Unpredictable Demand and Low-Volume Hospitals

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This Findings Brief assesses the degree to which the annual number of patient discharges varies from year to year for low volume hospitals. To the extent that demand for inpatient services is unpredictable, it is hard for administrators to set budget and recruitment goals, which are generally based on estimates of future hospital business. We find that:

Low volume facilities face considerably more instability from year to year in demand for inpatient services than larger hospitals.

Average variability over time for the smallest facilities — those with 500 or fewer discharges per year — is nearly 60% higher than the average for all hospitals.

Although low volume, rather than rurality, is the important factor, hospitals in very rural counties have to contend with substantially more fluctuation than other hospitals, primarily because they tend to be smaller.

Calculating variability

We looked at year-to-year changes in total number of patient discharges from 1990 through 1999, using data from Medicare cost reports. To see how variation is different across types of facilities, we divided hospitals into ten equal-sized groups ranked according to the number of discharges they reported in the last year of our study (FY 1998). We also considered hospitals grouped by degree of rurality, by region, and by type of ownership.

For facilities whose markets are growing (or shrinking) over time, some of the year-to-year variation in demand is part of a trend that a manager should be able to forecast and plan for. We therefore computed a standardized measure of variability that is adjusted at the individual hospital level for time trends in annual number of discharges (for a detailed explanation of this measure, see technical note at the end of this brief). The trend-adjusted measure allows us to separate variation in discharges that a manager can predict from the type of random fluctuations that are likely to present more difficulty for administrators.
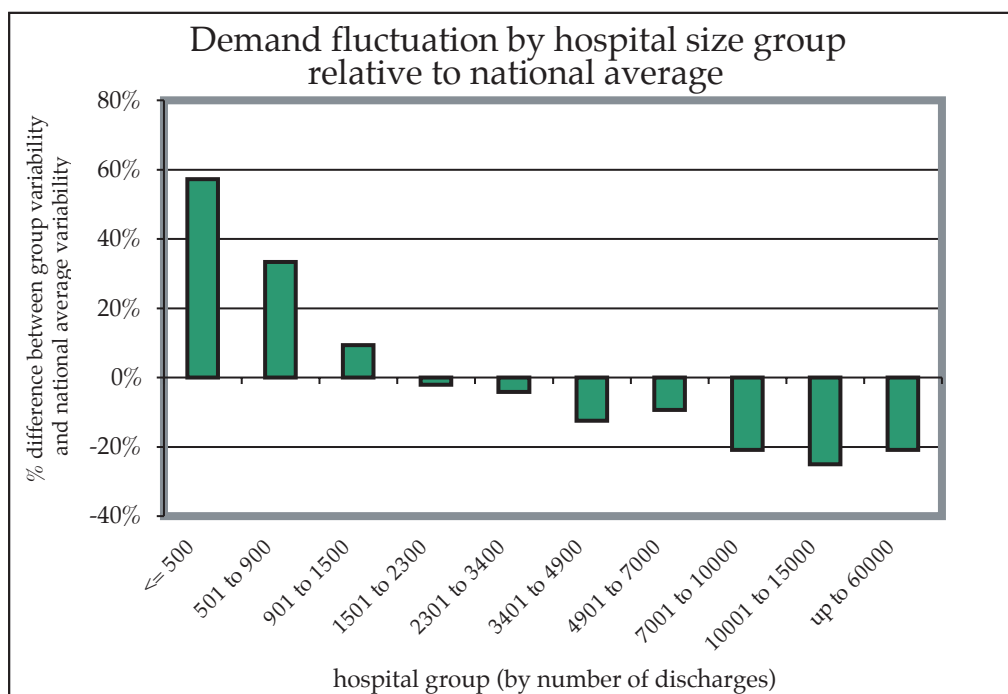
Year-to-year variation in annual discharges

Across all hospital groups, the proportion of year-to-year variation in discharges that can be predicted as part of a trend over time averages 30% (Figure 1). The remaining 70% of yearly demand variation is either random fluctuation, or the effects of one-time "shocks," such as a temporary disruption in local physician coverage. However, the absolute level of both predictable and unpredictable variability in discharges differs substantially by hospital volume. After removing the effect of hospital-level time trends, the smaller facilities still face considerably more instability in demand for inpatient services than the larger ones.

