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Trends in Settings for Peripheral Vascular Intervention and the Effect of Changes in the Outpatient Prospective Payment System

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ABSTRACT

BACKGROUND Peripheral vascular intervention (PVI) is an effective treatment option for patients with peripheral artery disease (PAD). In 2008, Medicare modified reimbursement rates to encourage more efficient outpatient use of PVI in the United States.

OBJECTIVES The purpose of this study was to evaluate trends in the use and clinical settings of PVI and the effect of changes in reimbursement.

METHODS Using a 5% national sample of Medicare fee-for-service beneficiaries from 2006 to 2011, we examined age- and sex-adjusted rates of PVI by year, type of procedure, clinical setting, and physician specialty.

RESULTS A total of 39,339 Medicare beneficiaries underwent revascularization for PAD between 2006 and 2011. The annual rate of PVI increased slightly from 401.4 to 419.6 per 100,000 Medicare beneficiaries ($p = 0.17$), but the clinical setting shifted. The rate of PVI declined in inpatient settings from 209.7 to 151.6 ($p < 0.001$), whereas the rate expanded in outpatient hospitals (184.7 to 228.5; $p = 0.01$) and office-based clinics (6.0 to 37.8; $p = 0.008$). The use of atherectomy increased 2-fold in outpatient hospital settings and 50-fold in office-based clinics during the study period. Mean costs of inpatient procedures were similar across all types of PVI, whereas mean costs of atherectomy procedures in outpatient and office-based clinics exceeded those of stenting and angioplasty procedures.

CONCLUSIONS From 2006 to 2011, overall rates of PVI increased minimally. However, after changes in reimbursement, PVI and atherectomy in outpatient facilities and office-based clinics increased dramatically, neutralizing cost savings to Medicare and highlighting the possible unintended consequences of coverage decisions. (J Am Coll Cardiol 2015;65:920–7) © 2015 by the American College of Cardiology Foundation.

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Lower-extremity peripheral vascular intervention (PVI) has supplanted open surgical revascularization as the primary mode of revascularization for patients with peripheral artery disease (PAD) in the United States. The rate of PVI increased approximately 3-fold from 1996 to 2006 (1,2). In line with these utilization trends, health care expenditures for PVI also have risen (1,3,4). By 2005, inpatient hospital costs accounted for the majority of overall health care expenditures for patients with PAD, and mean inpatient costs for patients with PAD had surpassed inpatient costs for patients with coronary artery disease (3). Faced with these rising costs, both the National Institutes of Health and the Institute of Medicine have identified PAD as a top priority for future research, with a key focus on health care quality, costs, and outcomes (5,6).

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In 2008, to encourage greater efficiency and lower overall costs, the U.S. Centers for Medicare & Medicaid Services modified reimbursement rates for PVI performed in outpatient hospital settings, ambulatory surgery centers, and office-based clinics (7). The effect of these changes in reimbursement on the performance of PVI in outpatient settings, access to care for patients with PAD, and costs is unknown.

METHODS

DATA SOURCES. We obtained a 5% national sample of data from the Medicare fee-for-service inpatient, outpatient, and carrier standard analytic files as well as the corresponding denominator files from 2006 to 2011. The inpatient files contain institutional claims for facility costs covered under Medicare Part A and beneficiary, physician, and hospital identifiers; admission and discharge dates; and diagnosis and procedure codes. The outpatient files contain claims from outpatient facility providers. Noninstitutional provider claims for services covered under Medicare Part B are included in the carrier files. Denominator files include patient demographic characteristics, birth and death dates, and information about program eligibility and enrollment.

STUDY POPULATION. From the carrier files, we identified Medicare beneficiaries ≥65 years of age who had a diagnosis of PAD and a peripheral revascularization procedure on the same claim between January 1, 2006, and December 31, 2011. We defined PAD using International Classification of Diseases-Ninth Revision-Clinical Modification (ICD-9-CM) diagnosis code 250.7, 440.0, 440.2x, 440.3x, 440.4, 440.9, 443.9, 444.0, 444.2x, 444.8x, 445.02, 447.1, or 707.1x in any position. We defined peripheral revascularization procedures using current procedural terminology (CPT) code 35492, 35493, 35495, 37205 to 8, 35450, 35470, 35473, 35474, 37220 to 37235, 35563, 35565, 35556, 35558, 35566, 35571, 35646, 35661, 35656, 35666, 35351, 35355, 35302, 35371, 35303, or 35304 to 6. We counted all procedure instances, which were defined as 1 per patient and per day. We limited the study population to patients enrolled in Medicare fee-for-service for at least 12 months before the index revascularization procedure to capture information about comorbid conditions.

