Significant physician practice variability in the utilization of endovenous thermal ablation in the 2017 Medicare population

Margaret Mann, MD,[a] Peiqi Wang, MD, MPH,[b] Marlin Schul, MD, MBA,[c] Neil M. Khilnani, MD,[d] Angela Park, BS,[b] Martin A. Makary, MD, MPH,[b,e] *and* Caitlin W. Hicks, MD, MS,[f] *Cleveland, Ohio; Baltimore, Md; Lafayette, Ind; and New York, NY*

ABSTRACT

Background: There has been a substantial increase in the use of procedures to treat lower extremity venous disease in the United States over the past decade. A specialty society-selected metric was applied to evaluate the use of endovenous thermal ablation (EVTA) in Medicare beneficiaries and factors associated with physician practice variations. We used confidential physician reports of this benchmark data to increase physician recognition of individualized usage relative to their peers.

Methods: We used 100% Medicare fee-for-service claims data to identify all patients 18 years of age and older who underwent at least one lower extremity EVTA over a 1-year period (January 1, 2017, to December 31, 2017). A physician-specific annual rate of EVTA performed per patient was calculated. Individual physician results were shared confidentially with each provider billing Medicare for more than 10 ablations during the study period by mail, benchmarked to the distribution of use by their peers nationally. Hierarchical multivariable linear regression was used to identify patient and provider characteristics associated with high rates of thermal ablations per patient.

Results: A total of 102,145 Medicare beneficiaries (median age, 72.1 years; 67.8% female) underwent an EVTA by 2462 physicians during the study period. The majority (96.4%) of patients underwent 1 to 5 ablations, 3.3% underwent 6 to 10 ablations, and 0.3% underwent 11 or more ablations. The median and mean physician ablation rates were 1.6 (interquartile range, 1.3-2.2) and 1.9 ± 0.8 ablations per patient annually, respectively. There were 106 physicians (4.3%) who had an ablation rate of 3.4 or greater, which is two or more standard deviations above the national mean. After adjusting for patient-level variables, characteristics independently associated with outlier physicians included specialties other than vascular surgery, fewer years in practice, and higher overall venous ablation practice volume ($P \leq .03$).

Conclusions: Using a physician-generated metric of performance, the physician use EVTA performed annually per patient is highly variable, and this variability correlated with physician discipline, years in practice, and is more common in physicians who perform ablation the most. Our data show that there is considerable variability in the use of EVTA in Medicare beneficiaries, and that outlier physicians performing a high number of venous ablation procedures per patient are identifiable using a peer-benchmarked practice pattern measure via claims-based data. (J Vasc Surg: Venous and Lym Dis 2019;7:808-16.)

Keywords: Endovenous ablation; EVTA; Medicare; Practice patterns; Outliers

An estimated 23% to 33% of adults between 18 and 64 years of age have varicose veins and chronic venous insufficiency. Nearly one-fourth of affected patients have advanced disease including skin changes and active or healed venous ulcers[1,2] Overall, the problem of venous disease has an estimated financial burden in the United States of $14.9 billion each year.[3]

Technological innovations have resulted in a dramatic shift in the management of venous disease from a hospital-based surgical intervention to an outpatient, minimally invasive endovenous ablation procedure. Endovenous thermal ablation (EVTA), performed with either radiofrequency ablation (RFA) or endovenous laser ablation (ELA), has been demonstrated to have a shorter recovery time, with similar or better postoperative pain, improvements in quality of life, and lower rates of varicose vein recurrence compared with conventional surgery for venous reflux.[4] However, since their

From the Department of Dermatology, Case Western Reserve University, Cleveland[a]; the Department of Surgery, Johns Hopkins University School of Medicine, Baltimore[b]; the Indiana Vascular Associates, LLC, Lafayette[c]; the Weill Cornell Vein Center, Division of Interventional Radiology, Weill Cornell Medicine, New York[d]; the Department of Health Policy & Management, Johns Hopkins Bloomberg School of Public Health, Baltimore[e]; and the Division of Vascular Surgery and Endovascular Therapy, Johns Hopkins University School of Medicine, Baltimore.[f]

This work was funded in part by a grant from the American Vein and Lymphatic Society and the Foundation for Venous & Lymphatic Disease.

Author conflict of interest: none.

Additional material for this article may be found online at www.jvsvenous.org.

