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Research Syntheses

Evidence-Based Hospital Referral (EHR)

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Executive Summary

This synthesis focuses on the reduction of errors and improvement of health care quality using *evidence-based hospital referral (EHR)* strategies. A substantial body of peer-reviewed literature published in top-tier journals confirms that the more experience a clinician or hospital has caring for patients with select high-risk conditions or performing high-risk surgeries--like heart surgery--the more likely patient care will be provided appropriately and without error. Evidence consistently shows that such high-volume providers tend to deliver superior quality of care to patients, as reflected in patients' lower mortality rates following complex procedures.

The volume-outcome relationship is the likely result of a complicated causal chain of events linking high-volume to better patient outcomes. Some people believe that experience (i.e., "practice makes perfect") accounts for the volume-outcome effect. Others contend that hospitals achieve a high volume of patient referrals because they have a reputation for outstanding quality. It is more likely, however, that the volume-outcome relationship is due to system-wide factors. Physician skill, well-organized clinical teams, use of practice guidelines, availability of technologically sophisticated equipment, and the skills and abilities of auxiliary medical personnel combine to produce positive results.

Despite the fact that we do not understand fully the mechanisms underlying the volume-outcome relationship, volume is a proxy measure of the quality of care for specific procedures. Health care purchasers, public and private, can use volume as a criterion in physician and hospital selection and contract negotiation. The Leapfrog Group calls the use of volume or outcome data to refer patients to particular physicians or hospitals evidence-based hospital referral. There is strong evidence that if patients in need of specific high-risk surgeries or treatments in the United States selected high-volume hospitals for their care, more than 4,000 lives could be saved annually. However, this quality-improving, error-reducing, patient safety practice is not widespread.

Purchaser Tips

The Leapfrog Group consists of more than 110 large purchasers and coalitions that work to "mobilize employer purchasing power to trigger breakthroughs in the safety and the overall value of health care to American consumers" (see www.leapfroggroup.org). The Leapfrog Group is promoting evidence-based hospital referrals for a select set of high-risk surgeries and neonatal conditions. Leapfrog member purchasers will employ various mechanisms to guide patients needing care in these areas to hospitals and clinical teams that treat a comparatively high volume of patients needing a given procedure or, when a valid outcome measurement system exists, that demonstrate superior outcomes.

The Leapfrog Group has identified favorable volume thresholds for seven procedures and conditions:

Treatments[1]	Volume Threshold (EHR Standard)
1. Coronary artery bypass	Volume ? 500/year
2. Coronary angioplasty	Volume ? 400/year
3. Abdominal aortic aneurysm repair	Volume ? 30/year
4. Carotid endarterectomy	Volume ? 100/year
5. Esophageal cancer surgery	Volume ? 7/year
6. Delivery with an expected birth weight of less than 1,500 grams or gestational age of less than 32 weeks	Regional neonatal ICU[2] with average daily census ? 15
7. Delivery with pre-natal diagnosis of major congenital anomalies.	Regional neonatal ICU[2] with average daily census ? 15

[1] **Source**: "Evidence-Based Hospital Referral (EHR)": *Factsheet*. November 2000. http://www.leapfroggroup.org/FactSheets/EHR_FactSheet.PDF. For definitions of these treatments, see www.healthscope.org/Interface/health_resources/health_care_links/glossary.asp

[2] Applies in states in which hospital licensing agency makes such a designation.

The Leapfrog Group maintains that hospitals that meet these criteria or that demonstrate mortality rates below regional norms offer higher odds of survival and therefore patients should be referred to them for those conditions and procedures (The Leapfrog Group, 2000). For some procedures and treatments, EHR can reduce a patient's risk of death by more than 30 percent.

Putting evidence-based hospital referral (EHR) into practice

Few health care purchasers have educated enrollees about the benefits of EHR or designed benefits or provider networks to accommodate its implementation. To begin promoting more widespread implementation of EHR, purchasers can educate enrollees about its benefits and provide them with comparative hospital information to consider in selecting a hospital for care. The *Pacific Business Group on Health*'s (PBGH) "Healthscope" web site (www.healthscope.org/default.asp), for example, provides consumer-oriented information on the volume-outcome effect for more than 10 specific

conditions and procedures and provides procedure-specific volume information for hospitals in California. Publicizing such information can empower consumers to make quality-based health care choices and help increase hospital, physician, and health plan awareness about the importance of EHR.