Figure 1
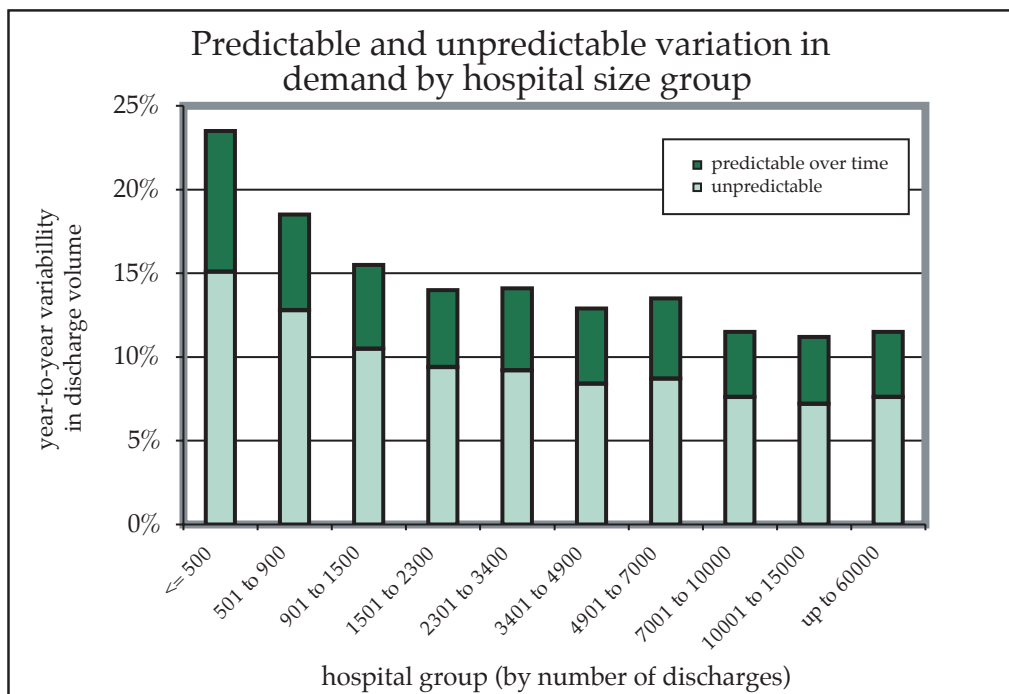
Variability among low-volume facilities – defined as those with 500 or fewer discharges per year at the end of this period – is about 60% higher than the average for all hospitals (Figure 2). The pattern that is shown in Figure 2 is the same when we examine each individual region of the country. It is also present when we separate hospitals according to whether they are for-profit, private-nonprofit or publicly owned. It appears that greater variability is a function of the size of the facility rather than location, yet because the smallest hospitals tend to be located in the smallest communities, greater variability is largely a rural problem. While less than 10% of all short-stay hospitals reported 500 or fewer acute discharges in 1998, 89% of the hospitals in this category are located in non-metropolitan counties. One half of the hospitals located in very rural counties (those with no towns having more than 2,500 residents), and about 20% of the hospitals in moderately rural counties (those with towns having between 2,500 and 10,000 residents) were low-volume hospitals.

Figure 2

Demand fluctuation by hospital size group relative to national average

y-axis: % difference between group variability and national average variability

x-axis: hospital group (by number of discharges)

Groups: <= 500, 501 to 900, 901 to 1500, 1501 to 2300, 2301 to 3400, 3401 to 4900, 4901 to 7000, 7001 to 10000, 10001 to 15000, up to 60000

Discussion

The data presented here reflect medium and long-term changes in demand for inpatient services at the individual hospital level. Managers should be able to respond to long-term trends in demand by adjusting their bed capacity and their staffing levels, but responding to random fluctuations from one year to the next is more difficult.[1] There are a variety of reasons why small rural hospitals might have less flexibility to react in ways that would maximize short-term efficiency. For example, if there tend to be local shortages of professional personnel in the community, administrators may choose to retain their nursing and medical ancillary staff even during slow periods lasting several months, because skilled employees will not remain in the area to be re-hired at a later date when demand picks up again. The loss or acquisition of a single physician in a small community can have a substantial impact on discharges in any one year, and administrators may be wary of closing capacity while they are actively recruiting, even when the beds remain empty.