Correspondence: Caitlin W. Hicks, MD, MS, Division of Vascular Surgery and Endovascular Therapy, Johns Hopkins University School of Medicine, 600 N Wolfe St, Halsted 668, Baltimore, MD 21287 (e-mail: chicks11@jhmi.edu).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2213-333X

https://doi.org/10.1016/j.jvsv.2019.06.019

introduction almost 20 years ago, there has been a substantial and sustained increase in the overall number of these procedures performed on patients with lower extremity chronic venous disease (CVD). An analysis of procedures performed for CVD in Medicare beneficiaries found a 15% compounded annual growth rate (CAGR) of the use of phlebectomy, sclerotherapy, RFA, and ELA procedures from 95,206 in 2005 to 332,244 in 2014. The CAGR was primarily attributable to rapid increases in RFA (31% CAGR) and ELA (22% CAGR) with the overwhelming majority performed with an outpatient office setting.[5]

The factors leading to the increased use of EVTA has been discussed and mirrors trends in other medical procedures.[6] The possibilities include an increased demand for procedures by patients who are more apt to choose treatment since the introduction of minimally invasive office-based procedure, overuse related to physician education gaps, and/or distorted or misguided physician incentives.[7-12]

The American Vein and Lymphatic Society (AVLS), in conjunction with investigators from Johns Hopkins University School of Medicine, joined together to officially assess EVTA use in the United States, and to identify specific physician characteristics associated with practice variation using a physician-developed performance metric applied to insurance claims data.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective cohort study of 2017 Medicare claims data linked to physician national provider identifiers
- **Key Findings:** Among 2462 physicians who performed endovenous thermal ablation procedures in 102,145 patients with chronic venous insufficiency, the mean physician ablation rate was 1.9 ± 0.8 ablations per patient annually. After adjusting for patient-level variables, outlier physicians (n = 106; ablation rate ≥2 standard deviations above the mean) tended to be of a nonvascular surgery specialty, have fewer years in practice, and have a higher overall venous ablation practice volume.
- **Take Home Message:** Our data show that there is considerable variability in the use of endovenous thermal ablation in Medicare beneficiaries, and that outlier physicians performing a high number of venous ablation procedures per patient are identifiable using a peer-benchmarked practice pattern measure via claim-based data.

METHODS

Study population. The study design and methods for data collection and archiving were reviewed by the Johns Hopkins School of Medicine Institutional Review Board and were approved this study. Informed consent was not required because the data being analyzed are publicly available and no patient-identifiable data were collected. We used the 100% Medicare fee-for-service carrier claims from 2017 to identify all patients 18 years of age or older who underwent at least one EVTA procedure between January 1, 2017, and December 31, 2017, using the Current Procedural Terminology (CPT) codes for RFA and ELA (Table I). We chose to use a one-year time frame to quantify these trends to allow for physicians to perform enough Medicare-billed EVTA cases to provide an adequate number to calculate individual EVTA rates that would not be highly skewed by a single patient interaction.

Patient characteristics. For each Medicare beneficiary who was treated with either RFA or ELA during the study period, we obtained the patients' age, sex, race, and ZIP code of residence from the Medicare Master Beneficiary Summary File. ZIP code was mapped to the Federal Information Processing Standard (FIPS) code using the sashelp.zipcode file (SAS, Inc, Cary, NC). The FIPS code was further mapped to the core-based statistical area (CBSA) code using a CBSA to FIPS County Crosswalk from the National Bureau of Economic Research. CBSA codes were used to determine if a patient resided in a metropolitan area (with an urban core of ≥50,000 population) or a rural area (ie, micropolitan area [with an urban core of 10,000-50,000 population] or non-CBSA area).

We examined diagnosis codes (Supplementary Table, online only) associated with each ablation encounter to determine its indication. We categorized the indication into two groups: (a) varicose veins with pain, swelling, or inflammation (defined as having a diagnosis of pain or swelling or inflammation but no diagnosis of ulcer for any procedure) and (b) varicose veins with ulceration (defined as having any diagnosis of ulceration during the course of the study period).

Physician population and characteristics. We identified the physician providing the thermal ablation procedure by the National Provider Identifier number associated with each encounter claim. Physicians who treated fewer than 10 patients during the study period were excluded according to our Medicare data use agreement. We obtained information on physicians' characteristics from Medicare Data on Provider Practice and Specialty and Physician Compare National Downloadable File. Physician characteristics of interest included sex, years since graduation from medical school, primary specialty, practice region, and location, as well as the annual venous ablation volume during the study period.

Outcome. The primary outcome was the mean number of thermal ablations a physician performed per patient during the study period, which was calculated by

Table I. Current Procedural Technology (*CPT*) codes used to identify patients undergoing endovenous thermal ablation (EVTA)

CPT code	Description
36475	laser ablation first vein
36476	laser ablation, subsequent vein
36478	radiofrequency ablation, first vein
36479	radiofrequency ablation, subsequent vein

counting the reimbursed thermal ablation codes per patient billed by that specific physician (Table II). Physician outliers were defined as those physician whose EVTA rate was two or more standard deviations above the mean. We chose this cutpoint based on statistical measures because there are currently no guidelines reporting appropriate EVTA rates per patient per year. Of note, the data are right skewed; if we changed our statistical cutpoint to (Q3 + 1.5 × IQR) using the Tukey method, the cutpoint did not change.

During our initial data check, we found that 26.7% of all thermal ablation procedures were not billed with a CPT modifier to indicate laterality. Therefore, we calculated the number of thermal ablation procedures for each patient instead of for each limb. If a procedure was billed with a modifier indicating left or right limb or billed without a modifier, then it contributed one count to the total number of procedures. If a procedure was billed with a modifier indicating bilateral procedure, then it contributed two counts. In cases where multiple ablations were performed on the same day (presumably for different veins, but we cannot be sure), each individual ablation contributed to the actual ablation counts.

