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The "Bundle Busters": Incidence and Costs of Postacute Complications Following Total Joint Arthroplasty

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ABSTRACT

Background: Recently, a bundled payment model was implemented in the United States to improve quality and reduce costs. While hospitals may be rewarded for lowering costs, they may be financially exposed by high cost complications, the so-called bundle busters. We aimed at determining the incidence, etiology, and costs of postacute complications after total joint arthroplasty (TJA).

Methods: A retrospective study was conducted using a prospectively collected database of patients who underwent primary total hip arthroplasty (THA) or total knee arthroplasty (TKA) from January 2015 to April 2016. Nurse navigators performed postoperative surveillance to identify patients with complications and unplanned clinical events in the 90-day postoperative period. This was combined with episode-of-care costs provided by third-party payers to derive the mean and per capita costs of postacute complications and clinical events.

Results: Among 3018 THA and 5389 TKA patients, 3.35% of THA and 2.62% of TKA patients sought emergency department or urgent care services, 2.62% of THA and 3.69% of TKA patients required hospital readmission, and 3.99% of TKA patients required manipulation. Joint-related complications were more common following THA, whereas medical complications were more frequent after TKA. The most costly complications after THA were periprosthetic fracture, dislocation, and myocardial infarction, compared to deep infection, myocardial infarction, and pulmonary embolism after TKA.

Conclusion: Joint-related complications were among the most costly events after TJA, and given their higher incidence after THA, had a larger impact on per capita costs. Medical complications were more common after TKA and more costly. Despite these events, postacute complications made up less than 5% of the total 90-day costs of TJA.

Total joint arthroplasty (TJA) is an effective and increasingly popular operation for improving function and relieving pain in patients with end-stage hip or knee arthritis [1,2]. In 2010 alone, it was estimated that 406,000 individuals underwent total hip arthroplasty (THA) and 620,000 underwent total knee arthroplasty (TKA) in the United States, which is expected to increase [3,4]. Despite its success, complications still occur that result in utilization of emergency department (ED) services, hospital readmission, and even reoperation. Preventing such complications will continue to be critical for maintaining access and affordability of this procedure for the millions who will require it in the decades to come.

The recently implemented Comprehensive Care for Joint Replacement model strives to improve both cost and quality of care by sharing financial responsibility for patient outcomes in the 90-day perioperative period with hospitals and physicians through a "bundled" payment system. Simply put, hospitals will be rewarded when actual episode-of-care (EOC) costs are below predetermined targets and penalized when costs exceed intended levels [5,6]. Clearly, the time has come for surgeons to have a more complete understanding of both the incidence and costs of complications following TJA. Therefore, the principal goal of this study was to not only determine the incidence and etiology of postacute complications following TJA but also identify which complications have the largest impact on EOC costs, the so-called bundle busters.

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Materials and Methods

A retrospective study was conducted using a prospectively collected database of patients who underwent primary THA or TKA at a single institution from January 2015 to April 2016 and whom were assigned a nurse navigator in the perioperative period. We excluded patients who underwent revision, conversion, or unicompartmental arthroplasty, in addition to those who underwent surgery for fracture. This study was performed with the approval of our institutional review board.

Beginning in January 2015, our institution adopted a nurse navigator program, in which all patients were assigned a nursing advocate to provide postoperative surveillance. Nurse navigators contact patients at 11, 30, and 90 days postoperatively to identify complications and unplanned clinical events both at our institution and outside hospitals, which are prospectively monitored in real time using an electronic database (Locus Health, Charlottesville, VA).

Cases were performed by 30 fellowship-trained surgeons at 17 different hospitals and surgical centers. Patients undergoing THA received uncemented components, and patients undergoing TKA received a cemented posterior-stabilized or cruciate-retaining prosthesis. All patients received preincisional antibiotics and a standardized multimodal pain regimen both before and after hospital discharge. Inpatient physiotherapy and occupational therapy generally began on the day of surgery and continued until discharge. Patients were discharged home after they could demonstrate independence with essential daily functions. However, a small number of patients were transferred to an inpatient rehabilitation facility or skilled nursing facility if they were deemed unfit for home discharge. Formal outpatient physical therapy was standard of care for patients after TKA but was not commonly prescribed after THA. Instead, patients participated in unsupervised home exercise.

In addition to nurse navigator surveillance, we also reviewed multiple institutional databases, including provider clinical dictations, postoperative patient phone calls, and administrative codes for postdischarge procedures (current procedural terminology) and diagnoses (International Classification of Disease codes). Unremarkable urgent care (UC) or ED visits, in which there was no identifiable complication, were categorized as such. Hospital readmissions were considered to be either inpatient status, in which the patient's condition met insurance criteria for hospital admission, or observation status, in which the patient could be observed for less than 2 midnights.

