Original Article

Patterns of Ninety-Day Readmissions Following Total Joint Replacement in a Bundled Payment Initiative

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ABSTRACT

Background: Alternative payment models aim to improve quality and decrease costs associated with total joint replacement. Postoperative readmissions within 90 days are of interest to clinicians and administrators as there is no additional reimbursement beyond the episode bundled payment target price. The aim of this study is to improve the understanding of the patterns of readmission which would better guide perioperative patient management affecting readmissions. We hypothesize that readmissions have different timing, location, and patient health profile patterns based on whether the readmission is related to a medical or surgical diagnosis.
Methods: A retrospective cohort of 80 readmissions out of 1412 total joint replacement patients reimbursed through a bundled payment plan was analyzed. Patients were grouped by readmission diagnosis (surgical or medical) and the main variables analyzed were time to readmission, location of readmission, and baseline Perioperative Orthopaedic Surgical Home and American Society of Anesthesiologists scores capturing pre-existing state of health. Nonparametric tests and multivariable regressions were used to test associations.
Results: Surgical readmissions occurred earlier than medical readmissions (mean 18 vs 33 days, $P = .011$), and were more likely to occur at the hospital where the surgery was performed ($P = .035$). Perioperative Orthopaedic Surgical Home and American Society of Anesthesiologists scores did not predict medical vs surgical readmissions ($P = .466$ and .879) after adjusting for confounding variables.
Conclusion: Readmissions appear to follow different patterns depending on whether they are surgical or medical. Surgical readmissions occur earlier than medical readmissions, and more often at the hospital where the surgery was performed. The results of this study suggest that these 2 types of readmissions have different patterns with different implications toward perioperative care and follow-up after total joint replacement.

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The annual number of total hip and knee replacements performed for arthritis has increased substantially over the past decade [1]. Current estimates project an increase in total hip and total knee replacement by 174% (572,000) and 673% (3.48 million) respectively by the year 2030 [2]. Given this surge in demand, the Center for Medicare and Medicaid services created an initiative to help control costs and improve quality of care delivered to this population. This pilot project, the Bundled Payment for Care Improvement Initiative (BPCI), was a successful alternative payment, voluntary demonstration project, and it led to the mandatory Comprehensive Care for Joint Replacement (CJR) project which began on April 1, 2016. CJR aims to increase value of care by holding

providers accountable for readmissions and complications associated with total joint arthroplasty (TJA). Hospitals and providers are reimbursed a set amount for all care provided to a patient from admission for index surgery and for a 90-day period after discharge [3]. This emphasizes the importance of postdischarge care [4] because any readmissions during that period will not be reimbursed beyond the initial payment. Given this new payment structure, a key to improving cost effectiveness and quality metrics is to improve clinical protocols and pathways [5].

To achieve this goal, it is of prime importance that providers develop a better understanding of the patterns and factors associated with postsurgical readmissions, which play a major role in the cost and quality of care [6]. A relevant variable is the timing between medical and surgery-related readmissions. Given a 90-day episode of reimbursement under the bundled payment model, it is important to understand whether the readmissions occurring during this period are medical rather than surgical because this holds different implications for postoperative monitoring and follow-up. Similarly, preoperative health status and baseline comorbidities may affect the cause of readmission, and therefore hold importance in postoperative follow-up. For instance, patients with multiple comorbidities may be more likely to be readmitted for a medical diagnosis within the first 90 days, and perhaps should not be considered a complication of surgery, and may also demand closer medical follow-up postoperatively. Finally, another variable worth examining is the location of readmission. It seems likely that patients with a postoperative surgical complaint would return to the hospital where the surgery was performed, as opposed to another convenient hospital if the readmission cause was not surgery related. This is particularly relevant when considering the hospital costs associated with readmission.

The main aim of this study is to identify key factors that are associated with readmission within 90 days and whether readmission is related to surgery or medical diagnoses. We hypothesize that surgical readmissions are less frequent, occur earlier in the bundled episode, and are more likely to occur at the hospital where the surgery was performed, rather than at a different location. Furthermore, we also hypothesize that readmissions for medical rather than surgical complications are associated with poorer pre-existing health status.

