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Original Research

Hospital and Surgeon Medicare Reimbursement Trends for Total Joint Arthroplasty

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ABSTRACT

Background: Over 1 million total joint arthroplasties (TJAs) are performed every year in the United States, creating Medicare cost concerns for policy makers. The purpose of this study is to evaluate recent trends in Medicare utilization and reimbursements to hospitals/surgeons for TJAs between 2012 and 2017.
Methods: We tracked annual Medicare claims and payments to TJA surgeons using publicly available Medicare databases and aggregated data at the county level. Descriptive statistics and multivariate regression models were used to evaluate trends in procedure volume, utilization (per 10,000 Medicare beneficiaries), and reimbursement rates and to examine associations between county-specific variables and TJA utilization and reimbursements.
Results: Between 2012 and 2017, there was an 18.9% increase in annual primary TJA volume (357,500 cases in 2012 to 425,028 cases in 2017) and a 2.0% increase in annual primary TJA per capita utilization (73.4 cases per 10,000 Medicare beneficiaries in 2012 to 74.8 in 2017). The Midwest and the South had higher utilization rates compared with the Northeast and West ($P < .001$). Utilization rates for primary TJA procedures also had a significant negative association with the poverty rate ($P < .001$). Medicare Part B payments to surgeons fell by 7.5%, equivalent to a 14.9% inflation-adjusted decline, whereas hospital reimbursements and charges increased by 0.3% and 18.6%, respectively, during the study period.
Conclusions: Despite increasing TJA volume and utilization, surgeon reimbursements have continued to decline, whereas hospital payments and hospital charges have increased significantly more than surgeon charges. Cost containment efforts will need to address other expenditures such as hospital costs and implant costs to better align financial risks and incentives for TJA surgeons.

Introduction

Total joint arthroplasty (TJA) procedures, which include hip and knee replacements, have become popular and cost-effective treatment options, which have proven effective to provide significant pain relief and improved function to millions of patients annually [1-4]. Multiple factors, including an increasing prevalence of arthritis perhaps secondary to an aging population in the United States, have continued to drive an unprecedented rise in the demand for TJA—especially within the Medicare population [5]. There are now over 1 million total hip and knee arthroplasties performed every year in the United States [6]. This has created a major concern for policy makers because of the anticipated levels of stress placed on the Medicare system, the primary payer for over 60% of TJA procedures [7]. TJA volume is expected to continue increasing, with projections estimating that over 2 million procedures will be performed annually by 2030 [8]. This is expected to result in an estimated $50 billion in annual Medicare expenditures [9].

There has been a recent legislative shift toward cost reduction measures, especially for high-cost and high-volume joint replacement surgeries. The Bundled Payments for Care Improvement (BPCI) program and the Comprehensive Care for Joint Replacement (CJR) model have gradually shifted Medicare payments for lower extremity arthroplasty to a bundled payment model, which bases provider compensation on quality measures [10,11]. Bundled payment models aim to limit health-care expenditures and avoidable services by reimbursing providers on the basis of expected (ie, average) costs, with the overall objective of improving value by incentivizing high-quality care at lower costs. As a result, hospitals

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and surgeons increasingly share the risk of costly postoperative expenses and complications, which ultimately incentivizes cost efficiency and care quality.

Previous studies have reported decreases in surgeon reimbursements from Medicare for TJA procedures, particularly between 2000 and 2012 [5,12,13]. However, studies assessing more recent trends in Medicare TJA reimbursements are limited. Furthermore, the effects and consequences of recent cost-containment efforts by Medicare on surgeon and hospital reimbursements remain unclear. As TJA volume and costs continue to increase, especially in the Medicare system, it is important for orthopaedic surgeons to be aware of larger trends. Furthermore, surgeons should understand these trends in light of alternative payment models and potential effects on risk-sharing and revenue-sharing partnerships with hospitals. As such, the purpose of this study is to evaluate and report recent trends in Medicare reimbursements to hospitals and surgeons for TJAs between 2012 and 2017, as well as trends in Medicare-participating hospital and surgeon charges.

Material and methods

The Centers for Medicaid and Medicare Services (CMS) operates the Medicare program, which is the largest insurer for a population that includes over 40 million people aged 65 years and older, as well as other special populations. Medicare expenditures for services such as TJA include 2 parts—Medicare Part A and Medicare Part B payments. The Medicare Part A program provides reimbursement payments to cover hospital expenses and other inpatient and surgical costs, including implants. Medicare Part B covers payments to providers for services and procedures, as well as any outpatient care required during postsurgical follow-up. As part of the Affordable Care Act's efforts to reduce health-care costs and increase transparency of Medicare expenditures, the CMS released publicly available (Public Use File [PUF]) databases of annual procedure volume, reimbursement, and inpatient charge data. In this retrospective study, we tracked and analyzed the Medicare Part A (hospital and inpatient payments) and Part B (physician reimbursements) insurance databases from 2012 to 2017.

The Part A Inpatient Utilization and Payment PUF database contains information on inpatient discharges and hospital payments from Medicare, in addition to hospital-specific charges, and is organized by Medicare Severity Diagnosis-Related Groups (MS-DRGs). The Part B Physician and Supplier PUF database contains annual claims data for each provider (those providers with an annual case volume of at least 10), organized by unique National Provider Identifier numbers, in addition to the location of the index surgery including the city and state. Provider claims data contain information on procedure volume and physician reimbursement (average Medicare payment), organized by Healthcare Common Procedure Coding System (HCPCS) code, which is the Medicare equivalent of a current procedural terminology (CPT) code (copyrighted to American Medical Association). The average Medicare payment amount is defined as the average amount that Medicare paid to physicians for a service, after a patient's deductible and coinsurance amounts have been deducted. This represents Medicare's allocation of expenditures for physician payment, after controlling for patient contributions. We did not include Medicare payments to physicians for facility fees. Under the BPCI program, Medicare continues to make fee-for-service payments, but the total expenditures for the service are later reconciled against a bundled payment amount determined by the CMS, and a payment amount or additional charge is retrospectively made by Medicare, reflecting the difference between target price and actual expenditures. The databases also contain submitted charges from Medicare-participating hospitals and surgeons, representing the average amount billed to uninsured patients, and used in several studies as a cost multiplier indicator (ie, rising costs will push the charge amounts higher as providers attempt to recoup potential losses from uninsured services).

