How Rural Hospital Closures Affect Rural Residents

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This study estimates a model of rural patient hospital choice between the nearest rural, urban, or research hospital. We present separate estimates for inpatient and outpatient visits, for different diagnoses, and for emergency and nonemergency admissions. The analyses illustrate the tradeoffs between hospital quality and distance in deciding whether to choose the nearest hospital or to travel farther for an alternative. We then simulate two hospital closing scenarios. We find that closing the lowest-quality rural hospitals is a better policy prescription than closing the least used hospitals since closing low-quality hospitals results in a substantial increase in average quality of hospital with only a slight increase in distance traveled for chosen hospitals.

The population shift from rural to urban regions has decreased the population density around hospitals in small towns and rural areas. The combination of thinning populations and greater competition from urban hospitals makes it more difficult for rural hospitals to maintain a large enough patient base to cover their costs.

Following a pattern of decline that started in the 1970s, these factors have led to a steady decrease in the number of rural hospitals over the last two decades. Since 1990, the number of rural hospitals decreased 20% while the number of urban hospitals only decreased 3.5% (Figure 1). An issue we investigate in this study is the loss of a local hospital for rural residents.

Healthcare Setting and Data

To help stop the decline in the number of rural hospitals, in the 1990s Medicare enacted the Critical Access Hospital (CAH) program. With rural hospitals being particularly dependent on publicly subsidized healthcare—almost 60% of their revenue comes from Medicare and Medicaid—the program was devised to prop up hospitals in isolated areas where residents had few other healthcare options.

Under its original rules, these hospitals had to be located at least 35 miles away from any other hospital, which means only about one-third of the nation's 1,300 Critical Access Hospitals would have qualified under the original rules.

However, the law was amended to allow states to designate "necessary provider" hospitals, which lessened or removed proximity restrictions.

More recently, federal budgetary constraints have led to renewed interest in imposing the more stringent funding rules, which would lead to further closure of rural hospitals in Iowa and elsewhere.

We focus our analysis on Iowa, a state with a large number of rural hospitals where a substantial majority of them receive funds from CAH. The Iowa Hospital Association records include every inpatient admission and outpatient visit to Iowa hospitals. We have access to the recorded visits occurring between January 1, 2002 and December 31, 2002. The database includes 209,687 inpatients that were treated and discharged from an Iowa hospital during this period and 138,685 outpatient records. We divide hospitals into three groups: rural, urban, and research.

Our focus is on the determinants of hospital choice for rural residents, where a rural resident's status is defined by their zip code in the 2000 U.S. Census. As shown in Table 1, hospital choices do not differ much between inpatient and outpatient treatments. Almost 70% of rural residents choose a rural hospital for inpatient and outpatient service. Urban hospitals serve 12% of rural residents and 18% are served by research hospitals. The average rural patient lives about five miles from the nearest rural hospital, but lives 51 miles from the nearest urban hospital and 71 miles from the nearest research hospital.

