Determinants of Direct Medical Costs in Primary and Revision Total Knee Arthroplasty

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Abstract

Background TKA procedures are increasing rapidly, with substantial cost implications. Determining cost drivers in TKA is essential for care improvement and informing future payment models.

Questions/Purposes We determined the components of hospitalization and 90-day costs in primary and revision TKA and the role of demographics, operative indications, comorbidities, and complications as potential determinants of costs.

Methods We studied 6475 primary and 1654 revision TKA procedures performed between January 1, 2000, and September 31, 2008, at a single center. Direct medical

costs were measured by using standardized, inflation-adjusted costs for services and procedures billed during the 90-day period. We used linear regression models to determine the cost impact associated with individual patient characteristics.

Results The largest proportion of costs in both primary and revision TKA, respectively, were for room and board (28% and 23%), operating room (22% and 17%), and prostheses (13% and 24%). Prosthesis costs were almost threefold higher in revision TKA than in primary TKA. Revision TKA procedures for infections and bone and/or prosthesis fractures were approximately 25% more costly than revisions for instability and loosening. Several common comorbidities were associated with higher costs. Patients with vascular and infectious complications had longer hospital stays and at least 80% higher 90-day costs as compared to patients without complications.

Conclusions High prosthesis costs in revision TKA represent a factor potentially amenable to cost containment efforts. Increased costs associated with demographic factors and comorbidities may put providers at financial risk and may jeopardize healthcare access for those patients in greatest need.

Level of Evidence Level IV, economic and decision analyses. See Instructions for Authors for a complete description of levels of evidence

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Introduction

The societal and economic burden of musculoskeletal diseases is considerable and expected to increase dramatically with aging of the population, higher rates of diagnoses and treatment, and growing demand for musculoskeletal surgical procedures, particularly TKA [2, 28, 41]. The annual

number of TKA procedures has risen steadily over the last two decades with more than 600% growth expected from 2005 to 2030 [21, 23, 24]. Importantly, much growth is occurring among younger patients who likely will outlive their implants and require subsequent revision surgeries [24].

Hospital costs for TKA have grown 25% over a mere 3-year period between 2004 and 2007 [1]. Furthermore, the increasing use of newer and more expensive prostheses also increases costs per case [20].

Surprisingly, there are few reliable estimates of the direct medical costs of TKA. To date, most studies have relied on only hospital data without physician services (eg, Nationwide Inpatient Sample) and typically pooled data from multiple sources to estimate total direct medical costs [10, 15, 16, 31, 34]. These studies employed a variety of methods for estimation of direct medical costs, including patient diaries, hospital accounting systems, and crude reimbursement rates and charges. More recent studies estimated TKA costs by combining charges or average Medicare amounts and the Current Procedural Terminology code-based professional fees [36]. Some of these methods may be problematic as charges do not accurately reflect true cost of care and simple conversions, such as a single overall cost-to-charge ratio conversion (typically 0.5 or 0.6) for all cost centers, do not take into account the differences across various departments, which may range from 0.2 to 3.0 [13, 35]. Furthermore, many studies measured costs only for the index hospitalization, although relevant care can be substantial both before hospitalization and after discharge. An accurate assessment of the cost of TKA requires measurement of costs at the individual patient level with actual use of resources involved in a patient's care throughout the full cycle of care, not just the hospitalization period, and not limited to services by the orthopaedics department but all services by all specialties involved in TKA care or comorbidities. It is necessary to account for the postdischarge period when rehabilitation and complication costs can be substantial. Finally, nonmodifiable patient characteristics, such as comorbidities, can be associated with higher or lower costs. Combined with outcome information, accurate cost information can transform discussion about care improvement in TKA and influence future payment methodology.

We therefore (1) determined the components of hospitalization and 90-day costs in both primary and revision TKA and examined (2) demographics, (3) operative indications, (4) comorbidities, and (5) complications as potential determinants of costs in primary and revision TKA.

Patients and Methods

The study population included 6475 primary and 1654 revision TKA procedures performed at the Mayo Clinic,

Rochester, MN, USA, campus between January 1, 2000, and September 31, 2008. We excluded patients who had undergone unicompartmental knee arthroplasty and/or bilateral procedures during the same hospitalization or during the postdischarge 90-day window. We limited the TKA procedures to Major Diagnostic Category (MDC) 8 musculoskeletal diseases, ie, orthopaedic surgery admissions. This study was approved by the Mayo Clinic Institutional Review Board. In accordance with the Minnesota Research Authorization Statute and the Mayo Clinic Institutional Review Board guidelines, we also excluded patients who had denied research authorization for use of their medical records in research.

