

# Expanding on the Relationship Between Volume, Quality, and Outcomes

Auerbach AD, Hilton JF, Maselli J, et al. Shop for quality or volume? Volume, quality, and outcomes of coronary artery bypass surgery. *Ann Intern Med* 2009;150:696–704.

## Study Overview

**Objective.** To compare how volume of procedures and differences in quality affect outcomes for coronary artery bypass surgery.

**Design.** Retrospective, multicenter, observational cohort study.

**Setting and participants.** 81,289 patients aged  $\geq 18$  years who had coronary artery bypass grafting as their principal procedure (identified by ICD-9-CM code). Patients received care from a total of 1451 surgeons at 164 hospitals from October 2003 to September 2005. Hospitals were mostly small to mid-size nonteaching hospitals serving a largely urban patient population (94% of cohort). Data were collected through *Perspective*, a voluntary, fee-based database developed to measure quality of care, utilization of care, and health outcomes.

**Main outcome measures.** The primary outcome measures were 30-day mortality rate and 30-day readmission rate. Readmission rate was defined as a return to the hospital of discharge within 30 days. Volume was defined as the total number of procedures by hospital and surgeon and was categorized by quartiles. The following 6 quality measures were dichotomized: use of serial compression devices within 2 days of procedure, use of statins within 2 days of

procedure, use of prophylactic antimicrobial, correct choice of prophylactic antimicrobial, use of aspirin within 2 days of procedure, and use of  $\beta$  blockers within 2 days of procedure. The total number of quality measures missed during a patient visit was used as a measure of system-level ability to provide care.

**Main results.** Readmission and mortality rates were similar for all quartiles of hospital and surgeon volume. The majority of hospitals (51%) and surgeons (78%) were in the lowest quartile of volume by provider. The median hospital volume for the “lowest” quartile was 142 patients per year and the median highest volume quartile was 744 patients per year. Median surgeon volume for the lowest quartile was 40 patients per year and 158 for the highest quartile. 2% of all patients died within 30 days of discharge and 11% were readmitted within 30 days of discharge date. Mean missed quality measures ranged from 2.11 to 2.56 (out of 6) for hospitals and 2.18 to 2.40 (out of 6) for surgeons. The association between the number of quality measures missed and mortality rate was strong. After adjusting for clinical factors, highest hospital volume was associated with lower readmission risk and lowest surgeon volume was associated with higher mortality rates. After adjusting for case volume and clinical risk factors, patients who did not receive aspirin (odds ratio, 1.89 [95% confidence interval (CI), 1.65–2.16] or  $\beta$  blockers (odds ratio, 1.29 [CI, 1.12–1.49]) had higher odds

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for death. After adjusting for individual quality measures, associations between volume and readmission or death did not change. Mortality rates for the lowest-volume centers (adjusted mortality rate, 1.05% [CI, 0.81%–1.29%]) and the highest volume centers (adjusted mortality rate, 0.98% [CI, 0.72%–1.25%]) were similar if no quality measures were missed. Patients who had an operation by a low-volume surgeon had a higher odds ratio for 30-day mortality compared with patients who received care from a highest quartile surgeon. This holds true even after adjusting for individual quality measures, implying that the surgeon volume effect on outcomes is independent of quality of care measures and other hospital factors.

**Conclusion.** Physician compliance with nationally recommended quality measures is associated with improved mortality rates, independent of hospital or surgeon volume, in patients receiving coronary artery bypass surgery.

### Commentary

Numerous studies over the past 2 decades have examined the relationship between volume of procedures and effect on outcome for surgical conditions. A large number of these studies led to the conclusion that to increase the probability of a better outcome, a patient should seek care at a high-volume hospital and preferably with a high-volume provider. These studies have also encouraged policymakers to recommend that patients pursue high-volume facilities for certain procedures [1]. A 2001 IOM report goes so far as to suggest that hospital accreditation could include volume as a requirement or that more specialty boards should include volume as a requirement before physician certification [1]. Even previous research has suggested that certificate of need laws could be used to encourage patients to go to high-volume facilities to improve patient outcomes [2].

This study by Auerbach et al is a welcome addition to the rich literature related to the study of the role of volume and quality in patient outcomes. This retrospective study found that adherence to accepted quality practices is a better predictor of improved outcomes than volume and concludes that efforts to increase quality of care in the 2 days after coronary artery bypass surgery should result in improved patient outcomes. Readmission and mortality rates for coronary artery bypass surgery were lower for patients with proper postoperative care (ie,  $\beta$  blockers, aspirin, or a statin lipid-lowering drug; prophylactic antimicrobials; and serial leg compression device), regardless of whether the procedure was performed at a high- or low-volume facility.

The study does not necessarily invalidate previous work explaining the volume–outcome connection but adds to the understanding about the relationship between volume and

quality. Although the prevailing wisdom is that volume is the key to improved outcomes, this study implies that outcomes are more dependent on the degree that physicians and hospitals adhere to basic quality guidelines. This finding will likely continue the trend of health care organizations seeking to improve their adherence to quality standards.

Several limitations must be noted in interpreting the results of this study. Use of an administrative database limits the ability to differentiate between complications and preexisting conditions. In addition, extracting quality measures from billing data instead of chart review for quality improvement has not been validated. Another limit is the way in which the predictors were calculated: volume measures were aggregated by hospital and surgeon while quality was measured at the patient level. Patient-level measures are much stronger than a hospital level measure because individual quality varies within a hospital. This gives more predictive power to the quality measure.

Considering the limitations of this study, there is still much opportunity for outcomes researchers to examine the volume–quality relationship. This study reminds us there are many areas in medical practice that lack follow-through with accepted, evidenced-based practices. This study does not definitively answer the quality–volume question, but it adds to the literature and is a building block for further research. It will be interesting to see how this study and related research affects health care policy and referral patterns.

### Applications for Clinical Practice

In general, clinicians should consider increasing adherence to quality measures to improve patient outcomes, regardless of whether they practice in a low- or high-volume facility. Referring patients to high-volume centers may not be necessary in the current health care environment of quality improvement. Specific to coronary artery bypass surgery, clinicians should focus on improving postoperative care in regards to use of aspirin,  $\beta$  blockers, statins, compression devices, and prophylactic antimicrobials. Hospitals should continue efforts to improve quality through systematic efforts to follow evidence-based treatments.

—Review by James M. Pitcavage, MSPH, (Geisinger Center for Health Research, Danville, PA),  
and Nirav R. Shah, MD, MPH

### References

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2. Ho V. Certificate of need, volume, and percutaneous transluminal coronary angioplasty outcomes. *Am Heart J* 2004;147:442–8.