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Patient Outcomes Following Total Joint Replacement Surgery: A Comparison of Hospitals and Ambulatory Surgery Centers

Kathleen Carey, PhD^{a,*}, Jake R. Morgan, PhD^b, Meng-Yun Lin, PhD^c, Michael S. Kain, MD^d, William R. Creevy, MD^d

^aDepartment of Health Law, Policy and Management, Boston University School of Public Health, Boston, MA

^bBoston University School of Medicine, Section of Infectious Disease, Boston, MA

^cBoston University School of Medicine, Section of General Internal Medicine, Boston, MA

^dBoston Medical Center, Department of Orthopedic Surgery, One Boston Medical Center Place, Boston, MA

Abstract

Background—For several years, many orthopedic surgeons have been performing total joint replacements in hospital outpatient departments (HOPDs) and more recently in ambulatory surgery centers (ASCs). In a recent shift, the Centers for Medicare and Medicaid Services (CMS) began reimbursing for total knee replacement surgery in HOPDs. Some observers have expressed concerns over patient safety for the Medicare population particularly if CMS extends the policy to include total hip replacement surgery and coverage in ambulatory surgery centers (ASCs).

Methods—This study used a large claims database of non-Medicare patients to examine inpatient and outpatient total knee replacement and total hip replacement surgery performed on a near elderly population during 2014–2016. We applied propensity score methods to match inpatients with ASC patients and HOPD patients with ASC patients adjusting for risk using the HHS Hierarchical Condition Categories risk adjustment model. We conducted statistical tests comparing clinical outcomes across the three settings and examined relative costs.

Results—Readmissions, post-surgical complications, and payments were lower for outpatients than for inpatients. Within outpatient settings, readmissions and post-surgical complications were lower in ASCs than in HOPDs but payments for ASC patients were higher than payments for HOPD patients.

Conclusion—Our findings support the argument that outpatient total joint replacement is appropriate for select patients treated in both HOPDs and ASCs, although in the commercially insured population, the latter services may come at a cost. Until further study of outpatient total

*Reprint requests: Kathleen Carey, PhD, Department of Health Law, Policy and Management, Boston University School of Public Health, 715 Albany Street, Boston, MA.

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joint replacement in the Medicare population becomes available, how this will extrapolate to the Medicare population is unknown.

Keywords

joint replacement; hospital outpatient; complications; ambulatory surgery center

Introduction

More than one million patients receive total knee arthroplasty (TKA) or total hip arthroplasty (THA) every year in the U.S., a number expected to grow to nearly four million by 2030 [1]. While joint replacement has become a highly effective surgical intervention, it is also a costly one. Owing to improved surgical techniques, pressure from payers and patients' desire to return to activities, a number of commercial insurers have begun covering TKA and THA performed in outpatient settings, including hospital outpatient departments (HOPDs) and, more recently, ambulatory surgery centers (ASCs). The number of ASCs performing TKA and THA also has begun to rise. In 2017, over 200 ASCs were performing outpatient joint replacement compared to 25 in 2014 [2]. The trend away from the inpatient setting is expected to accelerate; greater than one half of primary joint replacement surgeries are predicted to take place in an outpatient setting by 2026 [3].

While prior studies of inpatient TKA and THA have shown considerable variation in post-operative complications including readmission, infections and revision surgery [4–8], studies based on small samples of outpatient TKA and THA found HOPD settings to be clinically feasible for select patients [9–10]. Other small sample studies used matched controls to compare inpatient and HOPD settings for TKA [11–12] and THA [13] and found comparable outcomes in the perioperative period. Measured differences in payments across settings also showed repeatedly that TKA and THA treatment in HOPDs translated into large cost savings to payers [12–14]. Studies of total joint replacement in freestanding ASCs have begun only recently, with the generally positive result that the ASC setting is safe for select patients [15–19]. One study showed greater patient satisfaction in ASCs compared to the traditional inpatient stay [20]. While ASCs are normally perceived as low cost settings, previous studies of total joint replacement have not conducted comparisons of hospital and ASC relative costs.