Statistical analysis. We used a hierarchical linear regression model to evaluate patient-level and physician-level characteristics associated with the number of thermal ablations a patient underwent in a year. We modeled patients' number of thermal ablations as a continuous outcome. The first-level variables in the model were patient characteristics including age, sex, race, and indication for ablation (ie, pain/swelling/inflammation vs ulcer). The second-level variables included physician characteristics including sex, years since medical school graduation, practice region and location, primary specialty, and annual venous ablation patient volume (stratified by tertile). We also included a random intercept for physician to account for the correlation of patients within the same physician. All statistical analyses were performed using SAS Enterprise Version 7.1 (SAS, Inc).

RESULTS

Study cohort. Overall, 102,145 patients underwent an EVTA during the study period (Table III). Of these, 94.1% (n = 96,145) underwent ablation for pain/swelling/inflammation, and 5.9% (n = 6000) underwent venous ablation for an ulcer. The median age was 72.1 years (interquartile range [IQR], 67.9-77.8), including 10,343 patients aged 18 to 64 years, 67.8% (n = 69,269) were female, and 85.0% (n = 86,768) were white. The majority of patients lived in a metropolitan setting (84.8%; n = 86,663). The Southern region had the highest number of patients (44.3%; n = 45,206), followed by the West (22.0%; n = 22,500) and the Midwest (18.4%; n = 18,827). Slightly less than one-half of patients (45.1%; n = 46,089) underwent one ablation, 29.2% (n = 29,874) underwent two ablations, and 25.6% (n = 26,182) underwent three or more ablations during the study period. Only a small proportion of patients (3.3%; n = 3344) underwent between 6 and 10 ablations and ≥11 ablations (0.3%; n = 286).

Physician cohort. There were 2462 physicians who performed more than 10 EVTA procedures during the study period (Table IV). The majority of physicians were male (90.4%; n = 2225), and the median number of years since medical school graduation was 24.0 (IQR, 18.0-32.0). The most prominent specialty was vascular surgery (30.1%; n = 740), followed by cardiology (27.0%; n = 664), general surgery (15.1%; n =371), radiology/interventional radiology (10.0%; n =246), and cardiothoracic surgery (4.3%; n = 105). Similar to the patient distribution, the majority of physicians practiced in a metropolitan setting (93.7%; n = 2308), and the South was the most prevalent region (44.5%; n = 1096). The median number of venous ablation patients treated per physician during the 1-year study period was 24.0 (IQR, 15.0-42.0). Of these physicians, 35.4% (n = 871) treated between 11 and 18 patients, 32.2% (n = 792) between 19 and 34 patients, and 32.5% (n = 799) treated 35 or more patients. During the study period, 59.5% (n = 1465) performed fewer than 50 EVTA procedures, 19.7% (n = 486) performed between 50 and 100 EVTA procedures, and 20.8% (n = 511) performed more than 100 EVTA procedures.

Table II. Formula for calculating the physician-level metric of average number of endovenous thermal ablation (EVTA) procedures performed per patient

$$\text{Average no. of thermal ablations per patient} = \frac{\text{(CPT codes 36475 + 36476 + 36478 + 36479) performed by a physician}}{\text{No. of patients treated with a thermal ablation by the same physician}}$$

CPT, Current Procedural Technology.

Table III. Characteristics of Medicare patients undergoing endovenous thermal ablation (EVTA) in 2017

Characteristic	Patients undergoing thermal ablation (N = 102,145)
Age, years	
Median [IQR]	72.1 [67.9-77.8]
18-64	10,343 (10.1)
65-74	54,601 (53.5)
75-84	30,061 (29.4)
85-94	6952 (6.8)
≥95	188 (0.2)
Sex	
Male	32,876 (32.2)
Female	69,269 (67.8)
Race	
White	86,768 (85.0)
Black	6030 (5.9)
Asian	1686 (1.7)
Hispanic	4011 (3.9)
North America Native	312 (0.3)
Other or unknown	3338 (3.3)
Region of residence	
Midwest	18,827 (18.4)
Northeast	15,525 (15.2)
South	45,206 (44.3)
West	22,500 (22.0)
Other	87 (0.1)
Population density of residence	
Metropolitan	86,663 (84.8)
Rural	15,482 (15.2)
Number of venous thermal ablations, median [IQR]	2.0 [1.0-3.0]
Indication	
Pain/swelling/inflammation	96,145 (94.1)
Ulceration	6000 (5.9)

IQR, Interquartile range.
Values are presented as number (%) unless otherwise indicated.

Physician performance. The median and mean number of ablations per patient during the study period for the entire group of physicians were 1.6 (IQR, 1.3-2.2) and 1.9 ± 0.8 vein ablations per patient, respectively. Of the 2462 physicians included in the analysis, 29.2% (n = 720) had an ablation rate of more than two per patient, 14.5% (n = 357) had an ablation rate of more than 2.5 per patient, and 4.3% (n = 106) had a venous ablation rate two or more standard deviations above the mean, or 3.4 or more ablations per patient (Table IV; Fig).