In addition to enrollee education, purchasers can promote EHR through benefit design and health plan and provider contracts. Currently, the incentive structure in closed-network plans discourages external referrals. A purchaser could contract with health plans to refer patients who need certain complex procedures to high-volume providers (or those that have demonstrated superior outcomes). Purchasers could also create financial incentives to reward plans that refer enrollees to high-volume hospitals (Dudley et al., 2000a).

Synthesis of Research[1]

The proportion of patients who do not survive a specific medical procedure can be used as a direct or "outcome" measure of the quality of care for that procedure. Applying this type of measurement in comparisons across hospitals can be helpful to patients trying to select a hospital for care. However, such comparisons can create controversy in the medical community because it is difficult to account for differences in the *severity of illness* of the patients different hospitals treat. Removing the potentially confounding effect of health status differences in patient populations requires *risk adjustment*, which statistically removes health status differences among the patient populations for which mortality rates are calculated. Otherwise, differences in mortality rates may reflect differences in health or sickness prior to treatment, rather than differences in the quality of care patients received.

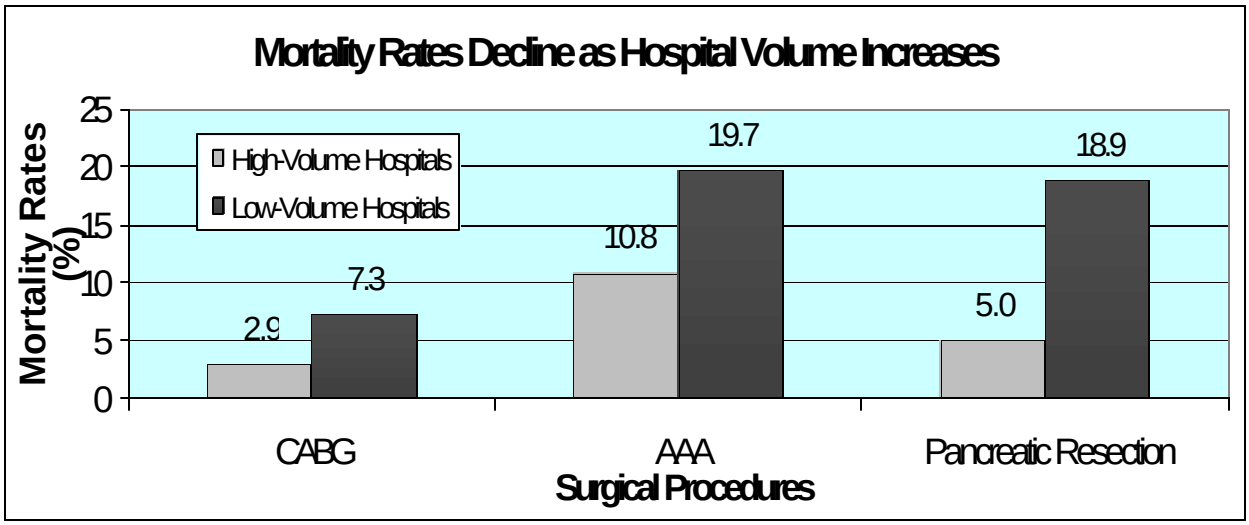
Unfortunately, there is no generally agreed upon risk-adjustment methodology. Only a few states (New York, Pennsylvania, and California) have risk-adjusted, statewide mortality reporting systems for select, complex procedures, such as coronary artery bypass graph surgery (Lara, 2001). When risk-adjusted outcome data are not available, the number of times a doctor or hospital has performed a procedure, administered a treatment or provided a certain type of care can be a proxy for measuring quality. For certain procedures, volume is a "predictor" of outcomes because higher volume is positively associated with better patient outcomes.

