Regional Availability Of High-Volume Hospitals For Major Surgery

Many patients continue to undergo high-risk surgery at hospitals with inadequate experience in performing their procedure.

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ABSTRACT: Despite evidence of increased risks, a large number of patients still have surgery in low-volume hospitals. To better understand why, we used Medicare data to study the regional availability of high-volume hospitals. More than half of patients undergoing three procedures in low-volume hospitals lived in regions lacking a high-volume hospital. Some regions simply lacked enough cases to support a high-volume hospital. Other regions had enough cases but too many hospitals performing them. Although consolidation of surgical services may be feasible in some settings, volume-based referral strategies are impractical for many U.S. regions.

In light of strong relationships between procedure volume and outcomes for high-risk surgery, there have been numerous efforts aimed at directing patients to high-volume hospitals or surgeons.¹ The Leapfrog Group, a large coalition of public and private employers, is using a variety of financial incentives to steer patients to high-volume hospitals for five selected procedures. More broadly, a diverse collection of groups—including Internet provider-rating services (such as www.healthgrades.com), patient advocacy groups, and the lay media—are advising patients to consider volume as they decide where to undergo other procedures.²

Despite growing attention to this issue, however, many patients continue to undergo high-risk procedures at low-volume hospitals.³ For example, between 1994 and 1999 nearly half of Medicare patients who had pancreatic resection underwent surgery in hospitals that performed three or fewer of these operations each year. Patients in these hospitals experienced mortality rates severalfold higher than their counterparts in higher-volume hospitals.⁴

Although other factors are no doubt at work, many surgical patients, particu-
larly those residing in rural areas, may simply not have ready access to hospitals that have adequate experience with high-risk surgery. To test this hypothesis empirically, we used methods from the *Dartmouth Atlas of Health Care* to explore the availability of high-volume hospitals across U.S. tertiary health care markets.5

**Study Data And Methods**

- **Study population.** We studied the delivery of three high-risk operations (coronary artery bypass graft, or CABG, elective abdominal aortic aneurysm repair, and pancreatic resection) in the national Medicare population from 1999 to 2001. These operations have well-known volume-outcome associations and represent three of the five procedures targeted by the Leapfrog Group’s evidence-based hospital referral initiative.6 Leapfrog, a coalition of more than 150 private and public purchasers of health care, rates hospitals according to three practices that will improve the safety of health care provided to employees. One of these practices, evidence-based hospital referral, recommends selective referral to high-volume hospitals for five procedures: CABG, abdominal aortic aneurysm repair, pancreatic resection, esophagectomy, and percutaneous coronary intervention.

- **Hospitals.** We defined *high-volume hospitals* as those meeting minimum volume thresholds set forth by the Leapfrog Group in the 2003 update to its criteria for evidence-based hospital referral.7 We first determined the average annual Medicare volume for each hospital performing at least one of the three procedures. To extrapolate Medicare volumes to total volumes, we used data from the Nationwide Inpatient Sample to determine the proportion of the total number of cases (all payers) performed among Medicare patients.8 Finally, the total volume was estimated by multiplying each hospital’s observed Medicare volume by the overall total/Medicare ratio for each operation. Hospitals that had an average total volume above the Leapfrog criteria from 1999 to 2001 were considered high-volume.

We studied patients’ access to high-volume hospitals in each of the 306 U.S. hospital referral regions (HRRs). As defined for the *Dartmouth Atlas of Health Care*, HRRs reflect distinct, naturally occurring markets for tertiary health care services.9 The methods for defining HRRs are described in detail elsewhere, but we briefly review the two main steps. In the first step, a series of hospital service areas (HSAs) representing local health care markets were defined. ZIP codes were assigned to HSAs based on where the plurality of Medicare beneficiaries received inpatient care for common medical conditions. In the second step, these HSAs were grouped into HRRs based on where the plurality of beneficiaries went for major cardiac operations. Further checks verified that all of these HRRs contained at least one hospital that performed major neurosurgical procedures. Because hospitals that perform major cardiac and neurosurgical procedures also tend to perform other high-risk surgical procedures, HRRs provide a useful approximation of the geographic boundaries of the health care markets for the procedures in our analysis. Prior analyses by the *Dartmouth Atlas* group have demonstrated a median local-
ization index (proportion of all hospitalizations occurring within a region) of 88 percent across HRRs, with a range of 66–97 percent.10