EOC expenditures were obtained from Centers for Medicare & Medicaid Services (CMS) Quality and Resource Use Reports, which are provided biannually, and Independence Blue Cross Claim Data Warehouse Reports, which are conveyed annually. As such, data on postacute care costs were not available for all patients in our cohort. In tabulating postacute EOC costs, only costs subsequent to discharge from the acute inpatient hospital were considered. Expenditures associated with direct discharge to an inpatient rehabilitation facility or skilled nursing facility were not included, as they are not a reflection of postdischarge complications or events. However, extended care facility costs following hospital readmission were considered to be part of postacute care. Postacute care costs were provided as both mean cost per episode and per capita cost. Mean cost per episode was obtained by calculating the average postacute EOC cost for each patient who experienced a particular clinical event or complication and for whom cost data were available. Per capita cost was calculated as an estimate of the cost burden or cannibalization that can be attributed to a particular clinical event or complication per patient in the entire cohort, not just those experiencing that particular event. This was calculated as the mean cost per episode for patients with a particular complication or clinical event less the mean cost for patients with an uncomplicated course (presumed baseline cost of postdischarge care), which was subsequently multiplied by the incidence of that particular complication or event.

Statistical Analysis

Continuous variables were compared with a Student *t*-test and categorical variables with a Fisher exact test. A *P* value of <.05 was considered significant.

Results

We identified 3953 THA and 7003 TKA patients in our electronic navigator database during the study period, of which 3018 THA and 5389 TKA patients met study inclusion criteria. Mean age at the time of surgery was 64.5 years and 67.1 years for THA and TKA patients, respectively ($P < .0001$; Table 1). While nearly an equal number of males (48.3%) and females (51.6%) underwent THA, considerably more TKA patients were female (60.4%) as compared to male (39.6%; $P < .0001$). Mean body mass index was 29.1 kg/m^2 and 31.1 kg/m^2 for THA and TKA, respectively ($P < .0001$). Simultaneous, bilateral TKA (12.2%) was more common than simultaneous, bilateral THA (3.2%; $P < .0001$). The mean length of hospitalization was 1.44 days and 1.95 days for THA and TKA, respectively ($P < .0001$). A greater proportion of THA patients (89.9%), as compared to TKA patients (78.9%), were discharged directly home ($P < .0001$), and a higher proportion of TKA patients (25.5%) required home healthcare services compared with THA patients (13.6%; $P < .0001$).

Of all THA and TKA patients, 93.6% and 88.9% of patients, respectively, experienced an uncomplicated 90-day postoperative course, with no ED or UC visits, hospital readmissions, or other associated complications ($P < .0001$; Table 2). Additionally, 3.35% of THA and 2.62% of TKA patients sought ED or UC services ($P = .057$). While there was a higher incidence of complicated ED or UC visits after THA (2.29%) than TKA (1.56%; $P = .021$), there was no difference in the incidence of uncomplicated ED or UC visits (1.06% for THA vs 1.13% for TKA; $P = .83$). Of note, only 43% of patients returned to the ED at the original operating facility. In contrast to ED and UC visits, there was a higher incidence of hospital readmission after TKA (3.69%) compared to THA (2.62%; $P = .009$). More specifically, while readmission for a medical complication was more likely for TKA patients (2.04%) than THA patients (1.16%; $P = .003$), there was

Table 1
Baseline Demographics and Patient Characteristics.

Variable	Total Hip Arthroplasty (N = 3018)	Total Knee Arthroplasty (N = 5389)
Age (y)	64.45 (10.96)	67.08 (9.33)
Gender		
Male	1462 (48.4%)	2134 (39.6%)
Female	1556 (51.6%)	3255 (60.4%)
BMI (kg/m^2)	29.14 (5.08)	31.07 (5.07)
Simultaneous bilateral	96 (3.2%)	657 (12.2%)
Length of stay (d)	1.44 (1.05)	1.95 (1.18)
Discharge location		
Home	2714 (89.9%)	4251 (78.9%)
IRF or SNF	290 (9.6%)	1088 (20.2%)
Not available	14 (0.5%)	50 (0.9%)
Home healthcare services	410 (13.6%)	1374 (25.5%)

Continuous variables as mean (standard deviation).
Categorical variables as raw sample N (%).
BMI, body mass index; IRF, inpatient rehabilitation facility; SNF, skilled nursing facility.