In this study, we contribute to the literature on total joint replacement by comparing TKA and THA across inpatient, HOPD, and ASC settings using a single large claims database of non-Medicare patients. We examine outcomes during the 90-day period following surgery. Additionally, we weigh the relative cost of providing these services across settings.

Methods

Data Source

We conducted quantitative data analysis using the Truven Health Analytics *MarketScan® Commercial Claims and Encounters* (MarketScan) database. MarketScan, which contains data on up to 50 million covered lives per year, is one of the few large commercial insurance

claims databases available to researchers. Data include detailed information on place of service, procedures, diagnoses, as well as actual payments to providers and allows tracking unique patients over time.

Study Population

We focused on the near elderly population, identifying all patients aged 55–64 who underwent TKA or THA in an inpatient, hospital outpatient, or ASC setting during calendar years 2014–2016, were enrolled for 12 months prior to the procedure and for 90 days following the procedure. Identification began with ICD-9 procedure codes 81.54 (TKA) and 81.51 (THA) and Current Procedural Terminology (CPT) codes 27447 (TKA) or 27130 (THA). Beginning in 2015, providers began transitioning to ICD-10 codes. Hence for 2015–2016, in addition to ICD-9 codes 81.54 and 81.51, we identified ICD-10 codes according to the CMS General Equivalence Mapping tool (GEMs) that matches ICD-9 and ICD-10 codes.

Patients undergoing TKA or THA in HOPD or ASC settings are carefully selected according to their relatively low risk and minimal likelihood of postoperative complications. In order to compare these patients with comparably low risk inpatients, we created four matched samples, comparing inpatient to ASC cases for TKA and THA, and HOPD to ASC cases for TKA and THA. The matching involved two steps. First, we created a propensity score, which is the likelihood of being in the ASC group versus inpatient or HOPD, based on two measures: risk scores and region of residence. We obtained risk scores using the HHS-Hierarchical Conditions Category (HHS-HCC) risk adjustment model which was designed by CMS to use claims data to risk adjust the population of individuals who purchased individual or small group commercial insurance under the Affordable Care Act [21]. The HHS-HCC model uses an individual's demographics and diagnoses captured over a 12-month period to determine a risk score, which is a relative measure of anticipated costliness of an individual, reflecting the individual's health risk. We used the 12-month period prior to the joint replacement procedure to determine individuals' risk. An individual's region of residence was defined as Northeast, North Central, South, or West. The propensity score balances our treatment selection so that individuals with similar HHS-HCC living in the same region will have similar propensity scores. We estimate the propensity scores with a logistic regression predicting treatment category (inpatient, HOPD or ASC) based on HHS-HCC risk score and region of residence.

Second, we applied the estimated propensity scores in a case-control match to create four samples. This process makes best matches first and next-best matches next, in a hierarchical sequence, selecting controls without replacement [22]. For a 1:N case-control match, sample size is important for two reasons: first, to ensure a sufficient number of individuals to match without replacement and second to ensure that the best, next-best, etc. match are reasonably close. For both TKA and THA, the large sample of inpatient procedures allowed for creation of a 3:1 matched sample of inpatients to ASC patients; the outpatient sample sizes allowed reasonable 1:1 matching of HOPD patients to ASC patients. We matched 2,574 TKA inpatients with 858 TKA ASC patients and 1,869 THA inpatients with 623 THA ASC patients. We further matched 450 HOPD TKA patients with 450 TKA ASC patients and 271 HOPD THA patients with 271 ASC THA patients.

Outcomes

For each case, we identified cases of 30-day readmission, 90-day readmission, and complications within 90 days including surgical site infection, deep-vein thrombosis, pulmonary embolism, dislocation/loosening/breakage of the prosthesis, and revision surgery. Consistent with the CMS Hospital Readmissions Reduction Program, we included readmissions for all causes. We also included cost outcomes: payment for the index hospitalization or index outpatient encounter, payments for all post-acute care to 90-days post-surgery and total episode payments.