ABBREVIATIONS AND ACRONYMS

CPT = current procedural terminology

ICD-9-CM = International Classification of Diseases-Ninth Revision-Clinical Modification

OPPS = outpatient prospective payment system

PAD = peripheral artery disease

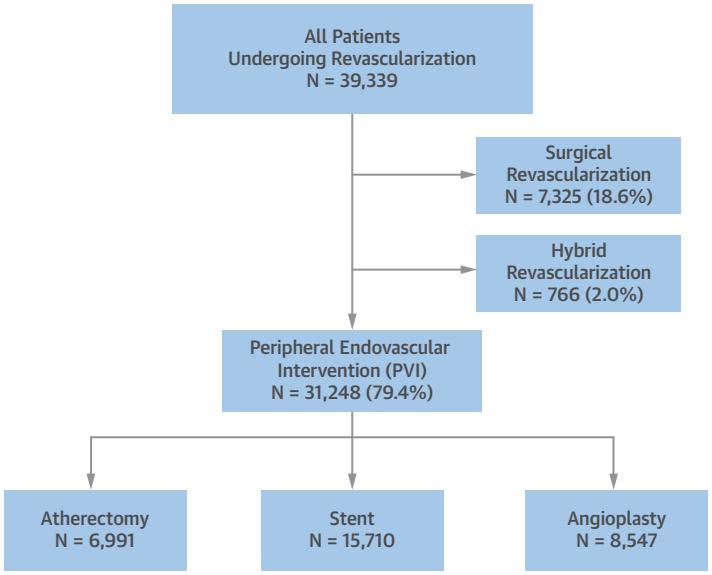
PVI = peripheral vascular intervention

STUDY VARIABLES. We categorized PVI in 3 ways: 1) angioplasty alone, using the CPT code for percutaneous transluminal angioplasty and no CPT code for atherectomy or stent implantation; 2) atherectomy using the CPT code for atherectomy with or without a code for angioplasty or stent; and 3) stent implantation using the CPT code for stent implantation with or without a code for angioplasty and without a code for atherectomy. We categorized surgical revascularization using CPT codes as either lower-extremity bypass or endarterectomy. We categorized hybrid revascularization using CPT codes for PVI and surgical revascularization on the same claim.

Clinical setting, as defined by the location of care that was received on the physician claim, could include inpatient facility, outpatient facility, office-based clinic, or ambulatory surgery center. On the basis of physician specialty codes, we categorized provider specialty as surgery (vascular, cardiovascular, and general), cardiology, radiology, and other.

PATIENT CHARACTERISTICS. Patient demographic characteristics included age, sex, race, and U.S. geographic region. We used previously validated methods to identify comorbid conditions with ICD-9-CM diagnosis codes on the claims billed to Medicare for up to 365 days before the date of the index procedure (8,9). Specifically, we searched all inpatient, outpatient, and carrier claims for the 365 days preceding January 1 of each study year for evidence of chronic obstructive pulmonary disease (ICD-9-CM codes 416.8, 416.9, 490 to 505, 506.4, 508.1, and 508.8), heart failure (428.x, 398.91, 402.x1, 404.x1, 404.x3, and 425.4 to 425.9), coronary artery disease (410.x to 414.x, 429.2, and V45.81), dementia (290.x, 294.1, and 331.2), diabetes mellitus (250), hypertension (401 to 405 and 437.2), cancer (140 to 172, 174 to 195, 200 to 208, and 238.6), renal disease (403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 582.x, 583.0 to 583.7, 585.x, 586.x, 588.0, V42.0, V45.1, and V56.x), and stroke or transient ischemic attack (435, 436, 4371, 4379, 438, 3401, 43411, 43491, 43301, 43311, 43321, 43331, 43381, and 43391).

FIGURE 1 Flow Diagram of the Assignment of Medicare Beneficiaries to Peripheral Vascular Intervention Categories



Flow diagram demonstrating the assignment of Medicare beneficiaries to categories (atherectomy, stenting, or angioplasty). Patients who underwent surgical revascularization and hybrid revascularization during the study period were excluded. Overall, 31,248 Medicare patients underwent peripheral endovascular intervention and were included in the current analysis.

