Comparison of readmission and early revision rates as a quality metric in total knee arthroplasty using the Nationwide Readmission Database

Kenneth L. Urish[1,2,3], Yongmei Qin[4], Bassel Salka[4], Benjamin Y. Li[4], Tudor Borza[5], Michael Sessine[4], Peter Kirk[4], Brent K. Hollenbeck[4], Jonathan E. Helm[6], Mariel S. Lavieri[7], Ted A. Skolarus[8], Bruce L. Jacobs[9]

[1]Arthritis and Arthroplasty Design Group, The Bone and Joint Center, Magee Womens Hospital, University of Pittsburgh Medical Center, Pittsburgh, PA, USA; [2]Department of Orthopaedic Surgery, Department of Bioengineering, and Clinical and Translational Science Institute, University of Pittsburgh, Pittsburgh, PA, USA; [3]Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA, USA; [4]Department of Urology, Division of Oncology, Dow Division for Urologic Health Service Research, University of Michigan, Ann Arbor, MI, USA; [5]Department of Urology, University of Wisconsin School of Medicine and Public Health, William S. Middleton Memorial Veterans Hospital, Madison, WI, USA; [6]Health Services Research & Development, Center for Clinical Management Research, VA Ann Arbor Healthcare System, Ann Arbor, MI, USA; [7]Department of Industrial and Operations Engineering, University of Michigan, Ann Arbor, MI, USA; [8]Department of Urology, Division of Oncology, Dow Division for Urologic Health Service Research, Health Services Research & Development, Center for Clinical Management Research, VA Ann Arbor Healthcare System, University of Michigan, Ann Arbor, MI, USA; [9]Department of Urology, University of Pittsburgh, Pittsburgh, PA, USA

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Correspondence to: Kenneth L. Urish, MD, PhD. Magee Bone and Joint Center, Department of Orthopaedic Surgery, University of Pittsburgh, 300 Halket Street, Suite 1601, Pittsburgh, PA 15232, USA. Email: ken.urish@pitt.edu.

Background: After release of the Comprehensive Care for Joint Replacement bundle, there has been increased emphasis on reducing readmission rates for total knee arthroplasty (TKA). The potential for a separate, clinically-relevant metric, TKA revision rates within a year following surgery, has not been fully explored. Based on this, we compared rates and payments for TKA readmission and revision procedures as metrics for improving quality and cost.

Methods: We utilized the 2013 Nationwide Readmission Database (NRD) to examine national readmission and revision rates, the reasons for revision procedures, and associated costs for elective TKA procedures. As data are not linked across years, we examined revision rates for TKA completed in the month of January by capturing revision procedures in the subsequent following 11-month period to approximate a 1-year revision rate. Diagnosis and procedure codes for revision procedures were collected. Average readmission and revision procedure costs were then calculated, and the cost distributed across the entire TKA population.

Results: We identified 20,851 patients having TKA surgery. The mean unadjusted 30- and 90-day TKA readmission rates were 3.4% and 5.8%, respectively. In contrast, the mean unadjusted 3-month and approximate 1-year reoperation rates were 1.0% and 1.6%, respectively. The most common cause for revision was periprosthetic joint infection, which accounting for 62% of all reported revision procedures. The mean payment for 90-day readmission was roughly half ($10,589±$11,084) of the mean inpatient payment for single reoperation procedure at 90 days ($20,222±$17,799). Importantly, nearly half (46%) of all 90-day readmissions were associated with a reoperation event within the first year.

Conclusions: Readmission following TKA is associated with a 1-year reoperation in approximately half of patients. These reoperations represent a significant patient burden and have a higher per episode cost. Early reoperation may represent a more clinically relevant target for quality improvement and cost containment.

