Peter F. Lawrence, MD, SECTION EDITOR
From the Vascular and Endovascular Surgery Society

Reimbursement in hospital-based vascular surgery: Physician and practice perspective

Jennifer L. Perri, MD, MBA, Robert M. Zwolak, MD, PhD, Philip P. Goodney, MD, MS, Gretchen A. Rutherford, MBA, *and* Richard J. Powell, MD, *Lebanon, NH*

ABSTRACT

Objective: The purpose of this study was to determine change in value of a vascular surgery division to the health care system during 6 years at a hospital-based academic practice and to compare physician vs hospital revenue earned during this period.

Methods: Total revenue generated by the vascular surgery service line at an academic medical center from 2010 through 2015 was evaluated. Total revenue was measured as the sum of physician (professional) and hospital (technical) net revenue for all vascular-related patient care. Adjustments were made for work performed, case complexity, and inflation. To reflect the effect of these variables, net revenue was indexed to work relative value units (wRVUs), case mix index, and consumer price index, which adjusted for work, case complexity, and inflation, respectively. Differences in physician and hospital net revenue were compared over time.

Results: Physician work, measured in RVUs per year, increased by 4%; case complexity, assessed with case mix index, increased by 10% for the 6-year measurement period. Despite stability in payer mix at 64% to 69% Medicare, both physician and hospital vascular-related revenue/wRVU decreased during this period. Unadjusted professional revenue/wRVU declined by 14.1% ($P = .09$); when considering case complexity, physician revenue/wRVU declined by 20.6% ($P = .09$). Taking into account both case complexity and inflation, physician revenue declined by 27.0% ($P = .04$). Comparatively, hospital revenue for vascular surgery services decreased by 13.8% ($P = .07$) when adjusting for unit work, complexity, and inflation.

Conclusions: At medical centers where vascular surgeons are hospital based, vascular care reimbursement decreased substantially from 2010 to 2015 when case complexity and inflation were considered. Physician reimbursement (professional fees) decreased at a significantly greater rate than hospital reimbursement for vascular care. This trend has significant implications for salaried vascular surgeons in hospital-based settings, where the majority of revenue generated by vascular surgery care is the technical component received by the facility. Appropriate care for patients with vascular disease is increasingly resource intensive, and as a corollary, reimbursement levels must reflect this situation if high-quality care is to be maintained. (J Vasc Surg 2017;66:317-22.)

In recent years, there has been a steady increase in government expenditure dedicated to health care. Health care expenditure accounted for 12% of the gross domestic product of the United States in 1990, 13% in 2000, and 17.5% in 2015.[1] In light of this situation, the government has reason to control costs of programs such as Medicare and Medicaid. Approximately 70% of patients nationwide requiring vascular interventions are insured through Medicare.[2] At our institution, Dartmouth-Hitchcock Medical Center (DHMC), three-quarters of patients treated by vascular surgeons are insured by a government-sponsored program. Traditionally, hospital-based (or employed) vascular surgeon reimbursement has been driven primarily by professional revenue generated in a fee-for-service environment through submitted *Current Procedural Terminology* codes. Hospital reimbursement (ie, technical revenue) is generated by diagnosis-related group (DRG) for inpatients and by ambulatory payment classification (APC) for outpatients. Currently, 24% of vascular surgeons work under a hospital-based contract[3] rather than a physician-owned practice. With a trend toward hospital-based employment and the potential shift toward value-based reimbursement models, it becomes increasingly important to understand the value of a vascular surgery practice to the health care system. Presently, there are no available data on the topic of how reimbursement has changed for the individual physician compared with the hospital or the overall value of the vascular service line to the health care system. The purpose of this study was twofold: to show the trend in net revenue in a

From the Section of Vascular Surgery, Dartmouth-Hitchcock Medical Center.
Author conflict of interest: none.
Presented at the Scientific Session of the Vascular and Endovascular Surgery Society Spring Meeting, National Harbor, Md, June 8-11, 2016.
Correspondence: Jennifer L. Perri, MD, MBA, Dartmouth-Hitchcock Medical Center, 1 Medical Center Dr, Lebanon, NH 03756 (e-mail: Jennifer.l.perri@hitchcock.org).
The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.
0741-5214

http://dx.doi.org/10.1016/j.jvs.2017.03.417

Table I. Physician and hospital unadjusted net revenue for fiscal years 2010 to 2015, with work relative value units (*wRVUs*), consumer price index (*CMI*), and case mix index (*CMI*) corresponding to these years