We obtained demographic and clinical data from the Mayo Clinic Total Joint Registry (MCTJR) [5]. MCTJR has been in operation since 1969 and contains detailed baseline and followup data on all patients who had undergone TKA at the Mayo Clinic in Rochester. All patients are followed up by the surgeon at least twice in the first postsurgical year, in Years 2 and 5, and at 5-year intervals thereafter to ascertain both clinical and patient-reported outcomes. The overall clinical followup in the registry is 80% complete at 20 years [6].

The MCTJR were further supplemented by administrative data on residency status and comorbidities. Since the residency status could affect costs for postacute care at the Mayo Clinic (eg, more distant patients would likely return home for rehabilitation), we used zip codes to categorize residency as local (Olmsted County and 10 surrounding counties in southeast Minnesota), regional (rest of 120-mile region), and national/distant (remainder of patients). We assigned Elixhauser comorbidities at the time of surgery using administrative data [12]. Elixhauser is a commonly used risk adjustment instrument that relies on ICD-9 codes to identify 30 individual comorbidities.

Operative indications for TKA were obtained from the registry and grouped into three categories for primary TKA (degenerative arthritis, inflammatory arthritis, and other, including osteonecrosis and posttraumatic arthritis) and five categories for revision TKA (prosthesis loosening, wear, and/or osteolysis, instability, infection, bone or prosthesis fracture, and other). Post-TKA complications included complications during index hospitalization and the 90-day window and were grouped into five categories: infections (deep and/or superficial), vascular complications (eg, myocardial infarction, stroke, gastrointestinal bleeding, local arterial complications), thrombotic complications (eg, pulmonary embolism, deep vein thrombosis), dislocation and/or instability, and fracture of the bone or prosthesis components.

We obtained utilization and cost data from the Olmsted County Healthcare Expenditure and Utilization Database (OCHEUD). This database contains line item details (date,

type, frequency, and billed charge) for every procedure or service billed to the Mayo Clinic patients. Recognizing the discrepancies between billed charges and true resource use, widely accepted bottom-up microcosting valuation techniques are employed to generate standardized inflation-adjusted estimates of the cost of each service or procedure in constant dollars [19, 27]. Specifically, OCHEUD assigns cost to resource utilization based on Medicare payment models. The methodology is applied to all patients' services, regardless of payer. Hospital-billed inpatient and outpatient services and procedures (eg, room and board, radiology, physical therapy, supplies) are valued by multiplying the billed charge for each item by the cost center-specific cost-to-charge ratio for the year in which the service was delivered. Cost-to-charge ratios for each cost center are obtained from published Medicare cost reports. Professional services (eg, examinations and consultations, diagnostic and therapeutic procedures) and ancillary services (eg, laboratory, radiology, physical therapy) provided to patients in clinic, outpatient, and inpatient settings are valued using national average Medicare reimbursement rates. The algorithm applies the gross domestic price implicit price deflator for all services to express the costs for each year in 2010 constant dollars.

The time window for utilization and cost data was defined as the 90-day period beginning 1 day before the index surgery. We used Berenson-Eggers Type of Service (BETOS) [3] and UB04 codes to classify the line item data, which were then summed by type of service over both the index hospitalization and the total 90-day period. We further grouped costs into 19 clinically relevant categories as room and board, intensive care unit (ICU) room and board, emergency room, operating room, anesthesia, prostheses, nonprosthesis supplies, physician surgery, physician radiology, physician anesthesia, blood, radiology, pharmacy, medicine, laboratory, pathology, physical therapy, and other hospital and professional costs.