COST ANALYSIS. We defined Medicare expenditures as the amount paid by both the Medicare program and Medicare beneficiaries for care received on the date of the revascularization procedure. Expenditures included payments on inpatient, outpatient, and carrier claims. Given the extreme variability in costs for inpatient procedures, we restricted inpatient cost data to patients undergoing elective hospital admission and having an inpatient stay of ≤3 days.

STATISTICAL ANALYSIS. We described patient and clinical characteristics of the study population as frequencies with percentages for categorical variables and medians with interquartile ranges for continuous variables. To test for differences between groups, we used chi-square tests for categorical variables and Kruskal-Wallis tests for continuous variables. We calculated the annual rates of lower-extremity revascularization procedures and the annual rates of PVI on the basis of 3 factors: clinical setting, type of PVI, and physician specialty. We adjusted all rates for age and sex to the Medicare fee-for-service population and report them as rates per 100,000 beneficiaries. We used linear regression to test for linear temporal trends. The institutional review board of the Duke University Health System reviewed and approved this study. We used SAS statistical software version 9.2 (SAS Institute Inc., Cary, North Carolina) for all analyses.

RESULTS

In a 5% sample of Medicare fee-for-service beneficiaries, we identified 39,339 patients who underwent lower-extremity revascularization procedures between 2006 and 2011. Figure 1 shows the flow diagram of patients included in the study. Of the 39,339 total patients, 31,248 (79.4%) underwent PVI, 7,325 (18.6%) underwent surgical revascularization procedures, and 766 (2.0%) underwent hybrid revascularization procedures. Of the patients who underwent PVI, 27.3% had angioplasty alone (with no atherectomy or stent), 22.4% had atherectomy (with or without angioplasty or stent), and 50.3% had stent implantation (with or without angioplasty, and with no atherectomy).

Table 1 shows the characteristics of the study population. Patients who underwent PVI with atherectomy or angioplasty alone were older, more likely to be men, more likely to be black, and more likely to have renal failure, diabetes mellitus, heart failure, and stroke, compared with patients who underwent PVI with stenting. Patients who underwent PVI with atherectomy also were more likely to have ischemic heart disease, be treated by a cardiologist, and reside in the Midwest or South, compared with patients who underwent PVI with angioplasty alone or stenting.

Table 2 shows age- and sex-adjusted procedure rates per 100,000 Medicare beneficiaries. The overall rate of PVI increased slightly from 401.4 in 2006 to 419.6 in 2011 ($p = 0.17$). This increase in the use of PVI was offset by a reduction in the rate of surgical revascularization procedures from 115.5 in 2006 to 77.8 in 2011 ($p < 0.001$). The rate of hybrid revascularization procedures remained stable. PVI with angioplasty alone (97.7 in 2006 to 109.4 in 2011) and atherectomy (96.4 in 2006 to 125.9 in 2011) increased during the study period, and the use of stents decreased modestly (207.4 in 2006 to 184.3 in 2011).

We observed a marked reduction in the rate of PVI performed in inpatient hospital settings (209.7 in 2006 to 151.6 in 2011) (Central Illustration, Table 3). There was a concomitant increase in the rate of PVI performed in outpatient hospital settings (184.7 in 2006 to 228.5 in 2011) and office-based clinics (6.0 in 2006 to 37.8 in 2011). The rate of atherectomy in outpatient hospital settings and office-based clinics underwent the largest effective change after the 2008 Medicare payment change (38.6 in 2006 vs. 83.7 in 2011).