The Part A database was queried for hospital payments for TJA patients by filtering with MS-DRG codes 469 and 470 for primary TJAs and 466, 467, and 468 for revision TJA procedures. Although these codes do not differentiate between hip and knee arthroplasties, they stratify procedures based on case complexity, as defined by Medicare's list of complication and comorbidities. DRG 466 is coded by Medicare as having major complications and comorbidities (MCCs), DRG 467 has complications and comorbidities (CCs), and DRG 468 included noncomplex procedures without complications or comorbidities. Similarly, DRG 469 includes primary TJA with MCCs, whereas DRG 470 includes cases without MCCs. For each MS-DRG code, we tracked annual total discharges and Medicare hospital payments and aggregated the data geographically, both at the county level and at the hospital referral region level. We also used discharge and payment data to calculate mean Medicare payment per case. The Part B database was queried for providers who performed primary TJA procedures by filtering with HCPCS/CPT code 27130 for primary THAs and 27447 for primary total knee arthroplasties (TKAs). Revision TJAs were queried using HCPCS/CPT codes 27132, 27134, 27137, and 27138 for revision THAs and 27487, 27486, and 27488 for revision TKAs. We reviewed provider claims data from 2012 to 2017, and for each procedure type, we measured total annual claims at the county (or county-equivalent) level. We also calculated mean reimbursement per case by using reimbursement data and claims data. Revision TJA volume was not measured because of incomplete information in the Medicare database.

We used descriptive statistics to analyze trends in procedure volume, utilization rates (per 10,000 Medicare beneficiaries), and average payment per case at the national level and stratified by US census region (Northeast, Midwest, South, West) and by urban and rural counties. We defined "urban counties" as those within a census-defined metropolitan statistical area (MSA), and counties that were not part of an MSA were considered rural. Major metropolitan areas ("major MSA") were defined as MSAs with a total population over 1 million. All other census-designated metropolitan areas, including mid-sized and small MSAs ("mid-sized MSA") were defined as MSAs with a total population below 1 million. In our analysis of claims volume and utilization, we controlled for the number of surgeons receiving Medicare reimbursements and total Medicare beneficiaries within each county, and we calculated the density of TJA surgeons per 1 million Medicare beneficiaries. In our analysis of Medicare payments, we used economic principles to analyze annual financial trends over

Table 1
Volume for primary total joint arthroplasty, 2012-2017.

Case	Volume (aggregate Medicare services/claims)						% Change	
	2012	2013	2014	2015	2016	2017	% Overall change	CAGR (%)
TJA	357,500	371,266	367,205	384,532	413,920	425,028	18.9	3.5
THA	104,243	111,564	115,968	124,390	133,193	138,086	32.5	5.8
TKA	253,257	259,702	251,237	260,142	280,727	286,942	13.3	2.5

Table 2
Utilization for primary total joint arthroplasty, 2012-2017.

Case	Utilization (per 10,000 medicare beneficiaries)						% Chang	
	2012	2013	2014	2015	2016	2017	% Overall change	CAGR (%)
TJA	73.4	73.5	70.6	71.9	74.8	74.8	2.0	0.4
THA	21.4	22.1	22.3	23.3	24.1	24.3	13.6	2.6
TKA	52.0	51.4	48.3	48.6	50.7	50.5	−2.8	−0.6

CAGR, compound annual growth rate.

the study period. For example, we calculated the growth in Medicare payments between 2012 and 2017 using the compound annual growth rate, which provides average year-over-year growth during a defined time period. In addition, we factored for the effect of inflation in the United States during the study period by using the consumer price index, provided by the US Bureau of Labor and The World Bank, to calculate inflation-adjusted Medicare payment figures [14,15]. All statistical analyses were performed using Stata (version 15.1, College Station, TX), which was used to create adjusted linear regression models to examine associations between county-specific variables (ie, urban or rural, average household income, poverty rate, percent Medicare population, race/ethnicity demographics) and procedure volume, utilization, and reimbursement rates. We included county-level covariates, fixed effects, and a linear time trend in all our regression models to account for possible confounding variables and other geographic-specific factors. We obtained county-level and state-level data from a publicly available database published online by the US Census Bureau (data.census.gov) [16]. All data were retrieved deidentified and are publicly available.

Results

Volume and utilization

During the 2012 to 2017 period, there was an 18.9% increase in annual primary TJA volume (from 357,500 cases in 2012 to 425,028 cases in 2017) and a 2.0% increase in annual primary TJA per capita utilization (73.4 cases per 10,000 Medicare beneficiaries in 2012 to 74.8 in 2017) (Tables 1 and 2). TJA utilization also varied geographically—the Midwest and South regions had higher utilization rates compared with the Northeast and West (Tables 3 and 4, Fig. 1). Mid-sized metropolitan areas had higher utilization rates than the major metropolitan areas (population over 1 million) and rural areas ($P < .001$, Tables 3 and 4). Multivariable regression analysis found that utilization rates of primary TJAs also had a significant negative association with the poverty rate ($P < .001$).

Hospital payments and charges

Medicare reimbursement payments to hospitals for TJA cases had a modest nominal increase of 0.3% from a mean payment per case of $12,415.04 in 2012 to $12,458.07 in 2017. However, after adjusting for inflation, this represented a real decline of 7.7% during the study period. Primary and revision cases had similar inflation-adjusted decreases in Medicare payments, with 10.6% and 11.1% declines, respectively. TJA payments to hospitals were risk adjusted according to case complexity and patient comorbidities. Complicated TJA cases (+MCC or + CC) received significantly more Medicare payment per case, when directly compared with uncomplicated TJA cases (−MCC or −CC) ($P < .001$, Tables 5 and 6). However, when comparing changes in payment between 2012 and 2017, complicated and uncomplicated primary TJAs experienced similar inflation-adjusted declines of 10.0% and 10.1%, respectively. However, there was a significant difference in reimbursement declines between complicated revision TJAs (ranging from 2.8% to 4.3%) and uncomplicated revision TJAs (7.2%) ($P < .001$).