The study comprised 6475 primary and 1654 revision TKA procedures over the 8-year time period. Overall, mean age was 68 years and 57% of the patients with primary TKA and 53% of the patients with revision TKA were female (Table 1). The indication for primary TKA surgery was degenerative arthritis in 96% of patients. The indications for revision TKA surgery were wear, osteolysis, and/or loosening in 41% of patients, infections in 24%, instability in 18%, and bone and/or prostheses fractures in 9%. Approximately 55% of patients had a BMI of 30 kg/m² or more. Comorbidity burden was slightly higher ($p = 0.002$) in patients who had undergone revision TKA procedures than in those with primary procedures (mean number of comorbidities/patient, 1.09 versus 0.99). The most common comorbidity was hypertension, followed by diabetes, valvular disease, chronic pulmonary disease, and

Table 1. Baseline patient characteristics

Characteristic	Primary TKA (n = 6475)	Revision TKA (n = 1654)
Female	3712 (57%)	872 (53%)
Age (years)	68.4 (11.1) [†]	68.2 (11.4) [†]
Operative indication in primary TKA		
Degenerative arthritis	6211 (96%)	
Inflammatory arthritis	90 (1%)	
Other	174 (3%)	
Operative indication in revision TKA		
Wear, osteolysis, loosening		677 (41%)
Infection		392 (24%)
Instability		297 (18%)
Fracture		150 (9%)
Other		136 (8%)
Body mass index (kg/m ²)		
Mean (SD)	31.6 (6.6)	31.8 (6.9)
N (%) with BMI ≥ 30 kg/m ²	3,516 (55%)	919 (56%)
Selected comorbidities*		
Patients with no comorbidities	2801 (43%)	666 (40%)
Number of comorbidities/patient	0.99 (1.14) [†]	1.09 (1.22) [†]
	1 (0, 2) [‡]	1 (0, 2) [‡]
Hypertension	2876 (44%)	770 (47%)
Diabetes	530 (8%)	195 (12%)
Diabetes with complications	136 (2%)	41 (2%)
Valvular disease	472 (7%)	115 (7%)
Chronic pulmonary disease	403 (6%)	96 (6%)
Hypothyroidism	390 (6%)	72 (4%)
Fluid and electrolyte disorders	143 (2%)	64 (4%)
Congestive heart failure	126 (2%)	49 (3%)
Depression	180 (3%)	48 (3%)
Anemia	114 (2%)	40 (2%)
Obesity	171 (3%)	51 (3%)
Neurologic disorders	88 (1%)	36 (2%)
Peripheral vascular disorders	94 (1%)	24 (2%)
Solid tumors without metastases	73 (1%)	16 (1%)
Metastatic cancer	18 (0.3%)	1 (0.1%)
Lymphoma	26 (0.4%)	3 (0.2%)
Renal failure	74 (1%)	24 (2%)
Coagulopathy	69 (1%)	21 (1%)
Pulmonary circulation disorders	50 (1%)	25 (2%)
Liver disease	43 (1%)	11 (1%)
Paralysis	17 (0.3%)	3 (0.2%)
Residency		
Local Olmsted County patients	2375 (37%)	215 (13%)
Regional (120-mile region)	1587 (24%)	431 (26%)
Distant	2513 (39%)	1008 (61%)

* Identified using Elixhauser comorbidity algorithm; [†]values are expressed as mean, with SD in parentheses; [‡]values are expressed as median, with interquartile range in parentheses; all other values are expressed as number of patients, with percentage in parentheses.

hypothyroidism. Thirty-seven percent of the patients with primary TKA and 13% of the patients with revision TKA were local patients. The proportion of distant patients (ie, from outside the 120-mile region surrounding the Mayo Clinic) was higher in revision procedures than in primary TKA.

We first examined study population characteristics and the components of hospitalization and 90-day costs in both primary and revision TKA. Patient characteristics are expressed as means with SDs, medians with interquartile ranges, and frequencies and percentages. Direct medical costs and components of costs in primary and revision TKA were calculated separately for the hospitalization period alone (ie, index hospitalization costs) and 90-day period (ie, total costs). Costs are presented as mean and median cost per patient including SDs and interquartile ranges. We then examined differences in hospitalization and total costs associated with demographics, indications, comorbidities, and complications using descriptive statistics and linear regression models. We used a sequence of regression models to determine the cost variation associated with (1) a combination of preoperative patient characteristics (demographics, indications, and individual

comorbidities), (2) patient characteristics and postoperative complications, and (3) length of stay. The first model fit considered only preoperative patient characteristics, ie, demographics, indications, BMI, and comorbidities. Additional analyses were performed to examine change in estimates by excluding selected patient groups (ie, patients with costs exceeding \$50,000, patients younger than 25 years, patients with malignancies), combining primary and revision cohorts, and modeling covariates with total 90-day costs. Finally, the modeling process was repeated with log-transformed costs. All statistical analyses were performed using SAS® Version 9.3 (SAS Institute, Inc, Cary, NC, USA).