Analyses

We examined rates of readmissions and complications following TKA and THA comparing inpatients with matched ASC patients and HOPD patients with matched ASC patients. We applied Chi-square tests for the equality of two proportions for independent samples. For the Chi-square test to be valid, cell counts must not be too small. In cases where the cell count was less than 5, we used Fisher's Exact test, which is a more conservative test of the difference between two proportions. Finally, we compared index, post-acute and total payments across samples in descriptive analyses. All analyses were conducted using SAS v9.4.

Results

As seen in Table 1, patients receiving TKA in ASCs had readmissions rates that were only about one-third as large as readmission rates for TKA inpatients: 1.98% compared to 5.56% for readmission within 30 days ($p<0.001$) and 3.15% compared to 9.87 % for 90 days ($p<0.001$). Complication rates were low at both sites and did not differ substantially across sites (6.29% for inpatient and 5.48% for ASC; $p=0.387$). We observe similar yet very low rates of revision surgery, less than 1% for both inpatient and ASC ($p=0.221$).

Readmission rates and revision surgeries were somewhat lower for THA at both sites; however, there is a similar pattern of much lower readmission rates at ASCs (30-day readmissions; $p=0.011$) and (90-day readmission; $p<0.001$). Complication rates were also lower for THA compared to TKA, especially in ASCs where they averaged only 1.93% compared to 5.83% for inpatients ($p<0.001$).

Results for the HOPD to ASC comparisons are shown in Table 2. For TKA, readmission rates were again much lower for ASCs: 1.56% compared to 4.00% for readmissions within 30 days ($p=0.026$) and 2.89% compared to 6.22% for 90 days ($p=0.017$). Complication rates were only slightly higher in HOPDs compared to ASCs (5.33% versus 4.67%; $p=0.646$). There were no revision surgeries at either site. The HOPD to ASC comparison for THA patients shows the same general pattern. Readmissions were significantly smaller in ASCs compared to HOPDs (30-day readmissions 0.37% versus 2.95%; $p=0.038$) and (90-day readmissions 0.74% versus 2.95%; $p=0.001$). Complication and revision surgery rates were low at both sites, particularly in ASCs where the complication rate was only about 1% and there were no revision surgeries.

Finally, in Table 3 we display relative index, post-acute, and total average payments. For the TKA inpatient to ASC comparison, we see that the average payment to hospitals for the index stay was \$32,273, and to ASCs was \$27,839, or 13.7% lower than inpatient. Consistent with results of post-surgical outcomes and complication rate comparison, payments for post-acute care for inpatients exceeded post-acute care for ASC patients by 8.4%. The total episode cost was 12.8% lower for ASC patients. For THA, the index stay comparison is similar to TKA: for ASCs the cost is 13.9% lower than the inpatient stay. Post-surgical costs are 20.5% lower in ASCs, and total episode costs are 14.8% lower.

Results for the HOPD to ASC cost comparison differ from the inpatient to ASC comparison. The index event costs in ASCs exceed those of HOPDs by 8.4% for TKA and 16.1% for THA. The post-acute care costs are lower in ASCs, by 5.5% for TKA and 34.4% for THA, reflecting the lower readmissions and post-surgical complication rates in ASCs. The total episode costs, however, are 5.3% and 5.1% higher in ASCs, for TKA and THA respectively.

Discussion

This analysis compared outcomes and costs following total joint replacement across three settings in a commercially-insured population of near elderly non-Medicare patients. Two themes emerge. First, we did not observe that transition of TKA and THA out of the traditional inpatient setting compromised patient safety. Readmissions were significantly lower for outpatients than for inpatients, particularly for ASC patients. Rates of revision surgery were in all cases extremely small or zero, within 90 days of surgery. ASC patients fared better than HOPD patients regarding complications and revision surgeries in all four cases. While our data and methods allowed us to match patients on overall risk, we were unable to capture any information on the environments to which patients were discharged. However, our results support an interpretation that clinicians were successful in incorporating such information into selection of appropriate candidates for outpatient surgery. We cannot rule out the possibility that some of the outpatients who did experience complications may have been better serviced as inpatients; however, the numbers of events are extremely small, diminishing this concern.