Submitted charges by Medicare-participating hospitals saw significant growth during our study period, with an average increase of 18.6% (9.1% inflation-adjusted increase), and a statistically significant upward yearly trend ($P < .001$, Table 7). This increase has been primarily driven by increases in charges for complicated procedures (+CC or +MCC, DRG codes 466, 467, and 469), with an average increase of 17.9% (Table 7). Charges for procedures without complications or comorbidities (DRG codes 468 and 470) also experienced robust growth, averaging 14.6% during the study

Table 3
Geographic variation in TJA volume, utilization, surgeon distribution, and Medicare payments and charges—Medicare part B (surgeons).

Medicare part B (surgeons)	Urban/rural			US census region				
All TJA	Major MSA	Mid-sized MSA	Rural	Midwest	Northeast	South	West	National
Procedure volume (No. of primary services)	1,025,090	798,490	547,342	395,288	914,275	629,421	431,800	2,370,922
Utilization/10 k Medicare population	97.9	110.9	86.4	79.8	109.2	129.1	74.3	98.7
Surgeons per 1 M Medicare	176	196	173	142	193	244	144	181
Surgeon reimbursement per case ($USD)	$1105	$1047	$1032	$1133	$1046	$1059	$1073	$1069
Surgeon charge per case ($USD)	$6737	$5378	$5080	$6275	$7924	$5192	$4980	$5896
THA								
Procedure volume (No. of primary services)	348,412	243,008	157,406	141,661	268,302	193,632	145,231	748,826
Utilization/10 k Medicare population	33.3	33.7	24.8	28.6	32.0	39.7	25.0	31.2
Surgeons per 1 M Medicare	99	111	91	84	100	139	81	100
Surgeon reimbursement per case ($USD)	$1093	$1028	$1016	$1114	$1035	$1040	$1058	$1056
Surgeon charge per case ($USD)	$7288	$5536	$5150	$6908	$8572	$5272	$5018	$6270
TKA								
Procedure volume (No. of primary services)	676,678	555,482	389,936	253,627	645,973	435,789	286,569	1,622,096
Utilization/10 k Medicare population	64.6	77.1	61.6	51.2	77.1	89.4	49.3	67.6
Surgeons per 1M Medicare	168	189	168	135	188	236	138	175
Surgeon reimbursement per case ($USD)	$1112	$1055	$1038	$1143	$1051	$1067	$1080	$1075
Surgeon charge per case ($USD)	$6453	$5308	$5051	$5994	$7561	$5159	$4961	$5724

Table 4
Geographic variation in Medicare payments and charges—Medicare part A (hospitals).

Medicare part A (hospitals)	Urban/rural			US census region				
All TJAs	Major MSA	Mid-sized MSA	Rural	Midwest	Northeast	South	West	National
Hospital reimbursement per case ($USD)	$13,254	$11,995	$12,240	$12,082	$14,146	$11,619	$14,162	$12,613
Hospital charges per case ($USD)	$62,094	$55,747	$59,197	$48,878	$55,324	$60,160	$76,962	$59,357
Primary TJA								
Hospital reimbursement per case ($USD)	$12,856	$11,729	$12,030	$11,340	$12,844	$11,627	$13,453	$12,298
Hospital charges per case ($USD)	$60,294	$54,643	$58,218	$51,231	$49,726	$58,106	$68,307	$57,958
Revision TJA								
Hospital reimbursement per case ($USD)	$20,841	$18,389	$18,791	$18,566	$20,102	$18,526	$21,831	$19,745
Hospital charges per case ($USD)	$96,419	$82,296	$89,746	$83,237	$75,345	$90,154	$107,903	$90,944

period. Hospital charges were significantly higher on average in the West region ($76,962) compared with other US regions ($P < .001$), where average charges ranged from $48,878 in the Midwest to $55,324 in the Northeast and $60,160 in the South (Tables 3 and 4).

Surgeon payments and charges

Regarding surgeon reimbursements, Medicare payment per case decreased for TJA from 2012 to 2017, with an overall inflation-adjusted decrease of 14.9% (Table 7). When comparing hip and knee arthroplasties, there is a significant difference in mean reimbursement per case, at $1207.75 and $1166.73, respectively ($P < .001$). We found geographic variability in Medicare payments to surgeons. Mean reimbursements per case were on average higher in the Northeast and West compared with the South and Midwest ($P < .001$). In addition, surgeons performing TJAs in metropolitan areas received significantly higher reimbursement per case ($1079.89) compared with those performing TJAs in rural areas ($1031.89, $P = .009$).

Submitted charges by Medicare-participating TJA surgeons saw significantly reduced growth during our study period, compared with hospital charges, with an average increase of 4.9% (3.5% inflation-adjusted decrease) (Table 8). This increase has been primarily driven by increases in charges for complicated procedures (+CC or + MCC, DRG codes 466, 467, and 469), with an average increase of 17.9%. The growth in charges for most TJA procedures