Keywords: Total knee arthroplasty (TKA); readmission; revision procedure; Comprehensive Care for Joint Replacement; Nationwide Readmission Database (NRD)

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Introduction

The 2012 Affordable Care Act's shift from a fee-for-service model to one associated with quality of care has grouped hospital and professional care into a single payment over a 90-day period for total knee arthroplasty (TKA) (1,2). As a result, reducing readmission rates for TKA, one of the most common and largest procedural expenditures for Medicare, has become a generally accepted quality metric and initial target for minimizing excess post-discharge costs (3,4). TKA readmission rates, however, tend to be relatively low compared to other major index procedures. For example, readmission rates at 30 days after discharge for spine, posterior spinal instrumentation, and hip fractures are all greater than 10% while TKA readmissions rates are significantly less, ranging from 2% and 6% (4,5). This makes improving TKA quality or reducing cost by decreasing already low readmission rates a challenge secondary to floor effects.

Reoperation procedures in the first year are an alternative metric that could be used to quantify quality. Early TKA complications have been well-documented and require surgical revision procedures (6,7). Unlike many reasons for readmission that include non-modifiable comorbidities such as congestive heart failure that are not related to the knee itself, reoperation within the first year represents a more modifiable factor related to the knee where the surgeon may have increased control. Long term follow-up of TKA has demonstrated implant survivorship of approximately 95% at 10 years (8). Minimizing revision rates at 1 year would naturally improve overall quality. Large national registries and administrative databases report a reoperation rate in the first year after TKA between 1% and 3.4% (6,9-11). This has a comparable scale to 30-day readmission rates that range between 2% and 6% (4,5). Although there is limited data outside of large centers documenting first year TKA revision rates, the New Zealand Joint Registry indicated that periprosthetic joint infection is the most common early complication encountered with a 0.8% reoperation rate within 1 year while accounting for 47% of all TKA reoperations (6). This suggests that first-year reoperation rates may have a comparable scale to readmission rates and that periprosthetic joint infection may be a major cause of reoperation. Readmission rates have not been directly compared to differences in reoperation rates after the index TKA. We have previously reported on readmission rates after TKA (1) as have other groups (12-15). There is no data available comparing the actual costs of these readmissions and reoperation procedures.

For these reasons, we compared national rates and costs for readmissions and reoperations following TKA in the United States. The Nationwide Readmissions Database (NRD) accounts for 49% of all hospitalizations in the United States and, as the largest database of all-payer hospital admissions, addresses gaps in readmission and revision data by following readmissions and reoperations across different hospitals (16). This database contains discharge data from the National Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality. The objective of this study was to determine the reasons for TKA revisions and compare TKA revision rates and payments at approximately 1 year to readmission rates and payments at 30 and 90 days. We hypothesized that there would be little correlation between readmission rates and reoperation rates. Findings from this study provide important context and patterns in determining quality metrics for TKA procedures across all payers and geographic regions in the United States.

Methods

Data source and study population

We used the HCUP's NRD to identify adult men and women who underwent TKA in 2013. The NRD provides a nationally representative dataset to examine hospital readmissions. Based on the State Inpatient Database, the NRD is the largest database of all-payer hospital admissions that contains patient linkages to follow readmissions across different hospitals in different states. The NRD website summarizes the core data file and data elements. This is a retrospective study as the dataset became available in 2016 (7). Missing data in this set was 0.08%.

We used the initial month of 2013 to follow readmission and reoperation episodes of care. Since the NRD is not linked between different years, we identified reoperations over the following 11 months in 2013 to calculate an approximate 1-year revision rate. We identified TKA index and revisions procedures using designated *International Classification of Diseases*, *9th Revision*, *Clinical Modification* (ICD-9-CM) codes. As there may be more than one procedure code for each patient, we included all patients with the ICD-9 procedure code 8154 (TKA) and excluded any patients with the ICD-9 procedure code 8151 (total hip arthroplasty), 8006 (arthrotomy for removal of prosthesis), 8155 (revision knee replacement), 0080 (revision knee replacement), 0081–0084 (revision knee replacement), 27486 (reconstruction of thigh region), 27487 (reconstruction of femur), 27488 (reconstruction of femur) and diagnosis codes 73310 (pathologic fracture), 73314 (pathologic fracture femoral neck), 73315 (pathologic fracture of other part of femur), 73316 (pathologic fracture of tibia), 808 (fracture of pelvis), 820 (femoral neck fracture), 821 (fracture of femur unspecified), 827 (multiple fractures of lower limb), 828 (multiple fracture of lower and upper limbs). The cohort starts with 21,044 eligible patients with qualified TKA admission. The qualified admission means age being 45 or older, no missing length of stay (LOS), not died in Hospital admission, January 2013 TKA admission and with TKA procedure and diagnosis code. After we excluded transfers, against Medical Advice, and discharged alive but destination unknown, there are 20,851 patients in the cohort.