Results

The total index hospitalization cost was 42% higher in revision TKA than in primary TKA (Table 2). The largest proportion of index hospitalization costs in both primary and revision TKA, respectively, were those for room and board including ICU stays (28% and 23%), operating room (22% and 17%), prostheses (13% and 24%), and physicians

Table 2. Length of stay and total costs during the index hospitalization and the 90-day period after the index TKA procedure

Variable	Primary TKA (n = 6475)		Revision TKA (n = 1654)	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Length of stay (days)	4.50 (1.86)	4 (4, 5)	5.25 (3.05)	5 (4, 6)
Hospitalization costs (\$)	15,673 (5699)	14,583 (13,287, 16,409)	22,260 (9205)	20,461 (17,323, 24,997)
90-day costs (\$)	17,662 (11,059)	15,248 (13,707, 17,904)	24,314 (11,541)	21,563 (18,098, 26,577)

IQR = interquartile range.

Fig. 1 A graph shows index hospitalization costs by cost components. Room and board including ICU stays, operating room, prosthesis, and physician costs comprised the largest proportion of index hospitalization costs in both primary and revision TKA. The difference in index hospitalization costs between the two groups was

driven mainly by substantially higher prosthesis costs in the revision TKA group. Room & = room and board; OR = operating room; Phys = physical therapy; Labs = laboratory test; Anesthesio = anesthesiologist; Internal = internal medicine; Other = other supplies; EM = emergency room.

(16% and 14%) (Fig. 1). The difference in index hospitalization costs in revision TKA was driven mainly by substantially higher prosthesis costs, which were 170% higher (2.7-fold) than those in primary TKA. Overall, mean 90-day costs were \$17,662 in primary TKA and \$24,314 in revision TKA. Since followup care would be more likely to be complete at the Mayo Clinic for local patients (compared to regional and distant patients who might receive care elsewhere), we recalculated the 90-day costs for only these patients. In these local patients, mean hospitalization costs and 90-day costs were \$15,245 and \$17,706, respectively, in primary TKA and \$21,435 and \$23,675, respectively, in revision TKA. This corresponded to approximately \$2500 additional costs after discharge within the 90-day window.

In our analysis of index hospitalization costs by selected patient characteristics, we found no differences between men and women (Fig. 2A). In both primary and revision

TKA, the highest hospitalization costs were for the small group of patients younger than 25 years who had undergone TKA mostly for malignancies or avascular necrosis ($p < 0.001$) followed by patients older than 85 years (Fig. 2B). Patients older than 85 years also had higher ($p = 0.04$) 90-day costs than the middle-aged groups.

Hospitalization costs were similar in patients with degenerative and inflammatory arthritis but higher in other indications, including osteonecrosis and posttraumatic arthritis (Fig. 2C). Hospitalization costs were 25% higher ($p < 0.001$) for revision surgeries for infections and bone and/or prosthesis fractures than for revisions for instability or loosening (Fig. 2D). When all costs were considered during the 90-day window, revision surgeries for both infections and fractures were 30% more costly ($p < 0.001$) than revisions for instability or loosening.

Among the more common comorbidities, both the cost and length of hospital stay were higher for patients with

Fig. 2A–E Graphs show index hospitalization costs by patient characteristics: (A) sex, (B) age group, (C) operative indication in primary TKA, (D) operative indication in revision TKA, and

(E) number of comorbidities. The boxes represent the mean index hospitalization costs and lines represent the 95% CIs.

diabetes with or without complications, valvular disease, chronic pulmonary disease, fluid and electrolyte imbalances, and congestive heart failure. In fact, each additional comorbidity was associated with around 5% to 10% higher costs ($p < 0.001$) (Fig. 2E).

A total of 461 (7%) primary TKA and 151 (9%) revision TKA procedures resulted in at least one complication during the 90-day window. In the setting of both primary and revision TKA, presence of any complication was associated with 34% higher hospitalization costs and 65% higher 90-day costs. In particular, vascular complications were associated with the highest increase in hospital and 90-day costs. A total of 195 (3%) patients with primary TKA and 47 (2.8%) patients with revision TKA experienced vascular complications. These patients had longer hospital stays (average, 6.2 days) and their mean index hospitalization cost was 49% higher compared with patients without complications. Mean index hospitalization costs and 90-day costs for patients with primary TKA with vascular complications were \$22,887 and \$32,636, respectively. This corresponds to a cost difference of almost \$10,000 after discharge within the 90-day window. A total of 156 (2.4%) patients with primary TKA and 19 (1.2%) patients with revision TKA experienced thrombotic complications and the hospitalization costs were 30% higher in these patients than in patients without complications. A similar pattern was observed for fractures and infections (43% and 24% higher hospital costs, respectively). The magnitude of the effect of complications on direct medical costs was even more apparent for 90-day costs. As compared to patients without complications, mean 90-day costs almost doubled for patients with vascular complications and infections (97% and 80% higher 90-day costs in primary TKA, respectively).