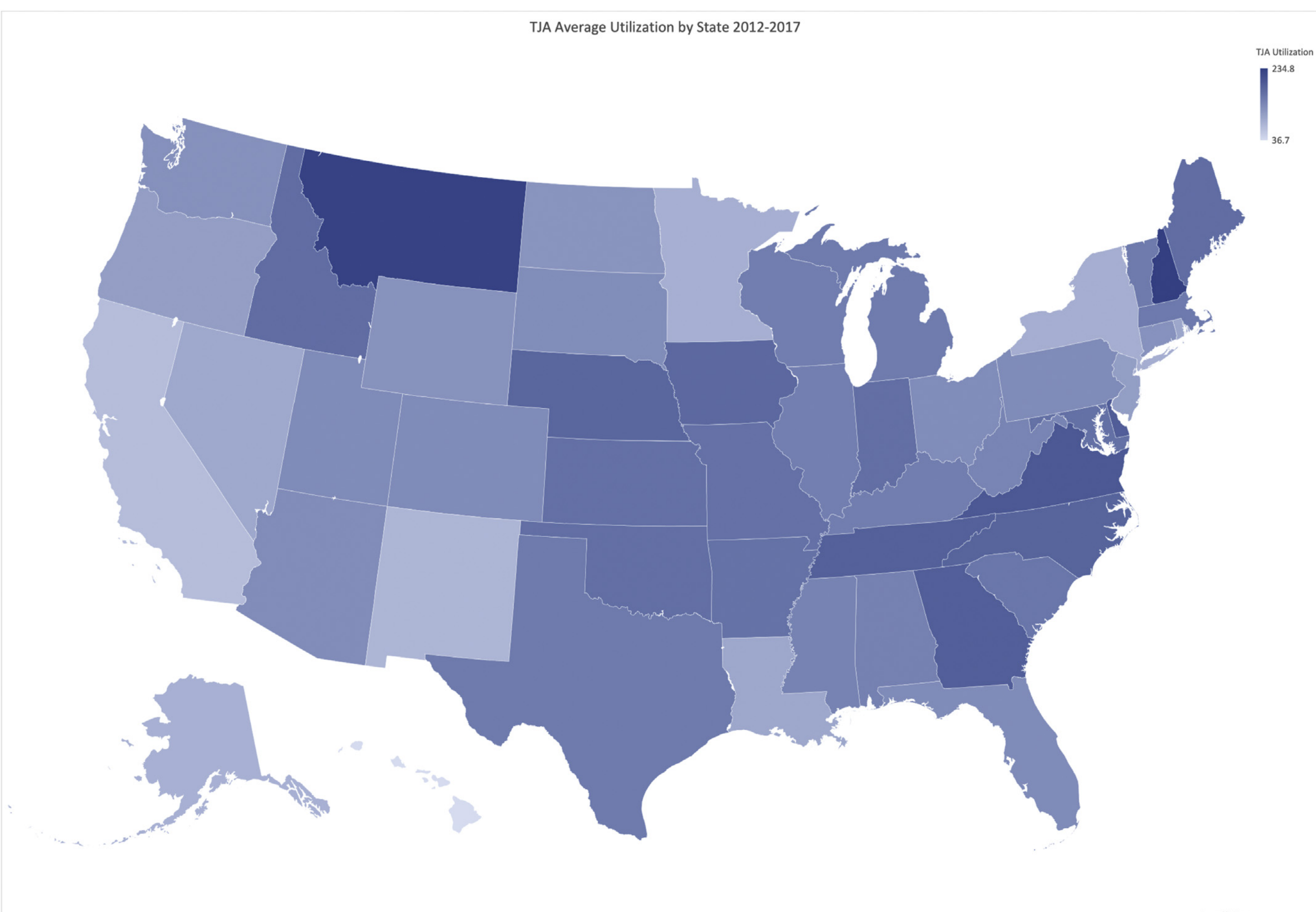

Figure 1. TJA average utilization by state (procedures per 10,000 Medicare beneficiaries).

Table 5
Annual trends in mean Medicare reimbursement per TJA episode to surgeons, 2012-2017.

Case		Mean surgeon reimbursement per procedure						% Change	CAGR	
Type	Joint	2012	2013	2014	2015	2016	2017	% Overall change	Raw (%)	Inflation adjusted (%)
Primary	TJA	$1123	$1125	$1033	$1038	$1036	$1038	−7.5	−1.6	−14.9
	THA	$1074	$1072	$1030	$1035	$1035	$1043	−2.9	−0.6	−10.7
	TKA	$1143	$1149	$1035	$1039	$1036	$1036	−9.4	−1.9	−16.6
Revision	TJA	$1295	$1284	$1314	$1290	$1291	$1295	0.0	0.0	−8.0
	THA	$1346	$1330	$1385	$1370	$1375	$1375	2.2	0.4	−6.0
	TKA	$1255	$1241	$1254	$1240	$1244	$1250	−0.3	−0.1	−8.3
TJA Total		$1127	$1129	$1040	$1043	$1040	$1043	−7.5	−1.5	−14.9

fell within the 3.9% to 9.3% range. Of note, revision THA charges increased 20.3% (10.6% inflation-adjusted increase) from $7880 per procedure in 2012 to $9478 in 2017, representing a significant upward yearly trend ($P < .001$). Surgeon charges for TJA procedures were significantly higher on average in the Northeast US region ($7924) compared with other US regions ($P < .001$), where average charges ranged from $4980 in the West to $5192 in the South and $6275 in the Midwest (Tables 3 and 4). Surgeon charges for THAs and TKAs were also each significantly greater in the Northeast compared with any other regions ($P < .001$). In addition, surgeon charges for THAs, TKAs, and TJAs overall were all significantly higher in large metropolitan areas (major MSAs), compared with rural areas ($P < .001$), and even compared with mid-sized metropolitan areas ($P < .001$, Tables 3 and 4). There was no significant difference in surgeon charges between surgeons in rural areas or mid-sized metropolitan areas.

Geographic distribution of TJA surgeons

Analysis of the geographic distribution of Medicare-participating TJA surgeons showed that there is a higher average density of surgeons in counties that are located within mid-sized metropolitan areas (196 surgeons per 1 million Medicare beneficiaries), compared with rural counties (173) or counties in major metropolitan areas (176) ($P < .001$, Tables 3 and 4). Moreover, average TJA surgeon density was also significantly higher in counties in the South (244 surgeons per 1 million Medicare beneficiaries), compared with counties in any other US region ($P < .001$, Tables 3 and 4, Fig. 2). Interestingly, the Midwest had the lowest density of TJA surgeons (142 surgeons per 1 million Medicare beneficiaries).

