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ABSTRACT

Rural hospitals play a crucial role in providing healthcare to rural Americans, a vulnerable and underserved population; however, rural hospitals have faced threats to their financial viability and many have closed as a result. This paper examines the hospital characteristics that are associated with patients choosing rural hospitals, and sheds light on the types of patients who depend on rural hospitals for care and, hence, may be the most impaired by the closure of rural hospitals.

Using data from California hospitals, the paper shows that patients were more likely to choose nearby hospitals, larger hospitals, and hospitals that offered more services and technologies. However, even after adjusting for these factors, patients had a propensity to bypass rural hospitals in favor of large urban hospitals. Offering additional services and technologies would increase the share of rural residents choosing rural hospitals only slightly.

Key Words: Rural hospitals, hospital choice, rural health

About 20 percent of the U.S. population and 2.6 million Californians live in rural areas, which cover about three-fourths of California's land. Rural residents have long been recognized as being vulnerable and underserved for health care. Rural populations fare worse on a number of measures of health compared with urban and especially suburban populations. Rural areas ranked poorly in 21 of 23 population health indicators considered by the Centers for Disease Control, including health behaviors, mortality, morbidity, and maternal and child health measures. In particular, rural residents have higher death rates from unintentional injuries, chronic obstructive pulmonary disease, and suicide. The rural environment is associated with higher rates of occupational injuries and a higher incidence of cancer caused by exposure to cancerous agents. Modifiable risk factors, such as obesity and smoking, are more common among rural residents and are related to higher mortality rates and prevalence of chronic health conditions in rural areas.[1,2] However, there is considerable regional variation in the health of rural populations across the country. For example, rural residents in the South have higher rates of heart disease, whereas those in the West have higher rates of alcohol abuse and suicide. Californians have lower adult and infant mortality rates, but higher rates of alcohol and substance abuse than the average American.[3]

An important feature of rural health care is the presence of persistent resource disparities. Rural areas have a lower density of physicians and nurses per capita compared to urban areas (20% of the nation's population, but only 9% of its physicians). Rural residents are more likely than urban residents to be uninsured, they are less likely to have a regular primary care physician, and they visit physicians less often.[1]

Rural hospitals are especially important providers in rural areas. Of the nearly 5,000 hospitals in the U.S., over 2,000 are in rural areas. Most rural hospitals are small, with fewer

than 100 beds. California has about 70 rural hospitals, and all have fewer than 76 acute care beds. Nearly half of these hospitals are district hospitals supported by a local tax base, and most of the rest are private nonprofits. Forty-one of California's rural hospitals are sole community providers.

Numerous rural hospitals in the U.S. have closed since the 1980s, and these closures have been a constant focus of concern, since closures can impede access to health care for the vulnerable rural residents who are the most reliant on these hospitals.[1] Some rural hospitals have been designated as Critical Access Hospitals by Medicare to help them stay viable. Managed care was especially challenging for rural hospitals because the nature of the market limited opportunities for cost savings and profit management. However, the penetration of managed care has been relatively low in rural areas of California, likely due to the lack of a concentrated population base with large employers and a shortage of health care providers.[4,5]

Rural hospitals provide both inpatient and outpatient care to rural residents. [6] Although the conditions treated and services provided in rural hospitals tend to be more general in nature and of lower complexity than in urban hospitals, some rural hospitals have intensive care units, and some perform invasive cardiologic procedures. [7-9] Availability of certain time-sensitive services, including obstetrical, trauma, and emergency room care, is of particular importance in rural areas. Although the volume of severe trauma cases seen in rural hospitals is usually low, these hospitals are the primary destination for the majority of cases of trauma that occur in rural areas, as well as for other urgent and emergent conditions.[10,11]

