



Hospital Acquired Conditions Are the Strongest Predictor for Early Readmission: An Analysis of 26,710 Arthroplasties



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ABSTRACT

Hospital readmission is a metric of hospital quality of care, yet little is known what factors predict hospital readmission following arthroplasty. Our aim was to identify variables associated with early readmission following knee and hip arthroplasty, with focus upon hospital acquired conditions (HACs). Retrospective cohort analysis using Surgical Care Improvement Project (SCIP) and Veteran's Affairs Surgical Quality Improvement Program (VASQIP) data was performed over a five-year period. Following 26,710 total and partial primary arthroplasties (16,808 knees and 9902 hips), the overall 30-day readmission was 7.3% (1940) with readmission rates of 6.6% for knee arthroplasty and 8.4% for hip arthroplasty. HACs accounted for 42% of all complications and were the strongest predictor of readmission. Efforts to reduce these events may improve cost and safety of arthroplasty.

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Joint arthroplasty is one of the most commonly performed surgical procedures and is principally used in the treatment of degenerative joint disease. The majority of patients experience improved function with joint pain relief. Due to the success of total joint arthroplasty and the growing aging population, it is anticipated that over the next twenty years primary total knee arthroplasty (TKA) will grow by nearly 700%, and primary total hip arthroplasty (THA) will increase by nearly 200% [1]. By 2015, annual costs of TKA and THA are projected to be \$40.8 billion and \$17.4 billion, respectively [2,3]. THA and TKA procedures combined account for the largest procedural costs in Medicare expenditures [2,4]. Unfortunately, complications and early readmissions do occur. As arthroplasty rates continue to increase, the rising costs associated with management of complications and readmissions have become a growing concern [5,6].

Hospital readmission is an important factor in patient outcomes and, in light of policy reform, has become a quality performance metric of health care [5,7]. Early hospital readmissions are a primary driver for the increases in total cost of inpatient care following joint arthroplasty [5]. Not specific to joint arthroplasty, readmission costs for Medicare are in excess of \$17 billion per year [8]. Starting in 2012, readmissions following specific procedures became a factor in pay-for-performance compensation models, with providers being penalized for unplanned readmissions [9,10]. Thus, all-cause hospital readmission represents an opportunity to simultaneously improve patient care and reduce costs [2].

Multiple factors have been associated with early readmission, but the results of such studies vary greatly and have been poorly reproduced [2,9,11–14]. Furthermore, such studies typically assess non-modifiable variables such as: increasing age, male gender, comorbid conditions, race, and procedure type (primary vs. revision, unilateral vs. bilateral TKA) [9,11,15–17]. Additionally, the impact of modifiable risk factors such as smoking status, alcohol consumption, obesity, length of index stay, and discharge disposition has mixed conclusions [9,11–14,17,18]. Current literature urges future studies to focus on modifiable risk factors, post-operative complications and preventable medical causes of readmission [5,9,17].

More recently, studies have begun to investigate complications following arthroplasty and their association with early readmissions. Over 40% of readmissions within 90 days of discharge are related to

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surgical complications, and more than 60% of patients may experience at least one complication following arthroplasty [15,17]. Further, nearly half of all 30-day readmissions have been identified as being potentially preventable [19]. In conjunction with healthcare quality promotion, reimbursement policy reform, and the Deficit Reduction Act of 2005, the Center for Medicaid and Medicare Services (CMS) has delineated a number of medical conditions, termed “Hospital Acquired Conditions (HACs),” which are viewed as resulting from or related to medical services rendered and are considered to be preventable complications. More specifically, HACs are medical conditions that the patient did not come to the hospital with but developed during or attributed to their hospital stay, care, or treatment. These HACs include: foreign object retained after surgery, air embolism, pressure ulcer stages III and IV, injuries related to falls and trauma (fracture, dislocation, intracranial injury, crushing injury, burn), catheter associated urinary tract infection, vascular catheter-associated infection, manifestations of poor glycemic control (diabetic ketoacidosis, nonketotic hyperosmolar coma, hypoglycemic coma, secondary diabetes with ketoacidosis, secondary diabetes with hyperosmolarity), surgical site infections, mediastinitis following coronary artery bypass graft, deep vein thrombosis and pulmonary embolism [20]. In 2012 alone, there were an estimated 4,316,000 HACs recorded [21]. Despite these collective issues being under scrutiny by the CMS for nearly a decade, no studies to date have investigated the relationship between HACs and early hospital readmissions following joint arthroplasty.

The purpose of this study was to identify variables associated with early readmission following hip or knee arthroplasty, with particular focus upon HACs. Our hypothesis is: HACs are significantly associated with complications and early readmission following lower extremity joint arthroplasty.