Discussion

Our study reports that although primary TJA volume and per capita utilization have increased since 2012, Medicare payments to surgeons have fallen, whereas payments to hospitals have continued to increase. When adjusting for inflation, Medicare payments to hospitals and surgeons have both fallen, but surgeon reimbursements have declined significantly more compared with hospital payments. We also found that increases in primary TJA volume and utilization are less than what has been previously projected, reflecting a possible plateau in the growth of procedure utilization within the Medicare population. Similarly, Nwachukwu et al. [5] reported modest increases in TJA utilization, which was less than previous growth projections, for Medicare beneficiaries between 2005 and 2011, citing overprojection, possible supply-side issues, and economic recession among the reasons for the slow growth. In addition, in a study of TKA utilization, Cram et al. [12] observed that although utilization experienced significant growth between 1991 and 2010, the growth rate plateaued in 2005 and stabilized in the years after. Sloan et al. [8] projected primary THA volume to grow to 635,000 annual procedures by 2030 and primary TKA volume to grow to 1.26 million procedures by 2030; however, TKA growth has been slowing in recent years, and growth is only projected to reach 935,000 procedures by 2030, instead of previously projected figures ranging from 1 to 3 million procedures [17].

Rising hospital costs have been shown to be a key driver of increasing health-care expenditures in the United States [18-23]. A previous study of Medicare reimbursement trends between 2000 and 2011 reported inflation-adjusted growth in annual Medicare Part A payments to hospitals, especially for cases coded for having complications or comorbidities (complex cases) [13]. However, these trends seemed to have reversed since 2012, with our study reporting real declines in annual Medicare payments to hospitals for complicated TJA cases, despite using similar methods for data collection and analysis. In a study of a 5% Medicare sample database, Quinlan et al. [24] found that hospital charges and payments relative to surgeon charges and payments for THA and TKA increased substantially between 2005 and 2014, despite stable patient complexity and decreasing length of stay. Our study similarly reports an increasing disparity in Medicare reimbursements to hospitals and surgeons, as hospital payments and charges for TJAs have continued to increase through 2017, whereas surgeon payments have fallen (−7.5%) and surgeon charges have not kept up with inflation (−3.5% inflation-adjusted decline). Similar trends

Table 6
Annual trends in mean Medicare hospital charge, 2012-2017.

Case		Mean hospital charge per procedure						% Change	CAGR	
Type	Complexity	2012	2013	2014	2015	2016	2017	% Overall change	Raw (%)	Inflation adjusted (%)
Primary		$53,490	$55,477	$57,174	$58,637	$60,403	$61,603	15.2	2.9	6.0
	(−) CC	$52,236	$54,228	$55,989	$57,369	$59,175	$60,366	15.6	2.9	6.3
	(+) MCC	$82,415	$85,334	$86,279	$89,662	$92,944	$94,168	14.3	2.7	5.1
Revision		–	$88,079	$86,447	$90,016	$91,429	$97,829	11.1	2.1	2.2
	(−) CC, - (MCC)	–	–	$74,601	$77,319	$78,768	$84,719	13.6	2.6	4.5
	(+) MCC	–	–	$144,572	$150,204	$175,411	$172,917	19.6	3.6	10.0
	(+) CC	–	$88,079	$92,919	$97,154	$98,842	$105,482	19.8	3.7	10.2
All TJA		$53,490	$56,663	$58,884	$60,385	$61,834	$63,462	18.6	3.5	9.1

CC, Comorbidities; CAGR, compound annual growth rate.

Table 7
Annual trends in mean Medicare reimbursement per TJA episode to hospitals, 2012-2017.

Case		Mean hospital reimbursement per procedure						% Change	CAGR	
Type	Complexity	2012	2013	2014	2015	2016	2017	% Overall change	Raw (%)	Inflation adjusted (%)
Primary		$12,415	$12,422	$12,520	$12,315	$12,109	$12,058	−2.9	−0.6	−10.6
	(−) CC	$12,052	$12,081	$12,213	$12,005	$11,826	$11,772	−2.3	−0.5	−10.1
	(+) MCC	$20,792	$20,582	$20,046	$19,915	$19,621	$19,605	−2.2	−0.4	−10.0
Revision		–	$20,532	$19,557	$19,542	$19,529	$19,851	−3.3	−0.7	−11.1
	(−) CC, - (MCC)	–	–	$16,635	$16,645	$16,498	$16,776	0.8	0.2	−7.2
	(+) MCC	–	$20,532	$21,118	$21,121	$21,442	$21,686	5.6	1.1	−2.8
	(+) CC	–	–	$35,069	$34,482	$36,349	$36,493	4.1	0.8	−4.3
All TJA		$12,415	$12,717	$12,931	$12,718	$12,452	$12,458	0.3	0.1	−7.7

CAGR, compound annual growth rate.

appear to be occurring in the private insurance market, with Cooper et al. [25] reporting a widening gap between hospital prices and physician prices from 2007 to 2014. These findings highlight the need for policy makers to address the disproportionate growth of hospital prices and inpatient costs.

Hospital charges represent the amount an insured patient would be billed for inpatient service, and they have continued to increase significantly (18.6%) since 2012, at a disproportionate rate compared with surgeon charges. Within our analysis of the Medicare Part A database, we found wide variation in hospital payments and charges, which reflects similarly wide variation in inpatient costs [26-28]. Inpatient costs involve various expenditures including ancillary hospital services, operating room staffing and equipment, and most notably, implant costs. Within our analysis of the Medicare Part A database, there was wide variation in hospital charges, reflecting similarly wide variation in TJA costs across different hospitals in various geographic areas. Cooper et al. [25] suggested hospital market consolidation through mergers and acquisitions, which create less competition as a possible reason for rising hospital charges, and several studies have shown that hospital prices increase in these highly consolidated markets [29-31]. Another consideration is the significant costs of joint implants, which represent one of the largest expenditures for TJA-servicing hospitals [32], with implant list prices ranging from $1797 to $12,651 for hip and knee replacement procedures, according to a 2012 study [33]. A 2017 study found wide variation in the prices paid for TJA implant orders by hospitals across the United States, depending on hospital-specific characteristics including purchasing power, facility size, and vendor negotiations and relationships with surgeons [32]. The study also reported that hospitals that collaborated with surgeons on implant purchasing decisions paid an average of 23% less for THA implants and 17% less for TKA implants, compared with hospitals that negotiated prices separately from surgeons [32]. Because Medicare does not negotiate directly with implant manufacturers, individual hospitals with variable bargaining power are left to cover implant costs using the all-inclusive bundled Medicare payment, which was originally intended to incentivize cost efficiency. Recent innovations in surgical and medical device technologies have improved surgical protocols and enhanced minimally invasive surgical techniques, which may expedite postoperative discharge and recovery [34]. In addition, well-defined patient selection criteria for outpatient surgery, along with optimized anesthesia and postoperative pain management protocols, have helped reduce readmission risk and associated costs [35-37]. Increased payer coverage of outpatient procedures has also pushed procedure volume out of the costly inpatient hospital setting and into comparatively cost-efficient ambulatory surgical centers.