The limited service offerings in many rural hospitals lead some rural residents to use urban hospitals.[11-16] One study found that up to one-half of rural pregnant women bypassed rural hospitals to obtain obstetrical care in urban areas.[17] The impact of rural hospitals' service

offerings on access to obstetrical care is likely to depend on proximity to urban areas and other factors. Another study found an overall bypass rate of 30 percent, with higher rates for private insured patients and for patients seeking complex treatment.[18]

Several studies have assessed the factors that influence the use of rural and urban hospitals by Medicare beneficiaries.[16,19,20] Not surprisingly, seniors who live in rural areas use rural hospitals for most routine care; however, rural seniors use urban hospitals for coronary and other specialized surgical care and large hospitals, both urban and rural, for the care of complex conditions.[16,19-21] Among rural Medicare beneficiaries, older patients were found to be more likely to choose the closest hospital whereas those with more severe illnesses were more likely to bypass their closest rural hospital.[22] In Colorado, 45 percent of rural Medicare patients bypassed their local rural hospital. Patient choice was affected by a combination of hospital and patient characteristics including ownership type, the number of beds, patient age, and medical condition.[23]

Rural hospitals in California, like their counterparts elsewhere, face numerous challenges to their survival. Nearly three-fourths of the rural hospitals in the state are losing money, and several have filed for bankruptcy in recent years. Many California rural hospitals have dropped services, including emergency departments and inpatient surgery, and several have closed. Reports have suggested that the closure of some rural hospitals may threaten access to care, [24,25] and that the closure of rural hospitals may be detrimental to the economic health of the local community. [26] However, other studies have found limited effects of closures on outcomes. [27]

The main objective of this study is to assess the hospital characteristics that influence rural residents' decisions to use rural hospitals rather than bypass them to obtain inpatient care in urban areas. Based on the literature we reviewed, a particular focus of the study is whether

patients' tendency to bypass rural hospitals is explained by the limited services and technologies many of them offer. The study goes beyond earlier research on this topic in two ways. First, while other studies have focused on rural hospital choice among Medicare beneficiaries, we use data from a general population. Second, we employ an analytic approach that enables us to quantify the effect of a hospital's characteristics on the probability that patients will use that hospital. Using the results of these analyses, we assess the degree to which offering particular services or technologies would encourage patients to choose rural hospitals. The study also sheds light on the types of patients who depend on rural hospitals for care and, hence, may be the most impaired by the closure of rural hospitals.

CONCEPTUAL FRAMEWORK

The conceptual framework for this study is based on an extension of the standard model of hospital choice that incorporates the institutional features of urban and rural hospitals.[28-30] In this model, individuals' choice of hospital is assumed to depend on the distance between the hospital from the patient's home, the technical capabilities of the hospital (e.g., whether the hospital has the facilities necessary to treat the patient's condition), and whether the patient's insurance coverage will pay for treatment at the hospital. Patients' demographic profile may also affect their hospital choice; for example, more seriously ill patients may prefer more technologically sophisticated hospitals.

DATA AND METHODS

Data Sources and Study Sample

We used 2000 California hospital discharge data and the 2000 American Hospital Association Annual Survey of Hospitals to develop a database that characterizes the choice set of hospitals for rural patients. The discharge data, obtained from the Office of Statewide Health Planning and Development (OSHPD), contains information on each inpatient discharge from an acute care hospital in California. We identified all discharges from general acute care hospitals and from pediatric hospitals in California, and selected those whose source of admission was in the community (i.e., we excluded patients admitted from nursing homes and correctional facilities). We also limited the study to patients 5 years old or older.

