation to anything other than financial motivations.

The observed variations in practice patterns are of significant interest to those involved in health care policy as they point to potential regional variability in service availability, lack of consensus with regard to disease management, or potential overutilization or abuse of services.[14-16] Overutilization has previously been demonstrated as a cause of variation in the rate of coronary angiography, upper endoscopy, and carotid endarterectomy in Medicare patients, with high-volume practitioners being the most likely to perform unindicated procedures.[14]

The results from our study expand on the limited number of other investigations of the use of EVT in the Medicare population. Prabhakar et al[8] demonstrated a compound annual growth rate of 15% in the performance of minimally invasive treatments for superficial venous disease from 2005 to 2013, with an increase in utilization per 1000 Medicare beneficiaries from 2.8 to 9.4 during the same period. Nonsurgical providers accounted for the majority of the observed growth in procedure volume. Whereas these findings demonstrated the overall increase in utilization, the authors did not assess variation in utilization at the provider level. It has previously been proposed that the knowledge asymmetry that is innate in the physician-patient relationship in combination with a setting in which a third party is responsible for payment for services creates a scenario in which practitioners may offer services with marginal or no benefit to patients who readily accept them.[17]

Although previous studies have examined variations in the utilization of various procedures among the Medicare cohort,[14-16,18,19] our study is the first to investigate the impact of specialty on variation in the use of endovenous ablation procedures in this population. Furthermore, it is the first study to demonstrate the effect of provider-specific data points on variation in the application of EVT. These findings are of particular interest given the heterogeneity of the EVT provider population.

The lack of patient-related data does serve as a point of weakness of this study; we do not know the severity of disease being treated in each case and therefore do not know whether there was a regional variability in the severity of disease treated or whether there was a tendency of practitioners with particular training backgrounds to see patients with multifocal disease, necessitating multiple treatments. We additionally do not know