Independent predictors of venous ablation. Univariate linear regression analyses demonstrated patient and physician-level characteristics associated with EVTA (Table V). After accounting for each of these characteristics using a hierarchical logistic regression model, patients aged 65 to 74 years (vs >74 years), male sex, and white versus black race were all patient factors that were independently associated with having more venous ablation procedures (all $P \leq .01$; Table V). Having an ulcer (vs pain/swelling/inflammation) was also associated with an increased rate of ablations; patients with ulcers underwent 0.37 (95% confidence interval, 0.33-0.42) more venous ablation procedures compared with patients without ulcers ($P < .001$).

Among physician characteristics, being more than 21 to 30 years since medical school graduation (vs ≥31 years) and a general surgeon, cardiovascular surgeon, radiologist, or other specialty (vs a vascular surgeon) were independently associated with a higher number of venous ablation procedures per patient (all $P \leq .03$; Table V). Physicians with higher volume venous ablation practices (ie, ≥19 patients/year, equivalent to the top two tertiles) were also more likely to perform more venous ablations per patient compared with physicians with lower-volume practices (ie, <19 patients/year, or bottom tertile; $P < .001$). Physicians practicing in the Northeast versus Southern region had a lower number of venous ablations per patient ($P < .001$; Table V). There were no significant associations of physician sex or practice setting (metropolitan vs rural) with rate of venous ablation procedures after risk adjustment (all $P \geq .05$; Table V).

Profile of the high use physicians. There were 106 physicians with a venous ablation rate of 3.4 ablations or more per patient (ie, ≥2 standard deviations above the mean). These top outlier physicians performed an average of 8.2 venous ablations per patient, which was 0.9 venous ablations higher than the next highest physician. The top 106 outlier physicians treated a total of 8591 patients in the 1-year study period. Among the top 10 physician outliers (Table VI), the median number of years in practice was 22 years (range, 14-31 years) and the number of patients treated with venous ablation during the study period varied widely (median, 50.5 patients; range, 14-336 patients). Cardiologists composed 40.0% (n = 4) of the group, followed by vascular surgeons (20.0%; n = 2), and then one each of general surgeons, internal medicine, family practice, and interventional radiology.

Sensitivity analysis. We repeated our analysis limiting procedures to the first vein treated only (ie, CPT codes 36475 and 36478). Using these revised inclusion criteria, the median and mean physician venous ablation rates were 1.53 (IQR, 1.26-2.00) and 1.73 ± 0.67 venous ablations per patient, respectively. Of the 2462 physicians included in the analysis, 4.3% (n = 107) had a venous ablation rate of two or more standard deviations above the mean, or 3.1 or more ablations per patient. There is 75% overlap in outlier identification using limited codes versus full codes.

Table IV. Physician characteristics stratified by physician-level endovenous thermal ablation (EVTA) rates per patient (<3.4 vs ≥3.4 ablations per patient)

	Physicians with <3.4 ablations per patient (n = 2356)	Physicians with ≥3.4 ablations per patient (n = 106)
Sex		
Male	2,128 (90.3)	97 (91.5)
Female	228 (9.7)	9 (8.5)
Years since medical school graduation		
Median [IQR]	25.0 [18.0-32.0]	23.5 [18.0-30.0]
0-10	144 (6.1)	2 (1.9)
11-20	677 (28.7)	32 (30.2)
21-30	788 (33.5)	46 (43.4)
≥31	699 (29.7)	24 (22.6)
Unknown	48 (2.0)	2 (1.9)
Practice region		
Midwest	447 (19.0)	13 (12.3)
Northeast	387 (16.4)	12 (11.3)
South	1,049 (44.5)	47 (44.3)
West	472 (20.0)	34 (32.1)
Other	1 (0.04)	0 (0.0)
Population density of practice location		
Metropolitan	2,205 (93.6)	103 (97.2)
Rural	151 (6.4)	3 (2.8)
Primary specialty		
Vascular surgery	715 (30.4)	25 (23.6)
General surgery	350 (14.9)	21 (19.8)
Cardiothoracic surgery	99 (4.2)	6 (5.7)
Cardiology	645 (27.4)	19 (17.9)
Radiology	233 (9.9)	13 (12.3)
Other	314 (13.3)	22 (20.8)
Annual volume of endovenous ablation patients		
Median [IQR]	23.0 [15.0-40.0]	59.5 [33.0-108.0]
11-18	863 (36.6)	8 (7.6)
19-34	773 (32.8)	19 (17.9)
≥35	720 (30.6)	79 (74.5)

IQR, Interquartile range.
Values are presented as number (%) unless otherwise indicated.