For each discharge, we retained the following variables for the analyses: patient age, sex, race/ ethnicity (Asian, black, Hispanic or other race), and zip code of residence; type of admission (urgent or not urgent); major diagnostic category (MDC); two measures of severity of the admission – DRG weight (provided by OSHPD) and number of comorbidities; and primary payer (Medicare, Medicaid or other public program, private insurance, or uninsured). The number of comorbidities was constructed as the sum of the following comorbidity indicators: cancer with a poor prognosis, metastatic cancer, acquired immunodeficienciency syndrome, chronic pulmonary disease, coronary artery disease, congestive heart failure, peripheral vascular disease, severe chronic liver disease, diabetes with end organ damage, diabetes without end organ damage, chronic renal failure, nutritional deficiencies, dementia, and functional impairment.[31]

We also used data on hospital characteristics obtained from the AHA Annual Survey of Hospitals, which collects detailed information yearly from all hospitals in the U.S. and has a response rate of over 90%. For hospitals with missing or inconsistent AHA data, we used information obtained from OSHPD and from a variety of websites to create records containing

the hospital variables that we needed for the analyses. We verified hospital closures and conversions and dropped services reported in the AHA data through newspapers, trade publications, and telephone calls.

We retained the following variables from the AHA survey: bed size; ownership (for-profit, nonprofit, public [city or county], district); teaching status; and availability of various services and technologies, including alcohol and drug abuse out-patient services, cardiac services (catheterization lab, ICU, open heart surgery), medical/surgical ICU, general medical/surgical pediatric, psychiatric inpatient care, obstetrical services, trauma care, neonatal ICU services, and burn care unit. Virtually all hospitals had emergency services; therefore, we did not include this variable in our analyses.

We geocoded the street addresses of all hospitals in California and obtained their latitude and longitude. Using this information, we calculated the straight-line distance from each hospital to each patient in the discharge data using the latitude and longitude of the population centroid for the patient's zip code of residence.

Definition of Rural Hospitals and Rural Patients

To conduct the study, we needed to identify rural hospitals and residents of rural areas. We defined rural hospitals using the official definition established by California Senate Bill 1458 (Section 124840 of the California Health and Safety Code) in 1987. This definition includes about 60 hospitals in rural areas as well as about 10 hospitals with fewer than 76 beds that serve small communities that had fewer than 15,000 people in the 1980 census. Many of these communities have grown since rural hospitals were identified, but the hospitals continue to be classified in this group. In our analyses, we distinguished the hospitals in rural areas, which we

continue to refer to as "rural hospitals," from those that serve small communities, which we refer to as "small urban hospitals."

We defined rural areas in California that are expected to be served by rural and small urban hospitals by using several steps. According to the US Census Bureau definition, areas with a population density of 1,000 people or more per square mile are defined as urbanized. We used the 2000 census to identify the zip codes in our data set that had a population density that exceeded this threshold, and removed these zip codes from our data. We also used Geographic Information Systems (GIS) software to exclude zip codes that were surrounded by other heavily urban zip codes and thus were part of large urban agglomerations. We defined rural areas as the set of zip codes that remained after the exclusions.

Construction of Hospital Choice Sets

To conduct our analyses, we also needed to identify each rural resident's choice set of hospitals – i.e., the set of hospitals that the patient plausibly could have used. As noted earlier, we determined the straight-line distance between each rural resident admitted to an acute care hospital in California and each hospital in the state. We then calculated the distance to the nearest urban hospital for each patient discharge, and classified discharges into 7 groups defined by the 0-25th, 25th-50th, 50th-75th, 75th-90th, 90th-95th, 95th-98th, 98th-100th percentile of this distribution. Next, we calculated, for each of the 7 groups, the 90th percentile of the distribution of distance from patient residence to the hospital where the patient was actually admitted, and used this distance as the radius of a circle around each patient to define the patient's choice set as the hospitals that were located within the circle. We restricted the hospital choice set to the 90th percentile for computational feasibility since including all hospitals in the choice set for each patient discharge would yield a data set that is too large for the multivariate analysis method used

in this paper. Restricting to the 90th percentile excludes hospitals located far away that are unlikely to be in the patient's choice set.

