Is Patient Volume a Useful Quality Measure for Very Low Birthweight Infants?

Health insurers increasingly rely on a strategy known as evidence-based referral to steer patients to the best providers of care. Evidence-based referral in its broadest sense means referring patients with high-risk conditions to hospitals with the best outcomes. To cite one example, The Leapfrog Group, a Business Roundtable-sponsored collaborative of large employers and insurers, recently implemented an evidence-based referral standard for five surgical conditions and two neonatal conditions (very low birthweight [VLBW] and major congenital anomalies).

Because direct evidence of outcomes is usually unavailable, standards for many conditions rely on indirect evidence, such as volume of patients. Hospitals that treat a higher volume of patients have been shown to have better outcomes for many conditions. The Leapfrog Standard for VLBW infants (1,500 grams or below) is based on volume. The Leapfrog Standard requires that infants with an expected birthweight of less than 1,500 grams, a gestational age of less than 32 weeks, or correctable major birth defects should be delivered at a regional neonatal intensive care unit (NICU) that serves an average of 15 or more patients each day.

Measuring quality of care for VLBW infants presents a special challenge, because processes and outcomes of medical care for these infants vary markedly among different NICUs, even after adjustment for patient characteristics known to affect infant mortality, including gestational age, race, gender, presence of a birth defect, and mother’s use of prenatal care.

Is volume the most useful measure of quality of care for these infants? A study led by RAND Health researcher Jeannette Rogowski addressed this question. The goal of the study was to assess how accurately patient volume predicts quality of care for VLBW infants and to compare volume with direct indicators, such as patient mortality.

Key findings:

- The number of very low birthweight infants that a hospital treats each year does not reliably predict future mortality rates for such infants at that hospital.
- Past mortality rates for very low birthweight infants at a particular hospital are a more accurate predictor of future mortality rates.
- Standards for referring such infants to the highest-quality hospitals should take mortality statistics into account.

This Highlight summarizes RAND Health research reported in the following publication:

Data came from 332 NICUs in the Vermont Oxford Network of providers from across the United States. This network includes 40 percent of the NICUs in the United States and accounts for 50 percent of annual VLBW infant admissions. The study population included all 94,110 infants between 501 and 1,500 grams born in network hospitals between 1995 and 2000.

The study found that referrals for VLBW infants that rely on indirect measures such as volume are at best minimally effective for predicting outcomes and may unfairly penalize high-quality providers that have lower volumes. By contrast, direct measures such as infant deaths are more useful quality indicators for the purposes of selective referral: They predict future mortality rates more accurately and could therefore save infant lives.

**Higher Volume Does Predict Some Decrease in Mortality . . .**

The analysis found that an increase in volume was associated with a fairly large decrease in VLBW infant mortality (see the figure). Specifically, in hospitals with fewer than 50 annual admissions of VLBW infants, an additional ten admissions were associated with an 11-percent reduction in mortality. To an extent, the analysis supports the assumption made by The Leapfrog Standard: that a volume threshold exists below which mortality increases.

**Some Reduction in Infant Mortality Is Associated with Higher Volume**

![Graph showing observed/expected mortality vs. average annual volume per NICU]


**NOTE:** Solid line is the average standard mortality rate (SMR), estimated with a smoother. The SMR is calculated as the ratio of observed deaths to expected deaths in each NICU between 1995 and 2000.

**However, Volume Predicts Only a Small Amount of Mortality Variation Across NICUs**

However, as the figure also shows, mortality varies greatly across NICUs: Some low-volume NICUs have low mortality rates, whereas some high-volume NICUs have high rates. The study analyzed the relationship between hospital characteristics and variations in VLBW infant mortality rates and found that annual volume of admissions explained only a small amount—9 percent—of the variation in mortality rates across hospitals; other readily available hospital characteristics, such as level of care provided, public versus private ownership, and status as a teaching hospital, explained only an additional 7 percent. The variation in mortality explained by such characteristics is small compared with the remaining unexplained hospital-level effect (84 percent). In other words, systematic differences in mortality across hospitals were large relative to the differences that can be predicted by readily available hospital characteristics.

A more accurate prediction of current and future mortality rates can be found in a hospital’s prior mortality rates. Hospitals that ranked in the lowest 20 percent for VLBW infant mortality rates between 1995 and 1998 were also found to have significantly lower-than-average mortality in 1999–2000; hospitals in the highest 20 percent for mortality rates between 1995 and 1998 had significantly higher-than-average mortality rates in 1999–2000.

Using a hospital’s past mortality ranking can explain the variation in mortality rates across hospitals better than can using patient volume. In fact, use of past ranking according to whether a hospital is in the highest 20 percent or the lowest 20 percent in patient-mortality ranking captured 34 percent of the current (1999–2000) variation in mortality, whereas use of a similar ranking by patient volume captured only 1 percent of the current variation.

**Implications for Referral Strategies**

Patient volume explains only a small proportion of variations in outcomes across NICUs, which limits its usefulness as a quality measure. The study results suggest that direct quality indicators, such as patient mortality, are likely to outperform indirect quality indicators, such as patient volume. Thus, more lives could be saved if patient referrals were based on the former rather than the latter indicator.

There are two reasons for this suggestion. First, the difference in mortality between the best and worst hospitals was more than five times larger when hospitals were ranked on past mortality rates than on past volume. Thus, moving patients out of hospitals with high past mortality rates and into hospitals with lower past mortality rates will save more lives than will moving patients from low-volume hospitals to high-volume hospitals. Second, strategies that move patients from low-volume hospitals to high-volume hospitals affect few patients, since low-volume hospitals treat few patients.
Given the study’s estimates, a referral strategy that used a historical volume standard and moved all infants out of the lowest-ranked 20 percent and into the middle 60 percent of network hospitals in 1999–2000 would result in 11 lives saved annually in the Vermont Oxford Network compared with 115 lives saved annually using historical mortality experience.

Evaluating any actual referral strategy would involve other considerations. On the one hand, an actual referral strategy would be limited to pregnant women known to be at risk and to geographic areas with a choice of providers. Thus, one could not expect to move all infants out of the highest-mortality hospitals, and fewer lives would be saved. On the other hand, such a standard would presumably be applied to infants outside of the Vermont Oxford Network, leading to more lives being saved. Moreover, moving patients among providers would likely generate trade-offs in terms of family disruptions due to care received farther from home, potentially raising treatment costs.

Research is still needed to improve our understanding of how evidence-based referral strategies can best be designed to manage these trade-offs.