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The Effect of Surgery on the Profitability of Rural Hospitals

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Abstract**OBJECTIVE:**

The purpose of this research study is to determine the effect of surgery on the profitability of rural hospitals.

BACKGROUND:

Small rural hospitals are often the sole health care provider in their communities and the only source of care for many people. The provision of surgery in rural hospitals saves the lives of many trauma victims and people with surgical emergencies. Surgery can also have a substantial impact on the finances of a rural hospital as well as the local economy.

METHODS:

Longitudinal hospital financial data and market data from 2000 to 2008 were used to determine the relationship between volume of surgery services and profitability of hospitals that serve rural populations.

RESULTS:

There is a positive and statistically significant relationship between volume of surgery and operating margin ($p < .001$); an increase of 10 percentage points in the volume of surgery relative to net patient revenue increases operating margin by 2.0 percentage points, controlling for hospital and market characteristics.

CONCLUSIONS:

Surgery is an important service provided by rural hospitals. The service not only impacts the health of patients in rural communities but it also affects the financial performance of rural hospitals. Policy changes that affect the volume, reimbursement, and cost of surgery in rural hospital should be carefully assessed for consequences on the long-run financial viability of rural hospitals.

Small rural hospitals are often the sole health care provider in their communities and the only source of care for many rural Medicare and Medicaid beneficiaries, uninsured individuals, and other vulnerable groups. However, many of these institutions face internal and external challenges that threaten their ability to fulfill this mission, including the possibility of financial distress and closure.¹ Many small rural hospitals struggle to remain open in the face of slow population growth, workforce shortages, limited ability to tax, a poor local economy, aging facilities, competition from urban hospitals^{2,3}, high Medicare and Medicaid volumes, relatively low reimbursement rates^{2,4}, falling patient volume, and increasing costs.⁵ These challenges threaten the sustainability of rural hospitals and the provision of essential health care services to rural Americans.⁶

Among the array of services provided by rural hospitals, surgery is vital.⁷ The provision of surgery in rural hospitals saves the lives of many trauma victims and people with surgical emergencies. Patient access is enhanced by local provision of surgical services. Loss of surgery can reduce the provision of non-surgical services that rely on surgical backup⁸ and reduce access to other health and medical services.^{4, 8-10} Despite this need, there is substantial variation in access to surgical services by rural residents. Several studies have found that surgical volume varies greatly among rural hospitals, even among those with a similar mix of surgical providers. Many hospitals provide a limited set of basic surgical services, while some perform more complex procedures. Several hospitals have very low volumes for some complex procedures, raising a question about the safety of performing them.^{11, 12} Some argue that leaders of small rural hospitals must recognize not only the fiscal and service benefits of surgical services, but also the potentially adverse effect of low surgical volume on patient outcomes.^{11, 12}

This raises the question “what are the financial implications of providing surgery for rural hospitals?” Previous studies have found that surgical services typically generate 30-40% of rural hospital revenues^{7, 11, 13, 14} and substantially contribute to the financial health of rural hospitals.⁹ In a recent survey of critical access hospital administrators, nearly sixty percent of administrators who recruited a general surgeon reported it had good financial results for the hospital.¹⁵ Loss of surgery can lead to significant financial distress, perhaps hospital failure and closure.¹³ In one study, rural hospital administrators were asked about the consequences of losing their surgery program and 39.5% stated that the hospital would be forced to close.¹⁰ There is also evidence that loss of surgery can have a substantial negative impact on the local economy^{16, 17} because hospitals are often the largest employer in a rural community.⁴

The purpose of this study was to determine the effect of surgery provision on the profitability of rural hospitals. This understanding is important in an era of financially stressed rural hospitals, and results have important policy implications for the sustainability of rural hospitals and access to surgery by residents of rural communities.

METHODS

DATA

Rural communities are served by five types of rural hospitals (based on Medicare payment classification): in addition to prospective payment system hospitals (PPS), there are four additional hospital types with slightly different Medicare reimbursement mechanisms: critical access hospitals (CAH), Medicare-dependent hospitals (MDH), rural referral centers (RRC), and sole community hospitals

(SCH). Hospital financial data for these hospitals were drawn from Medicare Cost Reports in the Healthcare Cost Reporting Information System produced by the Center for Medicare and Medicaid Services. Market data were drawn from the Area Resource File produced by the Health Resources and Services Administration and from census data. The sample consisted of all rural acute hospitals for the years 2000 to 2008. Hospital cost reports with less than 360 days in a fiscal year were excluded from the data sample. Missing data were assumed to occur at random and hospitals with missing data on key characteristics were removed from the data set. The dependent variable was censored at the 1st and 99th percentile to mitigate the effect of outliers. The final sample consisted of 19,014 hospital year observations.