The research literature reveals the existence of statistically significant associations between high physician and *hospital volume* and better patient outcomes for a number of treatments and procedures. In the 2000 Institute of Medicine (IOM) workshop summary on interpreting the volume-outcome relationship, Halm, Lee, and Chassin examined 137 research articles on the relationship between hospital volume, *physician volume* or both, and patient outcomes for eight selected conditions and procedures.[2] Based on their review of 88 studies that met their criteria for inclusion,[3] the researchers found that 77 percent of the studies reported statistically significant relationships between either higher physician volume or higher hospital volume and better outcomes. The remaining 23% of studies found evidence of these relationships, but the results were not statistically significant. None of the studies documented a statistically significant association between higher volume and poorer outcomes (Halm et al., 2000).

The nature of the causal relationship between volume and outcomes is not fully understood, although there are several plausible explanations.

Figure 1 portrays the relationship between hospital volume and mortality rates measured in studies that received the highest possible quality rating across ten dimensions specified by Halm et al. in their review for the IOM. For each of three surgical procedures,[4] high-volume hospitals have substantially lower mortality rates than low-volume hospitals. Figure 2 shows that the same relationship exists, though to a somewhat lesser degree, for high-volume physicians and mortality rates for these surgical procedures.

Figure 1.



CABG stands for cardiac artery bypass graft.[5]
AAA stands for abdominal aortic aneurysm repair.[6]
Pancreatic Resection is removal of cancerous sections of the pancreas.[7]
From Halm et al. (2000). All findings are risk-adjusted and statistically significant.

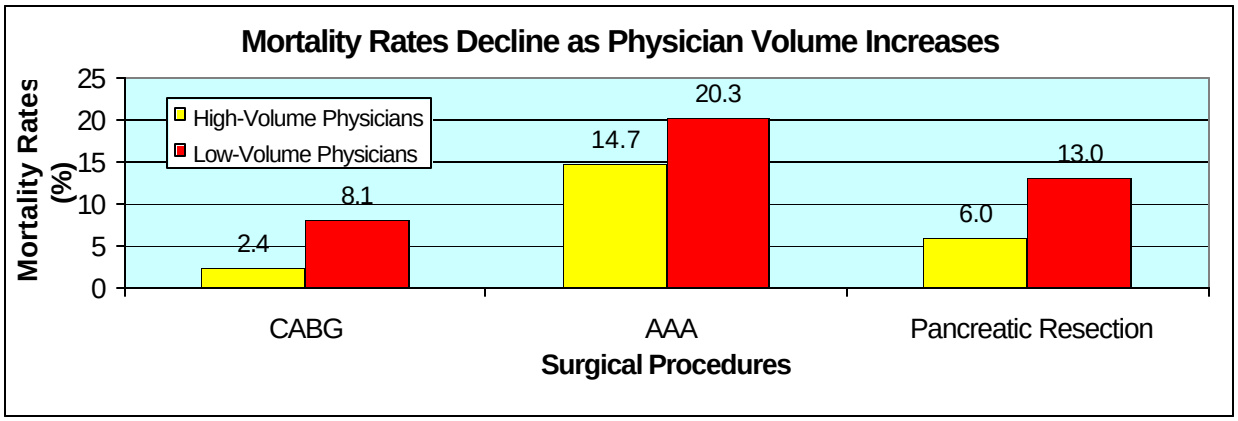


Figure 2.

CABG stands for cardiac artery bypass graft.[8]
AAA stands for abdominal aortic aneurysm repair.[9]
Pancreatic Resection is a cancer removal surgery.[10]

From Halm et al. (2000). All findings are risk-adjusted and statistically significant.

Studies that examine the effects of both hospital and physician volume suggest that hospital volume and physician volume have a combined impact on patient mortality that is greater than the impact of either alone. In short, studies suggest that high-volume physicians working in high-volume hospitals have the lowest patient mortality rates overall.

