



## The Potential Influence of Regionalization Strategies on Delivery of Care for Elective Total Joint Arthroplasty



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### ABSTRACT

Regionalization of total joint arthroplasty (TJA) to high volume hospitals (HVHs) may affect access to care and complication risk. Using administrative data, 2,560,314 patients who underwent primary total hip or knee arthroplasty from 1991 to 2006 were categorized by whether an HVH (>200 annual TJAs) was available locally. Associations among patient characteristics, hospital utilization, and in-hospital complications were estimated using regression modeling. The complication risk was higher (Odds Ratio 1.18 [95% CI: 1.16, 1.20]) if patients went to a local low volume hospital. Black and Medicaid patients were more likely to utilize the local low volume hospital than a local HVH. Utilizing a local HVH is associated with lower complication risks. However, patients from vulnerable groups were less likely to utilize these patterns.

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The rapidly growing utilization of total joint arthroplasty (TJA) [1,2] and increasing emphasis on value [3] substantiate the need for strategies to continuously improve efficiency and quality. The literature demonstrates the benefits of undergoing TJA at high volume institutions with high volume surgeons, as summarized in two systematic reviews [4,5]. The volume–outcomes relationship has prompted calls for selectively referring patients to high volume centers for total hip and knee arthroplasty [6–8], also referred to as regionalization [9,10]. While selective referral could potentially improve outcomes after TJA, previous work indicates that there may be unintended consequences for access to care and complication risk [7,11–14].

Although many patients undergo TJA at high volume hospitals (HVHs), 5%–8% of patients of all insurance types [15,16] and 10%–37% of Medicare beneficiaries received care at low volume hospitals (LVHs) [9,12,13,17,18]. While patients often attribute this pattern to convenience and proximity [13,18,19], 13–34% of the patients who underwent total knee arthroplasty at an LVH had traveled further than a local HVH [12,19]. Although it is expected that this pattern of care (choosing an LVH when an HVH was closer) would have a negative

effect on outcomes, this relationship has not been directly evaluated. The factors contributing to selection of a hospital and a surgeon are multifactorial [18,20] and may not be entirely under the patient's control. However, this evaluation of complication rates for patients who underwent surgery at an LVH instead of HVH within the same vicinity is needed to guide future decision making.

Empirical data demonstrating the possible effects of regionalization will influence future health policy. Both Losina et al [19] and FitzGerald et al [12] implied the negative consequences of “bypassing” an HVH, but did not directly evaluate the effects on outcomes. In the current investigation, we used data from 14 states to identify the frequency and predictors of hospital utilization for TJA, while considering the options available to each patient. We asked the following research questions: (1) Are vulnerable patient populations (elderly, non-white, Medicaid, and those from communities with lower socioeconomic status) less likely to receive care at high volume centers? and (2) What is the association between hospital utilization patterns and the risk of in-hospital complications after TJA?

### Materials and Methods

State-specific Healthcare Cost and Utilization Project (HCUP) data from 14 states (Arizona, California, Colorado, Florida, Iowa, Massachusetts, Maryland, Michigan, New York, North Carolina, New Jersey, Oregon, Washington, and Wisconsin) were used. Patients who underwent total hip arthroplasty (THA) or total knee arthroplasty (TKA) from 1991 to 2006 were identified using ICD-9-CM procedure codes (81.51 for THA; 81.54 for TKA). Patients with a diagnosis code indicating a

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This investigation was performed at Hospital for Special Surgery in New York, NY.

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prior knee or hip arthroplasty (ICD-9-CM V43.64 and V43.65) were excluded. A total of 2,560,314 patients undergoing THA or TKA were included in the current study (THA: 976,068; 38%; TKA: 1,584,246; 62%).

Hospital volumes for primary THA and TKA were determined from HCUP data. Hospitals performing  $\geq 200$  THAs during the four quarters prior to each patient's surgery were designated as "high volume", with the remaining hospitals categorized as "low volume". The same criteria were used for TKA. The patient's ZIP code was used to determine whether an HVH was available within their surrounding hospital service area (HSA; as defined by the Dartmouth Atlas of Health Care; hereafter referred to as "local") [21].

#### Definition of Hospital Utilization Patterns

To best replicate decisions that patients face before undergoing TJA, we created two base scenarios. In the first scenario, there was no HVH within the HSA where the patient lived ("local"). In the second scenario, there was an HVH within the patient's HSA.

