

Long-Term Trends in Hip Arthroplasty Use and Volume

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Abstract: We used Medicare administrative data to examine trends in primary and revision total hip arthroplasty (THA) use and hospital volume. Between 1991 and 2005, primary and revision THA use increased by 40.9% and 16.8%, respectively. The percentage of primary THA procedures performed in high-volume hospitals (those in the highest quintile of volume) increased slightly from 58.0% of all procedures in 1991 to 58.7% in 2005 ($P < .01$). The percentage of revisions performed in high-volume hospitals increased from 60.9% to 62.4% ($P < .01$). The percentage of primary THA procedures performed by low-volume hospitals remained relatively stable ($P = .36$), whereas the percentage of revision THA performed by low-volume hospitals declined ($P < .001$). In aggregate, these results suggest minimal evidence that regionalization of THA is occurring. **Keywords:** total hip arthroplasty, coronary bypass graft, hospital volume.

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Background

Total hip arthroplasty (THA) is one of the most common surgical procedures performed in the United States and worldwide [1,2]. In 2006, an estimated 280 000 THA procedures were performed in the United States at a cost of more than \$12 billion [3]. Total hip arthroplasty is generally safe, with major complication rates of approximately 3% for primary procedures and 8% for revision procedures [4,5].

More than 25 years of research have demonstrated an association between higher volume and improved patient outcomes for an array of surgical and medical procedures including THA [6-10]. Based upon these data, major health care purchasers and payors have attempted to guide patients in need of elective surgery such as THA to higher volume hospitals whenever

possible in efforts to improve outcomes and reduce costs [11,12]. Despite efforts to regionalize major surgical procedures to higher volume medical centers, there are few empirical studies evaluating whether such consolidation is occurring [13]. Moreover, almost all of the studies examining longitudinal trends in hospital volume have focused on coronary artery bypass graft (CABG) surgery [14,15] where secular trends of declining CABG utilization make interpretation of study findings difficult. Although some studies have found evidence that higher volume CABG hospitals have gained market share [14,16], other studies have found that regionalization of CABG may not be occurring [15,17].

In the area of orthopedics, very few studies have evaluated longitudinal trends in volume [18,19], and to the best of our knowledge, no studies have specifically evaluated trends in hospital THA volume. Thus, the objectives of the current study were to examine long-term trends in primary and revision THA use and hospital volume among Medicare enrollees. Our expectation was that, over time, we would find that use of THA substantially increased and that an increasing proportion of procedures were being performed by higher volume arthroplasty hospitals.

Methods

Data

We used Medicare Provider Analysis and Review part A data files to identify fee-for-service beneficiaries who underwent primary or revision THA between

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1991 and 2005. Patients were identified using *International Classification of Diseases, Ninth Revision, Clinical Modification*, procedure codes (81.51 for primary and 80.05, 81.53, 00.70, 00.71, 00.72, and 00.73 for revision THA) [9,20-22]. The part A files contain a range of data collected from discharge abstracts for all hospitalized fee-for-service Medicare enrollees including patient demographics; zip code of primary residence; *International Classification of Diseases, Ninth Revision, Clinical Modification*, codes for primary and secondary diagnoses and procedures; admission source (eg, emergency department or transfer from outside hospital); admission and discharge dates; discharge disposition (eg, home, another acute care hospital, dead); death occurring up to 3 years after discharge; each patient's unique Medicare beneficiary number allowing for identification of patient readmissions; and each hospital's unique 6-digit identification number. Comorbid illnesses present on the index admission were identified using algorithms described by Elixhauser et al [23,24], which consider 30 specific conditions and exclude comorbid conditions that may represent complications of care or that are related to the primary reason for hospitalization.

Because the objective of our study was to examine trends in volume and regionalization of elective THA procedures, we excluded several populations where surgery is typically more emergent and hospital choice more limited. In particular, we excluded patients with acute fractures (116 210 primary THAs and 27 746 revision THAs), patients undergoing THA after transfer from another acute care hospital (2400 primary THAs and 4399 revision THAs), and patients admitted through the emergency department (16 294 primary THAs and 28 092 revision THAs) in accordance with other studies assessing orthopedic outcomes [9,25,26].

Statistical Analysis

First, we examined the demographic characteristics and prevalence of comorbid illness for patients undergoing THA across the study period. We used analysis of variance for comparisons of continuous variables and the χ^2 test for categorical variables. All analyses were performed separately for primary and revision THA patients. For simplicity, tabular data are presented for years 1992, 1998, and 2004. Second, we examined the total number of primary and revision THA procedures performed each year using similar methods. We calculated primary and revision THA utilization rates as the number of procedures performed each year per 10 000 fee-for-service Medicare beneficiaries.

Third, we examined the total number of acute care hospitals providing care to Medicare enrollees each year and the proportion of these hospitals performing primary and revision THA each year. Because prior

studies have demonstrated that, in contrast to bypass surgery, many US hospitals performed very low volumes of THA (ie, <5 procedures per year), we considered a hospital to perform THA if it performed at least 1 primary or revision THA on Medicare beneficiaries during a particular year. We also calculated the mean and median hospital volume for primary and revision THAs for each year.

Fourth, to examine evidence for regionalization of THA, we began by stratifying hospitals into quintiles of primary and revision THA volumes for each year. We then compared how the threshold volume demarcating the highest volume quintile and lowest volume quintile changed over time, and we examined the mean volume for each quintile for each year. There is no established method for defining high-volume and low-volume THA hospitals, and establishing thresholds are made more difficult given a secular trend toward increasing THA use over time [18,19]. Although we considered defining high-volume and low-volume THA hospitals using a constant volume threshold applied to each study year (eg, high volume >100 primary THA per year; low volume <10 THA per year), we felt it more appropriate to allow thresholds for high-volume and low-volume hospitals to vary over time. We then defined a hospital as high volume during a specific year if their primary (or revision) THA volume met the threshold for the top quintile of volume for all hospitals in the same year. Likewise, a hospital was defined as *low volume* if their volume for primary (or revision) THA placed them in the lowest quintile of volume during the same year. After identifying all high-volume and low-volume hospitals for each study year, we calculated the percentage of all primary (and revision) THA procedures performed in high-volume and low-volume hospitals. To evaluate whether high volume THA hospitals were gaining a larger share of the overall THA market, we used simple linear regression.

Sensitivity Analysis

To assess the robustness of our results, we conducted an array of sensitivity analyses. In particular, we repeated our analyses after adding back the excluded populations described previously (eg, fracture patients). We also repeated our analyses using a constant threshold for high-volume and low-volume hospitals across time rather than volume quintiles. In primary THA, our thresholds for high-volume and low-volume hospitals were 100 per year and 10 per year, respectively, and 25 per year and 5 per year for revision THA, respectively.

All *P* values are 2 tailed, with *P* < .05 deemed statistically significant. All statistical analyses were performed using SAS 9.1.3 (SAS Institute Inc, Cary,

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