In the largest study to date of the relationship between hospital volume and surgical mortality in the U.S., Birkmeyer et al., (2002) examined Medicare claims data for 2.5 million procedures performed between 1994 and 1999. They focused on mortality associated with six types of cardiovascular procedures and eight types of cancer resections. They found that mortality declined as volume increased for all 14 procedure types, though they observed significant variation in the effect size. The size of mortality differences between lowest and highest volume hospitals ranged from over 12 percentage points to only 0.2 percentage points. Also, for some procedures, the decline in mortality from high to low volume hospitals was linear. For other procedures the mortality differential was noticeable only between hospitals with extreme differences in volume.

Why does high volume produce better outcomes?

Studies that examine the effects of physician and hospital volume on patient outcomes provide insight about the actual mechanisms at work. The traditional explanation is "practice makes perfect" (Luft et al., 1987). Although it is likely that specific cognitive and physical skills are improved with increased experience, leading to better outcomes, physician skill is just one component of a *system* of care delivery that affects the quality of care and patient outcomes. The fact that hospital volume is related to patient outcomes independent of physician volume indicates that high-quality care is the result of both individual effort and organizational structure and processes (Halm et al., 2000).

An alternative explanation builds on the observation that physicians are inclined to refer patients to hospitals and clinical teams with a demonstrably superior track record for specific procedures. In other words, the best hospitals and physicians are high-volume providers because they have a reputation for high quality (Luft et al., 1987). Empirical evidence does not support this theory, however. One study found that even when pertinent data regarding provider volume and outcomes are available, physicians do not use it to make referrals (Schneider and Epstein, 1996). Without guidelines (and aligned incentives) directing physicians to refer patients for high-risk, elective surgery to high-volume providers, it is unlikely that *selective referral* explains the variation in mortality rates between low- and high-volume physicians or hospitals (Halm et al., 2000).

The best explanation for the volume-outcome relationship may lie in the "systems perspective" described and endorsed in recent IOM publications on patient safety and quality improvement (Kahn et al., 1999; Institute of Medicine, 2001). The systems perspective suggests that a number of factors -- physician skill, well organized clinical teams, the use of practice guidelines, and the ability of ancillary personnel and various units within the hospital to work together – jointly produce the positive association

between volume and patient outcomes. For example, while the cardiologist's experience and competence is essential for minimizing in-hospital mortality rates for patients with acute myocardial infarction, so are the skills of the nurses who support the physician. For patients in an intensive care unit, the expertise and organization of the ICU staff also affect patient mortality rates **[**see **insert URL for Intensivists in ICUs]**. The organization of the surgical team and related hospital systems contribute to the efficacy of clinical decision-making and the way processes of care are carried out. Utilization of standardized protocols and advanced technological support tools, such as computer-based systems for drug prescribing and ordering **[**see **insert URL for CPOE],** also positively affect patient outcomes.

Potentially avoidable deaths

Researchers have estimated that 602 lives could have been saved in California in 1997 if EHR had been instituted and patients needing high-risk elective surgery had been channeled to high-volume hospitals (Dudley et al., 2000b).[11] Although this is only a projection, the study provides a reasonable estimation of the impact selective referral could have on patient safety. If the number of *potentially avoidable deaths* in California is extrapolated to the entire United States, thousands of lives could be saved annually by implementing EHR nationwide.

The Leapfrog Group commissioned researchers at Dartmouth Medical School to estimate the potential benefits of universal adoption of the three safety standards it advocates (Birkmeyer et al., 2000b). If every non-rural hospital in the country adopted EHR, Birkmeyer and colleagues estimated that 2,581 lives would be saved if patients were referred to high-volume hospitals for five high-risk procedures. They estimated that an additional 1,863 lives would be saved if evidence-based hospital referral were implemented for high-risk deliveries. Based on these findings, Birkmeyer et al. conclude that 4,444 lives would be saved each year if EHR became common practice for the procedures and treatments listed in footnote 1 of this synthesis.

What are the costs of EHR?

In assessing the costs of EHR, one begins by asking "*to whom"*? Referring patients to high-volume hospitals (HVH) necessarily means referring them "away" from low- or lower-volume hospitals (LVH). Thus, in terms of market share, there are winners and losers. However, from the purchaser's perspective, while the evidence is scant, some research indicates that length of stay (LOS) is significantly shorter for patients undergoing procedures in HVH (Phillips et al., 1995). (Depending on the nature of the payment agreement negotiated in purchasers' or plans' contracts with hospitals, shorter LOS can result in significant cost savings.) The same study found that costs for AMI patients were considerably greater at LVH than at HVH.