The second main theme relates to relative costs. The rationale for providing outpatient total joint replacement surgery is fixed in the value equation: for select patients, the outpatient setting is clinically appropriate, does not compromise patient safety and is much less expensive. Our results support that argument. Payments for both HOPD and ASC patients were lower than for inpatients. However, payments to ASCs exceeded payments to HOPDs by considerable margins. This is a notable result, since the broad rationale behind transition of services to the ASC is lower cost. Prior studies have found greater joint replacement patient satisfaction in ASCs [17, 20] and this may be a factor in driving up demand for ASC provision of these services. This result also aligns with an earlier study which found that relative ASC to HOPD payments by commercial insurers were considerably higher among ASCs that specialized in orthopedic surgery than ASCs in other specializations [23]. On the supply side, ASCs, which are primarily physician-owned and specialized, may be better positioned than hospitals to negotiate more aggressively around targeted surgical procedures and thus provide the appropriate services desired by patients.

The results of our analysis have implications for policymakers. In 2018, the Centers for Medicare and Medicaid Services (CMS) removed TKA from its inpatient-only (IPO) list. The change in CMS reimbursement rules has stirred standing concerns over the delivery of care in physician-owned specialty facilities. While current policy only permits outpatient TKA reimbursement for Medicare beneficiaries in HOPDs, many observers expect Medicare reimbursement for outpatient THA to follow [24], and CMS has sought comments on whether these procedures should be added to the ASC covered procedures list [25]. Since most ASCs are totally or partially physician-owned, provider incentives to perform TKA and potentially THA could lead to the unintended effect of higher overall utilization of these procedures. A Florida study of approximately 13,000 Medicare patients who received knee arthroscopy during 2006 found that the rate of procedures in hospital service areas with the highest one-third of ASC market share was more than twice that of hospital service areas with the lowest one-third [26].

CMS determined that appropriately selected patients could be successful candidates for outpatient TKA, a decision based on input from numerous stakeholders. However, movement of TKA from the IPO list has not been without its critics. Some state hospital associations, hospital systems and professional organizations representing orthopedic surgeons have expressed concern that TKA is an invasive procedure and that Medicare beneficiaries will face greater complications, recovery and rehabilitation needs than younger populations. Moreover, removal of TKA from the IPO list could lead commercial payers to implement coverage policies that would drive procedures toward outpatient settings that might not be sufficiently prepared to handle unforeseen complexities, raising patient safety concerns [27].

The patients studied here are near elderly and non-Medicare, such that results cannot be applied directly to the Medicare population of patients who are older and have more comorbidities. Yet our results supporting the contention that migration of total joint replacement surgery to outpatient settings is appropriate for some patients is encouraging, because a finding of patient safety failures in this age group would augur for even greater problems in an older population. It is important for future study that patient safety following outpatient joint replacement be monitored when data on Medicare patients becomes available.

There are limitations to our analysis. Our risk-adjustment was incomplete as we did not have information on follow-up protocol and adherence, or on social factors such as health habits or support at home that would allow more comprehensive control for selection. Moreover, the MarketScan database includes only claims that were voluntarily contributed from employer health insurance plans. While the data includes patients from all 50 states and the District of Columbia, it was not designed to be nationally representative.

Conclusion

A recent position statement on outpatient joint replacement by the American Association of Hip and Knee Surgeons emphasizes proper patient selection and states that an outpatient program should start with improved quality and safety outcomes [28]. Findings from this

study support the argument that outpatient total joint replacement is suitable for select patients, and the low rates of readmissions and complications observed suggest that physicians are exercising prudent judgment in selecting clinically appropriate candidates. Results are consistent with previous studies of outpatient joint replacement patient safety, although for ASCs in the sample we studied, it came at a cost.