In the first model, diabetes mellitus with or without complications, valvular disease, and chronic pulmonary disease were associated with higher hospitalization costs (Table 3). A number of other less common comorbidities were also associated with higher hospitalization costs, but the number of patients with some of these conditions was small, and despite their meaningful impact on cost, the model R^2 remained small at 0.17, indicating these comorbidities explained only 17% of variation in costs (Table 3). Complications were more common ($p < 0.001$) in patients with comorbidities, and including complications to the model explained 23% of variation in hospital costs. Finally, including length of stay to the model that already included comorbidities and complications improved prediction of cost variation with an R^2 of 0.66. By itself, length of stay explained 58% of the variation in hospital costs with an estimated increase in cost of \$2338/day. We performed several additional models, and the results remained largely unchanged. Performing the analyses with log-transformed

costs changed the models slightly, but the R^2 values were similar, ie, the proportion of variation explained by the models remained the same.

Discussion

Despite being a central target of cost reduction efforts, limited data exist to inform policy on the major drivers of healthcare costs in TKA. In this large contemporary cohort of patients who had undergone TKA, we determined the components of hospitalization and 90-day costs in both primary and revision TKA and examined demographics, operative indications, comorbidities, and complications as potential determinants of costs in primary and revision TKA.

Our findings should be interpreted in light of some potential limitations. First, we included only direct medical costs. Outpatient medication costs and indirect costs are not included and these costs can be substantial after TKA [30]. Second, costs are underestimated for patients who received their post-TKA care outside the Mayo Clinic. We tried to take this into account by estimating the 90-day costs for only local patients. Even so, we may be missing part of the followup costs. Third, we have not examined other potentially important patient level risk factors (eg, surgical complexity) [9]. We relied on a single set of comorbidity measures, which may not have captured all common comorbid conditions. Indeed, only 3% of the patients were classified as obese using the ICD-9 codes whereas 55% were classified as obese using the actual BMI measurements. Fourth, our study was limited to unilateral procedures and did not address costs associated with bilateral simultaneous and staged procedures. Although we acknowledge our results pertain to a single high-volume, tertiary-care institution and there is considerable variation [38] in the practice of TKA, our unique ability to combine medical record-based clinical data with detailed and appropriately costed line item hospital and physician administrative data during the 90-day period after TKA procedures in a large contemporary cohort provides important insights of clinical and policy relevance in improving value in TKA.

The costing methodology in our study differs in important ways from previous studies. First, we estimated standardized costs, rather than simply relying on charges. Second, we examined 90-day costs, in addition to the hospitalization period. Notably, with decreasing hospital length of stay after TKA, costs associated with short-term complications will be incurred during the postdischarge setting. Third, our study included professional services, which constitute about 16% of total costs. Some previous studies, such as those that used the Nationwide Inpatient Sample data, did not include such services. Finally, in

Table 3. Linear regression analyses of predictors of index hospitalization costs in primary TKA

Predictor	Index hospitalization cost (\$)		p value
	Parameter estimate	95% CI	
Intercept*	14,285	(14,001, 14,569)	0.001
Age groups			
< 25 years	10,738	(8761, 12,716)	0.001
35–44 years	1509	(627, 2391)	0.001
45–54 years	106	(–371, 583)	0.332
55–64 years	125	(–222, 472)	0.240
65–74 years	Reference	Reference	Reference
75–84 years	767	(444, 1091)	0.001
85+ years	1895	(1161, 2630)	0.001
Male	–45	(–302, 212)	0.365
Other indications in primary TKA [†]	6319	(5462, 7176)	0.001
BMI $\geq$ 25 kg/m ² (per 10-unit increase) [‡]	381	(165, 597)	0.001
Selected comorbidities			
Congestive heart failure	2379	(1444, 3314)	0.001
Valvular diseases	1017	(518, 1515)	0.001
Pulmonary circulation diseases	1874	(411, 3338)	0.006
Paralysis	3789	(1320, 6258)	0.001
Other neurologic disorders	1210	(119, 2301)	0.015
Chronic pulmonary diseases	686	(161, 1211)	0.005
Diabetes without complications	1092	(623, 1562)	0.001
Diabetes with complications	2253	(1361, 3145)	0.001
Renal failure	2820	(1600, 4041)	0.001
Metastatic cancer	14,061	(11,848, 16,274)	0.001
Solid tumors without metastasis	2478	(1358, 3598)	0.001
Coagulopathy	7181	(5939, 8422)	0.001
Fluid and electrolyte disorders	2501	(1620, 3381)	0.001