The majority of PVIs were performed by surgeons and cardiologists. By the end of the study period, the rate of PVI performed by surgeons (140.1 in 2006 to

TABLE 1 Characteristics of Patients Undergoing Peripheral Vascular Intervention, 2006 to 2011

	Overall (N = 31,248)	Atherectomy (n = 6,991)	Stent (n = 15,710)	Angioplasty (n = 8,547)	p Value
Age, yrs	76.0 (71.0–82.0)	77.0 (71.0–82.0)	76.0 (71.0–81.0)	77.0 (72.0–83.0)	<0.001
Male	14,191 (45.4)	3,282 (46.9)	6,987 (44.5)	3,922 (45.9)	0.002
Race					<0.001
Black	3,817 (12.2)	994 (14.2)	1,626 (10.4)	1,197 (14.0)	
White	26,112 (83.6)	5,633 (80.6)	13,528 (86.1)	6,951 (81.3)	
Other	1,319 (4.2)	364 (5.2)	556 (3.5)	399 (4.7)	
Medical history					
Acute MI	6,174 (19.8)	1,390 (19.9)	3,051 (19.4)	1,733 (20.3)	0.27
Cancer	4,676 (15.0)	1,013 (14.5)	2,335 (14.9)	1,328 (15.5)	0.17
COPD	13,406 (42.9)	2,880 (41.2)	7,012 (44.6)	3,514 (41.1)	<0.001
Renal failure	8,859 (28.4)	2,037 (29.1)	4,129 (26.3)	2,693 (31.5)	<0.001
Diabetes mellitus	16,771 (53.7)	4,078 (58.3)	7,697 (49.0)	4,996 (58.5)	<0.001
Dementia	1,696 (5.4)	385 (5.5)	765 (4.9)	546 (6.4)	<0.001
Heart failure	11,745 (37.6)	2,740 (39.2)	5,458 (34.7)	3,547 (41.5)	<0.001
Hypertension	29,383 (94.0)	6,643 (95.0)	14,669 (93.4)	8,071 (94.4)	<0.001
Ischemic heart disease	22,768 (72.9)	5,270 (75.4)	11,300 (71.9)	6,198 (72.5)	<0.001
Stroke/TIA	7,019 (22.5)	1,537 (22.0)	3,428 (21.8)	2,054 (24.0)	<0.001
Geographic region					<0.001
Midwest	8,596 (27.5)	2,042 (29.2)	4,182 (26.6)	2,372 (27.8)	
Northeast	4,585 (14.7)	705 (10.1)	2,542 (16.2)	1,338 (15.7)	
South	14,059 (45.0)	3,351 (47.9)	6,988 (44.5)	3,720 (43.5)	
West	4,008 (12.8)	893 (12.8)	1,998 (12.7)	1,117 (13.1)	
Clinical setting					<0.001
Inpatient	13,767 (44.1)	3,229 (46.2)	6,689 (42.6)	3,849 (45.0)	
Office	1,304 (4.2)	292 (4.2)	650 (4.1)	362 (4.2)	
Outpatient	16,074 (51.4)	3,459 (49.5)	8,320 (53.0)	4,295 (50.3)	
Other	103 (0.3)	11 (0.2)	51 (0.3)	41 (0.5)	
Physician specialty					<0.001
Cardiology	12,310 (39.4)	3,658 (52.3)	6,108 (38.9)	2,544 (29.8)	
Radiology	4,943 (15.8)	539 (7.7)	2,643 (16.8)	1,761 (20.6)	
Surgery	12,046 (38.5)	2,352 (33.6)	555 (37.9)	3,739 (43.7)	
Other	1,949 (6.2)	442 (6.3)	1,004 (6.4)	503 (5.9)	
Year of procedure					<0.001
2006	4,986 (16.0)	1,199 (17.2)	2,580 (16.4)	1,207 (14.1)	
2007	5,034 (16.1)	1,104 (15.8)	2,578 (16.4)	1,352 (15.8)	
2008	5,053 (16.2)	903 (12.9)	2,732 (17.4)	1,418 (16.6)	
2009	5,293 (16.9)	1,000 (14.3)	2,755 (17.5)	1,538 (18.0)	
2010	5,334 (17.1)	1,124 (16.1)	2,627 (16.7)	1,583 (18.5)	
2011	5,548 (17.8)	1,661 (23.8)	2,438 (15.5)	1,449 (17.0)	

Values are median (interquartile range) or n (%).
COPD = chronic obstructive pulmonary disease; MI = myocardial infarction; TIA = transient ischemic attack.

177.5 in 2011) surpassed the rate of PVI performed by cardiologists (154.9 in 2006 to 166.9 in 2011). The proportion of PVIs performed by radiologists continued to decline from 81.0 in 2006 to 50.8 in 2011 (**Central Illustration**).

