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## Differences in Hospital Billing for Total Joint Arthroplasty Based on Hospital Profit Status

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## ABSTRACT

**Background:** Regional variations in hospital billing for total joint arthroplasty (TJA) have been reported. It is not clear whether differences exist in hospital charges for TJA based on hospital profit status.

**Methods:** Data from the Centers for Medicare and Medicaid Services on Medicare Severity-Diagnosis Related Groups (MS-DRGs) 469 (TJA with comorbidity) and 470 (TJA without comorbidity) for fiscal year 2011 were analyzed. Differences in hospital charges and payments were investigated based on hospital profit status (nonprofit, government, and proprietary). Generalized estimating equations determined differences in charges and reimbursement between hospital types controlling for census region, MS-DRG, and number of discharges.

**Results:** Significant differences in billing between institutions existed with median average hospital charges for nonprofit, government, and proprietary institutions being \$70,514.30, \$73,540.99, and \$113,203.77 ( $P < .0001$ ), respectively, for DRG 469 and \$45,363.95, \$44,956.57, and \$62,715.39 ( $P < .0001$ ), respectively, for DRG 470. Median average Centers for Medicare and Medicaid Services payments for nonprofit, government, and proprietary institutions for DRG 469 were \$22,334.34, \$21,346.65, and \$21,281.30 ( $P = .017$ ), respectively, and \$14,461.95, \$14,466.04, and \$13,733.62 ( $P < .0001$ ), respectively, for DRG 470. Multivariate analyses indicate that nonprofit hospitals charge 5% more ( $P = .021$ ) and receive 3% less ( $P = .011$ ) reimbursement than government hospitals. Proprietary hospitals charge 34% more ( $P < .0001$ ) and receive 7% less ( $P < .0001$ ) reimbursement than government hospitals.

**Conclusion:** Significant differences in hospital charges based on institution profit status were found, with proprietary institutions charging significantly more than nonprofit and government institutions. However, proprietary institutions had the lowest median average reimbursement.

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Total joint arthroplasty (TJA) is an effective and proven treatment for end-stage joint disease, and its utilization is expected to continue to grow with the aging American population [1–3]. In addition

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to increasing utilization, charges for TJA have continued to climb despite decreased physician reimbursement, attempts to control implant costs, reduced length of stay, and other measures intended to curb expenditures [4,5]. As a result, health care reform and cost containment continue to be a significant area of interest [6,7].

In May 2013, Centers for Medicare and Medicaid Services (CMS) released data regarding the most common 100 inpatient Medicare Severity-Diagnosis Related Groups (MS-DRGs) for >3000 hospitals for fiscal year 2011. Included in this release of information were data regarding DRGs 469 (Major Joint Replacement or Reattachment of Lower Extremity with Major Complicating or Comorbid Condition) and 470 (Major Joint Replacement or Reattachment of Lower Extremity without Major Complicating or Comorbid

Condition). It also included the names and locations of the facilities, the number of procedures for each DRG performed, and the mean hospital charge and mean total payment for each DRG. Mean hospital charges were determined by each hospital for items and services provided based on what each institution charges for those services. Total payment amounts include the DRG amount, bill total per diem, primary payer payment amount, beneficiary Part A coinsurance amount, beneficiary deductible amount, beneficiary blood deductible amount, and DRG outlier amount.

The Centers for Medicare and Medicaid Services represents the largest payer for TJA [8,9]. Previously, it has been shown that regional differences in arthroplasty rates [1–3] exist with more recent studies showing significant variations among institutions for both charges and payments for TJA DRGs [9–12]. It is not clear, however, what the role of institution profit status plays on variations in both billing and payments for TJA. As such, the purpose of this study was to determine the difference in hospital billing and reimbursement practices between nonprofit, government, and proprietary institutions for TJA Medicare beneficiaries.

## Materials and Methods

We used the CMS Inpatient Medicare Provider Utilization and Payment Data [13]. This data set is publicly available and includes hospital-specific charges for >3000 US hospitals that receive Medicare Inpatient Prospective Payment System payments. The data represent >7 million discharges for fiscal year 2011–2012 of the top 100 most frequently billed discharges, paid under Medicare based on a rate per discharge using the MS-DRG. For this study, we restricted the data to MS-DRGs 469 (Major Joint Replacement or Reattachment of Lower Extremity with Major Complicating or Comorbid Condition) and 470 (Major Joint Replacement or Reattachment of Lower Extremity without Major Complicating or Comorbid Condition). Data from 932 institutions were available for DRG 469 and 2750 institutions for DRG 470. Institutions were divided based on funding into government supported, nonprofit, and proprietary groups according to CMS definitions. Analysis was performed to identify differences between mean hospital charges and mean payments for DRGs 469 and 470 based on institutional funding status. It is important to note that all payment data in this analysis are based on CMS payments. No payment data from other insurers were used. All dollars were adjusted for inflation using the 2011 Consumer Price Index factor of 1.043491791 [14]. Statistical analysis was subsequently performed to evaluate the associations between hospital profit status and MS-DRG hospital charges and hospital reimbursements.