Our goal in constructing the patient's choice set was to include all the hospitals that each patient would consider, but we found that the relevant choice set varied by location.[i] In particular, we observed that rural patients who lived far from urban areas tended to travel much farther than patients who lived close to urban areas in order to be hospitalized. Our method assigns the same hospital choice radius to patients who live in rural areas with similar proximities to urban hospitals. Assigning the same radius to all rural patients in the study would result in patients who lived in rural areas that border urban areas having radii that are too large, and patients who lived in remote rural areas having radii that were too small. As an alternative to constructing 7 groups based on the percentile of distance, we considered assigning radii based on county of residence. However, there was a great deal of within-county variation in travel distances to nearby hospitals, especially in large rural counties that bordered urban areas, indicating that the county did not provide a homogenous unit for calculating the 90th percentile radius. Our assessment is consistent with the Goody's (1993) finding that using county as a hospital market area results not only in the inclusion of areas from which the hospital does not draw patients but also in the exclusion of areas from which it does draw patients.[32]

Our final analytic dataset consisted of 224,990 patient discharges. Patients had between 2 and 199 hospitals in their choice sets, depending on the number of hospitals contained within the 90th percentile radius drawn around their residence zip code. The mean number of hospitals in patients' choice sets was 13.

Statistical Analysis

Our goal was to estimate the determinants of hospital choice for patients in rural areas. The appropriate analytic method must account for the fact that patients have a strong propensity to use hospitals near their homes.[28] Further, patients may consider many hospitals when making their choice. Hospital choice may be affected by the characteristics of each individual hospital in the choice set, and may also be affected by the characteristics of the patient.

Our statistical analysis was based on the conditional logit model, which was developed to analyze this type of problem.[28,29,33] The conditional logit model is the standard modeling framework for studies of hospital choice. In the conditional logit model, the probability that a patient uses a particular hospital is a function of the hospital's characteristics (e.g., rural, small urban or urban; distance; services and technologies; size), relative to the characteristics of other hospitals in the patient's choice set, and the patient's characteristics (e.g., disease type, severity, demographic characteristics). Patient characteristics are incorporated by interacting them with hospital characteristics. An important advantage of the conditional logit model is that it explicitly accounts for the characteristics of the hospitals that were not chosen as well as the one that was chosen. This is accomplished by fitting the model to a data file that includes, for each patient discharge, information on each hospital that the patient could have used. The conditional logit analysis file has one observation for each combination of patient discharge and potential hospital choice. An indicator variable identifies the hospital actually used for each patient discharge. We used STATA version 9.2 for the model estimation (www.stata.com, © StataCorp).

We estimated separate conditional logit models for adult patients with medical DRGs, surgical DRGs, and obstetrical conditions, as well as for children, because we expected that the effect of hospital and patient characteristics on patient choice of hospital would differ across these groups. The explanatory variables in our models included characteristics of the hospitals

and characteristics of the patients. The hospital variables included type of hospital (rural, small urban, and urban), distance from the patient's residence (logarithmically transformed), number of beds (logarithmically transformed), ownership type (for-profit, nonprofit, public, district), teaching status, and indicators for the availability of specific services and technologies (alcohol and drug abuse out-patient services, cardiac catheterization laboratory, cardiac ICU, open heart surgery unit, medical/surgical ICU, general medical/surgical pediatric unit, psychiatric inpatient care, obstetrical services, trauma care, neonatal ICU services, and burn care unit). These hospital variables were designed to capture the general technical expertise and capabilities available in the hospital that may affect patient choice and the hospital's ability to provide necessary services to a patient. We included all the indicators for services and technologies in each model (surgical, medical, obstetrical, and children) even if the service or technology was not directly relevant to the treatment of the particular patient group, because these indicators measure the general level of technical expertise in hospitals and may affect hospital choice for all patients. If a service or technology has no effect on choice for a certain patient group, the model will estimate a coefficient of zero for that indicator.

