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The James A. Rand Young Investigator's Award: Administrative Claims vs Surgical Registry: Capturing Outcomes in Total Joint Arthroplasty

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ABSTRACT

Background: Administrative claims in total joint arthroplasty are used for observational studies and payment adjustments under the Comprehensive Care for Joint Replacement (CJR) legislation. Claims data have not been validated against prospective surgical outcome registries for primary total hip (THA) or knee arthroplasty (TKA). We hypothesized that significant differences in reported comorbidity and adverse event measures exist between administrative claims and prospective registry data relevant to payment adjudication under the CJR reimbursement model.

Methods: Comorbidities and outcomes in primary TKA and THA in the United Healthcare and Medicare Standard Analytical File 5% Sample insurance claims datasets (PearlDiver Technologies, Inc) were compared to age-matched cohorts from the National Surgical Quality Improvement Program (ACS-NSQIP) surgical outcomes data from 2007 to 2011 using comparable International Classification of Diseases, Ninth Revision, Clinical Modification and Current Procedural Terminology codes at 30, 90, and 360 days from index arthroplasty. Pearson's chi-square test was used for statistical analyses.

Results: The total study population included 93,953 primary THA and 176,944 TKA patients. Primary TKA and THA patients in insurance claims cohorts had significantly fewer reported comorbidities, higher rates of surgical site infection, pulmonary embolism, wound dehiscence, thromboembolic events, and neurologic deficits, and lower reported rates of revision surgery than ACS-NSQIP cohorts within 30 days of primary TKA and THA. Cumulative incidence of adverse events increased significantly from 30 to 360 days after primary arthroplasty.

Conclusion: We report significant discordance in the prevalence of patient comorbidities and incidence of adverse events in primary THA and TKA between ACS-NSQIP and the administrative claims data of Medicare and United Healthcare. These disparities have implications for observational outcome studies as well as payment adjudication under the CJR reimbursement model in total joint arthroplasty.

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Administrative healthcare reimbursement claims include clinical data automatically or manually abstracted by standardized coding from primary clinical documentation for insurance and billing purposes. When aggregated from large samples of patients,

administrative claims are useful for describing epidemiologic trends in surgical practice and common outcomes at and above a regional level [1–4]. Conclusions based on claims data are increasingly appearing in observational studies of practice patterns and clinical outcomes in total hip (THA) and total knee (TKA) arthroplasty [5–9]. Effective from April 1, 2016, administrative claims have also become the basis of Centers for Medicare and Medicaid performance-based payment adjustments under the Comprehensive Care for Joint Replacement (CJR) model of reimbursement in total joint arthroplasty (TJA) [10].

Concordance of administrative claims diagnosis coding with diagnoses in the primary medical record has been fair to very good for TJA because the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) revision in 2005

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introduced specific definitions for primary and revision total joint procedures [11,12]. However, administrative claims retain poor-to-moderate accuracy for capturing adverse events in primary and revision TJA [11,12]. By contrast, prospective surgical registries are designed to capture comorbidities and adverse events [13,14]. A comparison of national administrative data for TJA to a prospective surgical outcome registry has not been reported. We hypothesized that significant differences in patient demographics, comorbidities, and adverse event rates among TJA patients relevant to payment adjudication under the CJR reimbursement model exist between a validated, prospective national clinical database registry of short-term surgical outcomes and the administrative claims from the largest public and largest private US insurance payors.

Materials and Methods

Retrospective cohorts of patients undergoing primary THA or TKA were identified by Current Procedural Terminology (CPT) code from deidentified administrative claims from United Healthcare (ING) and the Medicare National Claims History Standard Analytical File 5% (SAF5) between 2007 and 2011 (PearlDiver Technologies, Inc, West Conshohocken, PA) [15]. Patients <65 years of age were included from ING claims. United Healthcare represents the health maintenance organization with the largest share, approximately 10%, of the US private health insurance market for the study interval [16]. ING claims are not weighted nor randomly sampled. Patients ≥ 65 years were included from SAF5. Medicare was the primary insurance payor for 40 million persons ≥ 65 years and was the primary payor for 46% of aggregate hospital costs in 2012 [17]. Medicare administrative claims data are based on beneficiary program enrollment and reimbursement and/or payment information drawn from patients across multiple health maintenance organizations. The SAF5 is a randomly sampled subset weighted to represent the national Medicare patient population. ING and SAF5 offer the largest uniform administrative claims sets for the respective target age and payor demographics for the study interval [18].

Reference cohorts of patients <65 years of age and ≥ 65 years undergoing primary THA or TKA were identified in the prospectively collected American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) 30-day, short-term outcomes registry (American College of Surgeons, Chicago, IL) for the study interval of 2007–2011. Although multiple surgical registries reporting outcomes in TJA are available and suitable for use as a reference comparison, ACS-NSQIP represents a validated, accurate, and generalizable surgical registry reporting well-defined comorbidities and short-term, 30-day complications in elective surgeries that is well established in the study of TJA outcomes in the United States [2,14,19–22].