Table 4 shows mean payments for PVI in inpatient hospital settings, outpatient hospital settings, and office-based clinics. Mean payments for all inpatient PVIs were higher than payments for PVIs in outpatient settings and office-based clinics. Mean payments for angioplasty and stenting procedures in outpatient settings and office-based clinics increased steadily between 2006 and 2011, whereas there was a 100% increase in costs for outpatient atherectomies between 2006 and 2008 (at the time of the change in Medicare payments) and an additional 50% increase between 2008 and 2011 (after the change). Few office-based atherectomies were performed between 2006 and 2010. However, in 2011, the mean costs of office-based atherectomies ($13,478) mirrored inpatient procedure costs and exceeded the mean costs of outpatient atherectomies ($8,680), office-based stenting

TABLE 2 Age- and Sex-Adjusted Rates of Peripheral Vascular Interventions, Surgical Revascularization Procedures, and Hybrid Procedures per 100,000 Medicare Beneficiaries by Year

	2006	2007	2008	2009	2010	2011	p Value
Peripheral vascular intervention	4,986 (401.4)	5,034 (367.6)	5,053 (379.0)	5,293 (400.7)	5,334 (406.7)	5,548 (419.6)	0.17
Angioplasty	1,207 (97.7)	1,352 (98.6)	1,418 (106.4)	1,538 (116.4)	1,583 (120.6)	1,449 (109.4)	0.07
Atherectomy	1,199 (96.4)	1,104 (80.7)	903 (67.7)	1,000 (75.7)	1,124 (85.8)	1,661 (125.9)	0.38
Stent	2,580 (207.4)	2,578 (188.3)	2,732 (205.0)	2,755 (208.6)	2,627 (200.4)	2,438 (184.3)	0.44
Surgical revascularization	1,452 (115.6)	1,330 (97.6)	1,184 (89.1)	1,157 (87.7)	1,175 (89.8)	1,027 (77.8)	0.02
Bypass	1,247 (99.1)	1,073 (78.7)	922 (69.4)	910 (69.0)	902 (69.0)	796 (60.3)	0.02
Endarterectomy	205 (16.4)	257 (18.9)	262 (19.7)	247 (18.7)	273 (20.9)	231 (17.4)	0.52
Hybrid procedure	110 (8.8)	117 (8.6)	135 (10.2)	130 (9.9)	129 (9.8)	145 (11.0)	0.03

Values are n (rate per 100,000 beneficiaries).

procedures ($6,379), and office-based angioplasty procedures ($4,800). As shown in Online Table 1, mean costs for office-based atherectomy procedures were significantly different for atherectomy alone ($11,893) versus atherectomy plus stenting ($16,445).

DISCUSSION

Studies in the late 1990s and early 2000s reported a sharp rise in both the numbers and the overall costs of PVI, with a majority of the costs attributable to procedures performed in inpatient hospital settings (1–3,10). Accordingly, U.S. Centers for Medicare & Medicaid Services implemented changes in the outpatient prospective payment system (OPPS) in 2008 that led to the establishment of "ambulatory payment classifications" and bundling of payments for PVIs in outpatient facilities and office-based clinics (11). Our study of temporal trends and the rates and settings of PVI after changes in Medicare reimbursement had 3 main findings. First, the proportion of PVIs, and particularly atherectomy procedures, performed in outpatient hospital settings and office-based clinics increased significantly after the change to the OPPS. Second, mean Medicare expenditures for PVI were significantly higher for atherectomy procedures than for angioplasty and stenting procedures. Finally, the rate of growth in PVI stabilized between 2006 and 2011, but the rate of growth of atherectomy outpaced other modalities (i.e., angioplasty alone, stent implantation). In total, with the changes in reimbursement in 2008, overall Medicare expenditures for PVI likely decreased as a result of the shift in clinical settings for PVI; however, the expected cost savings were offset by greater use of more expensive atherectomies.

With changes in Medicare reimbursement, it is unsurprising that the use of PVI increased in outpatient hospital settings and office-based clinics because the main impetus for the changes was to provide incentives for outpatient use of these procedures, encourage greater efficiency, and ultimately, lower the overall costs of PVI to the Medicare program (7). In fact, we observed a 25% relative decline in PVI in inpatient facilities and a similar relative increase in PVI in outpatient facilities. A striking finding was the 5-fold increase in PVI in office-based clinics, especially as recent commentaries from practice management experts and professional societies have documented the increasing ownership of office-based clinics by physicians rather than hospitals or health care systems (11). We were unable to determine the ownership of office-based clinics in this study. A major reason for physicians to perform procedures in office-based clinics is to capture the entire bundled fee, rather than just the professional fees for inpatient (and outpatient) facility services. To our knowledge, no prior study has focused on the relationship between changes in reimbursement and trends in the clinical setting of PVI.