Materials and Methods

Study Design and Population

An Institutional Review Board–approved data repository containing patients undergoing total joint replacement at our institution from December 31, 2013 to September 4, 2015, who were part of the BPCI program, was analyzed in this retrospective cohort study. The data were collected as part of an existing quality control initiative evaluating performance in lower extremity joint replacement at a high volume, academic orthopedic hospital in an urban setting. Patients were included if they were admitted for a diagnosis-related group 469 or 470 (which includes primary [total or partial] hip, knee, and ankle replacement), and had primary insurance coverage consisting of Medicare part A and B or Railroad Medicare throughout their episode of care, and were part of the bundled payment program. Of this group of patients, we limited our analysis to elective TJA patients who were readmitted within 90 days following surgery and had complete data on our hypothesis variables of interest (Fig. 1).

The primary outcome of interest analyzed was a binary variable capturing the type of readmission in the first 90 days: whether related to the index procedure (ie, surgical) or unrelated to surgery (ie, medical). This was defined based on the CJR guidelines
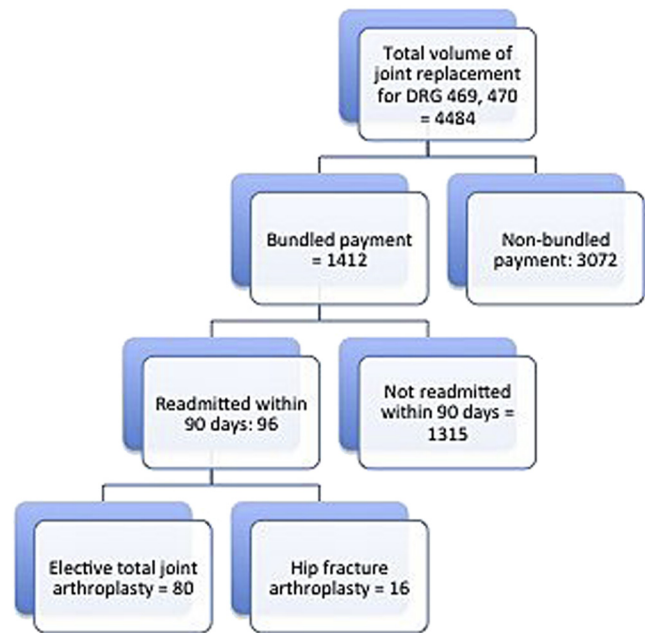

Fig. 1. Flowchart depicting the inclusion of subjects from a data repository of bundled payment program reimbursed total joint arthroplasty patients from December 31, 2013 to September 4, 2015 at one institution.

indicating the following readmission diagnoses as surgical complications: acute myocardial infarction, pneumonia, or sepsis/septicemia within 7 days of admission; surgical site bleeding, pulmonary embolism, or death within 30 days of admission; or mechanical complications, periprosthetic joint infection, or wound infection within 90 days of admission. If the reason for readmission did not fit this definition, it was considered a medical readmission. Only the initial readmission since surgery was considered and analyzed.

To test our hypotheses, we analyzed independent variables in association with the type of readmission. Time since discharge was analyzed as a categorical variable of <30 days or $\geq$30 days. The location of readmission was also a binary variable categorized as hospital of index surgery or outside hospital. Finally, to capture pre-existing medical condition, we utilized the Perioperative Orthopaedic Surgical Home (POSH) readmission scoring tool [7], which quantifies risk factors (methicillin-resistant *Staphylococcus aureus* colonization, smoking, body mass index [BMI], physical deconditioning, diabetes control, venous thromboembolism risk, history of vascular disease, alcohol or drug abuse) with scores ranging from 0 to 12 and predicts readmission risk (higher scores predicting higher risk). The categorical American Society of Anesthesiologists (ASA) score was also analyzed [8]. Demographic variables such as age, BMI, sex, race, smoking status, marital status, distance of living place from hospital, and discharge disposition were also considered in the analysis.

Statistical Analysis

Based on the Kolmogorov-Smirnov and the Shapiro-Wilk tests for normal distribution of continuous variables, there was non-normal distribution of subjects within some variables in the dataset. Therefore, nonparametric tests were used to test the associations of interest. Fisher's exact test and Pearson chi-square test were used as appropriate for categorical variables, while the Mann-Whitney U-test was used for continuous independent variables. Subsequently, a multivariable logistic regression model