The preoperative prevalence of medical comorbidities as well as the postoperative incidence of adverse events, revision surgeries, and unplanned readmissions coded in the ACS-NSQIP data were approximated by tabulating equivalent or comparable ICD-9 and CPT codes using the crosswalk methodology of Best et al [13] across all available inpatient and outpatient encounters within 30 days from index procedure in ING and SAF5 claims (Supplement PearlDiver Code). The incidence of each outcome was also assessed at 90, 180, and 360 days from the index arthroplasty surgery. Prevalence of each comorbidity and incidence of adverse surgical outcomes were compared by Pearson's chi-square test between age-matched cohorts of ACS-NSQIP registry and administrative claims patients. All statistical tests were 2-tailed, and the level of significance was set at $\alpha = 0.05$.

Results

The THA sample included 48,900 patients <65 years (8461 in ACS-NSQIP and 40,439 in ING) and 45,053 patients ≥ 65 years (8960 in ACS-NSQIP and 36,093 in SAF5). The TKA sample included 81,454 patients <65 years (11,727 in ACS-NSQIP and 69,727 in ING) and 95,490 patients ≥ 65 years (17,188 in ACS-NSQIP and 78,302 in SAF5). For TJA patients <65 years of age, there were statistically significant differences in sex and age distribution between ACS-NSQIP and ING for both THA (Table 1) and TKA (Table 2). The prevalence of lifestyle comorbidities including body mass index (BMI), smoking, and alcohol abuse was an order of magnitude greater in ACS-NSQIP cohorts <65 years than ING cohorts undergoing TKA and THA ($P < .001$ all comparisons). Cardiopulmonary comorbidities including hypertension (58.5% vs 1.5%, $P < .001$), chronic obstructive pulmonary disease (2.7% vs 0.2%, $P < .001$), prior coronary intervention (2.7% vs 0.1%, $P < .001$), and dyspnea on exertion or at rest (6.9% vs 1.2%, $P < .001$) were similarly more prevalent in the ACS-NSQIP TKA cohort <65 years than in ING claims. The magnitude of these disparities in comorbidities was observed between all THA claims and registry cohorts (Table 1) as well as between ACS-NSQIP and the SAF5 for TKA patients ≥ 65 years (Table 2). Angina, renal failure, dialysis, and dependence on mechanical ventilation were not captured in ING. BMI distributions did not sum to more than 19% or 65% of patients in the ING or SAF5 claims, respectively, indicating missing BMI, weight, and/or height data in claims entries compared with 100% in all ACS-NSQIP cohorts.

Among TJA patients ≥ 65 years, there were significant differences in sex and age distribution for TKA and THA. Diabetes was more prevalent among SAF5 than ACS-NSQIP patients (30.8% vs 13.1% and 36.3% vs 19.1%, respectively, $P < .001$) for THA and TKA, respectively. Peripheral vascular disease, history of transient ischemic attack, stroke, and smoking were also more prevalent in SAF5 ($P < .001$ for all comparisons). Alcohol abuse was clinically similar between the older cohorts (2.1% vs 1.8%, $P = .092$ and 1.4% vs 1.3%, $P = .187$). Hypertension was much more prevalent among ACS-NSQIP patients ≥ 65 years for THA (70.0% vs 19.0%, $P < .001$) and TKA (75.3% vs 19.8%, $P < .001$) patients. Angina was not captured in the SAF5 data.

With regard to postsurgical adverse events, THA patients <65 years in the ING cohort reportedly experienced significantly higher rates of acute prosthesis failure (4.5% vs 0.1%, $P < .001$), wound dehiscence (0.3% vs 0.1%, $P = .002$), deep vein thrombosis (DVT; 0.8% vs 0.3%, $P < .001$), coma (0.3% vs 0%, $P = .019$), new neurologic deficit (0.3% vs 0.1%, $P = .001$); lower rates of sepsis (0.1% vs 0.4%, $P < .001$) and blood transfusion (0.9% vs 12.3%, $P < .001$); and no significant difference in acute revision arthroplasty surgery, surgical site infections, pneumonia, pulmonary embolism, stroke, or myocardial infarction compared to ACS-NSQIP controls (Table 3). THA patients ≥ 65 years in the SAF5 cohort experienced significantly higher rates of acute prosthesis failure (6.5% vs 0.1%, $P < .001$), surgical site infection (2.0% vs 1.3%, $P < .001$), wound dehiscence (0.3% vs 0.1%, $P = .002$), sepsis (3.4% vs 0.5%, $P < .001$), DVT (4.9% vs 0.7%, $P < .001$), pulmonary embolism (1.5% vs 0.4%, $P < .001$), stroke (1.6% vs 0.3%, $P < .001$), coma (2.1% vs 0%, $P < .001$), new neurologic deficit (0.7% vs 0.1%, $P < .001$), myocardial infarction (1.5% vs 0.3%, $P < .001$), blood transfusion (0.9% vs 12.3%, $P < .001$); lower rates of acute revision arthroplasty (1.6% vs 2.1%, $P = .001$) and urinary tract infection (0.1% vs 2.0%, $P < .001$); and no significant difference in septic shock, pneumonia, unplanned reintubation, prolonged mechanical ventilation, or cardiac arrest requiring cardiopulmonary resuscitation compared to ACS-NSQIP controls (Table 3).

TKA patients <65 years in the ING cohort experienced significantly higher rates of acute prosthesis failure (4.7% vs 0.0%,

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