The Leapfrog Group also commissioned researchers at Dartmouth Medical School to analyze the economic implications of implementing The Leapfrog Group safety standards. Birkmeyer et al. (2000b) calculated average hospital profits (based on a cross-section of New England hospitals) for each EHR procedure or condition included in the estimates of lives saved. Table 1 summarizes the findings.

Table 1. Average Hospital Profit for EHR procedures/conditions.

Procedure/Condition	Average profit (per patient)*
Coronary artery bypass graft surgery	$ 6,840
Coronary angioplasty	$ 1,500
Elective AAA repair	$ 3,500
Carotid endarterectomy	$ 3,200
Esophageal cancer surgery	$ 5,600
Deliveries involving very low birth weight babies	$14,200
Deliveries involving congenital anomalies	$ 2,200

Source: Birkmeyer 2001

*Estimates from a cross-section of New England Hospitals.

Obstacles to implementing EHR

Where many see opportunities to improve patient safety and practice value-based purchasing, others see obstacles. Most states collect condition-specific, hospital volume data. But, with few exceptions, the health care system is not using this information to refer patients to high-volume physicians and hospitals.

In the case of EHR, some doctors resist the reporting of physician-level mortality rates and the use of volume data for selective referral. They feel that risk-adjustment methods do not adequately account for the severity of their patients' illness. In particular, physicians are understandably concerned when volume or outcomes data are reported on procedures they perform infrequently, such as esophagectomies. This is because a single year in which an abnormal number of patients died following surgery may not be a statistically valid reflection of his or her competence over the longer term. To address this "sample size" problem, New York State reports mortality rates only for physicians who perform a given procedure above a threshold number (Lara, 2001). Hospitals, too, resist publication of comparative quality data that may reflect poorly on their performance. However, there is mounting evidence that publishing condition-specific, hospital-level mortality rates motivates hospitals to improve quality of patient care, largely due to concern about reputation and market share (Lara, 2001).

There are other concerns about EHR. For instance, some physicians and patients worry about the disruption or discontinuity of care when patients receive care outside of their usual source. For some providers, EHR may mean loss of control and income. Some patients would rather see a familiar physician or go to a nearby hospital, even if evidence suggests that they stand a better chance of a good outcome elsewhere. Finally, the impact of selective referral on LVH can lead to *regionalization* of care. That is, if fewer and fewer patients go to LVH for certain procedures, the clinicians at these facilities will have less and less experience providing those procedures over time. For example, a hospital may have a lower chance of saving a patient in need of an emergency angioplasty if its clinical team hasn't done one in six months or a year (Birkmeyer, 2000a). This problem is likely to be particularly acute in rural areas. The

reader is referred to Epstein (2002) for a detailed discussion of this and related issues concerning the volume-outcome relationship.

Areas for Future Research

The wealth of evidence that HVH have lower risk-adjusted mortality rates than LVH provides strong support for adopting EHR for certain medical conditions and procedures. However, there are several areas for future research on this topic (as identified in the IOM Workshop Report (Institute of Medicine, 2000)).