VARIABLES

Operating margin. To measure hospital profitability, we use operating margin¹⁸, defined as $100 * (\text{operating revenue} - \text{operating expenses}) / (\text{operating revenue})$. The ratio excludes investment income and other types of revenue and expenses unrelated to operating activities. Operating margin is the dependent variable and is stated as a percentage.

Surgical volume. Total surgery charges as a percentage of total hospital charges [$100 * (\text{Operating room charges} + \text{Recovery room charges}) / (\text{Total hospital charges})$] is used as the measure of surgical volume. Charges were assumed to be highly correlated with volume of hospital activity; thus the higher the percentage, the greater the proportion of hospital activity from surgery.

Hospital characteristics. Several measures were included to control for hospital characteristics. Binary variables are used to indicate type of hospital (CAH, MDH, PPS, RRC, SCH, and SCH/RRC). Rural PPS hospitals were the reference group. In addition, every year some rural hospitals convert from one Medicare classification to another and these hospital-year observations are labelled “transition hospital”. The size of the hospital was measured using total number of beds. System status indicates whether a hospital is a stand-alone organization or part of a system of organizations or a hospital network. Medicare days and Medicaid days as percents of total inpatient days control for payer mix.

Market characteristics. An array of measures was included to control for community differences in the demand for hospitals services and the level of competition. To define a market for a rural hospital, the number of Medicare discharges for each residence ZIP - hospital dyad was created from the Market Service Area files for 2000-2009 (that is, the number of Medicare beneficiaries residing in a particular ZIP who were admitted to a particular hospital in 2000). For each hospital, dyads with a distance of more than 150 miles between the residence and the hospital were eliminated, under the assumption that distances of this amount are atypical for the vast majority of patients. After this exclusion, residence ZIPs were aggregated in descending order of number of discharges to the hospital until 75% of the hospital discharges was achieved. These ZIPs were used to define the market for the hospital in that year. The total population in the market, the market population density and the percent of the population age 65 and over describe the demand for hospital services in the market area. The average per capita income, unemployment rate and percentage of families or persons in poverty measures a community’s financial ability to purchase health care services.¹⁹ The likelihood of a rural resident to bypass a rural hospital and services at another facility is measured by the average distance travelled, calculated as the (discharge-weighted) average straight-line distance from the residence ZIP centroid to

the local hospital. The average straight-line distance of the hospital to the next closest hospital with greater than 100 beds measures the amount of hospital competition in the market area, as does the hospital's market share (the hospital's discharges as a percentage of the total discharges in a hospital's market area).²⁰ The location of the hospital was described as either metro or non-metro according to the Rural Urban Community Area (RUCA) Codes. Time trends are accounted for using year indicators.

STATISTICAL ANALYSIS

A fixed-effects regression model was used to control for characteristics of hospitals that do not change over time and Huber-White ("robust") standard errors were calculated.

RESULTS

Figure 1. Summary statistics of dependent and independent variables (N=19,014)

	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
<i>Dependent variable</i>				
Operating margin (%)	0.64	9.85	-45.98	30.69
<i>Surgery volume</i>				
Surgery charges / total hospital charges (%)	8.38	6.59	0.0	95.17
<i>Hospital Characteristics</i>				
Critical Access Hospital (%)	35.78			
Medicare Dependent Hospital (%)	9.02			
Rural Prospective Payment System Hospital (%)	20.25			
Rural Referral Center (%)	8.26			
Sole Community Hospital (%)	21.22			
Sole Community Hospital/Rural Referral Center (%)	3.69			
Transition hospital (%)	1.77			
Total beds	59.26	59.51	2	1328
System affiliation (%)	13.52			
Medicare / total hospital inpatient days (%)	60.71	15.96	0	100
Medicaid / total hospital inpatient days (%)	11.33	9.86	0	100
<i>Market characteristics</i>				
Total population in market area (1,000s)	61.94	91.41	0.67	2522.55
Market population density (1,000 population per square mile)	0.043	0.34	0.00024	46.34
Population age 65 and over in market area (%)	16.13	3.67	4.47	34.76
Average per capita income in market area (\$1,000s)	18.11	3.57	6.42	57.39
Average unemployment rate in market area (%)	6.37	2.75	0.20	28.19
Average rate of families or person in poverty	23.98	8.73	3.77	62.10

in market area (%)				
Average distance from place of residence to hospital (miles)	15.08	9.93	0.012	288.48
Average distance to next closest larger hospital with > 100 beds (miles)	43.77	41.94	1.86	942.86
Hospital discharges / total discharges in market area (%)	28.47	11.96	0.078	92.36
Metro status (%)	11.84			
Non metro status (%)	88.16			
<i>Year</i>				
2000 (%)	10.13			
2001 (%)	10.33			
2002 (%)	10.70			
2003 (%)	11.12			
2004 (%)	11.16			
2005 (%)	11.22			
2006 (%)	11.57			
2007 (%)	11.98			
2008 (%)	11.79			

