

Total Knee Arthroplasty Volume, Cost-Utilization, and Outcomes During the COVID-19 Pandemic: Early Results From New York

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INTRODUCTION: Over 800,000 total hip and knee arthroplasties are performed annually in the United States, 60% of which is paid for by the Medicare system. As the baby Boomer population ages, further increasing demand for arthroplasty, Medicare appears poised to move toward a bundled payment model, which would eliminate the current separation between hospital and physician reimbursement.

COVID-19 put unprecedented pressure on the health care system in New York as hospitals diverted substantial human and physical resources to meet rising critical care demands. In particular, many resources normally used to provide orthopaedic care were repurposed, including anesthesia providers, operative and nursing staff, operating rooms, and postanesthesia care units. There has been a gradual return of elective orthopaedic services as the peak of COVID-19 pandemic has begun to fall.

In this context, it is important for surgeons to understand the financial trends impacting arthroplasty today. The purpose of this study was to provide an overview of these trends in total knee arthroplasty (TKA) utilization and economic impact across a large urban public-hospital system in New York City, comprised largely of a Medicare population over the past three decades.

METHODS: We conducted a retrospective chart review using the Current Procedural Terminology (CPT) code describing primary TKA procedures in a large urban public-healthcare system from January 2019 to May 2022. Demographic, clinical, and functional variables were extracted from the electronic medical record, including age at surgery, sex, body mass index, billed American Society of Anesthesiologists (ASA) score, and the ASCVD (atherosclerotic cardiovascular disease) risk score. Variables related to the surgery which were also collected included surgical duration, anesthesia type, need for ICU care postoperatively, and immediate 30-day complications requiring a return to the OR. Economic variables collected included primary payer, length of stay (LOS), total hospital admission charges/cost, hospital surgical charges/cost, and surgical implants charges/cost. Relationships between continuous variables were analyzed using Wilcoxon rank-sum tests and Kruskal–Wallis non-parametric tests. An ANOVA (Analysis of Variance) analysis was used to assess whether there was a significant difference between groups. A robust response screening platform was utilized to identify possible predictors of LOS, cost and postop complication. A backwards stepwise regression model was utilized to determine independent predictors. A p-value of < 0.05 was set as statistical significance. JMP Pro statistical software (JMP®, Version 16. SAS Institute Inc., Cary, North Carolina) was used for all analyses.

RESULTS: We identified 1111 patients meeting our study criteria. The majority of patients were women (n=784, 70.6%), and the mean age of our cohort was 64.8 (±9.0) years old. Most patients were classified as either ASA 2 or 3 (n=988, 96.9%). The average ASCVD score was 15.4 8 (±11.6), with a mean operative time of 125.9 8 (±70.3) minutes. The average postop LOS was 2.9 8 (±2.7) days. Less than 1% (n=7) required postop ICU care. A total of 16 patients (1.4%) suffered a complication in the first 30-days postop that required a return to the OR. The majority of payers were either Medicaid (n=515, 46.4%), or Medicare (n=380, 34.2%). The mean hospital admission charge was \$54,000 (±\$25,908), and the mean hospital surgical charge was \$33,106 (±\$12,944).

Bivariate analysis found post-operative return to surgery to be significantly associated with age and gender (p-value <0.05). LOS was significantly associated with anesthesia-type, BMI, ASA and race (p-value <0.05). Hospital admission charges were significantly associated with surgical duration, anesthesia-type, ethnicity, race, ASA, year-of surgery, age, and BMI (p-value <0.05). Independent predictors of LOS were anesthesia type, BMI and ASA (R² =0.21, p-value <.0001). Independent predictors of admission charges were anesthesia type, surgical duration, BMI, ASA, race and ethnicity (R² =0.27, p-value <.0001). Independent predictors of surgical charges were anesthesia type, surgical duration, year-of-surgery, and ethnicity (R² =0.23, p-value <.0001).

DISCUSSION AND CONCLUSION: In summary, our data paints an interesting financial picture for TKA performed in a large urban public-healthcare system. As Medicare payment policy for total knee arthroplasty shifts toward bundling, an awareness of factors associated with outlier costs will be requisite to remain profitable. A return to pre-COVID-19 orthopaedic care will be reliant on increasing capacity, but this will have substantial cost implications that must be accounted for.

Table 1. Characteristics of Primary TKA Cohort

Characteristics		All Patients, N=1111	
	N	Mean (SD)	% of Total
Age	1111	64.64 (9.88)	
BMI	1111	32.32 (5.73)	
Gender	N	% of Total	
Female	764	70.67%	
Male	347	29.43%	
Patient Race			
Other	216	46.44%	
Black or African American	479	27.77%	
White	107	8.67%	
Asian	92	5.83%	
Native American or Alaskan Native	4	0.39%	
Patient Ethnic Group			
Non-Hispanic or Latina	646	60.77%	
Hispanic or Latino	417	39.23%	

Table 2. Perioperative Factors

All Patients, N=1111		
TKA Date (year)	N	% of Total
2019	267	24.02%
2020	257	23.13%
2021	419	37.73%
2022	188	16.92%
Billed ASA Physical Status		
ASA 1 (Normal Healthy)	16	1.37%
ASA 2 (Mild Systemic Disease)	405	45.99%
ASA 3 (Severe Systemic Disease)	523	51.27%
ASA 4 (Severe Threat)	16	1.37%
Primary Anesthesia Type		
Spinal	9	0.81%
General	391	35.29%
MAC	60	5.36%
Regional	387	34.83%
Spinal	255	23.01%
	N	Mean (SD)
ASVD 10 Year Risk Score (%)	611	15.37 (11.65)
Operative Time (min)	1064	22.94 (70.20)
Length of Stay (days)	1111	2.68 (2.66)
	N	% of Total
Postop Transferred to ICU		
Yes	7	0.63%
Postop Return to Surgery		
Yes	16	1.49%

Table 3. Primary Payer and Cost Distribution

All Patients, N=1111		
Primary Payer	N	% of Total
Medi	515	46.35%
Med	380	34.20%
Med	125	11.26%
Med	87	7.83%
Med	3	0.27%
NO FAULT	1	0.09%
Surgical Cost	Mean	SD
Residual Admission Charge	\$12,099.01	\$23,956.50
Hospital Surgical Cost	\$7,185.13	\$1,596.49
Hospital Surgical Charges	\$25,762.82	\$1,536,344
Implantable Supply Used Cost	\$2,796.01	\$1,268.87
Implantable Supply Used Charge	\$4,006.04	\$4,266.23

Figure 1. Patient Demographics

Characteristic	Count	Percentage
Age		
18-24	10	0.9%
25-34	20	1.8%
35-44	40	3.6%
45-54	100	9.0%
55-64	200	18.0%
65-74	300	27.0%
75-84	400	36.0%
85+	51	4.6%
Gender		
Female	764	68.7%
Male	347	31.3%
Race		
White	107	9.6%
Black or African American	479	43.1%
Hispanic or Latino	417	37.5%
Other	216	19.5%
Ethnicity		
Non-Hispanic or Latina	646	58.1%
Hispanic or Latino	417	37.5%
Insurance		
Medicare	515	46.3%
Medicaid	380	34.2%
Private	125	11.3%
Other	87	7.8%
Uninsured	3	0.3%
Unknown	1	0.1%