Fiscal year	2010	2011	2012	2013	2014	2015
Physician revenue, $	5,576,963	5,353,000	5,119,661	4,887,198	4,419,000	4,966,786
Hospital revenue, $	22,452,439	20,590,000	21,705,700	22,356,318	21,471,000	23,619,934
wRVUs	41,915	40,181	41,020	44,930	43,582	43,436
CPI	218.056	224.935	229.594	232.957	236.736	237.017
CMI (vascular)	2.41	2.4	2.48	2.52	2.51	2.61

vascular surgery division over time in real dollars (adjusted for volume, inflation, and case complexity) and to compare that trend in physician reimbursement with the net technical revenue derived by the hospital for these same services.

METHODS

We conducted a retrospective review of the billing database at DHMC corresponding to the fiscal years 2010 to 2015 under the approval of our Institutional Review Board. DHMC is a 445-bed hospital located in Lebanon, New Hampshire, serving as a major tertiary care referral site for New Hampshire, Vermont, and northern Massachusetts. The vascular surgery division employs nine surgeons, with a full-time employee measure of 4.2 after accounting for nonclinical work during the years studied. Hospital and physician practice financial statements were reviewed for net revenue. Individual patient billing was not examined, and as such, patient consent was not required. As is standard in accounting practice, net revenue was calculated as gross charges less contractual agreements, bad debt recovery, and charity. Net revenue was calculated separately for the physicians and for the hospital. Physician revenue pertains to all professional fees received for vascular-related services rendered by vascular surgeons in the operating room, same-day endovascular suite, and vascular laboratory plus all separately reportable inpatient and outpatient evaluation and management services. Hospital revenue was calculated on the basis of technical revenue received from DRG and APC payment. To adjust for change in volume on an annual basis, both physician and hospital net revenues were divided by annual work relative value units (wRVUs) generated by the vascular surgeons during the parallel 1-year time frame. DHMC operates as a single-unit health care provider. In this capacity, there is no allotment for office-based procedures; procedures are reimbursed as either a DRG or APC in the hospital setting. Whereas work, practice expense, and malpractice RVUs are calculated for Medicare reimbursement, it is only the wRVUs that were used to index revenue. To adjust for inflation, net revenue was divided by the relative change in consumer price index (CPI, as published by the U.S. Bureau of Labor), indexing all dollars to 2010, which served as the base year for analysis. To adjust for case complexity, net revenue was indexed to the vascular surgery case mix index (CMI) for the corresponding year, with 2010 again serving as a baseline. The wRVUs, vascular CMI, and CPI are listed in Table I. Statistical analysis was undertaken using Stata 14.0 (StataCorp LP, College Station, Tex). Nonparametric *z*-tests were used to analyze change in net revenue over time (using the STATA function nptrend), adjusted by wRVU, CMI, and CPI. The Wilcoxon signed-rank test was used to compare change in adjusted physician revenue vs change in hospital revenue for the period studied.

RESULTS

During fiscal years 2010 to 2015, a total of 5940 operative cases, 3860 outpatient endovascular suite procedures, and 65,599 vascular laboratory studies were performed by vascular surgeons at DHMC. Unadjusted professional net revenue for this work was $5.58 million in fiscal year 2010, decreasing to $4.97 million in fiscal year 2015, a 10.9% decline ($P = .07$; revenue, wRVU, CPI, and CMI values are listed in Table I). In contrast to the decline in net professional revenue, unadjusted hospital net revenue corresponding to vascular surgery services rose 5.20%, increasing from $22.5 million in fiscal year 2010 to $23.6 million in fiscal year 2015 ($P = .58$; Fig 1). In the vascular surgery practice, physician wRVUs generated were 41,900 in 2010 increasing to 43,600 in 2015, a 4.0% increase. After adjusting only for wRVUs, which provided a normalization for physician volume and time and intensity expended, physician net revenue per wRVU declined by 14.1% during the 6-year period ($P = .09$), whereas hospital net revenue per wRVU increased by 1.5% ($P = .85$). When taking into account inflation (CPI), the physician revenue/wRVU, indexed to 2010 dollars, decreased by 20.9% from 2010 to 2015 ($P = .07$), whereas the hospital equivalent decreased by 6.6% ($P = .24$). CMI increased from 2.4 to 2.6 during the time studied (an 8.3% increase). When taking into account year over year change in CMI without an adjustment for inflation, the physician revenue/wRVU indexed to 2010 complexity decreased by 20.6% during the years studied ($P = .09$), with the hospital equivalent decreasing by 6.3% ($P = .07$; ie, adjusting for CMI and wRVU but not CPI). Finally, when indexing to wRVUs, change in CPI, and change in