Figure 1 shows the average operating margin was 0.64% (SD 9.9%), with a minimum of -46% and a maximum of 31%. The average volume of surgery as measured by surgery charges to total hospital charges was 8.38% (SD 6.59%), with a minimum of zero (no surgery) and a maximum of 95.17%. CAHs were the most common type of hospital in the sample (35.78%) and transition hospitals were the least common (1.77 %). The average number of beds was 59.26, with a minimum of 2 in a CAH and a maximum of 1,328 in a RRC. A small proportion of hospitals reported a system affiliation (13.52%) and Medicare and Medicaid patients accounted for the majority of inpatient days (60.71% and 11.33%, respectively).

Figure 2. Fixed Effects Model Predicting Rural Hospital Operating Margin

DEPENDENT VARIABLE: OPERATING MARGIN ^a	REGRESSION COEFFICIENT	ROBUST STANDARD ERRORS
<i>Surgery Volume</i>		
Surgery charges / total hospital charges*100 ^b	0.21**	0.044
<i>Hospital Characteristics</i>		
Critical Access Hospitals	4.14**	0.45
Medicare Dependent Hospital ^c	0.21	0.48
Rural Prospective Payment System Hospital ^c	-0.41	0.46
Rural Referral Center ^c	-0.16	0.69
Sole Community Hospital ^c	0.93	0.50
Sole Community Hospital/Rural Referral Center ^c	0.12	0.67
Transition Hospital	0.41	0.46
Total beds	0.0061	0.0057
System affiliation	0.46	0.32
Medicare / total hospital inpatient days	0.012	0.012
Medicaid / total hospital inpatient days	-0.020	0.016
<i>Market characteristics</i>		
Total population in market area	0.015**	0.0056
Market population density	-6.08	6.25
Population age 65 and over in market area	0.078	0.075
Average per capita income in market area	0.064	0.077
Average unemployment rate in market area	0.012	0.099
Average rate of families or person in poverty in market area	0.11*	0.054
Average distance from place of residence to hospital	0.036	0.020
Average distance to next closest hospital with > 100 beds	-0.021	0.013
Hospital discharges / total discharges in market area	0.074**	0.014
<i>Time</i>		
Year 2001 ^d	0.18	0.19
Year 2002 ^d	0.84**	0.22
Year 2003 ^d	-0.12	0.32
Year 2004 ^d	0.23	0.34

Year 2005 ^d	0.74*	0.37
Year 2006 ^d	0.86*	0.42
Year 2007 ^d	0.86*	0.44
Year 2008 ^d	-0.28	0.47
Constant	-11.70**	2.67
Number of observations	19,014	
Number of groups	2,463	

F Statistic (28, 2462) = 15.37, p = 0.0000

^a Operating margin is calculated using the following formula: (Operating revenue-Operating expenses)/Operating revenue*100

^b Variable is a proxy measure of the volume of surgery services performed at a rural hospital. This metric is calculated using the following formula: (Total operating room charges + Recovery room charges)/Total hospital charges*100

^c Reference Hospital is Rural Prospective Payment System

^d Reference is Year 2000

*Statistically significant at the 5% level. **Statistically significant at the 1% level.

Note: Fixed effects are at the hospital level.

Figure 2 provides the results from the fixed effects regression analysis. The results indicate that, after controlling for hospital characteristics, market characteristics, and year, there is a positive and statistically significant relationship between surgery volume and operating margin ($p < 0.001$). An increase of 10 percentage points in the volume of surgery is associated with an increase of 2 percentage points in operating margin.

Figure 2 also shows that a higher operating margin was also associated with CAH status, market population, market share, poverty rate, and year. In comparison to rural PPS (the reference group), CAHs had a higher operating margin of approximately four percentage points. A 10,000 increase in the market population increases operating margin by 0.15 of a percentage point, and a 10 percentage point increase in market share increases operating margin by 0.7 percentage points. An increase of 10 percentage points in the percentage of families or persons in poverty in a market area is associated with an increase in operating margin of 1.1 percentage points. The years 2002, 2005, 2006, 2007 also had a positive significant association with operating margin of rural hospitals.