- The impact EHR would have on marketplace structure is unknown. For example, if EHR were to result in less competition among hospitals, the cost of the treatments and procedures highlighted for selective referrals may increase.
- The economic and access to care impact of EHR on low-volume hospitals, particularly in rural areas, may be profound and needs further investigation.
- Because few studies use longitudinal data to examine the volume-outcome relationship over time, several questions remain unanswered: 1) What is the shape and duration of the learning curve for physicians and clinical teams? 2) What ongoing volume minimum is required to maintain the proficiency physicians and hospitals achieve as high-volume providers? 3) Are there "volume thresholds" above which outcomes do not continue to improve, or even get worse? 4) What, if any, portion of the observed outcome difference between high- and low-volume physicians and hospitals is due to chance?
- In all likelihood, specific clinical processes are performed more often in high-volume hospitals or by high-volume physicians, which may bear a direct relationship to patient outcomes. Studies that detail specific processes of care performed by high-volume providers during certain procedures or treatment regimens would advance our understanding of the volume-outcome effect (Wilson et al., 2000).
- Using case study methodology to examine the work organization of high-volume clinical units may identify some of the underlying structural factors of the volume-outcome relationship.
- The volume-outcome relationship may exist for many other conditions and procedures that researchers have yet to study. Investigation of the association between volume and outcome for additional conditions and procedures could help save lives, particularly if EHR becomes standard practice.
- Researchers have rarely investigated the relationship between volume and non-fatal health outcomes. More information may temper or bolster the recommendation that patients be referred to high-volume doctors and hospitals for specific conditions and procedures.
- Researchers have yet to establish definitively the extent to which differences in mortality rates between high- and low-volume providers are due to differences in patient selection or *case mix*. The refinement and application of risk-adjustment techniques will provide a more scientific basis for EHR.

Definitions

Case mix: The grouping of patients handled by a practitioner or hospital according to such factors as age, sex, diagnosis, treatment, and severity of illness.

Comorbidity: An additional condition or conditions that a patient has at the same time as their primary condition or an illness or injury before a patient's hospitalization that may extend the patient's hospital stay.

Error: the failure of a planned action to be completed as intended (i.e., an error of execution) or the use of a wrong plan to achieve an aim (i.e., an error of planning).

Evidence-Based Hospital Referral (EHR): Ensuring that patients with high-risk conditions are treated at hospitals (and by physicians) with characteristics shown to be associated with better outcomes. Purchasers, health plans, hospitals, practitioners, and patients can use available information to select hospitals and physicians with the best track records.

Hospital volume: The number of specific procedures performed by a hospital over a defined period of time (usually one year).

The Leapfrog Group: Composed of more than 110 public and private organizations that provide health care benefits, The Leapfrog Group (www.leapfroggroup.org) works with medical experts throughout the U.S. to identify problems and propose solutions that it believes will improve hospital systems that could break down and harm patients. Representing more than 32 million health care consumers in all 50 states, Leapfrog provides important information and solutions for consumers and health care providers.

Medical error: is the "failure of a planned action to be completed as intended (i.e. error of execution) or the use of a wrong plan to achieve an aim (i.e. error of planning)" in the course of managing a patient's medical condition (Kohn, 1999).

The Pacific Business Group on Health (PBGH): A non-profit coalition of more than 40 employers based in San Francisco that works to improve the quality of health care while moderating costs. PBGH supports value-based purchasing and works closely with payers, providers, and researchers in quality assessment and improvement efforts.

Physician volume: The number of specific procedures performed by a physician over a defined period of time (usually one year).

Potentially avoidable deaths: Deaths that potentially could be avoided if patients are treated at a high-volume hospital instead of a low-volume hospital. A quantification of deaths attributable to low-volume hospitals or physicians, calculated by subtracting the number of expected deaths (based on risk-adjustment) from the observed number of deaths.

Preventable adverse events: are preventable injuries due to the management of a patient's medical condition rather than to the patient's underlying health condition.

Regionalization: The process of concentrating high-risk surgical procedures in high-volume hospitals through the implementation of selective referral.

Risk adjustment: Risk-adjustment techniques are used to increase the accuracy of mortality rate comparisons. The elements of *case mix*, patient selection, the *severity* of the condition, and the presence of *comorbidity* are calculated and mortality rates are adjusted accordingly. Larger hospitals that treat older, sicker patients who have multiple health problems may have a higher mortality rate for major operations relative to other area hospitals, despite the fact that they are high-volume. By risk-adjusting the mortality rates, the effect of volume can be isolated and identified.

Selective referral: The referral of patients needing certain high-risk procedures or with high-risk conditions to hospitals and practitioners that have a reputation for or have data that reflect high-quality patient care.

Severity of Illness: The seriousness of a patient's condition. Severity of illness may differ among patients diagnosed with the same condition. Researchers have created "severity indices" or "scores" to quantify the severity of illness. The methods correlate the "seriousness" of a disease in a particular patient with the statistically "expected" outcome (e.g., survival, morbidity, etc.).