■ Procedures. The three included procedures vary widely according to how often they are performed, ranging from very common (CABG) to relatively rare (pancreatic resection). Patients undergoing each operation were identified using the appropriate combination of codes from the International Classification of Diseases, Ninth Revision (ICD-9).

For each of the three procedures, we categorized HRRs according to the presence or absence of at least one high-volume hospital for that procedure. If the region had none and the combined total number of procedures performed by all hospitals located within the HRR fell below the Leapfrog volume threshold, we considered the HRR to have inadequate caseloads to support a high-volume hospital. Otherwise, we considered the HRR to have sufficient cases but too many hospitals.

Results

The total number of cases in the United States, the number of hospitals performing each procedure, and the Leapfrog volume thresholds are shown in Exhibit 1. Overall, more than half of surgical cases were performed in low-volume hospitals during 1999–2001 for all three procedures.

The availability of high-volume hospitals varied widely across geographic regions for each procedure. More HRRs had at least one high-volume hospital for CABG (42 percent) and abdominal aortic aneurysm repair (44 percent) than for pancreatic resection (16 percent) (Exhibit 2). Although many HRRs along the Pacific Coast and parts of the Intermountain West lacked high-volume hospitals for all three procedures, regional availability of high-volume hospitals tended to vary by procedure.11

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Total U.S. cases</th>
<th>Number of hospitals performing procedure</th>
<th>Leapfrog definition of “high-volume hospital”</th>
<th>Percent of cases in low-volume hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABG</td>
<td>818,043</td>
<td>1,102</td>
<td>≥450 per year</td>
<td>52</td>
</tr>
<tr>
<td>Abdominal aortic aneurysm repair</td>
<td>121,048</td>
<td>2,571</td>
<td>≥50 per year</td>
<td>64</td>
</tr>
<tr>
<td>Pancreatic resection</td>
<td>14,288</td>
<td>1,435</td>
<td>≥11 per year</td>
<td>60</td>
</tr>
</tbody>
</table>

NOTES: The MEDPAR files contain hospital discharge abstracts for the acute care hospitalizations of all Medicare recipients covered by the hospital care program (Part A). Because only patients covered by fee-for-service arrangements are included, our sample excludes the approximately 10 percent of Medicare patients who were enrolled in risk-bearing health maintenance organizations (HMOs) during this period. These numbers were further adjusted to represent the total number of U.S. cases using the Nationwide Inpatient Sample as described in the Methods section. CABG is coronary artery bypass graft.
In many regions that lacked a high-volume hospital, there were enough overall cases to meet the volume threshold, but there were too many hospitals performing them. With CABG, most HRRs without a high-volume hospital had sufficient overall caseloads, but too many hospitals were performing the procedure (Exhibit 2). In contrast, with pancreatic resection (and to a lesser extent abdominal aortic aneurysm repair), most HRRs lacked sufficient overall caseloads to support even a single high-volume hospital.

Most of the three procedures were performed in regions with existing high-volume centers (Exhibit 2). Overall, 71 percent of patients resided in HRRs with high-volume hospitals for CABG, with a similar proportion for abdominal aneurysm repair and a lower proportion for pancreatic resection. When only patients treated at low-volume centers were considered, however, a disproportionate number lived in HRRs that lacked high-volume hospitals for CABG (56 percent), pancreatic resection (64 percent), and abdominal aortic aneurysm repair (45 percent) (Exhibit 3).