DISCUSSION

The primary finding of this study is that an increase of 10 percentage points in the volume of surgery is associated with an increase of 2 percentage points in operating margin. Consider a hospital with an operating margin of 1 percent that currently has 20 percent of its total charges resulting from surgery. If the surgery percentage increases from 20 percent to 30 percent (an increase of about 1.5 standard deviations), then operating margin would be expected to increase from 1 percent to 3 percent. In 2008, for the average CAH in the sample, an increase of 2 percentage points in operating margin equates to approximately \$370,000 in additional operating income. To small hospitals like CAHs, \$370,000 can mean the difference between survival and closure. In 2008, 554 out of 1212 CAHs in the sample had negative operating margins. Hypothetically, a 10 percent increase in the volume of surgery would have reduced the number of CAHs with negative operating margins by 120. For the average RRC in the sample, an increase of 2 percentage points in operating margin equates to approximately \$3 million in additional operating income.

Better financial performance of CAHs (relative to rural PPS) has been identified previously²¹; unadjusted analyses comparing profitability measures found that CAHs performed roughly 2-3 percentage points higher than rural PPS; our results here are similar. Creation of CAHs under the Medicare Rural Hospital Flexibility Program was intended to increase the financial stability of small rural hospitals. By nearly all accounts the financial condition of converters has improved, in large part due to the enhanced revenues resulting from the transition from PPS to cost-based reimbursement for Medicare beneficiaries.²²

Both market share (the proportion of market discharges to the hospital) and market size (number of people residing in the service area) have positive effects on operating margin, which is consistent with previous findings.²³ Higher profitability is obtained through greater market power – increased volume of services, greater negotiating power with commercial insurers, and perhaps reputational effects (their market size is due to better reputation among consumers).

The positive effect of poverty was unexpected. A possible explanation is that the use of a fixed effects model in this study may capture a different effect than traditional cross-section analysis which has found poverty leads to lower profitability.²⁴ Unemployment, per capita income, and poverty rates are correlated, but this significant result held even when the other socioeconomic status measures were omitted from the model. This finding is curious and warrants further study.

There are important policy implications of this study. We find a clear relationship between volume of surgery and profitability of rural hospitals. More specifically, the contribution of surgery to hospital profitability is determined by three factors: 1) volume; 2) reimbursement, and; 3) cost. Policy changes that affect any of these factors may affect the profitability of rural hospitals and ultimately threaten their long-term financial viability.

Volume of surgery. The volume of surgical services performed in rural hospitals is influenced by many factors including the size of the rural surgical workforce, the recruitment of rural surgeons, rural general surgery training programs, surgeon professional reimbursement, referral patterns including patient bypass, and hospital facilities and equipment. A policy change that results in reduction in training support could reduce the number of rural surgeons which, in turn, would have adverse consequences for the financial viability of many rural hospitals.

Reimbursement for surgery. The reimbursement received for surgical services performed in rural hospitals is influenced by Medicare, Medicaid, and commercial insurer payment rates as well as payer mix, including the amount of uncompensated care. Compared to urban hospitals, most rural hospitals have a higher proportion of Medicare and Medicaid patients. A policy change that affects hospital reimbursement for surgery for these beneficiaries may adversely affect the financial viability of rural hospitals. For example, the Congressional Budget Office recently included the following as an option for reducing the federal deficit: Mandatory Spending Option 24: Eliminate the Critical Access Hospital, Medicare-Dependent Hospital, and Sole Community Hospital Programs in Medicare.²⁵ Under this proposal, small rural hospitals would no longer be able to participate in programs that compensate them at relatively higher rates for Medicare beneficiaries. The CBO itself states that the increased financial pressure resulting from the elimination of special payments to CAHs, MDHs, and SCHs might force some of those hospitals to convert to outpatient facilities or close altogether and patients who reside in those areas might have difficulty getting access to care. Thus, changes to Medicare reimbursement for surgery and other services could ultimately threaten the long-term financial viability of many rural hospitals.

The analysis has several limitations. The use of surgery by the hospital was measured using a revenue-based measure; other measures (such as number of surgeries) may yield different estimates, and the broad measure of “surgery” used here is based on operating and recovery room revenue, which may include activities not commonly considered “surgical”. Although operating margin is a measure of the profit from all hospital operations, this metric might not be an adequate indicator of financial performance attributed to the delivery of surgery. Other time-variant variables known to influence hospital profitability such as hospital reputation, CEO tenure, debt-structure, board governance, quality of care provided by the hospital, etc. are not included in the analysis.

CONCLUSIONS

Surgery is an important service provided by rural hospitals. The service not only impacts the health and economic well-being of the rural communities but also has an effect on the financial performance and viability of rural hospitals. Changes in the provision of surgery among rural hospitals will affect not only the local availability of quality healthcare by residents, but the financial strength of the hospital, and thus careful consideration of the effect of policies aimed at altering the provision of surgeries in rural areas is warranted.

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