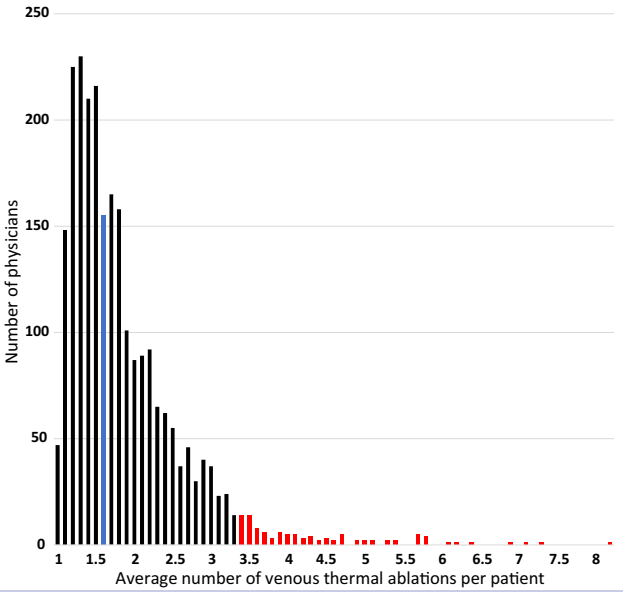

Fig. National distribution of physicians' average number of endovenous thermal ablations (EVTAs) per patient. Note: *Blue bars* represent the median number of thermal ablations per patient (1.6), and *red bars* represent outlier physicians.

DISCUSSION

There has been a dramatic growth in the use of venous thermal ablation procedures since their introduction in 1999.[5] Increased use is expected with the adoption of improved diagnostic and therapeutic procedures.[13-15] EVTA is a safe and effective minimally invasive technology that can be performed in an office environment with a shorter recovery and equivalent long-term outcomes. Increased patient acceptance of treatment undoubtedly leads to more patients presenting for treatment and could conceivably drive part of the measured increased use. It might also be applied to patients, who based on age or other comorbidities, would otherwise not be considered for conventional surgery that usually involved a higher level of anesthesia and a longer period of convalescence.

It is currently estimated that between 6% and 11% of all medical procedures performed in the United States are unnecessary.[12] As such, the judicious application of new technology to prevent overuse is important. In a physician survey, the top cited reasons for overtreatment were fear of malpractice and patient pressure/request.[6] Other factors driving overuse may include poor physician judgment based on educational or experience gaps,[16] financial incentives of our fee for service system, and lack of peer review and shared knowledge in private practice settings.[17] Lack of standardization in training, diagnostic, and treatment protocols and data to support clear and through medical guidelines may also contribute.[6]

In the current study, we applied a specialty society-selected, physician-developed quality metric for EVTA and analyzed factors associated with various levels of use. We found that the mean number of EVTA performed per patient was 1.9, but that more than 100 physicians exceeded this mean by more than two standard deviations. After adjusting for patient factors, physician characteristics that were independently associated with more EVTA per patient included specialties other than vascular surgery, fewer years in practice, and higher EVTA practice

Table V. Hierarchical linear regression of factors associated with the number of endovenous thermal ablation (EVTA) procedures performed per patient per year

Patient characteristics	Unadjusted difference in No. of thermal ablations (95% CI)	*P* value	Adjusted difference in No. of thermal ablations (95% CI)	*P* value
Age, years				
18-64	−0.06 (−0.10 to −0.02)	.001	0.00 (−0.03 to 0.03)	.98
65-74	Reference		Reference	
75-84	−0.11 (−0.13 to −0.08)	<.001	−0.07 (−0.09 to −0.05)	<.001
85-94	−0.19 (−0.24 to −0.15)	<.001	−0.17 (−0.21 to −0.13)	<.001
≥95	−0.30 (−0.55 to −0.06)	.02	−0.26 (−0.47 to −0.06)	.01
Sex				
Male	Reference		Reference	
Female	−0.03 (−0.06 to −0.01)	.006	−0.08 (−0.10 to −0.07)	<.001
Race				
White	Reference		Reference	
Black	−0.10 (−0.15 to −0.05)	<.001	−0.12 (−0.16 to −0.08)	<.001
Asian	−0.02 (−0.10 to 0.06)	.65	−0.07 (−0.14 to 0.01)	.07
Hispanic	0.14 (0.09-0.20)	<.001	0.00 (−0.05 to 0.05)	.91
North America Native	−0.13 (−0.32 to 0.07)	.20	0.00 (−0.16 to 0.17)	.95
Other/unknown	0.00 (−0.06 to 0.06)	.90	−0.06 (−0.11 to −0.01)	.02
Indication				
Pain/swelling/inflammation	Reference		Reference	
Ulceration	0.40 (0.35-0.45)	<.001	0.37 (0.33-0.42)	<.001
Physician characteristics				
Sex				
Male	Reference		Reference	
Female	0.10 (0.06-0.14)	<.001	0.11 (0.00-0.21)	.05
Years since medical school graduation				
0-10	0.00 (−0.05 to 0.05)	.92	0.10 (−0.04 to 0.24)	.16
11-20	0.07 (0.04-0.10)	<.001	0.04 (−0.04 to 0.12)	.33
21-30	0.22 (0.20-0.25)	<.001	0.09 (0.01-0.16)	.03
≥31	Reference		Reference	
Practice region				
Midwest	−0.10 (−0.13 to −0.07)	<.001	−0.06 (−0.14 to 0.03)	.18
Northeast	−0.31 (−0.34 to −0.28)	<.001	−0.20 (−0.29 to −0.11)	<.001
South	Reference		Reference	
West	0.17 (0.14-0.20)	<.001	0.06 (−0.02 to 0.14)	.13
Other	−0.88 (−1.55 to −0.20)	.01	−0.71 (−2.19 to 0.77)	.35
Population density of practice location				
Metropolitan	Reference		Reference	
Rural	−0.19 (−0.24 to −0.15)	<.001	−0.11 (−0.23 to 0.02)	.10
Primary specialty				
Vascular surgery	Reference		Reference	
General surgery	0.37 (0.34-0.40)	<.001	0.33 (0.23-0.42)	<.001
Cardiothoracic surgery	0.40 (0.35-0.45)	<.001	0.25 (0.10-0.41)	.002
Cardiology	0.02 (−0.01 to 0.05)	.16	0.09 (0.00-0.17)	.03
Radiology	0.40 (0.36-0.44)	<.001	0.33 (0.21-0.44)	<.001
Other	0.41 (0.38-0.45)	<.001	0.44 (0.35-0.54)	<.001