Outcomes

The objective of this study was to assess readmission and reoperation rates among patients undergoing TKA. We defined a readmission as a hospital admission that occurred within two specific time periods (i.e., 30 and 90 days) of the index surgery that was not planned. We used 30 and 90 days to be consistent with the readmission definition used by the Hospital Readmissions Reduction Program and the time period included in the Comprehensive Care for Joint Replacement bundle, respectively (17). Revision rates were defined as a reoperation within 11 months of the initial index TKA population. If there were a series of readmissions for a single patient, only the first readmission was counted in determining the readmission rate. If there were a series of procedures for a single patient, only the first procedure was counted in determining the reoperation rate. The order of priority to count these observations included TKA revision procedure, excisional debridement, and non-excisional debridement. The reasons for revision procedures were determined using diagnosis and procedure codes as noted above. As a note, the National Readmission Database defines hospital size by bed number which varies based on geographic location. This does not represent overall arthroplasty procedure volume for the hospital.

Statistical analysis

We calculated the readmission and reoperation costs for each episode of care using an established method (18,19) based on total readmission and reoperation charges and hospital-specific cost-to-charge ratios developed by the HCUP (20). The cost-to-charge ratio provides a way to estimate the cost of hospital services, as opposed to the hospital charges. We determined mean readmission and reoperation costs and then calculated what the cost would be if distributed across the entire TKA population in our cohort.

We divided reoperation procedures between revision procedures and debridements. Revision procedure codes were defined as 00.80 (all component revision), 00.81 (tibial component revision), 00.82 (femoral component revision), 00.83 (patellar component revision), 00.84 (isolated tibial insert exchange), 80.06 (arthrotomy/removal of prosthesis), and 81.55 (revision TKA, not otherwise specified). Debridement was classified as either excisional (86.22) or non-excisional (86.28). Analyses were performed using SAS v9.4 (Cary, NC, USA).

Results

We identified 20,851 patients having TKA surgery across the states participating in NRD in the first month of 2013. Demographics of the cohort are described in *Table 1*. A comparison of reoperation and readmission rates in the first year of the index TKA procedure are described in *Table 2*. The mean unadjusted 30- and 90-day readmission rates were 3.4% and 5.8%, respectively. Although, there is little relevance in the current health care model, 1-year readmission rates were included for the

Table 1 Patient characteristics

Characteristics	TKA cohort
Number of patients	20,851
Mean age, n [SD]	67 [9]
Age group, n [%]	
45 to 54	2,037 [10]
55 to 64	5,863 [28]
65 to 74	8,400 [40]
75 to 84	4,060 [19]
85 or older	491 [2]
Sex, n [%]	
Female	12,484 [60]
Male	8,367 [40]
Median household income ($), n [%]	
37,999 or less	4,029 [20]
38,000–47,999	5,393 [26]
48,000–63,999	5,719 [28]
64,000 or more	5,371 [26]
Comorbidities[a], n [%]	
Diabetes without complications	3,964 [19]
Diabetes with complications	372 [2]
Chronic pulmonary disease	2,903 [14]
Rheumatologic disease	831 [4]
Renal disease	924 [4]
Congestive heart failure	434 [2]
Obese or overweight[b]	4,512 [22]
LOS, n [%]	
2 days or less	5,733 [28]
3 days	10,798 [52]
4 days	2,341 [11]
5 days or more	1,958 [9]
Discharge destination, n [%]	
Home	5,408 [26]
Home care	9,613 [46]
Skilled nursing facility	5,830 [28]
Primary payer, n [%]	
Medicare	12,680 [61]
Non-Medicare	8,150 [39]
Location, n [%]	
Urban	18,926 [91]
Rural[c]	1,904 [9]
Hospital type, n [%]	
Teaching	8,882 [43]
Non-teaching	11,948 [57]
Hospital size, n [%]	
Small	3,577 [17]
Medium	5,709 [27]
Large	11,544 [55]