Materials and Methods

We employed a retrospective cohort study using national Veteran’s Administration (VA) data on patients from 96 hospitals undergoing total and partial knee or hip arthroplasties from 2005 to 2009. The study protocol was reviewed and approved by the local VA Institutional Review Board with waiver of informed consent.

Data Sources

Data from both the Surgical Care Improvement Project (SCIP) and the Veterans’ Affairs Surgical Quality Improvement Program (VASQIP) were used. The Veterans Health Administration (VHA) Office of Information and Analytics External Peer Review Program contracts with the West Virginia Medical Institute to collect VA hospital SCIP measures. The process began in 2005 according to guidelines set forth by the Joint Commission on Accreditation of Healthcare Organizations and the Centers for Medicaid and Medicare Services. Frequent assessment of the abstracted information to assure reliability is performed [22]. The VASQIP was started in 1991 to analyze risk-adjusted 30-day postoperative morbidity and mortality data within the VA healthcare system [23,24]. The VASQIP collects demographics, preoperative risk and laboratory data, operative data, and 30-day postoperative morbidity and mortality outcomes on a majority of patients undergoing major surgery in the VA Healthcare System. Clinical nurse reviewers, trained in clinical medicine and quality assurance, complete in-depth training on the data collection procedures and detailed definitions of each of the variables. The quality of the data at a sample of VA Medical Centers showed that VASQIP data are highly reliable [25]. Readmissions data were obtained from the Corporate Data Warehouse.

Study Cohort

Patients undergoing primary hip arthroplasty (CPT codes 27125, 27130, 27236) or primary knee arthroplasty (CPT codes 27440, 27441,

27442, 27443, 27446, 27447) were included in the sample [26]. Patients who were ASA 5 ($n = 5$), undergoing revision arthroplasty ($n = 799$, CPT codes 27486, 27487, 27134, 27132, 27137, 27138) or had a wound classification other than clean ($n = 272$) were excluded.

Study Variables

The independent variable of interest was HAC incidence, defined as one of four complications: venous thromboembolism (VTE), urinary tract infection (UTI), surgical site infection (SSI), or pneumonia. These four complications were selected from the CMS core ten items as VASQIP collects only a specific group of complications, as well as identification of these events being the most frequent and applicable risks to our cohort and procedures. The dependent variable of interest was re-admission within 30 days of discharge from the index hospital stay.

Patient level covariates known to predict early readmissions, including demographics, lifestyle variables (e.g., tobacco and alcohol use), cardiovascular, pulmonary, renal, hepatobiliary, nutritional and immune comorbidities (defined as regular administration of oral or parenteral corticosteroid medication in the 30 days prior to admission for a chronic medical condition) were obtained from VASQIP [25]. Procedure covariates considered in our analyses include type of arthroplasty (hip or knee), procedure indication, wound classification, American Society of Anesthesiologist (ASA) status, and duration of the operation (incision to surgery end time).

Statistical Analyses

Risk factors for readmission within 30 days of hospital discharge were identified using chi-square tests. Multivariate logistic regression models were used to assess independent predictors of 30-day readmission at the patient level, and linear regression was used to estimate correlation with readmission rates at the hospital level. Facility level analysis was performed, computing Pearson correlation coefficients and excluding VA hospitals that contributed fewer than 10 cases. All analyses were completed using SAS v9.2.

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Results

A total of 26,710 surgical procedures performed at 96 VA facilities were included in this five-year cohort. Of those, 16,808 (62.9%) were knee arthroplasties, with the remaining 9902 (37.1%) procedures being hip arthroplasties. Overall, 7.3% ($n = 1940$) of all cases were readmitted within 30 days following the index stay discharge. Broken down, 6.6% ($n = 1106$) of knee arthroplasties underwent early readmission, whereas 8.4% ($n = 834$) of hip arthroplasties were readmitted ($P < 0.0001$) (Table 1).

Overall, 12.4% ($n = 3306$) of patients experienced at least one post-operative complication and were subsequently more likely to be readmitted than those without a complication (26.1% vs. 4.6%, $P < 0.0001$). Forty-four percent of readmissions were associated with at least one post-operative complication. There were a total of 3571 complications, with HACs accounting for 41.7% ($n = 1489$) of all complications among 1405 patients (Table 2). Likewise, there were 2082 non-HAC complications among 1901 patients (Table 2). Urinary tract infections, accounting for 33.8% of all HACs, were the most frequent HAC experienced, followed by surgical site infections (26.9%), VTE (23.5%), and pneumonia (15.8%) (Fig. 1). HACs were concomitant with at least one other hospital acquired condition 11.1% of the time.

Multivariate logistic regression analysis of all complications, patient, and procedure level covariates identified HACs to be the strongest

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