**Discussion**

Despite growing evidence of strong, inverse relationships between volume and mortality rates with certain procedures, many patients continue to undergo high-risk surgery at hospitals with inadequate experience. As a result, there are a large number of potentially avoidable surgical deaths in the United States. For example, the Leapfrog Group estimates that more than 2,000 deaths could be averted each
year in the United States with five procedures alone if patients had surgery at hospitals that met their volume standards.12

While volume-based referral may save lives, these policies have been criticized on several fronts.13 Some argue that volume standards create obvious incentives for hospitals to perform more cases, which could lead to unnecessary surgery for some discretionary procedures. Others argue that hospitals (and their surgeons) may become less proficient with related procedures or emergency operations that must be handled locally. For example, the surgeon no longer performing elective abdominal aortic aneurysm repair may be less prepared to manage patients with ruptured aneurysms.

Our study addresses another, more practical limitation of volume-based referral: Patients may not have access to high-volume hospitals. For three high-risk procedures, we found that approximately half of patients in low-volume hospitals lived in regions without a high-volume center. Many of these regions had enough overall cases but too many hospitals sharing them. In other regions, however, there were simply not enough cases to support a single high-volume center. These findings suggest the need to consider access and geography as volume-based referral strategies are implemented.

Study limitations. We should consider several limitations of our analysis. First, the geographic units on which our analysis were based—HRRs from the Dartmouth Atlas project—were created based on referral patterns for cardiac surgical and neurosurgical care. Although they may not perfectly reflect health care markets for other types of tertiary care, it is likely that surgical treatment of peripheral vascular and major cancer surgery share similar referral patterns. Further, previous analyses from the Dartmouth Atlas project suggest that a small proportion of Medicare patients are hospitalized outside their HRRs.14 Second, the availability of a high-volume hospital within an HRR may be considered a blunt indicator of access.
HRRs vary extensively in their geographic size, from small urban centers to more rural regions that are hundreds of miles wide. It is likely that many patients residing in HRRs without high-volume centers live within short distances to such hospitals of adjoining HRRs. Conversely, high-volume hospitals in large, rural HRRs may be too far away for some patients living in those regions. These issues could be addressed more directly by examining patient travel times.15

Policy implications. Room to move on volume-based referral. Almost half of all patients undergoing surgery in low-volume settings live in regions already served by high-volume hospitals. It is worth considering why this is the case. First, some patients may be making informed decisions to undergo surgery at their local low-volume hospital. One study, based on hypothetical scenarios, showed that some patients would accept increased operative mortality risks locally instead of traveling to a distant referral center.16 However, it is not clear whether patients would have voiced the same preferences if faced with real decisions or if the designated referral center was nearby.

Second, patients may be making uninformed decisions. Despite considerable media attention to this issue, many patients are likely unaware of the importance of procedure volume with some procedures or how to obtain volume information for hospitals or surgeons in their area.17 This problem could be addressed by better educational efforts by private health plans, public-sector health agencies, and consumer advocacy groups.

Third, and perhaps most likely, patients at low-volume hospitals may be deferring decisions about where to have surgery to their doctors. The advice of regular or referring physicians is the most important determinant of where patients receive their hospital-based care.18 Referrals made by many physicians are no doubt influenced more by habit and their desires to support their local hospitals and surgeons and less by information about comparative hospital performance.19 If physicians are primarily responsible for steering patients to low-volume centers for high-risk surgery, educational efforts aimed at patients and their families will have limited effect. Creating real change in referral patterns may require selective contracting and other financial disincentives set by payers and purchasers.