Table 1 (*continued*)

[a], Represent seven most common comorbidities; [b], indicated by an International Classification of Diseases, ninth revision code; [c], rural includes micropolitan areas. TKA, total knee arthroplasty; SD, standard deviation; LOS, length of stay.

sake of completeness. The mean unadjusted 3-month and approximate 1-year reoperation rates were 1.0% and 1.6%, respectively. The majority of the reoperation were from TKA revision surgical procedures (84%) as opposed to excisional or non-excisional debridements (16%).

The most common causes for revision in the first year (*Table 3*) were periprosthetic joint infection (42.3%, n=242), other mechanical complication (13.8%, n=79), and dislocation of prosthetic joint (10%, n=57). Overall, periprosthetic joint infection accounted for 62% (n=242) of all reported revision procedures. This correlates with the most common procedure performed was isolated tibial insert revision (19.2%; *Table 4*). This diagnosis contributed to 56% (n=61) of all isolated tibial insert revisions, the most common revision procedure at 29% (n=110) of all identifiable procedures. The other most common surgical revision diagnoses were mechanical loosening of the prosthetic joint at 8% (n=36), dislocation of the prosthetic joint at 12% (n=57), and other mechanical complications at 17% (n=79). These diagnoses are the heaviest contributors to the femoral, patella, and tibial component revisions, respectively.

The costs of readmissions and reoperations were compared (*Table 5*). The average cost of each 30- and 90-day readmission episode was $9,936 (±$11,360) and $10,589 (±$11,084), respectively. In comparison, the mean inpatient cost of a single admission for a reoperation (revisions or

Table 2 Comparison of reoperation and readmission rates in the first year of the index TKA procedure

Characteristics	30 d	90 d	6 m	11 m
Readmission rate, n (%)	703 (3.4)	1,206 (5.8)	1744 (8.4)	2,632 (12.6)
Revision rate, n (%)	47 (0.2)	102 (0.5)	160 (0.8)	279 (1.3)
Excisional and nonexcisional debridements, n (%)	27 (0.1)	50 (0.2)	63 (0.3)	73 (0.4)
Reoperation rate, n (%)	68 (0.3)	137(0.97)	206 (1.0)	333 (1.6)

Multiple procedures on the same patient were only counted once. The reoperation rate is not the sum revision rate and excisional and non-excisional debridement rate. If a patient had both a debridement and a revision, only the revision was counted in the reoperation rate. TKA, total knee arthroplasty; d, days; m, months.

Table 3 Epidemiology of revision procedures based on diagnosis codes

Diagnosis codes	Total, all revisions
Number of revisions	572
99640 Unspecified mechanical complication	<11 (<1.9%)
99641 Mechanical loosening of prosthetic joint	36 (6.3%)
99642 Dislocation of prosthetic joint	57 (10.0%)
99643 Broken prosthetic joint	<11 (<1.9%)
99644 Periprosthetic fracture	19 (3.3%)
99645 Periprosthetic osteolysis	<11 (<1.9%)
99646 Articular bearing surface wear	<11 (<1.9%)
99647 Other mechanical complication	79 (13.8%)
99649 Other mechanical complication of other implant	14 (2.4%)
99666 Periprosthetic infection	242 (42.3%)
99660 Infection due to unspecified device	0
No diagnosis code	113 (19.8%)