In 2018, TKAs were removed from the inpatient-only list by the CMS, expanding coverage to hospital outpatient department settings, and they were eventually added to the Medicare ambulatory surgical center−payable list in January 2020, making ambulatory TKAs eligible for Medicare reimbursement.

The increasing adoption of value-based delivery models has transferred risk away from payers such as Medicare and onto surgeons and hospitals as part of new shared-risk payment structures, which incentivize cost efficiency and value. However, there have been inconclusive results and ongoing debate regarding the potential cost savings of value-based models and their efficacy in maintaining or improving care quality at a lower cost [38]; however, it appears that although risk is being shared between hospitals and providers, financial incentives are disproportionately aligned, especially when considering the significant declines in surgeon reimbursements compared with hospital payments in the Medicare system. This phenomenon of increasing hospital and implant costs while surgeon reimbursement declines has also been observed in other orthopaedic procedures, including spinal fusions [39-44] and shoulder arthroplasty [5,13,45,46]. Shared-risk bundled models may disproportionately restrict care for patients with higher complication risks, including those of lower socioeconomic status. Our analysis found that utilization rates of primary procedures were significantly more reduced in counties with

Table 8
Annual trends in mean Medicare surgeon charges per TJA episode, 2012-2017[a].

Case		Mean surgeon charge per procedure						% Change	CAGR (compound annual growth rate)	
Type	Joint	2012	2013	2014	2015	2016	2017	% Overall change	Raw (%)	Inflation adjusted (%)
Primary	TJA	$5690	$5785	$5855	$5899	$5929	$5973	5.0	1.0	−3.4
	THA	$5997	$6084	$6186	$6203	$6275	$6370	6.2	1.2	−2.3
	TKA	$5564	$5656	$5702	$5754	$5764	$5781	3.9	0.8	−4.4
Revision	TJA	$7120	$7447	$7619	$7531	$7721	$7782	9.3	1.8	0.5
	THA	$7880	$8399	$8800	$9064	$9236	$9478	20.3	3.8	10.6
	TKA	$6502	$6580	$6635	$6591	$6864	$6840	5.2	1.0	−3.2
TJA total		$5725	$5825	$5895	$5933	$5963	$6007	4.9	1.0	−3.5

[a] Changes in surgeon charges can be explained primarily by regional and hospital-based variations because surgeon charges mostly remain CPT standardized.

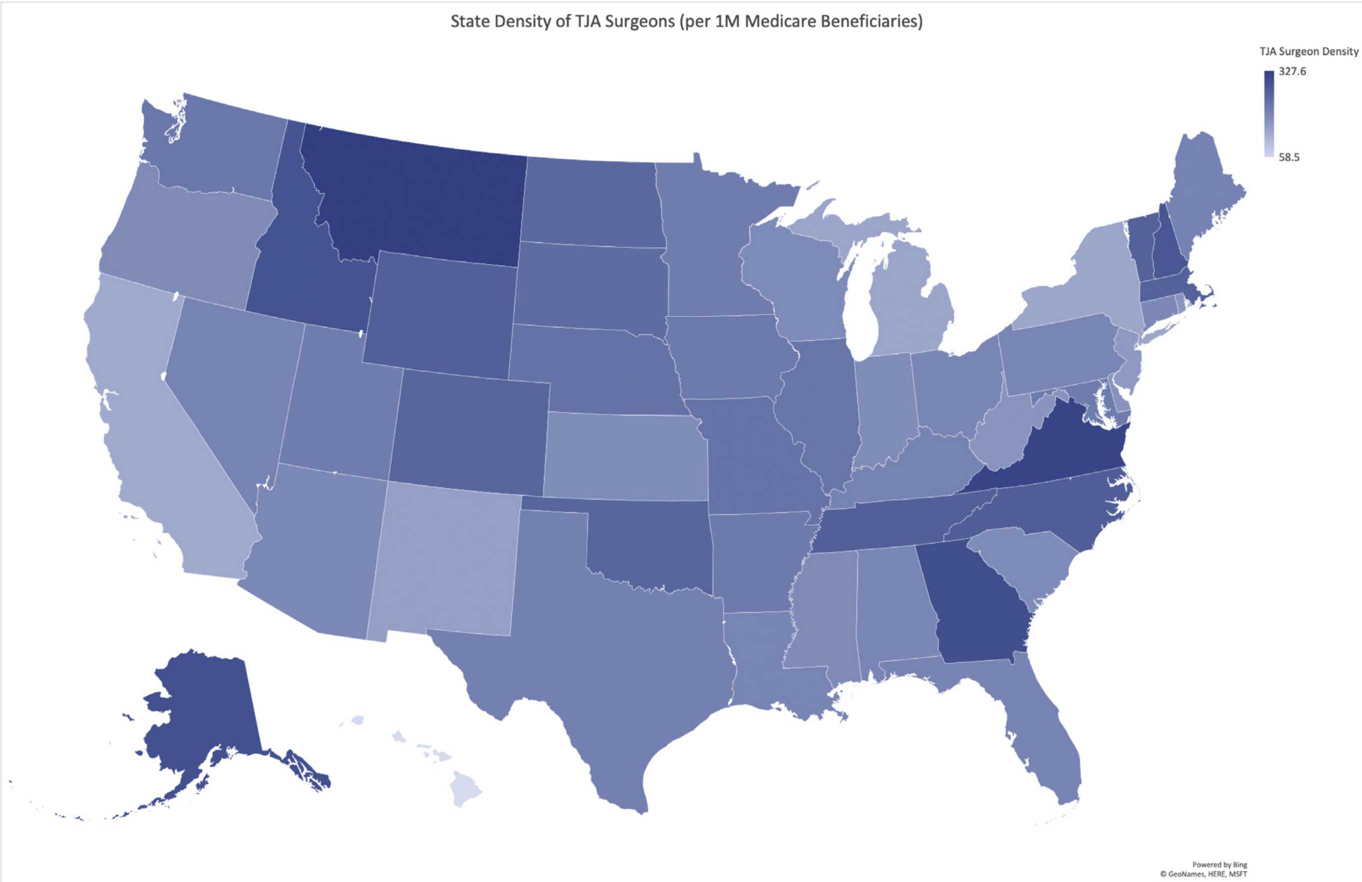

Figure 2. State density of TJA surgeons (per 1 million Medicare beneficiaries).