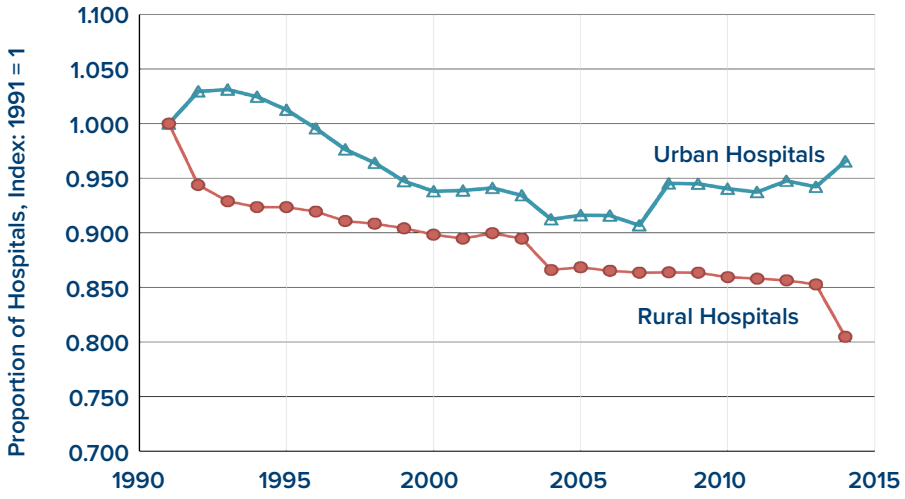

Figure 1. Urban and Rural Community Hospitals in the United States, 1991–2014

Note: Index=1 in 1991, series adjusted for change in data series in 2004
Source: American Hospital Association

Table 1. Mean Values of Variables by Hospital Location and Inpatient/Outpatient Status

	Total	Rural	Urban	Research
	----------Inpatient----------			
Hospital Choice (Share)		0.69	0.12	0.19
Distance	43	5	51	71
Quality	3.32	2.45	3.84	3.66
Age	54.5			
Percent Male	0.41			
Percent with Insurance	35%			
Percent Self-pay	3.6%			
	----------Outpatient----------			
Hospital Choice (Share)		0.70	0.12	0.18
Distance	42	5	51	70
Quality	3.28	2.46	3.79	3.60
Age	55.7			
Percent Male	0.44			
Percent with Insurance	45%			
Percent Self-pay	2%			

Health Grades, Inc. compiled the data on hospital quality. There are significant quality differences between hospitals, exemplified by the company's simple one-to-five-star rating system. To avoid missing data, we used the two most common ailments, heart failure and pneumonia, to measure hospital quality since quality measures based on other criteria were missing for at least 31% of hospitals. There is a pronounced rise in quality when comparing rural hospitals to urban or research hospitals, with urban hospitals actually marginally outperforming research hospitals, as illustrated in Table 1.

Hospital Choice Model and Hospital Closing Simulation

We base our analysis on an empirical model that estimates the sensitivity of rural choice of local, urban, or specialized research hospitals on distance to and quality of each of the three hospital options. We derive estimates of hospital choice for inpatient visits, for outpatient visits, separately for the most common diagnoses, and for emergency or nonemergency admissions. We use these estimates to simulate how potential hospital closings will alter hospital choices made by rural Iowa patients. We illustrate how two hospital closing scenarios: (1) closing 25% of the lowest-quality rural hospitals, and (2) closing 15% of the least-used rural hospitals in Iowa, affect the average distance to, and quality of, the chosen hospital.

Few studies have evaluated the role of hospital quality in patient choices; however, this is likely to be a key factor explaining the incentives to bypass rural hospitals. Liu et al. (2007) surveyed 647 hospital inpatients for their assessments as to why patients would bypass a local hospital. Following the lack of local specialists, the second-most common reason cited for bypassing a local hospital was poor reputation or quality of local care.

While a hospital closure may lower utility because of increased distance to the nearest hospital, the decrease in utility may be offset if other hospital options are of higher quality. Individual attributes including age, gender, and insurance status will affect relative utility from the three hospital types. Consistent with that reasoning, we assume that rural residents choose hospitals to maximize expected utility from hospital services.

We initially estimate a model which assesses the probability of choosing a hospital, separately for inpatient and outpatient choices. We then allow for more heterogeneity by estimating hospital choice equations for each admission type and the most common diagnoses, which isolate each patient group by urgency. For each set of results, it is important to interpret the coefficients within the context of the sample being used. For example, we will have one set of results that averages the hospital choice effects of factors across all inpatient conditions, and then another set of results for each of the hospital admission codes. The coefficients on distance and quality are difficult to interpret directly, and so we transform the results into elasticities for ease of interpretation.