The model was derived using a stepwise method for including comorbidities significant at the one-sided 2.5% level and has an R^2 of 0.17; * the intercept value of \$14,285 should be interpreted as the average hospitalization cost of primary TKA in a female patient aged 65 to 74 years with degenerative arthritis or inflammatory arthritis with none of the 13 comorbidities listed in the table; [†]the reference group for indication is degenerative arthritis; [‡]this value refers to an increase in BMI of 10 units above 25 kg/m².

contrast to gross costing studies [7, 29], we applied bottom-up, microcosting, which involves direct enumeration and costing of nearly every service billed to a patient undergoing TKA. Not all administrative data sources will provide sufficiently granular detail to facilitate this type of costing.

An important finding of our study that confirms previous observations is the large influence of prosthesis costs, especially in the setting of revision TKA [14, 20, 32]. Many authors question whether the higher costs of new prostheses are justified if their long-term effectiveness is similar to older and less expensive alternatives [7, 41]. Future cost containment efforts should include a focus on prosthesis costs.

Increased financial burden associated with periprosthetic joint infections is well recognized [8, 17, 18, 22, 25, 32, 33,

40]. For example, in a small, single-center study from the early 1990s, the cost of treatment of infected TKA was three to four times higher than that of primary TKA and twice higher than that of nonseptic revision TKA [17]. Short-term infectious complications in our study resulted in 80% higher 90-day costs and infected TKA revisions were 25% more costly than revisions for instability. Similar findings are reported in hip arthroplasty [8], which led many to conclude the disproportionate financial burden and lack of incremental reimbursement for management of periprosthetic joint infections may dissuade orthopaedic centers from management of such cases [8, 33]. Similarly, we demonstrated the financial burden of vascular and thrombotic complications is within the same range or even higher than infections. Although our findings are similar to the estimates of two recent studies [4, 39], our costs of

thrombovascular complications are not directly comparable, due to differences in time windows and cost definitions. An accurate assessment of the true financial burden of TKA complications requires a much longer time window than our 90 days and detailed clinical data on management strategies, beyond the scope of this study. Further work is urgently needed in this area.

TKA is being considered for episode-based bundled payments to cover both the inpatient hospitalization and the postdischarge period [11, 26, 37]. A recent study by Sood et al. [37] indicated, within the Medicare population, there was little variability in patient costs within hospitals and most of the variability in readmissions and costs occurred across hospitals. Furthermore, that study illustrated 70% and 90% of postdischarge costs were incurred during the 30- and 60-day postdischarge windows, respectively, suggesting longer episode lengths would not have major cost implications since most costs are incurred shortly after discharge. In our study, although the overall interquartile cost ratio in primary TKA (1.23) is lower than the 1.47 reported in the study of Sood et al. [37], Medicare patients constituted 67% of our patients and the interquartile cost ratio in patients 65 years or older is slightly higher (1.52) than the estimate derived from Medicare data. Also, our study is likely missing followup costs for nonlocal patients, and neither earlier studies nor ours accounts for the modes of postdischarge rehabilitation, which may have a major impact on utilization and costs.

In summary, the cost of care for TKA is affected by patient characteristics. A major driver of higher costs in revision TKA is prosthesis costs, a factor potentially amenable to cost containment efforts. Revision procedures for infections and fractures are more costly than revisions for dislocation or instability. Several common preoperative comorbidities are associated with longer hospital stays and higher costs. Postoperative complications not only are more common in patients with comorbidities but also are associated with the highest inpatient and 90-day costs. Increased costs associated with demographics, underlying indications for TKA, and comorbidities may put providers at financial risk under episode-based payments and may jeopardize access to TKA for those patients in greatest need. With robust cost data combined with valid, medical record-derived clinical data, we believe these findings can inform future policy decisions in TKA.

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