

**Effect of Hospital and Surgeon Volume on Mortality After Hip Fracture***Kanu Okike, MD, MPH<sup>1</sup>; Priscilla Chan, BS, MS<sup>2</sup>; Liz Paxton, MA<sup>2</sup>*<sup>1</sup>*University of Maryland Medical Center, Honolulu, Hawaii, USA;*<sup>2</sup>*Kaiser Permanente Surgical Outcomes and Analysis, San Diego, California, USA*

**Purpose:** Several studies have documented a positive relationship between procedure volume and clinical outcomes. A few studies have examined the relationship between volume and outcome among hip fracture surgeries, but the results have been inconclusive. The purpose of this study was to assess the hip fracture volume-outcome relationship by analyzing data from a large managed care registry.

**Methods:** Using an integrated health-care system's hip fracture registry, we identified all surgically treated hip fractures in patients over age 60. Data were recorded on characteristics of the patient (age, gender, race/ethnicity, body mass index, ASA [American Society of Anesthesiologists] score, medical comorbidities) as well as the procedure (surgeon, hospital, procedure, anesthesia type, time from admission to surgery) and outcomes (complications, mortality). To allow for minimum 1-year follow-up, we included all hip fractures sustained between 2010 and 2013. To determine surgical case volume, the registry was used to determine the number of hip fracture surgeries performed in the preceding 12 months. Surgeon volume was divided into terciles and classified as low (0-13 cases/year), medium (14-20 cases/year), or high (21 or more cases/year). Similarly, hospital volume was divided into terciles and classified as low (0-124 cases/year), medium (125-186 cases/year), or high (187 or more cases/year). The primary outcome was mortality at 1 year postoperative. Secondary outcomes were mortality at 30 and 90 days postoperative as well as reoperation (lifetime), medical complications (90-day), and unplanned readmission (30-day). To determine the relationship between volume and these outcome measures, multivariate logistic and Cox proportional hazards regression were performed controlling for the covariates listed above. The study was approved by the organization's institutional review board.

**Results:** Of the 14,294 patients in the study sample, the majority were female (71%) and white (79%), and the average age was 81 years. The procedures performed included internal fixation (63%), hemiarthroplasty (34%), and total hip arthroplasty (2%), while the anesthesia was general (57%), spinal/epidural (36%) or mixed (3%). The overall mortality rate was 6% at 30 days, 11% at 90 days, and 21% at 1 year. There was no association between surgeon or hospital volume and mortality at 30 days, 90 days, or 1 year (Table 1). There was also no association between surgeon or hospital volume and reoperation, medical complications, or unplanned readmission ( $P > 0.05$ ).

**Conclusion:** In this analysis of hip fractures in a large integrated health-care system, the observed rates of mortality, reoperation, medical complications, and unplanned readmission did not differ by surgeon or hospital volume. The mortality rates observed at the hospitals in our study (including those with low volume) were lower than reported in the literature. The standardized policies and protocols of the integrated health-care system may contribute to these lower rates.

**Table: One-Year Mortality, by Surgeon and Hospital Volume**

	Multivariate Odds Ratio of Mortality by 1 year** (95% Confidence Interval)	p-value
Surgeon volume		
Low (0-10 cases/year)	0.92 (0.81 – 1.03)	0.16
Medium (11-15 cases/year)	1.09 (0.97 – 1.22)	0.16
High (16-23 cases/year)	0.99 (0.89 – 1.10)	0.85
Very high (24+ cases/year)*	1.00	---
Hospital volume		
Low (0-111 cases/year)	<b>1.14 (1.03 – 1.28)</b>	<b>0.015</b>
Medium (112-152 cases/year)	<b>1.19 (1.06 – 1.34)</b>	<b>0.004</b>
High (153-204 cases/year)	1.03 (0.89 – 1.10)	0.63
Very high (205+ cases/year)*	1.00	---

\*Reference category

\*\*Odds ratios were adjusted for potentially confounding variables including age, gender, race/ethnicity, body mass index (BMI), American Society of Anesthesia (ASA) score, chronic pulmonary disease, liver disease, renal failure, alcohol abuse, anesthesia type, time from admission to surgery, and procedure performed (internal fixation, hemiarthroplasty, or total hip arthroplasty).