In our simulation where we close the least-used hospitals, we opt for a utilization threshold of 50%. Therefore, we shutter all of the hospitals that were chosen less than 50% of the time. These hospitals would be the most threatened if the Medicare Critical Access Hospital standards become more stringent. Rural patients living nearest to the closed hospitals under this simulation selected them between 6% and 41% of the time. Our second simulation assumes that the reduction in subsidy would be tied to hospital quality rather than current use. Our simulation results in closing 25% of the lowest-quality rural hospitals. The 24 hospitals closing under this scenario had quality rankings ranging from 1 to 1.83, well below the average hospital quality of 3.3.

Hospital Choice Results

The key elasticities from the hospital choice model are presented in Table 2. Distance is the single largest driving factor in the choice of hospital. At sample means, a 10% increase in distance lowers the probability of choosing that hospital type for inpatient services by 12.9%. Hospital choice is

less sensitive to quality, although a tradeoff between distance and quality is apparent. A 10% improvement in quality increases likelihood of choosing that hospital by 2.3% for an inpatient procedure. Hospital demand for outpatient services is also sensitive to distance, but not as much for quality. Our findings suggest that women, older patients, and patients who do not pay through insurance are more distance sensitive.

We expect that those patients with more severe or time-sensitive needs might be more sensitive to distance and less sensitive to quality. For inpatient hospitalizations, the three admission codes—ordered from most to least critical—are emergency, urgent, and elective. Consistent with our expectations, emergency and urgent admissions are much more sensitive to distance than elective ones. A 10% increase in distance leads to a 17.5% and 16.1% reduction in the probability of choosing a hospital for emergency and urgent patients respectively, while it only leads to a 8.3% drop for elective procedures. Choice of where to receive emergency and urgent care is also sensitive to quality, while choice of hospital for elective procedures is virtually unaffected by quality. There are apparent tradeoffs between distance and quality even for the most time-sensitive admissions.

Simulation of Closing 15 Percent of the Least Used Rural Hospitals

We estimate the resulting changes in expected distance and quality due to the simulated closures of 15% of the least-used hospitals. We investigate the effects separately by grouping all rural patients, then the subset of rural patients who originally chose a rural hospital, and then finally the subset of rural patients who originally chose one of the hospitals closed in the simulation. We find that the estimated distance and quality effects are surprisingly small. In the outpatient data, we see only a 2.2-mile increase (15.4%) in expected distance and a 0.044 increase in expected quality (1.6%). Though the percentage terms seem high, the magnitude of these changes are rather small. To put in perspective, the change in expected quality and distance for outpatient procedures has a baseline expected distance of 14.1 miles and a quality measure of 2.8.

The effects are larger when we confine the estimates to patients that chose rural hospitals or that chose one of the closed hospitals. Those patients who sought outpatient procedures and selected closed hospitals have an expected distance increase of 7.1 miles (284%) and a decrease in expected quality of -0.34 (-26.9%). When compared to inpatients, rural outpatients are more negatively affected by this hospital closure policy. Their expected travel distance to hospitals increases to 16 miles and the quality of hospital marginally rises to 2.8 on average.

In the inpatient data, there remains a consistent increase in distance and decrease of quality for those who chose rural hospitals and those who chose a closed hospital (the more adversely affected groups). Patients who chose closed hospitals experience an increase in expected distance of 6.1 miles and a decrease of -0.39 in expected quality. The inpatient data generally shares a more muted effect size when comparing to the outpatient data.

Generally, from closing the least-utilized rural hospitals, there are only modest increases in distance and nearly negligible decreases in quality. The magnitude of these changes vary by admission, but are at most a 7.2 mile increase in expected distance. All admission types see a reduction in the probability of choosing their closest rural hospital, which is largely shifted to the urban hospital. These small changes results may be indicative of rural populations moving closer to hospital care as they become older or sicker, reducing the impact of closing less-favored hospitals.