### Statistical Analysis

Standard univariate analyses were conducted to determine frequency, measures of central tendency, and variability. Visual

inspection of the data confirmed nonnormal distribution of the hospital charges and reimbursements (dependent variables). Bivariate analyses were conducted using the Kruskal-Wallis test. Generalized estimating equation regression methods were used to conduct multivariate analysis. Based on the Manning and Mullahy [15] algorithm, the log-scale residuals were evaluated for the amount of kurtosis (skewness). The coefficient of kurtosis was >3, which indicates that the distribution of both dependent variables (charges and payments) had heavy tailed log-scale residuals. Therefore, we log transformed the charges and the reimbursements and selected a generalized linear model. Two generalized estimating equation regression models were built for each of the dependent variables with hospital profit status (proprietary, nonprofit, and government [reference]) as the primary independent variable. We included MS-DRG (469 and 470 [reference]), census region (Northeast, Pacific Northwest, South, West, and Midwest [reference]), and number of discharges ( $\leq 22$  [reference], between 23 and 62, between 63 and 162, and >162) as covariates in each model. We also tested for significant interactions between the independent variables, and the best fitting models did not include interaction terms. Statistical analysis was conducted using SAS version 9.4 (Cary, NC), and a significance level of .05 was used for all statistical tests.

## Results

Statistical analysis of DRGs 469 and 470 revealed significant differences in the amount billed and reimbursed between the 3 types of hospitals. The median hospital charges (Table 1) for DRG 469 for nonprofit, government, and proprietary institutions were \$70,514.30 (interquartile range [IQR], \$54,794.86–\$94,488.27), \$73,540.99 (IQR, \$56,342.56–\$91,999.90), and \$113,203.77 (IQR, \$88,451.64–\$148,232.56), respectively ( $P < .0001$ ). For DRG 470, the median hospital charges for nonprofit, government, and proprietary institutions were \$45,363.95 (IQR, \$34,819.76–\$60,391.35), \$44,956.57 (IQR, \$35,164.32–\$55,892.96), and \$62,715.39 (IQR, \$47,381.35–\$83,184.38), respectively ( $P < .0001$ ). The results of the multivariate analysis of hospital charges are presented in Table 2. After controlling for DRG, region, and total discharges, proprietary hospitals charged 34% ( $\beta = 0.337$ ; 95% CI: 0.287–0.387;  $P < .0001$ ) more than government hospitals. Nonprofit hospitals charged 49% ( $\beta = 0.049$ ; 95% CI: 0.008–0.09;  $P = .021$ ) less than government hospitals. In addition to these significant differences by hospital type, there were significant differences in charges based on DRG and geographical region. Payments for DRG 460 were 48% higher than those for DRG 470 ( $\beta = 0.48$ ; 95% CI: 0.439–0.520;  $P < .0001$ ). In comparison with the Midwest region, payments were 37.5% higher across the West ( $\beta = 0.375$ ; 95% CI: 0.326–0.423;  $P < .0001$ ) and 9% higher across the South ( $\beta = 0.088$ ; 95% CI: 0.052–0.124;  $P < .0001$ ).

**Table 1**  
Unadjusted Differences Between Nonprofit, Proprietary, and Government Hospitals.

DRG	Nonprofit	Proprietary	Government	P Value <sup>b</sup>
Median charges (\$) <sup>a</sup>				
469	70,514.30 (54,794.86–94,488.27)	113,203.77 (88,451.64–148,232.56)	73,540.99 (56,342.56–91,999.90)	<.0001
470	45,363.95 (34,819.76–60,391.35)	62,715.39 (47,381.35–83,184.38)	44,956.57 (35,164.32–55,892.96)	<.0001
Median payments (\$) <sup>a</sup>				
469	22,334.34 (20,098.58–25,753.51)	21,281.30 (19,059.36–24,352.27)	21,346.65 (19,209.67–25,317.07)	.017
470	14,461.95 (13,161.68–16,449.65)	13,733.62 (12,570.84–15,551.16)	14,466.04 (13,099.93–17,490.05)	<.0001
Median total number of annual discharges				
469	17.00 (14.00–24.00)	15.50 (13.00–20.00)	16.00 (13.00–22.00)	.0192
470	120.00 (56.00–229.00)	75.00 (35.00–157.00)	74.50 (31.00–162.50)	<.0001

DRG, Diagnosis Related Group.

<sup>a</sup> Monetary values are inflation adjusted.

<sup>b</sup> Kruskal-Wallis test.

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