In addition to evaluating the shift of PVI to outpatient settings and office-based clinics, we also measured overall Medicare costs for PVI, including costs of facility services, nonfacility services (office-based clinics), and ambulatory payment classifications (the method of payment for facility outpatient services during the study period). Although inpatient facility costs likely overestimate costs for inpatient PVI, we restricted estimates of inpatient expenditures to procedures that were designated as elective and those associated with a hospital stay of <3 days. Throughout the study period, expenditures for angioplasty with or without stenting in inpatient settings were significantly higher than expenditures in outpatient settings and office-based clinics. After changes in the OPPS, Medicare payments for outpatient and office-based clinic atherectomies were the highest reimbursed procedures and mirrored

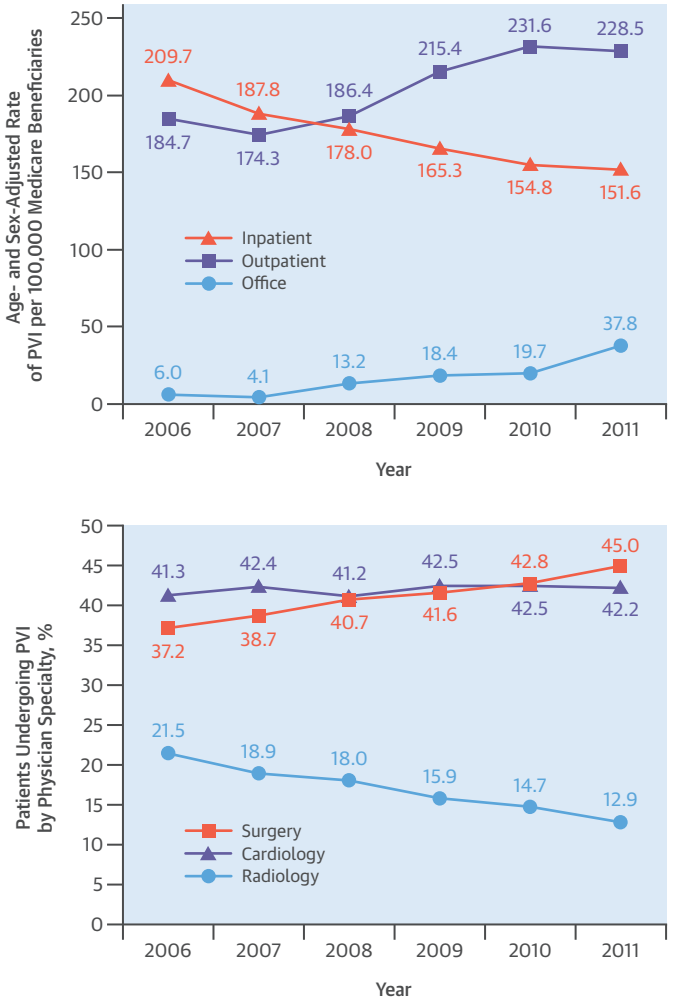
payments for inpatient atherectomies. Although total Medicare expenditures for PVI almost certainly declined as a result of declining rates of inpatient PVI during the study period, the increase in all atherectomies likely reduced the effect of these cost savings to Medicare, because of the significantly higher reimbursement for atherectomy in all settings.

Atherectomy use increased from 7 procedures per 100,000 beneficiaries in 2003 (1) to 125 procedures in 2011. A recent systematic review from the Cochrane Peripheral Vascular Diseases Group details the 4 randomized controlled trials comparing atherectomy to other established treatments (12). These 4 studies randomly assigned a total of 220 subjects (118 to atherectomy, 102 to balloon angioplasty) and found no statistically significant difference in initial procedural success, vessel patency at 6 months, and vessel patency at 12 months (13–16). No comparative-effectiveness studies with atherectomy have been performed, and for regulatory considerations, atherectomy devices operate through a pre-market notification or 510(k) approval mechanism.