(Continued on next page)

Table V. Continued.

Patient characteristics	Unadjusted difference in No. of thermal ablations (95% CI)	*P* value	Adjusted difference in No. of thermal ablations (95% CI)	*P* value
Annual volume of endovenous ablation patients				
11-18	Reference		Reference	
19-34	0.20 (0.16-0.23)	<.001	0.20 (0.12-0.27)	<.001
≥35	0.86 (0.83-0.89)	<.001	0.70 (0.62-0.77)	<.001

CI, Confidence interval.

volumes. Similar findings of overuse in high-volume physicians have been noted in other disciplines, and were associated with operating on less sick patients.[10]

Our benchmark mean venous ablation rate of 1.9 per patient per year based on the 2017 Medicare data is consistent with the 1.8 mean ablation rate recently reported in an analysis of the 2012-2015 Medicare data,[18] and the 1.7 mean ablation rate reported by Crawford et al[19] in an recent retrospective single-center analysis. Our findings are also consistent with a prior analysis of 2012-2014 Medicare data,[20] which noted greater use of EVTA procedures in high-volume physicians and those trained in disciplines other than surgery, cardiology, or radiology. In our study, the top 10 use rates were found in physicians from vascular surgery, general surgery, internal medicine, family practice and interventional radiology (Table VI), demonstrating that overuse is not a discipline-specific concern. This finding, along with the number of physicians from a variety of specialties who used EVTA at a rate substantially more than the median of their peers, suggests that overuse is unfortunately a ubiquitous problem in the field of venous disease.

There is a need to develop data-driven oversight, self-assessment, and clinical protocols to support decision making in the treatment of chronic venous insufficiency. Until the recent introduction of voluntary participation in registry opportunities, few other alternatives exist for physicians to assess their own performance relative their peers. Because venous procedures are primarily performed in outpatient office-based practice, very few quality control measures exist in the community and peer review in such practices is limited. Trying to address non–evidence-based practice in an effort to thwart excessive use in physicians who do not participate in specialty-specific CME or registries is therefore challenging for the specialty societies to undertake.

Providing physician-level feedback about procedural use as compared with peers is one way to engage physicians in a quality control program. The AVLS, in partnership with the Improving Wisely project at Johns Hopkins University, are collaborating to see if sharing confidential performance data with physicians will result in a decrease in practice variability, a recognized sign of inappropriate and or unnecessary care. As part of the collaboration, the groups created and distributed a one-page physician-specific report by US mail to each physician who billed Medicare for more than 10 EVTA per year. These reports included a histogram of the ablation rates of the studied physicians as well as the individual physician's rate (Fig). Physicians were notified if their rate was more than two standard deviations from the mean rate, and educational resources were suggested for practice enhancement. We expect that many physicians may be unaware of the value of the use of such a metric and of their EVTA rate in comparison with their peers, so providing data about physicians' expected and actual venous ablation rates per patient may improve self-awareness and considerations of their practice variations from their peers. Similar models of

Table VI. Characteristics of the top ten outlier physicians for endovenous thermal ablations (EVTAs)

Physician	Region	Years in practice	Specialty	No. of patients treated	Average No. of ablations per patient
1	South	10-20	Cardiology	33	8.2
2	Northeast	20-30	General surgery	74	7.3
3	Midwest	30-40	Cardiology	71	7.1
4	West	20-30	Internal medicine	54	6.9
5	Midwest	10-20	Family practice	35	6.4
6	South	20-30	Vascular surgery	47	6.2
7	West	10-20	Cardiology	14	6.1
8	South	20-30	Interventional radiology	336	5.8
9	West	20-30	Vascular surgery	161	5.8
10	West	20-30	Cardiology	159	5.8

individualized physician feedback using peer-benchmarking have been previously applied in other settings with positive behavior changes.[21-23] Our hope is that a similar intervention applied to venous ablation procedures will be equally effective at decreasing practice variation in EVTA. The AVLS and Improving Wisely plan to repeat the analysis 1 Medicare billing year after the distribution of the physician performance reports to assess for any changes in practice variability in our community and on an individual basis as well. We hope to report on this data in the future. We will also mail the updated physician-specific data to each individual physician to provide them with a report card on how their practice may have changed since the first assessment.