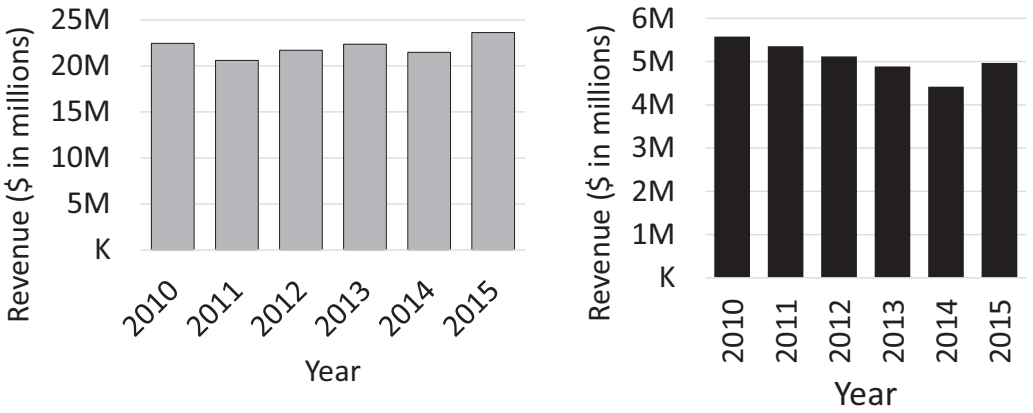

Fig 1. Annual revenue earned for vascular services to the hospital (*left*) and to the hospital-based physicians (*right*).

Table II. Physician and hospital revenue for fiscal years 2010 to 2015 indexed to work relative value units (*wRVUs*), consumer price index (*CPI*), and case mix index (*CMI*)

Fiscal year	2010	2011	2012	2013	2014	2015	Change,%	*P* value
Physician revenue/wRVU, $	133.05	133.22	124.81	108.77	101.39	114.35	−14.06	.09
Hospital revenue/wRVU, $	535.67	512.43	529.15	497.58	492.66	543.79	1.52	.85
Physician revenue/wRVU adjusted for CPI, $	133.05	129.15	118.54	101.82	93.39	105.20	−20.93	.07
Hospital revenue/wRVU adjusted for CPI, $	535.67	496.76	502.56	465.75	453.78	500.28	−6.61	.24
Physician revenue/wRVU adjusted for CMI, $	133.05	133.77	121.29	104.02	97.36	105.59	−20.65	.09
Hospital revenue/wRVU adjusted for CMI, $	535.67	514.57	514.21	475.86	473.03	502.12	−6.26	.07
Physician revenue/wRVU adjusted for CPI and CMI, $	133.05	129.69	115.19	97.37	89.67	97.14	−26.99	.04
Hospital revenue/wRVU adjusted for CPI and CMI, $	535.67	498.83	488.37	445.42	435.70	461.95	−13.76	.07

P values reflect change in adjusted revenue over time and are obtained from nonparametric *z*-tests.

CMI, adjusted physician net revenue declined 27.0% ($P = .04$), whereas adjusted hospital net revenue declined by 13.8% ($P = .07$; Table II). In comparing the change in fully adjusted physician net revenue with that of the hospital revenue, the physician revenue declined significantly more than the hospital revenue (Wilcoxon signed-rank test, $P = .04$). Adjusted net revenues for all variables described are pictured in Fig 2. Nonparametric *z*-tests for adjusted physician revenue revealed a statistically significant decrease from 2010 to 2015, when revenue was adjusted for volume, inflation, and case complexity ($P = .04$). When adjusting only for individual variables, there was a trend toward decreasing physician revenue, but it was not significant. Comparing the change in fully adjusted physician net revenue per wRVU (−27%) with the fully adjusted hospital net revenue per wRVU (−13.8%), physician revenue per RVU declined at a rate nearly twice that of the hospital ($P = .04$).