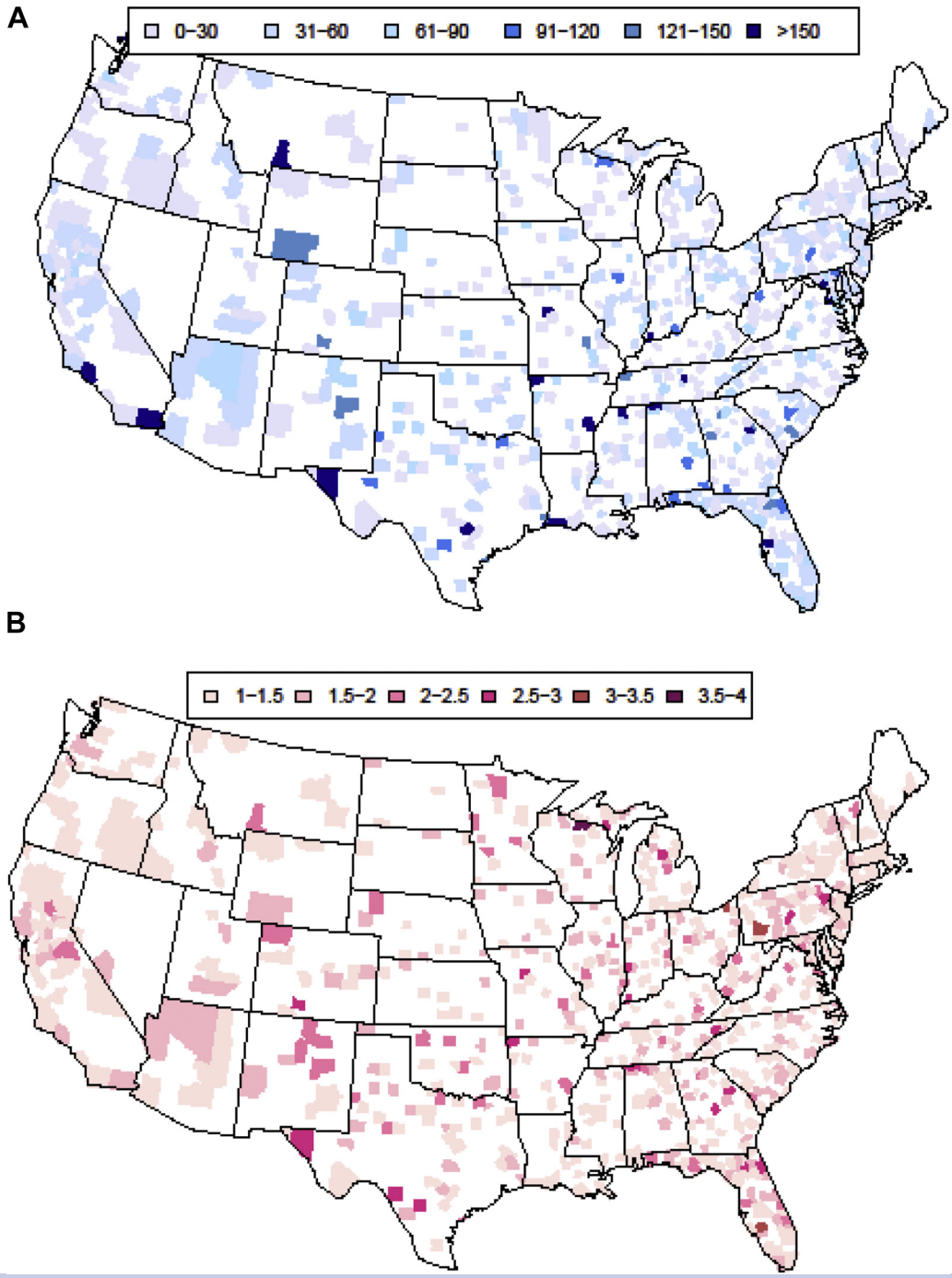

Fig. Choropleth density maps demonstrating regional variation in **(A)** average annual endovenous therapy (EVT) volume and **(B)** median utilization index (UI) for each county. Increasing color density represents increased EVT volume **(A)** or increased median UI **(B)**, corresponding to the guide located above each map.

the rate of failure of attempted EVT requiring additional treatments, which would increase the number of treatments per patient. As a result, it is impossible to determine the "correct" rate of EVT utilization in the observed population. In addition, the scope of the study is limited to Medicare beneficiaries, and we are not able to comment on utilization rates for patients with commercial insurance.

Endovenous ablation of the saphenous veins has been proven to be an effective treatment of symptomatic superficial venous reflux when it is performed by an experienced provider on an appropriate patient. Because of the relative ease with which the procedures can be performed, the low morbidity associated with them, and the lucrative reimbursement given to the provider, these techniques have gained widespread popularity with

Table II. Predictors of utilization index (UI) above the 75th percentile for all endovenous therapy (EVT) providers

	Univariable predictors	Multivariable predictors
	OR (95% CI)	OR (95% CI)
Year		
2012	Reference	Reference
2013	1.11 (0.96-1.28)	1.09 (0.92-1.28)
2014	1.31 (1.14-1.50)	1.31 (1.12-1.54)
Specialty		
Vascular surgery	Reference	Reference
Cardiology	1.21 (1.01-1.44)	1.07 (0.88-1.30)
General surgery	2.01 (1.69-2.38)	1.97 (1.63-2.39)
Radiology	1.86 (1.50-2.32)	2.05 (1.60-2.63)
Other surgical specialty	1.51 (1.19-1.92)	1.44 (1.10-1.90)
Other specialty	4.42 (3.71-5.28)	3.35 (2.74-4.09)
Service location		
Facility	Reference	Reference
Outpatient	4.00 (3.08-5.20)	2.62 (1.97-3.47)
Region		
Northeast	Reference	Reference
Midwest	1.91 (1.56-2.33)	1.53 (1.22-1.93)
South	1.67 (1.39-2.00)	1.15 (0.94-1.42)
West	1.65 (1.34-2.02)	1.18 (0.93-1.48)
Procedures per year		
<75th percentile	Reference	Reference
≥75th percentile	9.58 (8.43-10.88)	8.68 (7.59-9.91)

CI, Confidence interval; *OR*, odds ratio.

both patients and physicians. A rapid increase in both the number of procedures performed and the number of providers performing them has resulted.[8] The characteristics of these procedures that make them so appealing also make them prone to overutilization, especially given the general lack of oversight or certification required to perform such procedures in an outpatient setting. Such overutilization has been previously demonstrated in several medical procedures.[14] Our study has demonstrated that there is a wide variation in the utilization of EVT in the Medicare patient population that is attributable to patient-independent factors, suggesting that overutilization or misuse is taking place.

CONCLUSIONS

There is great variation in the intensity of vein ablation procedures performed on Medicare beneficiaries for the treatment of superficial venous reflux. This variation is observed when it is assessed according to both geographic location and provider specialty and is attributable to patient-independent factors. High-volume providers and those trained in specialties not traditionally associated with the management of lower extremity chronic venous disease are more likely to perform more EVT procedures per patient.