This study has some important limitations. First, we did not study patient outcomes that may not relate to ablation rates. Second, some patients may require more or fewer ablations based on their clinical situation or response to prior treatment. Consistent with this notion, we found that patients with CVD with ulceration underwent more venous ablation procedures than patients who presented with pain, swelling, or inflammation, which logic would suggest may be appropriate. It should also be noted that aggregated Medicare data do not allow for detailed patient risk stratification; although we adjusted for patient demographics and venous ablation indication in our risk adjustment, we were unable to analyze severity of disease in individual patients. Some physicians may see higher risk patients with more severe disease, thus requiring more ablations than their peers. An additional weakness of this study involves the limited number of procedure codes used in our query. CPT codes do not differentiate treatment of axial versus perforator veins, so we were unable to account for what veins were treated. We were also unable to determine why certain patients underwent very high numbers of ablations (eg, ≥11 ablations), although we suspect this may be related to a lack of education in the appropriate indications for treatment in some physicians and misguided financial incentives in others. In addition, patients who underwent multiple procedures by a number of different physicians in a practice would not have been captured by our physician-level analysis. Subsequent iterations analyzing the rate of EVTA and other venous procedures will be modeled to account for these potential causes of practice variation.

CONCLUSIONS

We present a specialty society-selected physician developed quality metric for the practice of venous ablation procedures among Medicare beneficiaries. Our data show that there is considerable variability in the use of EVTA in Medicare beneficiaries, and that outlier physicians performing a high number of venous ablation procedures per patient are identifiable using a peer-benchmarked practice pattern measure via claims-based data. The AVLS is planning to investigate whether sharing national and individual physician data with the individual physicians can become a quality improvement initiative that could help to decrease practice variability similar to peer benchmarking programs applied in other areas of medicine.

We would like to acknowledge the American Vein and Lymphatic Society and the Foundation for Venous & Lymphatic Disease for providing grant funding and personnel support for the Improving Wisely Vein Project.

AUTHOR CONTRIBUTIONS

Conception and design: MM, PW, MS, NK, AP, MAM, CH
Analysis and interpretation: MM, PW, MS, NK, AP, MAM, CH
Data collection: PW, AP, MAM, CH
Writing the article: MM, PW, MS, NK, CH
Critical revision of the article: MM, PW, MS, NK, AP, MAM, CH
Final approval of the article: MM, PW, MS, NK, AP, MAM, CH
Statistical analysis: PW
Obtained funding: MM, MS, NK, MAM
Overall responsibility: CH

REFERENCES

1. Evans CJ, Fowkes FG, Ruckley CV, Lee AJ. Prevalence of varicose veins and chronic venous insufficiency in men and women in the general population: Edinburgh Vein Study. J Epidemiol Community Health 1999;53:149-53.
2. Kaplan RM, Criqui MH, Denenberg JO, Bergan J, Fronek A. Quality of life in patients with chronic venous disease: San Diego population study. J Vasc Surg 2003;37:1047-53.
3. Rice JB, Desai U, Cummings AK, Birnbaum HG, Skornicki M, Parsons N. Burden of venous leg ulcers in the United States. J Med Econ 2014;17:347-56.
4. Nesbitt C, Eifell RK, Coyne P, Badri H, Bhattacharya V, Stansby G. Endovenous ablation (radiofrequency and laser) and foam sclerotherapy versus conventional surgery for great saphenous vein varices. Cochrane Database Syst Rev 2011:CD005624.
5. Prabhakar AM, Misono AS, Sheth RA, Rosenkrantz AB, Hemingway J, Hughes DR, et al. Changing Medicare Utilization of Minimally Invasive Procedures for the Treatment of Chronic Venous Insufficiency. J Vasc Interv Radiol 2017;28:818-24.
6. Brownlee S, Chalkidou K, Doust J, Elshaug AG, Glasziou P, Heath I, et al. Evidence for overuse of medical services around the world. Lancet 2017;390:156-68.
7. Emanuel EJ, Fuchs VR. The perfect storm of overutilization. JAMA 2008;299:2789-91.
8. Rubenstein JH, Pohl H, Adams MA, Kerr E, Holleman R, Vijan S, et al. Overuse of repeat upper endoscopy in the veterans health administration: a retrospective analysis. Am J Gastroenterol 2017;112:1678-85.
9. Murphy TP, Soares G, Kim M. Increase in utilization of percutaneous renal artery interventions by Medicare beneficiaries, 1996-2000. AJR Am J Roentgenol 2004;183:561-8.
10. Park RE, Chassin MR, Solomon DH, Keesey J, Kosecoff J. Predicting the appropriate use of carotid endarterectomy, upper gastrointestinal endoscopy, and coronary angiography. N Engl J Med 1990;323:1173-7.