DISCUSSION

The Centers for Medicare and Medicaid Services (CMS) has implemented provisions to limit reimbursement to physicians and hospitals. For example, twofold pressure has been placed on the physician: first, because of a relatively stagnant Medicare Conversion Factor (hovering between $34 and $38 during the past two decades)[4]; and second, because of the downward revaluation of many procedure RVUs. Moreover, CMS now has increased their demand for reporting quality metrics, with emphasis on alternative practice models that require significant infrastructure and support to meet the agency requirements.[5] This fact places a significant financial stress on smaller practices to develop the required infrastructure to compete in a value-based/alternative payment model environment. Currently, 64% of vascular surgeons operate under a physician-owned practice group (ie, nonacademic, not university affiliated), with results from a recent survey indicating that 10% plan to change to a hospital-owned practice[3] primarily for remuneration benefits. This conclusion is borne out in a 2014 survey conducted by Accenture, in which 194 physicians participated and gave as the top two reasons for leaving what was formerly known as private practice (1) reimbursement pressures and (2) overhead costs (reported by 36% and

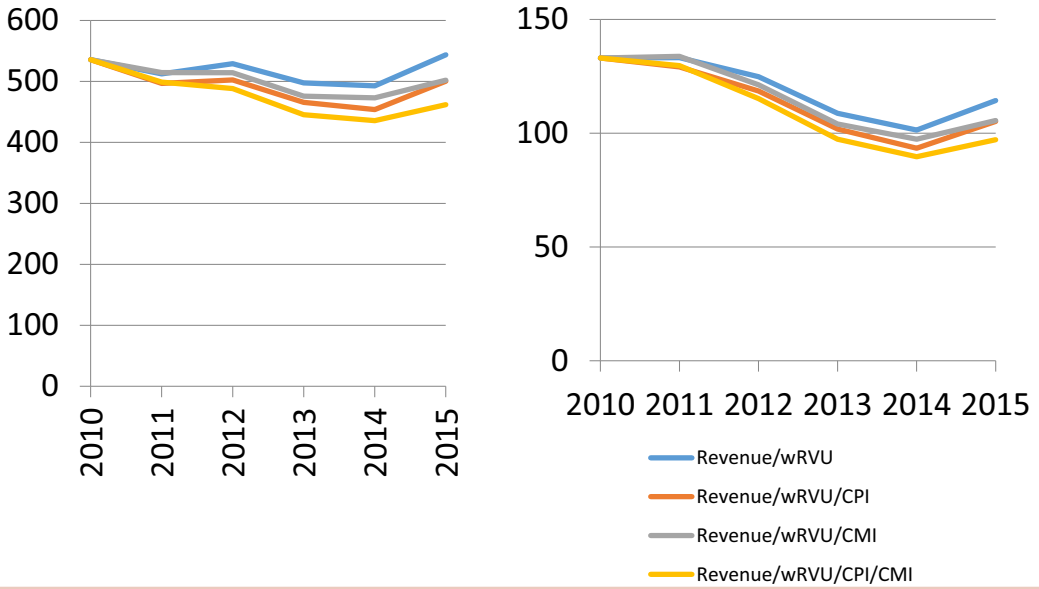

Fig 2. Annual revenue earned adjusted for work relative value unit (*wRVU*), consumer price index (*CPI*), and case mix index (*CMI*) for vascular services to the hospital (*left*) and to the hospital-based physicians (*right*).

23%, respectively).[6] In another survey of >20,000 U.S. physicians sponsored by The Physicians Foundation, the percentage cited who indicated they were an owner in a private practice or partner decreased from 62% in 2008 to 33% in 2016, reflecting the trend away from the private practice model.[7,8]