Table 4 Epidemiology of revision procedures based on procedure codes

Diagnosis codes	Total, all revisions	00.80 All component revision	00.81 Tibial component revision	00.82 Femoral component revision	00.83 Patella component revision	00.84 Isolated tibial insert revision	80.06 Arthrotomy removal of prosthesis	81.55 Knee revision, NOS	No surgery code
Number of revisions	572	84 (14.7%)	58 (10.1%)	36 (6.3%)	30 (5.3%)	110 (19.2%)	53 (9.3%)	14 (2.4%)	187 (32.7%)

debridement) ranged between $20,150 and $21,939. As debridements were a low percentage of overall procedures, mean revision costs during this time period ranged between $20,346 and $23,408. Distributed across the entire cohort, the 30- and 90-day readmission cost distributed across all TKA patients were $354 and $705, respectively. The approximate 1-year cost of reoperation and revision procedures were $396 and $310, respectively.

We performed a sensitivity analysis to examine if there was a relationship between patients readmitted at 30 or 90 days and patients who had a reoperation procedure (*Table 6*). At 30 days, 68 of the 333 readmissions (20%) had a reoperation. At 90 days, 137 of the 333 readmissions (41%) had a reoperation. At 1 year, 25% of patients readmitted at 30 days

Table 5 Comparison of reoperation costs to readmission costs at 1, 3, 6, and 11 months

Characteristics	30 d	90 d	6 m	11 m
Readmission cost, $ [SD]	9,936 [11,360]	10,589 [11,084]	11,697 [13,806]	12,393 [13,603]
Cumulative readmission cost, $	7,372,789	14,708,794	25,196,248	44,057,840
Cumulative readmission cost/person, $	354	705	1,208	2,113
Reoperation cost, $ [SD]	20,150 [18,780]	20,222 [17,799]	21,939 [20,883]	21,008 [18,023]
Cumulative reoperation cost, $	1,390,340	2,911,959	4,914,416	8,256,162
Cumulative reoperation cost/person, $	67	140	236	396

d, days; m, months; SD, standard deviation.

Table 6 Association between 30- and 90-day readmissions and reoperation procedures

Characteristics	30-day	90-day
Total reoperated	68/333 (20%)	137/333 (41%)
Readmitted and reoperated	82/333 (25%)	154/333 (46%)

and 46% of patients readmitted at 90 days had a reoperation.

We performed a logistic regression analysis to determine if there were any correlations between patients readmitted at 90 days and those that later had a reoperation at 1 year (*Table* 7). There were 1,206 patients readmitted within 90 days and 196 patients with a reoperation. There were 16 patients that were both reoperated and readmitted and they were excluded in analysis. Age, diabetes, LOS more than 5 days, and primary payer were the only factors that predicted a correlation between a 90-day readmission and a later reoperation. Older patients with diabetes that had a LOS more than 5 days that were then readmitted had an increased risk of a reoperation within 1 year.

Discussion

Our study has three main findings that support the notion of looking at 1-year revision rates as a quality and value metric following TKA. First, the approximate 1-year revision and reoperation rate for TKA is comparable in magnitude to 30- and 90-day readmission rates. Second, the mean cost of reoperation procedures are twice the mean cost of 30- and 90-day readmissions, but when distributed across the entire TKA population, the costs are comparable in scale. Finally, the proportion of patients readmitted at 90 days that had a reoperation event at approximately 1 year from the index procedure was impressive (46%). These findings suggest the first year TKA reoperation rate has potential as a metric for quality and value as compared to readmission rates, but that 90-day readmission rates may be associated with these reoperations.

Reoperation rates at one year are comparable in scale to readmission rates at 30 and 90 days. Reoperation rates in TKA within a year were 1.8%. Readmission rates were 4% within 30 days and 5.8% within 90 days. These observed readmission rates are comparable to those previously reported in the literature (1,21-29). The Standard Analytical File 5% Sample Insurance Claims dataset reported overall revision arthroplasty or liner exchange rate of 3.4% (11). Our data are consistent with national registries, showing 1.0% to 1.2% revision rates [8]. Prior to ICD-9 diagnosis codes, 2-year revision rates in the Medicare database have been reported at approximately 3% [7]. Overall, our observations agree with these other large databases.