Implications vary across stakeholders. For patients who prefer to return home as soon as possible after surgery, consultation with their physicians about same day surgery appears warranted. For payers, including both insurers and patients, differences in prices across settings should be considered. For CMS, the clinical outcomes in both HOPDs and ASCs are a positive finding. Yet a near elderly population is younger and likely more active with greater support at home than the population of Medicare beneficiaries. Going forward, it will be important to continually evaluate clinical outcomes as more joint replacements are provided in HOPDs and ASCs for Medicare as well as commercially insured patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Inpatient and Ambulatory Surgery Centers: Comparison of Total Joint Replacement Post-Surgical Events

	Total Knee Replacement				
	Inpatient (n=2,574)		Ambulatory Surgery Center (n=858)		p-value for equality of rates ^a
	# of Events	Rate (%)	# of Events	Rate (%)	
30-day Readmissions	143	5.56	17	1.98	<0.001
90-day Readmissions	254	9.87	27	3.15	<0.001
Post-Surgical Complications ^b	162	6.29	47	5.48	0.387
Revision Surgery	13	0.51	4	0.47	0.221
	Total Hip Replacement				
	Inpatient (n=1,869)		Ambulatory Surgery Center (n=623)		p-value for equality of rates ^a
	# of Events	Rate (%)	# of Events	Rate (%)	
30-day Readmissions	60	3.21	8	1.28	0.011
90-day Readmissions	143	7.65	10	1.61	<0.001
Post-Surgical Complications ^b	109	5.83	12	1.93	<0.001
Revision Surgery	4	0.21	1	0.16	0.396 ^c

^a Chi-square test for the equality of two proportions from independent samples^b Post-Surgical Complications include surgical site infection, deep vein thrombosis, pulmonary embolism, and dislocation, loosening or breakage of prosthesis^c Fisher's Exact test for the equality of two proportions from independent samples with small cell sizes

Table 2.

Hospital Outpatient Department and Ambulatory Surgery Centers: Comparison of Total Joint Replacement Post-Surgical Events

	Total Knee Replacement				
	Outpatient (n=450)		Ambulatory Surgery Center (n=450)		p-value for equality of rates ^a
	# of Events	Rate (%)	# of Events	Rate (%)	
30-day Readmissions	18	4.00	7	1.56	0.026
90-day Readmissions	28	6.22	13	2.89	0.017
Post-Surgical Complications ^b	24	5.33	21	4.67	0.646
Revision Surgery	0	0.00	0	0.00	-
	Total Hip Replacement				
	Outpatient (n=271)		Ambulatory Surgery Center (n=271)		p-value for equality of rates ^a
	# of Events	Rate (%)	# of Events	Rate (%)	
30-day Readmissions	8	2.95	1	0.37	0.038 ^c
90-day Readmissions	16	5.90	2	0.74	0.001 ^c
Post-Surgical Complications ^b	14	5.17	3	1.11	0.011 ^c
Revision Surgery	2	0.73	0	0.00	0.250 ^c

^aChi-square test for the equality of two proportions from independent samples

^bPost-Surgical Complications include surgical site infection, deep vein thrombosis, pulmonary embolism, and dislocation, loosening or breakage of prosthesis

^cFisher's Exact test for the equality of two proportions from independent samples with small cell sizes

Total 90-Day Episode Costs (\$): Comparison of Hospitals and Ambulatory Surgery Centers (ASCs)

Table 3.

	Total Knee Replacement				Total Hip Replacement			
	Inpatient \$ (n=2,574)	ASC \$ (n=858)	Inpatient \$-ASC \$	Percent Difference	Inpatient \$ (n=2,574)	ASC \$ (n=858)	Inpatient \$-ASC \$	Percent Difference
Index	32,273	27,839	4,434	-13.7	33,469	28,821	4,648	-13.9
Post-Acute	7,293	6,683	610	-8.4	5,545	4,408	1,137	-20.5
Total Episode	39,566	34,521	5,045	-12.8	39,014	33,229	5,785	-14.8
	Total Knee Replacement				Total Hip Replacement			
	Outpatient \$ (n=450)	ASC (n=450)	Outpatient-ASC	Percent Difference	Outpatient (n=271)	ASC (n=271)	Outpatient-ASC	Percent Difference
Index	25,024	27,128	-2,104	+8.4	25,238	29,311	-4,073	+16.1
Post-Acute	7,078	6,687	391	-5.5	7,016	4,601	2,415	-34.4
Total Episode	32,102	33,815	-1,713	+5.3	32,254	33,913	-1,659	+5.1