Useful Links

www.academyhealth.org
Academy for Health Services Research and Health Policy

http://www.acponline.org/journals/ecp/marapr01/shojania.htm
American College of Physicians/American Society of Internal Medicine

www.iom.edu
The Institute of Medicine

http://books.nap.edu/catalog/10005.html
Full text of the IOM report on the volume-outcome relationship

www.leapfroggroup.org
The Leapfrog Group

www.pbgh.org
The Pacific Business Group on Health

www.healthscope.org/default.asp
PBGH's Consumer Information web site

www.qualityforum.org
National Quality Forum

http://www.state.nj.us/health/cardiaccare/bibliography.htm
New Jersey Department of Health and Senior Services – Cardiac Care 5-Year Horizon Project

http://www.sts.org/outcomes/ny/nymain.html

New York State's Cardiac Surgery Reporting System

Related Topics

Computer Physician Order Entry Systems (CPOE)
Intensivist Staffing in Intensive Care Units (ICU)

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Acknowledgements

This research was funded by the Robert Wood Johnson Foundation, under its National Health Care Purchasing Institute. Junette Williams and Mark Chow provided research assistance. Suzanne Delbanco provided expert reviews and AcademyHealth colleagues provided editorial assistance. Although the analysis and conclusions are solely my own and do not necessarily reflect the views of the foundation, AcademyHealth colleagues, I am deeply indebted to them for their support and assistance, which made this work possible.

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[1] In May 2000, The Institute of Medicine (IOM) convened a workshop to examine the relationship between volume of health services and patient outcomes, to assess the policy implications of the use of volume as an indicator of quality, and to identify areas for future research. This research synthesis draws heavily from the IOM summary of the workshop (Dudley et al., 2000a; Halm et al., 2000; and Institute of Medicine, 2000) and a literature review (Dudley et al., 2000b).

[2] Coronary artery bypass graft (CABG) surgery, pediatric cardiac surgery, carotid endarterectomy, abdominal aortic aneurysm surgery, cancer surgery (five different types), coronary angioplasty, acute myocardial infarction, and AIDS treatment (Halm et al., 2000).

[3] Halm et al. (2000) considered an article that studied more than one condition as more than one study, hence there were 162 studies within 137 articles. Of these, 74 were excluded because volume was not an independent variable, the study sample was not community- or population-based, or the outcomes studied were not health outcomes. (See footnote 6 for more methodological details).

[4] Halm et al. (2000) rated each study on 10 items, including its representativeness and risk-adjustment technique. The distribution of quality scores ranged from 2 to 13. The findings presented in Figures 1 and 2 are from studies that received the highest score. The findings are risk adjusted and statistically significant.

[5] High-volume hospitals are defined as those that conduct more than 848 procedures per year, and low-volume hospitals as those that conduct less than 200 (Hannon et al., 1991).
[6] High-volume hospitals are defined as those that conduct 35 or more procedures per year, and low-volume hospitals as those that do less than or equal to five surgeries (Hannon et al., 1989).
[7] High-volume hospitals are defined as those that do conduct more than 80 procedures per year, and low-volume hospitals as those that conduct less than 10 (Lieberman et al., 1995).
[8] Physicians that conduct more than 116 procedures per year are defined as high-volume, and those that conduct less than 116 as low-volume (Hannon et al., 1991).
[9] High-volume physicians are defined as those that conduct more than 4 procedures per year, and low-volume physicians as those that conduct less than or equal to four (Hannon et al., 1989).
[10] High-volume physicians are defined as those that conduct over 41 procedures per annum, and low-volume physicians as those that conduct less than nine per year (Lieberman et al., 1995).
[11] Dudley et al. (2000b) examined the relationship between hospital volume and patient mortality for the purpose of estimating potentially avoidable deaths. They reviewed 72 articles investigating the volume-outcome relationship for 11 conditions or procedures, identified the highest quality study for each, and estimated mortality attributable to low volume. Calculating odds ratios for in-hospital mortality for the 11 conditions, they extrapolated these results to the state of California using OSHPD's 1997 hospital discharge database.