Reviewer's report

Title: Volume-Based Referral for Cardiovascular Procedures in the United States: A Cross-sectional Regression Analysis

Version: 1 Date: 3 March 2005

Reviewer: Brahmajee Nallamothu

Reviewer's report:

General
The manuscript by Epstein et al. is an analysis of volume-based referral strategies for CABG and PCI in the United States. It uses NIS HCUP data from 1998-2001 to estimate the potential impact of the Leapfrog Group’s evidence-based hospital referral guidelines. The authors found that although in-hospital mortality was higher at low-volume facilities, the number of patients that would need to be referred to prevent a single death was 230 for CABG and 805 for PCI. They conclude that volume-based referral strategies would prevent fewer deaths than previously reported and makes it difficult to justify the resources required for their implementation. The manuscript is very well-written. The analysis appears appropriate and the tables complement the manuscript text. Their findings are important and their conclusions seem reasonable. I have only a few comments.

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Major Compulsory Revisions (that the author must respond to before a decision on publication can be reached)
None.

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Minor Essential Revisions (such as missing labels on figures, or the wrong use of a term, which the author can be trusted to correct)
1) Epstein et al. cite an article by Birkmeyer and Dimick to make their argument that earlier works may have overestimated the benefits of volume-based referral strategies. They note that the Birkmeyer and Dimick article suggested that for PCI a volume-based referral strategy would have needed to move 91,153 patients in 2000 to avert 547 deaths (i.e., 167 patients referred to prevent a single death). These numbers are dramatically different from Epstein et al.’s results. Can the authors expand on why they believe such a large difference exists between the two studies? Both used NIS and risk-adjusted models that include age, gender, acuity and co-morbidities and seemed to account for clustering effects. It seems unlikely that the difference is due to the additional years of data in the Epstein et al. article. Was it because Epstein et al. limited their data to large MSAs or that they included concomitant valve procedures?

2) The authors should expand on their discussion of the use of volume-based referral strategies in today's healthcare environment. It should be noted that the Birkmeyer and Dimick article (see above) concluded that the use of volume-based criteria alone was inadequate for referral strategies in CABG and PCI. Their assessment was that risk-adjustment methods and other criteria based on processes and outcomes are likely to be superior. Do the authors agree with this conclusion or do they believe that all referral strategies are likely to be unsuccessful? Since most groups (including the Leapfrog Group) have largely moved away from the exclusive use of volume in their referral strategies, the authors’ comments on these issues would be more up-to-date and of great interest to the reader.

3) The authors included valve procedures in their risk-adjusted models for CABG. Were other concomitant open-heart surgeries such as thoracic aortic repairs identified or excluded in their patient populations?
4) Is the IMA graft rate reported in Table 1 (Page 2) correct? This is alarmingly low and not consistent with national registry data that suggest a usage rate of 75% in 2000 (Ferguson TB et al. JAMA 2003). If correct, it implies that this variable is either inadequate captured or undercoded in NIS. What impact did the inclusion of this variable have on their results?

Discretionary Revisions (which the author can choose to ignore)
1) Did the authors consider exploring other thresholds for a volume-based referral strategy besides the Leapfrog Group's recommendation? For example, the Leapfrog Group’s threshold of 450 annual cases for CABG has been criticized as overly strict. In addition, it appears from earlier studies that the greatest difference in in-hospital mortality rates exist between low- and high-volume hospitals at the extremes of volume. It might therefore be reasonable to refer patients from very-low volume hospitals only (i.e., less than 100, 100-250, 250-450 for CABG). An additional analysis could explore that hypothesis and even determine if an empirical threshold exists at which volume-based referral strategies may become worthwhile.

What next?: Accept after minor essential revisions

Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: No

Declaration of competing interests:

I declare that I have no competing interests. I have collaborated with one of the co-authors on this manuscript in unrelated work.