higher poverty rates, which may reflect reduced access to care for economically disadvantaged patients. In a study of 2011 Medicare reimbursement data, Padegimas et al. [47] found that hospitals in regions with sicker patient populations received lower reimbursements for TJAs. Belatti et al. [13] noted that although diagnostic codes for complicated cases were introduced for Part A hospital reimbursements, no such coding had been introduced for surgeon reimbursements in the Part B system, which still remains the case. To ensure that bundled payment models can provide equitable patient access for an aging and increasingly comorbid Medicare population, coding systems for Part B physician payments should adjust for case severity, as it does for hospital reimbursements, to accurately reflect the increased work and effort of surgery and perioperative management and to provide financial incentives to providers.

It is worth noting that the BPCI and CJR bundled payment models have been implemented by the CMS during this time period, but we were not able to include them into this analysis. As such, our analysis only describes general trends in Medicare payments to providers during the time period of implementation of BPCI and CJR, without comment on how bonus payments or risk-sharing paybacks affected provider reimbursements. In addition, it is important to note that changes in surgeon charges can be explained primarily by regional and hospital-based variations because surgeon charges mostly remain CPT standardized. Although our study focused on Medicare patients, it is worth considering that private insurance reimbursement is usually pegged to a Medicare multiplier. Further evaluation stratified by insurance type and across a broader population would be warranted.

Conclusions

Our study reported declining trends in Medicare reimbursements for TJAs to surgeons and hospitals that have not kept up with inflation, concurrent with increasing trends in TJA volume and utilization. Although the effect of bundled payment models on TJA costs remains unclear, our study confirms that Medicare reimbursements per case continue to decrease. At a time when implant prices and operational costs continue to rise, these recent trends may pose significant challenges not only for providers but also for hospitals and clinics, to meet the increasing demand for total joint arthroplasties in the Medicare population.

Conflict of interest

There were no sources of funding for this current study. The authors declare there are no relevant conflicts of interest to this current study. Unrelated to this current study, authors of this study report consulting or royalties from the following companies: KCI USA, Inc; Zimmer Biomet; LinkBio Corporation; Smith and Nephew, Inc.

References

[1] Krummenauer F, Wolf C, Gunther KP, Kirschner S. Clinical benefit and cost effectiveness of total knee arthroplasty in the older patient. Eur J Med Res 2009;14:76.
[2] Rorabeck CH, Murray P. The cost benefit of total knee arthroplasty. Orthopedics 1996;19(9):777.