Several aspects of physician reimbursement may not be well understood by vascular surgeons. First, while reimbursement is in flux, many vascular surgeons remain unfamiliar with current coding and reimbursement practice. In fact, in a recent survey, only 22.8% of vascular surgeons and interventional radiologists knew the correct reimbursement amount for common procedures performed.[9] Second, although overall there has been an increase in health care spending (ie, as a percentage of gross domestic product),[1] it is not yet borne out in the literature how vascular surgery in particular is affected. In general, physician wRVUs for open vascular surgical procedures have increased over time, but wRVUs for percutaneous vascular interventions have decreased. The interventional reduction has been due primarily to CMS-mandated bundling of radiologic supervision and interpretation in the procedural codes. Despite the fact that certain increases in RVUs have been realized for vascular open surgery, because the Medicare Conversion Factor has not increased with inflation, reimbursement in real dollars has declined. Under the 2012 Medicare Physician Fee Schedule, CMS bundled several lower extremity endovascular procedures that resulted in a further decline in overall physician reimbursement for peripheral vascular interventions.[10] By comparison, in the years studied, inpatient hospital market basket rates have increased from 0.998 to 1.118, a 12% increase.[11] This would imply that although the physicians are not reimbursed accordingly with changes in inflation, the hospitals see a 1% to 2% annual increase due to market basket adjustments.

The factors shown in our study demonstrate that physician reimbursement has declined significantly more than the corresponding hospital reimbursement as a result of these measures. In fact, net physician revenue declined twice as much as hospital net revenue for vascular services in the 6 years we reviewed. Previously, when almost all vascular surgeons were solo practitioners or members of professional groups with no financial link to a hospital, the substantial reduction in professional net revenue would likely have been the most important metric in this report. Now, for vascular surgeons employed in hospital salaried models, it is clear the main overall value of the vascular service line is revenue from technical reimbursement to the hospital amplified by the higher CMI that vascular patients bring to the inpatient setting. The professional revenue generated by vascular surgeons is much lower than and is declining at a faster rate compared with technical revenue. It is likely little consolation for hospital-based vascular surgeons, and no consolation for hospital administrators, that the larger hospital component of net vascular revenue is falling less rapidly than net physician revenue.

The logic of reductions in net revenue to physicians and hospitals for vascular services is especially difficult to understand when one considers the significant enabling role vascular surgeons play in a diverse group of service lines, such as surgical oncology, gynecology, spine orthopedics, interventional cardiology, and many others.

Vascular surgery provides additional assistance for these enumerated surgical specialists, which allows them to undertake more complex procedures. If vascular revenue cannot support resource utilization, many of these complex nonvascular operations may lose the important backup safety net when major vascular complications occur. Moreover, vascular surgical patients often have a broad set of medical requirements. For example, in a 2012 publication by Taylor et al, the authors reported gross margin of their vascular service line and data showing that 33% of new vascular patients admitted to the hospital required general medicine services, 10% needed emergency medicine care, and 9% needed cardiology workup. These findings would imply that not only does a vascular surgery division offer ancillary support in emergent cases to other services, but it also adds significant revenue to the hospital through other departments used by vascular patients.[12]

This study has several limitations. The data are collected from a single institution, at which the physicians' site of service is hospital inpatient and hospital outpatient. Technical payments for procedure-related resource utilization for arterial and venous operations and interventions are assigned to the hospital. Thus, our observations are primarily relevant for vascular surgeons at large medical centers where the office site-of-service is not invoked. Whereas CMI was used to adjust for year over year increases in complexity, CMI may also reflect appropriate coding of procedures as well as physician preferences in terms of procedures offered. Furthermore, in 2015, we adjusted the billing process for our physician-modified branched fenestrated devices. With a change in coding, we realized a 19% increase in contribution margin, which does increase the revenue in 2015 data. On a final note, there was a modest variation in payer mix from year to year. Patients insured by Medicare ranged from 64% to 69% during the study period, and there was no adjustment undertaken for this variation. However, the net impact of this variable is small because the increase in Medicare share is derived from a reduction on payment streams that were both higher and lower than the Medicare Physician, Hospital Outpatient Protective Payment System, and DRG fee schedules.

