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## Original Article

## Variation in Diagnoses for Hip Arthroplasty Among New York State Hospitals: Implications for the Comprehensive Care for Joint Replacement Model

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## ABSTRACT

**Background:** The Comprehensive Care for Joint Replacement model is designed to minimize costs and improve quality for Medicare patients undergoing joint arthroplasty. The cost of hip arthroplasty (HA) episode varies depending on the preoperative diagnosis and is greater for fracture than for osteoarthritis. Hospitals that perform a higher percentage of HA for OA may therefore have an advantage in the Comprehensive Care for Joint Replacement model. The purposes of this study are to (1) determine the variability in underlying diagnosis for HA in New York State hospitals, and (2) determine hospital characteristics, such as volume, associated with this.

**Methods:** The New York Statewide Planning and Research Cooperative System database was used to identify 127,206 primary HA procedures from 2010 to 2014. The data included underlying diagnoses, age, length of stay, and total charges. Hospitals were categorized by volume and descriptive statistics were used.

**Results:** OA was the underlying diagnosis for HA for 74.2% of all patients; this was significantly higher for high-volume (89.30%) and medium-volume (74.9%) hospitals than for low-volume hospitals (58.4%,  $P < .05$ ). HA for fracture was significantly more common at low-volume hospitals (32.4%) compared to medium-volume (18.0%) and high-volume (4.7%) hospitals ( $P < .05$ ). Length of stay was significantly greater at low-volume hospitals for all diagnoses.

**Conclusion:** High-volume hospitals perform a higher ratio of HA cases for OA compared to fracture, which may lead to advantages in patient outcomes and cost. The variation in underlying diagnosis between hospitals has financial implications and underscores the need for HAs to be risk stratified by preoperative diagnosis.

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Healthcare costs in the United States are rising at an unsustainable rate. Total hip and total knee arthroplasty are the most common inpatient procedures for Medicare beneficiaries. In 2014, there were more than 400,000 total hip and knee arthroplasty

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procedures performed in the United States, costing more than \$7 billion for the hospitalizations alone [1]. In an effort to curb rising healthcare costs and to promote quality, the Centers for Medicare and Medicaid Services (CMS) introduced the Bundled Payment for Care Improvement in 2011 [2,3]. In this model, rather than a fee-for-service structure, providers received a single bundled payment for the management of the entire episode of care surrounding lower extremity joint replacement including all care for 90 days following hospital discharge.

On April 1, 2016, CMS expanded this program with the Comprehensive Care for Joint Replacement (CJR) model [1]. The CJR model has been implemented in 791 hospitals located within 67 metropolitan statistical areas across the United States. During the 5 performance years of this model, hospitals will be provided a target price for each lower extremity joint replacement episode of care.

The target price will initially be hospital specific, but over the course of the 5-year period, the price will increasingly reflect the average cost of an episode of care within a hospital's specific geographical region. At the end of each fiscal year, hospitals that are cost-efficient will receive reconciliation payments, provided that they meet certain quality standards. Hospitals that exceed the target price spending will be forced to pay a penalty fee to Medicare.

Within this model, hospitals are rewarded if they are able to provide more cost-efficient and high-quality care compared to other hospitals in their regional geographic area. As this model is developed for more widespread use, it will be important to identify the factors that contribute to variations in cost and quality between hospitals. One factor that is likely to affect hospital cost is the patient's underlying diagnosis. Hip arthroplasty (HA) is most commonly performed for end-stage osteoarthritis (OA) of the hip but may also be performed for hip fracture, avascular necrosis, pathological fracture, and other diagnoses. CMS has recognized that the cost of care may vary based on patient diagnoses, and plans to implement a specific pricing methodology for hip fracture patients due to the specifically higher spending associated with these complex cases [1]. The purposes of our study are to (1) determine the variability in underlying diagnosis for HA in New York State hospitals, and (2) determine hospital characteristics, including volume, that are associated with this.

## Materials and Methods

The New York Statewide Planning and Research Cooperative System (SPARCS) administrative database was used to identify all 277,127 admissions from 2010 to 2014 for Medicare Severity-Diagnosis Related Group MS-DRG 469 (major joint replacement or reattachment of lower extremity with major complications or comorbidities [MCC]) or MS-DRG 470 (major joint replacement or reattachment of lower extremity without MCC). From this list, we isolated a total of 127,206 HA admissions with MS-DRG 301 ("hip joint replacement"). Extracted data included the associated International Classification of Diseases, Ninth Edition (ICD-9) code, patients' age, severity of illness, length of stay, and total charges per patient.