Table 2. Cross Sample Comparisons

	Distance	Quality	N	Rural	Urban	Research
	-------Inpatient Elasticity-------			--Inpatient Selection Rate--		
All Inpatient	-1.29**	0.23**	209,976	0.69	0.12	0.19
Nervous	-0.90**	-0.037	10,956	0.63	0.11	0.26
Respiratory	-2.13**	0.08**	24,362	0.81	0.08	0.11
Circulatory	-0.91**	0.33**	37,630	0.61	0.16	0.23
Digestive	-1.72**	0.047	21,277	0.76	0.10	0.14
Muscular	-0.87**	0.40**	20,745	0.58	0.19	0.23
Pregnancy	-1.73**	0.56**	20,033	0.70	0.13	0.18
Newborn	-1.65**	0.56**	19,238	0.69	0.13	0.18
Emergency	-1.75**	0.47**	52,219	0.74	0.08	0.18
Urgent	-1.61**	0.38**	68,648	0.74	0.14	0.12
Elective	-0.83**	-0.024*	71,097	0.60	0.14	0.26
	-------Outpatient Elasticity-------			--Outpatient Selection Rate--		
All Outpatient	-1.30**	-0.06**	138,685	0.70	0.12	0.18
Nervous	-1.05**	-0.47	4,055	0.63	0.15	0.22
Respiratory	-0.76**	0.026	2,527	0.61	0.11	0.28
Circulatory	-0.74**	0.15**	13,118	0.60	0.11	0.29
Digestive	-1.69**	0.11**	52,327	0.74	0.12	0.14

*Significant at the 10% level; ** Significant at the 5% level

Simulation of Closing 25 Percent of the Lowest Quality Rural Hospitals

Compared to eliminating the least-used hospitals, closing the lowest-quality hospitals has a more significant effect on distance but with an improved quality of the remaining choices. For outpatient data, there is an increase in expected distance of 2.9 miles (20.3%) and increase in expected quality of 0.22 (7.4%). Patients with outpatient procedures who originally chose a closed hospital saw an increase in 9.6 miles in expected distance but with an increase of 0.7 in expected quality.

Similar changes take place in the inpatient data and across admission types. Depending on the sub-group, the probability of choosing a rural hospital falls by 1.2 to 8.8 percentage points. This effect is smaller than in the previous scenario because we are not closing any higher-quality rural hospital that might attract more distant rural patients when low-quality competitors are removed.

As a main takeaway, we find that closing the lowest-quality rural hospitals results in an increase in expected distance—a larger effect than when closing the least-used hospitals—and a substantial increase in expected quality of care, up to 77% of baseline levels for the most adversely affected groups. Given heterogeneous impacts by admission type, these results bolster the basis of reducing certain non-emergency services—particularly for diagnoses that are bypassed regardless—without tremendous ramifications for other diagnoses or patient utility.

Discussion and Conclusion

This paper highlights distance as the most significant factor in patient choice while illustrating the burden of plausible hospital closing scenarios on rural residents. We find that distance from home significantly lowers the probability of a patient choosing a particular hospital, while hospital quality marginally raises the probability of choosing the hospital. The tradeoff is most salient for inpatient treatments and for emergency or urgent care. Proximity largely drives hospital choice for elective procedures and outpatient services.

Closing 15% of the least-used rural Iowa hospitals results in a marginal increase in expected distance of 1.8 miles and a small decrease in expected quality. Closing 25% of the lowest-quality rural hospitals results in a larger increase in expected distance of 2.8 miles with a significant increase in expected quality. These outcomes suggest that closing the lowest-quality hospitals is a better policy prescription than closing the least-used, providing a substantial increase in quality with only a marginally higher increase in distance.

Increases in expected distance for a subset of patients may be potentially too large for a time-sensitive condition, even if one closing scenario results in significant increases in expected quality. The differential effects for urgent/emergency admission types suggest that the preferential policy is to limit services in lowest-quality hospitals to time-sensitive, urgent/emergency procedures.

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For additional information, the authors recommend:

Liu, J.J, G.R. Bellamy, and M. McCormick. 2007. "Patient Bypass Behavior and Critical Access Hospitals: Implications for Patient Retention." The Journal of Rural Health 23 (1): 17–24. www.ncbi.nlm.nih.gov/pubmed/17300474