An important detail in our dataset is investigating the role of excisional and non-excisional debridements in the overall reoperation rate. The distinction between reoperation and revision rate is important. Reoperation rates include all surgical procedures related to the index procedure whereas revision rate includes surgical procedures with exchange of an implant related to the index procedure. Our study suggests that non-revision procedures (i.e., irrigation and debridement with no exchange of components) contribute little to the overall reoperation rate in the first year from the index procedure.

The primary cause of early revision during the first year

Table 7 Logistic regression analysis comparing patients readmitted at 90 days to patients with a reoperation procedure by 1 year

Characteristics	TKA		P value[a]
	90-day readmission	Any reoperation from 90 d to 11 m	
Number of patients, n [%]	1,189 [86]	196 [14]	
Mean age, n [SD]	69 [10]	64 [10]	<0.0001
Age group, n [%]			<0.0001
45 to 54	110 [9]	48 [24]	
55 to 64	284 [24]	53 [27]	
65 to 74	433 [36]	62 [32]	
75 to 84	305 [26]	32 [16]	
85 or older	55 [5]	1 [1]	
Sex, n [%]			0.29
Female	497 [42]	90 [46]	
Male	690 [58]	106 [54]	
Median household income ($), n [%]			0.98
37,999 or less	261 [22]	44 [23]	
38,000–47,999	324 [28]	53 [27]	
48,000–63,999	297 [26]	52 [27]	
64,000 or more	279 [24]	45 [23]	
Comorbidities[b], n [%]			
Diabetes without complications	306 [26]	37 [19]	0.04
Diabetes with complications	37 [3]	5 [3]	0.67
Chronic pulmonary disease	216 [18]	31 [16]	0.42
Rheumatologic disease	65 [5]	11 [6]	0.94
Renal disease	108 [9]	9 [5]	0.04
Congestive heart failure	57 [5]	9 [5]	0.90
Obese or overweight[c]	293 [25]	47 [24]	0.83
LOS, n [%]			0.04
2 days or less	233 [20]	55 [28]	
3 days	574 [48]	81 [41]	
4 days	187 [16]	26 [13]	
5 days or more	193 [16]	34 [17]	<0.0001
Discharge destination, n [%]			<0.0001
Home	232 [19]	61 [31]	
Home care	472 [40]	87 [44]	
Skilled nursing facility	483 [41]	48 [25]	

Table 7 (*continued*)

Table 7 (*continued*)

Characteristics	TKA		P value[a]
	90-day readmission	Any reoperation from 90 d to 11 m	
Primary payer, n [%]			<0.0001
Medicare	823 [69]	107 [55]	
Non-Medicare	364 [31]	89 [45]	
Location, n [%]			0.20
Urban	1,066 [90]	170 [87]	
Rural[d]	121 [10]	26 [13]	
Hospital type, n [%]			0.51
Teaching	467 [39]	82 [42]	
Non-teaching	720 [61]	114 [58]	
Hospital size, n [%]			0.18
Small	169 [14]	31 [16]	
Medium	362 [31]	47 [24]	
Large	656 [55]	118 [60]	

[a], P values: *t*-test for parametric continuous variables, Wilcoxon rank-sum test for non-parametric continuous variables, and chi-square for proportions; [b], represent seven most common comorbidities; [c], indicated by an *International Classification of Diseases*, ninth revision code; [d], rural includes micropolitan areas. TKA, total knee arthroplasty; SD, standard deviation; d, days; m, months; LOS, length of stay.

in this population was periprosthetic joint infection. More than 60% of all reoperations were related to infection. The most common revision surgical procedure to treat infection was isolated tibial insert exchange. This adds evidence to the growing body of literature that infection remains the primary cause of both acute and long-term failure. Rates of early failure in the New Zealand registry were similar with almost 50% of all reoperations at 2 years (6). Infection was either the primary or major cause of failure at early and long-term time points in both single center studies (30-32) and other large registries and administrative databases (6,7,33).