However, our findings suggest that volume-based referral initiatives with “teeth” should be targeted at regions already served by high-volume hospitals. To minimize access problems, the Leapfrog Group exempts hospitals in rural areas from its evidence-based hospital referral initiative. Although correct in concept, this rural-versus-nonrural dichotomy may be inadequate. Our analyses (including data not shown) suggest that many primarily rural HRRs have existing high-volume centers, while numerous nonrural HRRs do not.
Our study suggests that many more regions would have high-volume hospitals if high-risk cases were consolidated in fewer hospitals. However, it is not clear how to make this happen. Educational efforts and public reporting may influence some patients, but these measures are unlikely to bring about wholesale redistributions in surgical caseloads.\textsuperscript{20} States could impose more stringent certificate-of-need criteria for high-risk procedures, but this tool is better designed for limiting the proliferation of new centers than for curtailing the practices of existing centers.

Many smaller and less populated regions simply lack enough overall caseloads to support even a single high-volume center. Patients in these regions could conceivably travel out of region for selected high-risk procedures. Many patients, particularly those who are relatively affluent and educated, already travel considerable distances to undergo specific procedures at national centers of excellence. Payers and policymakers could consider models for extending this opportunity to other patients in areas lacking centers with appropriate experience.

Need for alternative approaches to improving surgical quality. Efforts to improve surgical quality will need to look beyond volume-based referral alone. As outlined in this paper, such strategies are impractical in many parts of the United States lacking high-volume centers. Moreover, although volume is clearly linked to lower mortality rates with many procedures on average, it remains a poor predictor of individual hospital performance. Many low-volume centers have very good performance, while some high-volume hospitals are clearly poor performers. Even if this result could be achieved, getting all patients to high-volume centers would only go so far in improving surgical outcomes.

For these reasons, it is worth considering alternatives to volume-based referral. Obviously, other criteria could be used to identify high-quality hospitals in regions lacking high-volume centers. For example, hospitals with high volumes for procedures other than the targeted operation could be chosen. New evidence has shown that the volume-outcome effect may not be specific to single procedures.\textsuperscript{21} Alternatively, hospitals with certain technological capabilities, high nurse-to-bed ratios, and intensive care units (ICUs) run by board-certified intensivists are also markers for better surgical outcomes.\textsuperscript{22} Hospitals staffed by surgeons with high procedure volumes, or subspecialty fellowship training, also have excellent outcomes.\textsuperscript{23} Unfortunately, these attributes all tend to be most associated with large, high-volume hospitals and thus may not be useful for identifying high quality in smaller hospitals.

In addition to structural measures such as volume, process-of-care or direct outcome measures could be used to signify high-quality hospitals, as reflected in the latest revision of surgical standards adopted by Leapfrog. Unfortunately, validated process measures of quality are not available for most surgical procedures. And when available, they often relate to secondary outcomes (for example, prophylactic antibiotics for wound infection) instead of being directly related to mor-
tality rates. Moreover, process measures often require access to clinical data, which are expensive and not widely available. Direct outcome measures also require clinical data (for adequate risk adjustment) and thus share the same limitation. Moreover, outside cardiac surgery, most operations are not performed often enough to measure outcomes precisely—even if the data were available.\(^{24}\)

Given the numerous obstacles facing selective referral strategies, we must not overlook efforts aimed at improving surgical care where it is already happening. To the extent that superior outcomes with some procedures can be linked to discrete, “exportable” processes of care, outcomes could be improved by educational efforts aimed at low-volume surgeons. For example, a nationwide effort to disseminate a specific surgical technique (total mesorectal excision) to surgeons in Norway greatly reduced recurrence rates after surgery for rectal cancer.\(^{25}\) The likelihood of achieving similar success with other procedures is not known. However, the existence of wide variations in surgical quality across the United States suggests that we should at least make the attempt.

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NOTES


4. Ibid.


8. For a more detailed description of the method used to convert Medicare volume to total, all payer volume, see Birkmeyer et al., “Hospital Volume and Surgical Mortality.”

9. Wennberg and Cooper, eds., The Quality of Medical Care in the United States.


11. This geographic variation can be seen in Supplemental Online Exhibits 1–3, available at content.healthaffairs.org/cgi/content/full/hlthaff.var.45/DC2.