AUTHOR CONTRIBUTIONS

Conception and design: PC, AM
Analysis and interpretation: JB, PC, AM
Data collection: JM, AS
Writing the article: JB
Critical revision of the article: JM, AS, PC, AM
Final approval of the article: JB, JM, AS, PC, AM
Statistical analysis: JM, AS
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Overall responsibility: JB

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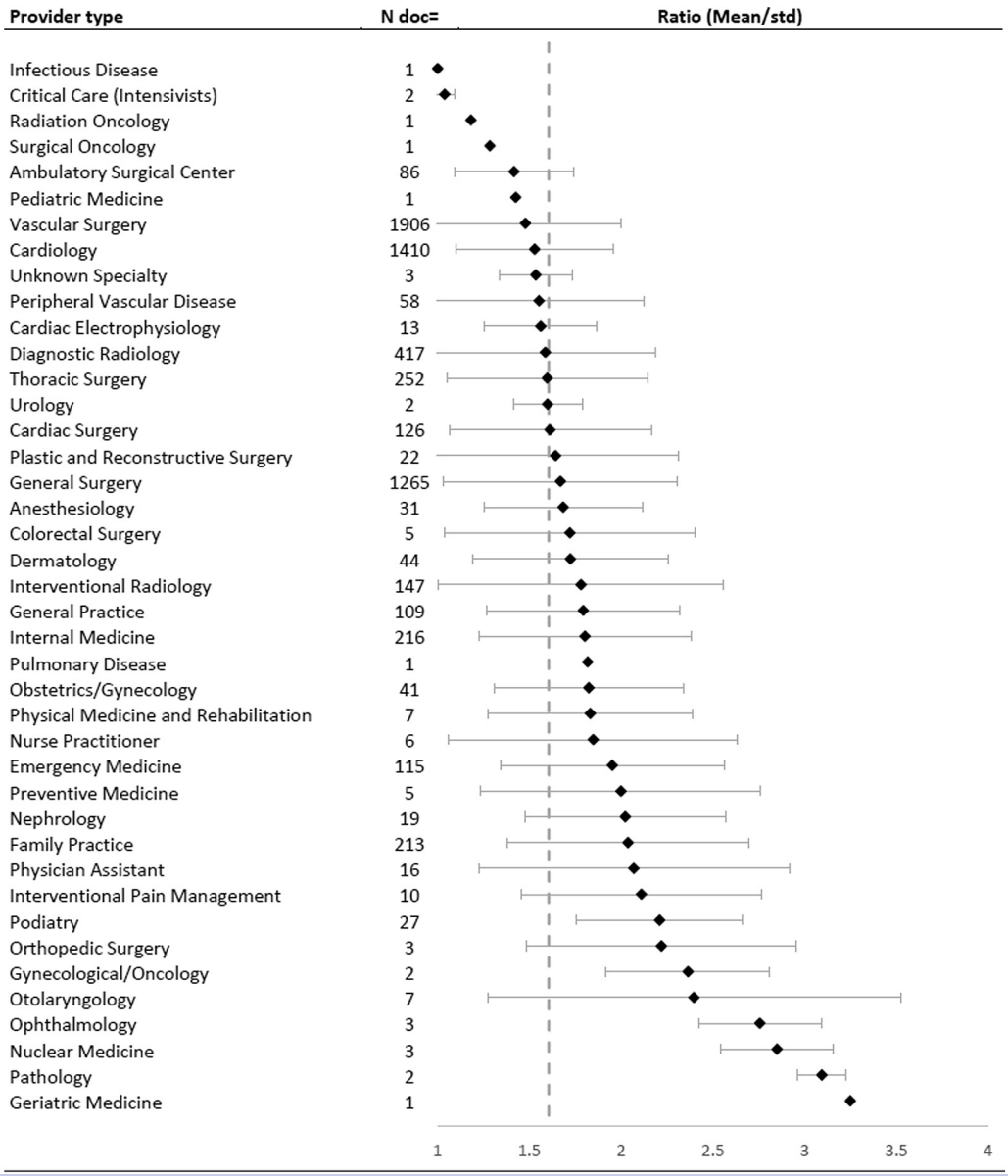

Supplementary Fig (online only). Specialties performing endovenous therapy (EVT). All EVT providers in the study are listed by training specialty, with the corresponding number of providers (*N doc*) in each specialty. The mean utilization index (UI) and standard deviation (*std*) for each specialty are indicated on the *right*. The *vertical dashed line* represents the mean UI for all providers in the study.