With randomized data lacking to support its use, the significant rise in atherectomy use during the study period in outpatient facilities and office-based clinics is likely related to higher reimbursement for atherectomy procedures. Another potential explanation is the introduction of better atherectomy technology for use during PVI; however, we were not able to explore this possibility with the current dataset. More than one-half of all office-based clinic procedures in 2011 were atherectomies, which is more than double the rate occurring in either inpatient or outpatient hospital settings. We observed significant differences in mean payments for services provided in outpatient facilities and office-based clinics. Payments for outpatient and office-based atherectomies were higher than payments for angioplasty, likely contributing to the continued rise in the use of these devices. In sum, reimbursement rates likely contributed to the more frequent use of atherectomy during the study period, and this increased use likely neutralized some of the cost savings to Medicare after changes to the OPPS, despite a lack of efficacy data supporting atherectomy use.

The treatment landscape for patients with symptomatic PAD has changed with the rapid expansion of PVI, as shown in multiple studies from national datasets in the late 1990s and early 2000s (1–3,17). Some of the studies were limited to the National Inpatient Sample, which does not allow for evaluation of the full spectrum of revascularization procedures, including procedures in outpatient facilities and office-based clinics (2,10,17). These studies also were limited by the use of ICD-9-CM procedure codes, rather than CPT codes, which are not specific enough to identify specific treatment modalities (angioplasty, atherectomy, or stenting). Our study represents a contemporary report on the state of endovascular

CENTRAL ILLUSTRATION Trends in PVI Among Medicare Beneficiaries



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(Top) Graph depicting the age- and sex-adjusted rates of peripheral vascular intervention (PVI) according to clinical setting (inpatient, outpatient, and office-based clinics). The rate of inpatient PVI declined by approximately 25%, whereas the rate of outpatient PVI increased by approximately 25%. The rate of PVI occurring in office-based clinics increased from 6 procedures per 100,000 Medicare beneficiaries in 2006 to 37.8 procedures per 100,000 Medicare beneficiaries in 2011. **(Bottom)** Graph depicting the age- and sex-adjusted rates of PVI according to physician specialty (vascular or general surgery, cardiology, and radiology). By the end of the study period, the rate of PVI performed by surgeons (140.1 in 2006 to 177.5 in 2011) surpassed the rate of PVI performed by cardiologists (154.9 in 2006 to 166.9 in 2011). The proportion of PVIs performed by radiologists continued to decline from 81.0 in 2006 to 50.8 in 2011.

TABLE 3 Age- and Sex-Adjusted Rates of Peripheral Vascular Interventions per 100,000 Medicare Beneficiaries by Clinical Setting and Year

Setting	2006	2007	2008	2009	2010	2011	p Value
Total procedures							
Inpatient	2,593 (209.7)	2,572 (187.8)	2,374 (178.0)	2,186 (165.3)	2,034 (154.8)	2,008 (151.6)	<0.001
Outpatient	2,306 (184.7)	2,387 (174.3)	2,484 (186.4)	2,844 (215.4)	3,033 (231.6)	3,020 (228.5)	0.01
Office	75 (6.0)	56 (4.1)	175 (13.2)	242 (18.4)	258 (19.7)	498 (37.8)	0.008
Angioplasty							
Inpatient	608 (49.4)	705 (51.5)	684 (51.3)	634 (48.0)	632 (48.0)	586 (44.2)	0.06
Outpatient	570 (46.0)	616 (44.9)	670 (50.3)	815 (61.7)	847 (64.7)	777 (58.7)	0.03
Office	24 (1.9)	24 (1.8)	52 (3.9)	82 (6.2)	102 (7.8)	78 (5.9)	0.02
Atherectomy							
Inpatient	718 (57.7)	640 (46.8)	453 (34.0)	446 (33.7)	422 (32.2)	550 (41.6)	0.14
Outpatient	476 (38.3)	464 (33.8)	446 (33.4)	548 (41.5)	692 (52.8)	833 (63.2)	0.03
Office	–*	–*	–*	–*	–*	270 (20.5)	0.23
Stent							
Inpatient	1,267 (102.6)	1,227 (89.5)	1,237 (92.7)	1,106 (83.6)	980 (74.6)	872 (65.8)	0.002
Outpatient	1,260 (100.5)	1,307 (95.6)	1,368 (102.7)	1,481 (112.2)	1,494 (114.1)	1,410 (106.6)	0.10
Office	47 (3.8)	32 (2.3)	119 (9.0)	156 (11.9)	146 (11.2)	150 (11.4)	0.03

Values are n (rate per 100,000 beneficiaries). *The Centers for Medicare & Medicaid Services cell size suppression policy stipulates that no cell containing data for fewer than 11 observations may be displayed.

care for patients with lower-extremity PAD in all clinical settings and distinguishes between treatment modalities.