Fluctuating demand can substantially affect hospital unit costs and operating margins, especially under fixed payment systems such as Medicare's PPS. Instability in demand may be one of the reasons why more than one-half of the facilities with fewer than 1,500 discharges per year (the smallest three groups in Figures 1 & 2) have chosen to minimize their risk of Medicare losses by converting to cost-based reimbursement as Critical Access Hospitals. A hospital that chooses Medicare cost-based reimbursement protects itself against losses in years when demand is low. However, a cost-reimbursed facility also gives up the chance to earn a positive margin in years when demand increases. For an analysis of within-hospital variation in Medicare cost per case and the relationship between volume and cost, see NC RHR & PAC Findings Briefs "Unstable Demand and Cost per Case in Low-Volume Hospitals".

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[1] In addition, we have found that on average, hospitals with high year-to-year variation in demand face even higher variation in daily demand, which also poses administrative difficulties.

Technical Note

To measure the variability of demand for each individual hospital we first compute the mean and standard deviation of its annual discharges over the nine-year period (upper frame of Figure 3). The standard deviation is defined as the square root of the average of the squared differences between the actual and the average annual discharges. Dividing the standard deviation by the mean gives us a measure called the "coefficient of variation", which is a proportional measure of the variation of each year. To adjust this measure to take time trends into account, we make the same type of computation but we start with a trend line instead of a fixed average, and we compute the deviation based on the difference between each year's demand and the trend line (lower frame of Figure 3). Dividing this measure by the predicted number of discharges from the trend line gives us a similar proportional measure of variation, but one that has eliminated the differences that are expected due to a trend over time. The trended variation can be the same or smaller than the untrended variation, but never bigger.

Figure 3

Adjusting variation for long-term trends:
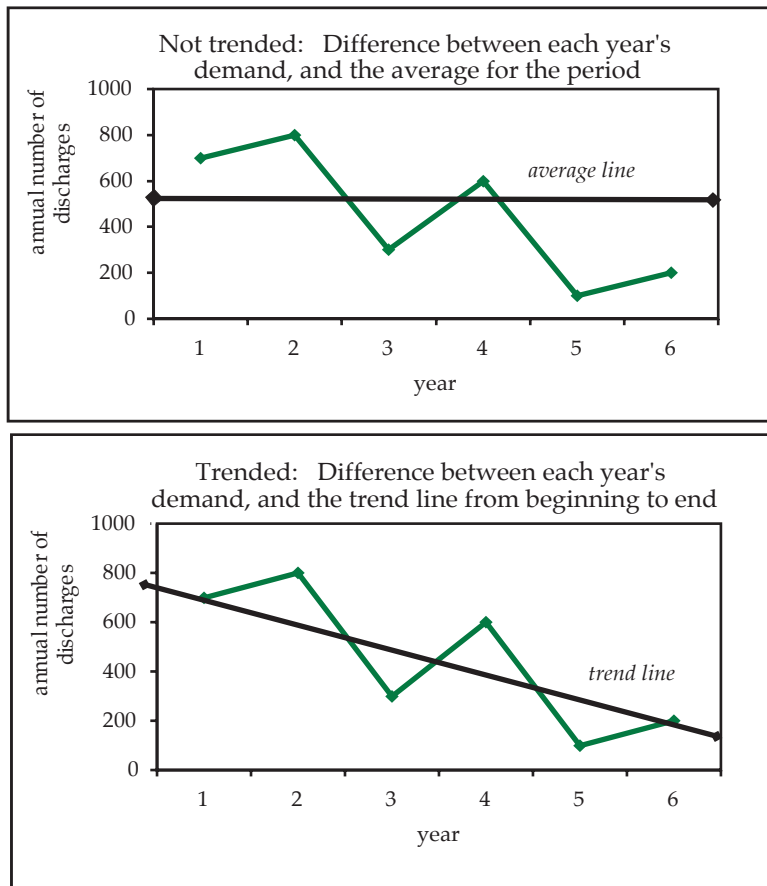
Data Sources

Medicare Hospital Cost Report Information System (HCRIS), FY 1990 through FY 1999; Area Resource File 2000.

Electronic versions of this and other North Carolina Rural Health Research and Policy Analysis Center documents can be found at:

http://www.shepscenter.unc.edu/research_programs/rural_program/