CONCLUSIONS

The aim in this study was to analyze financial data at a single institution to determine how physician and hospital net revenue for a vascular surgery division has changed over time in an era of "cost containment." When controlling for inflation and case complexity, it is apparent that net revenue per physician wRVU for hospital-based vascular surgeons and the associated hospital has declined. Vascular surgeon professional net revenue fell at a rate twice that of hospital net revenue for vascular surgery services. Whereas these data were obtained by retrospective analysis and pertain only to a single academic institution, the trends provide a purview of declining physician revenue for vascular surgeons working in the hospital inpatient and outpatient sites of service. Moreover, this study further highlights the incentive to perform certain procedures in an office setting, where physicians are reimbursed for the technical component through practice expense in addition to their professional services. Between 2011 and 2014, Medicare claims data suggest that for endovascular interventions in peripheral arterial disease, there was an 11% decrease in inpatient hospital procedures vs a 27% increase in outpatient hospital procedures and a 94% increase in physician office setting (this excludes atherectomy, which grew 290% in the office setting for the period).[13] Considering the disproportionate decline in professional reimbursement in the hospital setting, this rapid rise in office-based procedures is likely to continue. Moreover, with varying changes in professional vs technical revenue, the question arises as to why vascular surgeons are not reimbursed on the basis of the total global reimbursement rather than wRVUs, as is common practice.

AUTHOR CONTRIBUTIONS

Conception and design: JP, RZ, RP
Analysis and interpretation: JP, RZ, PG, GR, RP
Data collection: JP, RP
Writing the article: JP, RP
Critical revision of the article: JP, RZ, PG, GR, RP
Final approval of the article: JP, RZ, PG, GR, RP
Statistical analysis: JP
Obtained funding: Not applicable
Overall responsibility: JP

REFERENCES

1. Centers for Medicare and Medicaid Services. National health expenditures; aggregate and per capita amounts, annual percent change and percent distribution: calendar years 1960-2015. Available at: https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/nationalhealthexpenddata/nationalhealthaccountshistorical.html. Accessed December 27, 2016.
2. Health Care Financing Administration. Medicare Program. 1997 Medicare fee schedule: the final rule. Fed Regist 1996;61:59489-724.
3. Matthews MA, Satiani B, Lohr JM. Trends in a changing vascular practice environment for members of the Society for Vascular Surgery. J Vasc Surg 2013;57:586-92.e2.
4. Centers for Medicare and Medicaid Services. Sustainable growth rates and conversion factors. Available at: https://www.cms.gov/medicare/medicare-fee-for-service-payment/sustainablegratesconfact/index.html. Accessed December 27, 2016.
5. Department of Health and Human Services, Centers for Medicare and Medicaid Services. Medicare Program; Merit-based Incentive Payment System (MIPS) and Alternative Payment Model (APM) incentive under the physician fee schedule, and criteria for physician-focused payment models 2016. Available at: https://www.federalregister.gov/documents/2016/11/04/2016-25240/medicare-program-merit-based-incentive-payment-system-mips-and-alternative-payment-model-apm. Accessed December 27, 2016.

6. Accenture. 2015 Accenture independent physicians survey 2015. Available at: https://newsroom.accenture.com/news/many-us-doctors-will-leave-private-practice-for-hospital-employment-accenture-reports.htm. Accessed February 11, 2017.
7. The Physicians Foundation. 2016 Physicians Foundation biennial physician survey report 2016. p. 10. Available at: http://www.physiciansfoundation.org/news/the-physicians-foundation-2016-physician-survey/. Accessed February 12, 2017.
8. The Physicians Foundation. 2014 Physicians Foundation biennial physician survey report 2014. p. 41. Available at: http://www.physiciansfoundation.org/news/survey-of-20000-us-physicians-shows-80-of-doctors-are-over-extended-or-at/. Accessed February 12, 2017.
9. Wang A, Dybul SL, Patel PJ, Tutton SM, Lee CJ, White SB. A cross-sectional survey of interventional radiologists and vascular surgeons regarding the cost and reimbursement of common devices and procedures. J Vasc Interv Radiol 2016;27:210-8.
10. Centers for Medicare and Medicaid Services. CY 2012 physician fee schedule final rule 2011. Available at: https://www.gpo.gov/fdsys/pkg/FR-2011-11-28/pdf/2011-28597.pdf. Accessed December 27, 2016.
11. Centers for Medicare and Medicaid Services. Market Basket history and forecasts 2016. Available at: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/MedicareProgramRatesStats/MarketBasketData.html. Accessed February 14, 2017.
12. Taylor N, Lombardi JV, Toddes S, Alexander J, Trani J, Carpenter J. An all-inclusive and transparent view of a vascular program's direct impact on its health system. J Vasc Surg 2012;55:281-5.
13. Mukherjee D, Hashemi H, Contos B. The disproportionate growth of office-based atherectomy. J Vasc Surg 2017;65:495-500.

Submitted Jan 10, 2017; accepted Mar 11, 2017.