STUDY LIMITATIONS. First, symptoms and severity of PAD are not accurately captured in Medicare claims data. Second, the analysis included only patients who were age 65 years and older and enrolled in fee-for-service Medicare; generalizability to other patients is unclear. Third, Medicare claims data do not contain information on disease complexity, anatomy, and calcification, all factors that may influence the use of angioplasty, atherectomy, and stenting. Finally, estimation of Medicare expenditures is not specific to PVI in inpatient settings. Therefore, we may have overestimated expenditures for inpatient PVI compared with outpatient and office-based PVI despite our attempt to limit inpatient PVI to elective and short hospitalizations.

CONCLUSIONS

The rate of growth in PVI has stabilized. A decline in revascularization in inpatient settings was offset by a rise in procedures in outpatient hospital settings and office-based clinics. The rate of atherectomy use in lower-extremity interventions continues to increase, despite a relative dearth in

TABLE 4 Total Costs of Peripheral Vascular Intervention by Procedure, Setting, and Year*

Setting	2006	2007	2008	2009	2010	2011
Atherectomy						
Inpatient	11,342 ± 4,295	11,688 ± 4,094	12,583 ± 4,568	13,122 ± 5,511	12,945 ± 6,896	11,446 ± 6,383
Outpatient	2,763 ± 1,920	3,226 ± 2,291	5,720 ± 3,732	6,790 ± 3,909	7,204 ± 4,142	8,680 ± 4,970
Office	–†	–†	–†	–†	–†	13,478 ± 4,768
Stent						
Inpatient	11,589 ± 4,179	11,960 ± 4,796	11,994 ± 3,825	12,550 ± 4,634	12,901 ± 6,351	12,466 ± 7,077
Outpatient	4,367 ± 2,541	4,562 ± 2,756	6,012 ± 3,329	6,858 ± 3,356	7,341 ± 3,693	5,982 ± 3,639
Office	1,678 ± 1,724	1,432 ± 1,502	5,402 ± 2,643	5,543 ± 2,292	5,542 ± 1,914	6,379 ± 2,986
Angioplasty						
Inpatient	11,044 ± 3,736	11,554 ± 3,904	11,796 ± 3,739	11,820 ± 4,674	11,623 ± 3,590	13,197 ± 4,711
Outpatient	2,374 ± 1,441	2,361 ± 1,568	2,734 ± 1,670	3,164 ± 1,738	3,437 ± 1,902	3,742 ± 2,014
Office	3,789 ± 1,520	3,511 ± 1,478	3,781 ± 1,566	3,472 ± 1,400	3,546 ± 1,551	4,800 ± 2,028

Values are in U.S. dollars and are presented as mean ± SD. *Costs include professional and facility costs and patient deductibles and coinsurance. †The Centers for Medicare & Medicaid Services cell size suppression policy stipulates that no cell containing data for fewer than 11 observations may be displayed.

comparative-effectiveness and safety data to support its use. The goal of the modifications to the OPPS was to reduce costs, improve access to care, and encourage efficient delivery of care. The current study sheds light on possible unintended consequences of these payment decisions and highlights the need for further clinical studies to demonstrate the effectiveness and value of device technologies such as atherectomy.

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PERSPECTIVES

COMPETENCY IN SYSTEMS-BASED PRACTICE: Physicians, health care administrators, policy makers, and consumers should be aware that changes in reimbursement policy intended to improve access to and efficiency of care and reduce costs may have unintended consequences when they promote shifts in the proportion of interventional procedures for a given clinical indication.

TRANSLATIONAL OUTLOOK: Additional research is needed to examine the clinical outcomes of peripheral arterial interventions associated with changes in reimbursement policies and proportionate use of atherectomy compared with angioplasty and stenting in relation to patient-, provider-, and setting-specific factors.

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APPENDIX For a supplemental table, please see the online version of this article.