#### Scenario 1: No HVH Within the Patient's HSA

There were 1,512,069 patients (59.1% of study cohort) without a local HVH. These patients followed these patterns (Fig. 1): undergoing TJA at a local LVH (Pattern 1A), a non-local HVH (Pattern 1B), or a non-local LVH (Pattern 1C). There were 2591 (0.2% of study cohort) patients living in HSAs where no TJAs were performed in the preceding 12 months and 199,741 (13% of study cohort) patients where data for the maximum TJA volume for their HSA were missing. Both of these groups were included in Scenario 1 (no local HVH).

#### Scenario 2: A High Volume Hospital Within the Patient's HSA

There were 1,048,245 patients (41% of study cohort) who had a local HVH. These patients followed these patterns (Fig. 1): undergoing TJA at a local HVH (Pattern 2A), a local LVH (Pattern 2B), a non-local HVH (Pattern 2C), or a non-local LVH (Pattern 2D).

#### Potential Predictors of Regionalization

##### Patient Demographics

Age, gender, race, comorbidity, and insurance status were considered potential patient-level predictors for regionalization. Race was

defined as white, black, other, or unknown. Comorbidity scores were calculated using the Elixhauser comorbidity index [22]. Insurance status was defined as private, Medicare, Medicaid, other, or unknown.

#### Community Characteristics

Education (percentage of residents with a college degree), household income poverty (percentage of residents living below poverty level), and population density (persons per square mile) of communities were estimated based on patient residential zip code using 2000 US Census data.

#### Complications after TJA

To determine implications of hospital utilization, we identified in-hospital complications after each TJA using ICD-9-CM diagnostic coding (Appendix A). The complications were grouped into categories: orthopaedic, cardiovascular/cerebrovascular, thromboembolic, infection, and other medical complications.

#### Statistical Analysis

For patients without a local HVH (Scenario 1), the effects of patient and community characteristics on hospital utilization were estimated using a multinomial logistic regression model. A separate multinomial model was constructed for patients with a local HVH (Scenario 2) to examine the potential predictors for hospital utilization.

The effect of hospital utilization on likelihood of post-surgical complications was estimated using a regression model while adjusting for other patient and community characteristics. The comparisons in complication risk for patients without a local HVH (Scenario 1; Fig. 1) were based on the hospital patterns available to those patients:

- Local LVH (1A) vs. non-local HVH (1B)
- Local LVH (1A) vs. non-local LVH (1C)

The comparisons in complication risk for patients with an HVH within their HSA (Scenario 2; Fig. 1) were based on the hospital patterns available to those patients:

- Local HVH (2A) vs. local LVH (2B)
- Local HVH (2A) vs. different, non-local HVH (2C)
- Local HVH (2A) vs. non-local LVH (2D)

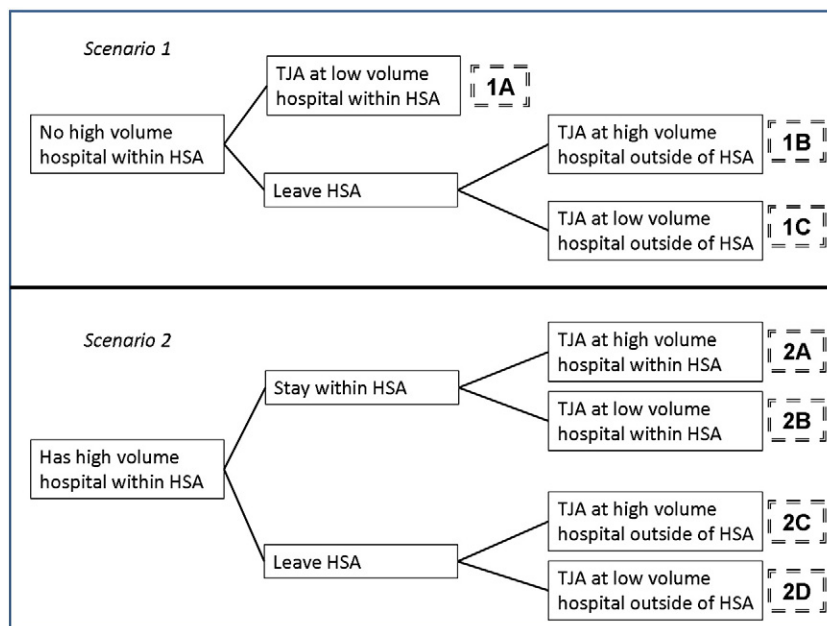


Fig. 1. Scenarios and patterns of hospital utilization for total joint arthroplasty.

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