Cost is an important measure of evaluating value in a surgical procedure. As care after a TKA has grouped hospital and professional care into a single payment over a 90-day period, the composition of cost in this period includes all aspects of a patient care including any readmission. Accurate measurement of the cost is challenging as this data is not widely available. An advantage of the NRD is access to cost data as compared to other administrative datasets. There is a large difference between what a medical facility charges for an episode of care and the actual cost of the episode of care. Although charge data is widely reported, few databases are able to provide the actual cost, allowing for a more accurate comparison. There is a paucity of data comparing actual cost of readmissions or reoperations. Per episode, the cost of reoperation was approximately twice the cost of each readmission episode. The combined cost of reoperation within 1 year was comparable in magnitude to the total cost of 30-day readmissions and almost half the cost of the 90-day readmission cost. Distributing the cost of each readmission and each reoperation across the entire TKA cohort demonstrated comparable magnitude of cost as well which is surprisingly low. Similar values have been reported previously (1).

We attempted to identify if there was a relationship between patients readmitted at 90 days and patients who had a reoperation procedure. At 90 days, 46% of patients readmitted at 90 days had a reoperation. A logistic regression analysis identified age, diabetes, LOS more than 5 days, and primary payer variables as variables that predicted patients readmitted at 90 days at risk for reoperation.

Our findings should be interpreted in the context of several limitations. There is a lack of laterality recorded with each revision procedure, and the ICD-9 code for TKA includes bilateral TKA and unicondylar knee procedures. This would potentially lead to revision procedures being incorrectly recorded when in fact the revision procedure was from the opposite knee or a unicondylar knee arthroplasty. As the observed revision rates in our study are comparable to other reported values in the literature (6), the incidence of this is small, and would not alter the overall interpretation of our results. A second possibility is that using ICD-9 criteria, debridement procedures are not location specific. This effect would over inflate contributions of reoperation rate to non-revision procedures. The fraction of reoperation rates was predominantly from revision procedures. Excisional and non-excisional debridements was a low percentage of reoperations. In a conservative measurement, when debridements are completely excluded, our overall conclusions would remain unchanged. A further limitation is that we were unable to track emergency room visits that resulted in a stay of less than 24 hours. By definition, any readmission that results in an inpatient stay is counted as a readmission. From this perspective, our readmission rate includes readmission for any reason outside of reoperations or revisions. Emergency room visits that do not result in an inpatient stay are not recorded. Finally, as with any database that represents a subset of the total population, there is a risk of bias due to a lack of generalizability. To help combat this issue, we used the NRD, which was specifically designed to address the lack of nationally representative readmission data for all ages and all payers. It includes 17 million readmission annually and, as a result, allowed us to evaluate over 20,000 TKA. The design of the NRD minimizes bias and allows the findings to be generalized to the majority of patients undergoing TKA in the United States.

The Center for Medicare and Medicaid Services' Comprehensive Care for Joint Replacement bundle has specific goals for improving TKA outcomes (1). At an administrative level, hospital readmissions are being used to achieve this goal, but hospital readmission rates for TKA are low, especially in comparison to other episodes of care where readmission rates of 10–25% are used as a quality metric. This suggests that a floor effect has been approached and other metrics may be useful, in addition to readmission rates, to assess overall quality and value (1). We compared rates of readmission and 1-year reoperation. The magnitude of each were similar, but we were unable to observe variables that suggested a relationship between patients readmitted at 90 days and patients that had a reoperation at 1 year. This suggests that reoperation rates add additional information in assessing overall value and quality at an administrative level. This does not suggest that reoperation rates serve as reimbursement model or that reoperation rates should replace readmission rates as a quality metric. There are a number of outside influences in both reoperation rates and readmission rates. Examining reoperation rates within the first year may not only be a useful metric to assess overall quality, but also a useful tool for surgeons to identify patients at risk for a poor clinical outcome.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/atm-19-3463). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. There were no animal studies conducted and therefore is exempt from IACUC approval and ARRIVE guidelines. This is a basic science article that does not include human subjects and is exempt from our institution's IRB approval process.

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