[3] Rorabeck CH, Bourne RB, Laupacis A, et al. A double-blind study of 250 cases comparing cemented with cementless total hip arthroplasty. Cost-effectiveness and its impact on health-related quality of life. Clin Orthop Relat Res 1994;298:156.
[4] Laupacis A, Bourne R, Rorabeck C, et al. The effect of elective total hip replacement on health-related quality of life. J Bone Joint Surg Am 1993;75(11):1619.
[5] Nwachukwu BU, McCormick F, Provencher MT, Roche M, Rubash HE. A comprehensive analysis of Medicare trends in utilization and hospital economics for total knee and hip arthroplasty from 2005 to 2011. J Arthroplasty 2015;30(1):15.
[6] Etkin CD, Springer BD. The American joint replacement registry-the first 5 years. Arthroplast Today 2017;3(2):67.
[7] Haas DA, Kaplan RS. Variation in the cost of care for primary total knee arthroplasties. Arthroplast Today 2017;3(1):33.
[8] Sloan M, Premkumar A, Sheth NP. Projected volume of primary total joint arthroplasty in the U.S., 2014 to 2030. J Bone Joint Surg Am 2018;100(17):1455.
[9] Wilson NA, Schneller ES, Montgomery K, Bozic KJ. Hip and knee implants: current trends and policy considerations. Health Aff (Millwood) 2008;27(6):1587.
[10] Curtin BM, Russell RD, Odum SM. Bundled payments for care improvement: boom or bust? J Arthroplasty 2017;32(10):2931.
[11] Greenwald AS, Bassano A, Wiggins S, Froimson MI. Alternative reimbursement models: bundled payment and beyond: AOA critical issues. J Bone Joint Surg Am 2016;98(11):e45.
[12] Cram P, Lu X, Kates SL, Singh JA, Li Y, Wolf BR. Total knee arthroplasty volume, utilization, and outcomes among Medicare beneficiaries, 1991-2010. JAMA 2012;308(12):1227.
[13] Belatti DA, Pugely AJ, Phisitkul P, Amendola A, Callaghan JJ. Total joint arthroplasty: trends in medicare reimbursement and implant prices. J Arthroplasty 2014;29(8):1539.
[14] Inflation, consumer prices (%). International Monetary Fund, International Financial Statistics and data files. World Bank Group. 2019. https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG. [Accessed 15 February 2020].
[15] Consumer Price Index. U.S. Bureau of Labor Statistics. 2019. https://www.bls.gov/cpi/data.htm. [Accessed 15 February 2020].
[16] Data - Census Bureau. 2019. data.census.gov. [Accessed 15 February 2020].
[17] Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am 2007;89(4):780.
[18] Missios S, Bekelis K. Hospitalization cost after spine surgery in the United States of America. J Clin Neurosci 2015;22(10):1632.
[19] Singh K, Nandyala SV, Marquez-Lara A, et al. A perioperative cost analysis comparing single-level minimally invasive and open transforaminal lumbar interbody fusion. Spine J 2014;14(8):1694.
[20] Liu CY, Zygourakis CC, Yoon S, et al. Trends in utilization and cost of cervical spine surgery using the national inpatient sample database, 2001 to 2013. Spine (Phila Pa 1976) 2017;42(15):E906.
[21] Zygourakis CC, Liu CY, Keefe M, et al. Analysis of national rates, cost, and sources of cost variation in adult spinal deformity. Neurosurgery 2018;82(3):378.
[22] Shields LB, Clark L, Glassman SD, Shields CB. Decreasing hospital length of stay following lumbar fusion utilizing multidisciplinary committee meetings involving surgeons and other caretakers. Surg Neurol Int 2017;8:5.
[23] Epstein NE, Schwall G, Reillly T, Insinna T, Bahnken A, Hood DC. Surgeon choices, and the choice of surgeons, affect total hospital charges for single-level anterior cervical surgery. Spine (Phila Pa 1976) 2011;36(11):905.
[24] Quinlan ND, Chen DQ, Browne JA, Werner BC. Surgeon reimbursement unchanged as hospital charges and reimbursements increase for total joint arthroplasty. J Arthroplasty 2019;35:605.
[25] Cooper Z, Craig S, Gaynor M, Harish NJ, Krumholz HM, Van Reenen J. Hospital prices grew substantially faster than physician prices for hospital-based care in 2007-14. Health Aff (Millwood) 2019;38(2):184.
[26] Saifi C, Fein AW, Cazzulino A, et al. Trends in resource utilization and rate of cervical disc arthroplasty and anterior cervical discectomy and fusion throughout the United States from 2006 to 2013. Spine J 2018;18(6):1022.
[27] Pahlavan S, Berven S, Bederman SS. Variation in costs of spinal implants in United States academic medical centers. Spine (Phila Pa 1976) 2016;41(6):515.
[28] Sullivan R, Jarvis LD, O'Gara T, Langfitt M, Emory C. Bundled payments in total joint arthroplasty and spine surgery. Curr Rev Musculoskelet Med 2017;10(2):218.
[29] Cooper ZC S, Gaynor M, Van Reenen J. The price ain't right? Hospital prices and health spending on the privately insured. Q J Econ 2019;134:51.
[30] Gaynor MH K, Town RJ. The Industrial Organization of Health care markets. Am Econ Assoc 2015;53(2):235.
[31] Gowrisankaran GN A, Town R. Mergers when prices are negotiated: evidence from the hospital industry. Am Econ Rev 2015;105(1):172.
[32] Haas DA, Bozic KJ, DiGioia AM, Song Z, Kaplan RS. Drivers of the variation in prosthetic implant purchase prices for total knee and total hip arthroplasties. J Arthroplasty 2017;32(2):347.
[33] Robinson JC, Pozen A, Tseng S, Bozic KJ. Variability in costs associated with total hip and knee replacement implants. J Bone Joint Surg Am 2012;94(18):1693.
[34] Basques BA, Ferguson J, Kunze KN, Phillips FM. Lumbar spinal fusion in the outpatient setting: an update on management, surgical approaches and planning. J Spine Surg 2019;5(Suppl 2):S174.
[35] Berger RA, Sanders S, Gerlinger T, Della Valle C, Jacobs JJ, Rosenberg AG. Outpatient total knee arthroplasty with a minimally invasive technique. J Arthroplasty 2005;20(7 Suppl 3):33.
[36] Hanson NA, Lee PH, Yuan SC, Choi DS, Allen CJ, Auyong DB. Continuous ambulatory adductor canal catheters for patients undergoing knee arthroplasty surgery. J Clin Anesth 2016;35:190.
[37] Cullom C, Weed JT. Anesthetic and analgesic management for outpatient knee arthroplasty. Curr Pain Headache Rep 2017;21(5):23.
[38] Bronson WH, Kingery MT, Hutzler L, et al. Lack of cost savings for lumbar spine fusions after bundled payments for care improvement initiative: a consequence of increased case complexity. Spine (Phila Pa 1976) 2019;44(4):298.
[39] Jain N, Phillips FM, Shimer AL, Khan SN. Surgeon reimbursement relative to hospital payments for spinal fusion: trends from 10-year medicare analysis. Spine (Phila Pa 1976) 2018;43(10):720.
[40] Hariri S, Bozic KJ, Lavernia C, Prestipino A, Rubash HE. Medicare physician reimbursement: past, present, and future. J Bone Joint Surg Am 2007;89(11):2536.
[41] Molina CA, Zadnik PL, Gokaslan ZL, et al. A cohort cost analysis of lumbar laminectomy—current trends in surgeon and hospital fees distribution. Spine J 2013;13(11):1434.
[42] Virk SS, Phillips FM, Khan SN. Reimbursement related to a 90-day episode of care for a one or two-level anterior cervical discectomy and fusion. J Bone Joint Surg Am 2016;98(16):1378.
[43] Virk SS, Phillips FM, Moffatt-Bruce SD, Khan SN. What factors influence reimbursement for 1 to 2 level anterior cervical discectomy and fusion procedures? Spine (Phila Pa 1976) 2019;44(1):E33.
[44] Virk SS, Phillips FM, Khan SN. Bundled payment reimbursement for anterior and posterior approaches for cervical spondylotic myelopathy: an analysis of private payer and Medicare databases. J Neurosurg Spine 2018;28(3):244.
[45] Bernstein J, Derman P. Paying surgeons less has cost more. Orthopedics 2012;35(12):e1804.
[46] Casp AJ, Smith JM, Brockmeier SF, Werner BC. Surgeon charges and reimbursements are declining compared with hospital payments for shoulder arthroplasty. J Shoulder Elbow Surg 2019;29:924.
[47] Padegimas EM, Verma K, Zmistowski B, Rothman RH, Purtill JJ, Howley M. Medicare reimbursement for total joint arthroplasty: the driving forces. J Bone Joint Surg Am 2016;98(12):1007.