11. Absurd vein care: can we fix it? A roundtable discussion. Vein Magazine 2015. Available at: https://www.veindirectory.org/magazine/article/practice-management/absurd-vein-care-can-we-fix-it-a-roundtable-discussion. Accessed April 18, 2019.
12. Lyu H, Xu T, Brotman D, Mayer-Blackwell B, Cooper M, Daniel M, et al. Overtreatment in the United States. PLoS One 2017;12:e0181970.
13. Crivello ML, Ruth K, Sigurdson ER, Egleston BL, Evers K, Wong YN, et al. Advanced imaging modalities in early stage breast cancer: preoperative use in the United States Medicare population. Ann Surg Oncol 2013;20:102-10.
14. Gelijns AC, Fendrick AM. The dynamics of innovation in minimally invasive therapy. Health Policy 1993;23:153-66.
15. Chernew MA, Fendrick AM, Hirth RA. Managed care and medical technology: implications for cost growth. Health Aff 1997;16:196-206.
16. Siah MC, Abramowitz SD, Haser P, Ricotta J, Woo EY, Mascata R. Evaluating the venous experience in vascular surgery training. J Vasc Surg Venous Lymphat Disord 2017;5:446-52.
17. Krishnan A, Xu T, Hutfless S, Park A, Stasko T, Vidimos AT, et al. Outlier practice patterns in Mohs micrographic surgery: defining the problem and a proposed solution. JAMA Dermatol 2017;153:565-70.
18. Crawford JM, Gasparis A, Almeida J, Elias S, Wakefield T, Lal BK, et al. A review of United States endovenous ablation practice trends from the Medicare Data Utilization and Payment Database. J Vasc Surg Venous Lymphat Disord 2019;7:471-9.
19. Crawford JM, Gasparis A, Amery S, Labropoulos N. Treatment pattern of consecutive patients with chronic venous disease. J Vasc Surg Venous Lymphat Disord 2019;7:344-8.
20. Baber JT Jr, Mao J, Sedrakyan A, Connolly PH, Meltzer AJ. Impact of provider characteristics on use of endovenous ablation procedures in Medicare beneficiaries. J Vasc Surg Venous Lymphat Disord 2019;7:203-9.e1.
21. Sacarny A, Barnett ML, Le J, Tetkoski F, Yokum D, Agrawal S. Effect of peer comparison letters for high-volume primary care prescribers of quetiapine in older and disabled adults: a randomized clinical trial. JAMA Psychiatry 2018;75:1003-11.
22. Hicks CW, Liu J, Yang WW, DiBrito SR, Johnson DJ, Brito A, et al. A comprehensive Choosing Wisely quality improvement initiative reduces unnecessary transfusions in an Academic Department of Surgery. Am J Surg 2017;214:571-6.
23. Albertini JG, Wang P, Fahim C, Hutfless S, Stasko T, Vidimos AT, et al. Evaluation of a peer-to-peer data transparency intervention for Mohs micrographic surgery overuse. JAMA Dermatol 2019 May 5. [Epub ahead of print].

Submitted May 3, 2019; accepted Jun 28, 2019.

Additional material for this article may be found online at www.jvsvenous.org.

Supplementary Table (online only). *International Classification of Diseases, Tenth Revision, Clinical Modification* (*ICD-10-CM*) diagnosis codes of venous diseases

Category	ICD-10-CM diagnosis codes
Pain/swelling/inflammation	I8000, I8001, I8002, I8003, I80209, I80291, I803, I8310, I8311, I8312, I83211, I83212, I83213, I83214, I83215, I83218, I83221, I83222, I83223, I83224, I83225, I83228, I83811, I83812, I83813, I83819, I83891, I83892, I83893, I83899, I87001, I87002, I87003, I87021, I87022, I87023, I872, I87301, I87302, I87303, I87309, I87321, I87322, I87323, I87329, I87392, I87393, I87399, I878, I879, M79604, M79605, M79606, M79609, M79651, M79661, M79662, M79669, R601, R609, R252
Ulceration	I83001, I83002, I83003, I83005, I83008, I83011, I83012, I83013, I83014, I83015, I83018, I83021, I83022, I83023, I83024, I83025, I83028, I83201, I83202, I83203, I83208, I83219, I87011, I87012, I87013, I87031, I87032, I87033, I87091, I87092, I87093, I87311, I87312, I87313, I87319, I87331, I87332, I87333, I87391, I83009, I83019, I83029, I83209, I83229, L97211, L97219, L97309, L97311, L97321, L97329, L97811, L97819, L97821, L97909, L97919, L97921, L97929, S81809A