In order to assess differences by hospital volume, we created 3 categories of hospital volume: low, medium, and high. In accordance with previous studies, all hospitals reporting DRG 469 and 470 were ranked in order of increasing total hospital volume, and then 3 groups were defined by selection of whole-number cutoff points for annual volume that most closely sorted the patients into 3 groups of equal size [4–10]. For 2014, the resulting low-volume, medium-volume, and high-volume categories consisted of hospitals performing 228 or less, between 229 and 585, and over 586 total hip arthroplasty (THA) surgeries per year, respectively. The whole-number cutoff points varied by year.

To determine the primary diagnosis for each patient undergoing THA, we determined the ICD-9 code associated with each DRG 469 and 470. The 3 most common ICD-9 codes were identified: (1) 715—OA and allied disorders, (2) 820—fracture of the neck of the femur, and (3) 733—other disorders of bone and cartilage. All other ICD codes were included under the category "other." The number of THAs with these 3 codes was then determined for low-volume, medium-volume, and high-volume hospitals, with trends examined over time from 2010 to 2014. Differences in patient age, length of stay, total charges, and severity of illness between low-volume, medium-volume, and high-volume hospitals were determined using 1-way analysis of variance. Differences between individual groups were determined using post hoc analysis. The ratio of THAs performed for OA vs hip fracture was calculated over the time

period studied. Pearson correlation analysis was used to determine the relationship between these variables, with statistical significance set at  $<0.05$ .

## Results

Between 2010 and 2014, a total of 127,206 HA procedures were performed in the 175 hospitals included for analysis. In 2014, low-volume, medium-volume, and high-volume hospitals performed an average of 67.6 (range, 1–227), 343.1 (range, 229–585), and 1293.3 (range, 590–4217) THA procedures. The average number of HA procedures increased for low-volume ( $n = 58.78$ – $67.6$ ;  $P > .05$ ), medium-volume ( $n = 224.6$ – $343.1$ ;  $P < .05$ ), and high-volume hospitals ( $n = 892.4$ – $1293.3$ ;  $P < .05$ ) from 2010 to 2014, but none of these changes were statistically significant. The most common diagnoses associated with HA in order of prevalence were ICD-9 715 (OA and allied disorders), ICD-9 820 (fracture of neck of femur), and ICD-9 733 (other disorders of bone and cartilage; Fig. 1). OA was the underlying diagnosis for HA for 74.2% of all patients; this percentage was significantly higher for high-volume (89.3%) and medium-volume (74.9%) hospitals than for low-volume hospitals (58.4%,  $P < .05$ ; Fig. 1). The percentage of HAs performed for femoral neck fracture was significantly higher at low-volume hospitals (32.4%) compared to medium-volume (18.0%) and high-volume (4.77%) hospitals (Fig. 1). The next most common diagnosis was ICD-9 733 ("other disorders of bone and cartilage"), which comprised approximately 5% of HA performed across all hospitals (Fig. 1).

The average number of HA procedures per diagnosis by hospital volume from 2010 to 2014 is shown in Table 1. The average number of HA procedures performed per year for OA increased for high-volume (from 782.2 to 1168.6 procedures/year), medium-volume (from 162.9 to 268.0 procedures/year), and low-volume hospitals (from 32.8 to 41.1 procedures/year) over the time period studied; however, none of these changes were statistically significant. The average number of HA procedures performed per year for all other diagnoses did not significantly increase over the time period studied or by hospital volume (Table 1).

The average patient age for all THA patients was lower at high-volume hospitals (63.9 years) compared to medium-volume (67.3 years) and low-volume (69.8 years) hospitals ( $P < .05$ ). The average age of patients undergoing THA for femoral neck fracture was significantly greater than for OA (81.1 vs 64.5,  $P < .05$ ). Overall length of stay was significantly higher in low-volume hospitals (4.78 days) compared to medium-volume (3.68 days) and high-volume hospitals (2.98 days), which remained true for both OA and hip fracture patients.

The ratio of HA procedures performed for OA vs hip fracture is significantly greater at high-volume hospitals (OA/fracture ratio = 18.74) than medium-volume (ratio = 4.19) or low-volume (ratio = 1.80) hospitals (Table 2). This ratio has slowly increased for all hospitals for the time period from 2010 to 2014. The relationship between the total number of HA procedures performed per year and the ratio of HA procedures performed for OA vs femoral neck fracture was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality and linearity. There was a strong, positive correlation between the 2 variables,  $r = 0.917$ ,  $n = 171$ ,  $P < .00001$ , with greater hospital volume associated with a higher ratio of HA performed for OA vs hip fracture.

## Discussion

We found that the ratio of THA procedures performed for OA compared to femoral neck fracture is significantly higher at

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