We also included several patient characteristics in the models, interacted with a combined indicator variable for rural and small urban hospitals, to allow for the possibility that the propensity to choose these hospitals differed across types of patients. (We combined rural and small urban hospitals to construct the interaction terms because there were very few small urban hospitals. The patient characteristics were: patient age (children: 5-9, 10-14; adults: 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75 or older), sex, race/ethnicity, type of admission, MDC (nervous system, eye, ear, respiratory, circulatory, digestive, pancreatic, muscular system, skin, endocrinal, kidney, male reproductive, female reproductive, blood, neoplasm, infections, injury,

and other diagnostic codes), the two measures of severity of the admission, and primary payer. For the child and obstetrical analyses, we combined Medicare and Medicaid program participation since very few individuals were eligible for Medicare. For the child analysis, we also combined eye and ear MDCs, and neoplasm and male reproductive MDCs with "other" MDCs, since there were few cases of each of these.

We also included several additional interactions of patient and hospital characteristics, based on clinical considerations. We anticipated that the availability of a cardiac catheterization laboratory, cardiac ICU, and open heart surgery unit was likely to have a larger effect on hospital choice for patients with circulatory disorders. Therefore, we included interactions of these service indicators with an indicator for circulatory disorders in the surgical models. We also included the interaction of distance to the hospital with whether the case was urgent, because we expected urgent cases to be more likely to be admitted in hospitals close to their residence. We included the interaction of distance to the hospital with the DRG weight to examine if individuals with more complex cases were more likely to travel farther in order to receive appropriate care.

Simulations

Interpretation of conditional logit coefficients is not straightforward, because their effect depends on the characteristics of all the hospitals in each patient's choice set. Further, we were interested in estimating how the choice of urban vs. non-urban hospitals changes if the latter hospitals began to offer additional services. Therefore, we used simulations to obtain the distribution of patients who would choose rural, small urban, and urban hospitals under various scenarios. Our simulations were based on changing hospital characteristic and addressed the following question: How would the proportion of patients choosing urban, rural, and small urban

hospitals change if rural and small urban hospitals had additional facilities (e.g., trauma units, cardiac catheterization labs, cardiac ICUs), additional beds, or different ownership (for-profit, non-profit, district, or public)? To answer this question, we set the simulated characteristic to the desired value for all rural and small urban hospitals in the data, and then predicted the probability of choosing each hospital. We summed the probability of choosing rural hospitals, small urban hospitals, and urban hospitals across all hospitals in each patient's choice set to obtain each patient's predicted probability of choosing hospitals of each type.

RESULTS

Descriptive Analyses

Table 1 describes the characteristics of the hospitals that could potentially be chosen by rural Californians. Rural and small urban hospitals are substantially smaller than urban hospitals with 37 and 64 beds, on average, compared to 211 in urban hospitals. Rural and small urban hospitals also offer fewer services and technologies than urban hospitals. They are less likely to have alcohol and drug units, cardiac services, psychiatric services, and neonatal ICU services, among others.

Table 2 provides a descriptive profile of our analysis sample of patient discharges. The demographic profile is expected – with seniors over the age of 65 accounting for 56% of medical discharges and 44% of surgical discharges. Private insurance pays for over half of child discharges, but only 25% of medical discharges. The distance travelled to the hospital is far greater for discharges among children and surgical patients than among medical or obstetric cases. This pattern may be partly explained by fact that 96% of medical discharges and 69% of obstetric discharges as classified as urgent compared to only 42% of surgical discharges.

To describe the patterns of hospital use by residents of rural areas, we tabulated the proportions of patient discharges in rural, small urban, and urban hospitals by patient characteristics including age, insurance status, urgency of admission, and type of condition (Table 3). Two-thirds of rural discharges were in urban hospitals, while just over one-fourth were in rural hospitals and 7 percent used hospitals classified as small urban. Seniors were more likely than children to use rural and small urban hospitals, and patients with infectious diseases, injuries, and respiratory problems were more likely than patients with surgical conditions to use rural hospitals. Patients with urgent admissions were more likely to choose rural hospitals compared to patients with non-urgent admissions. Patients who used urban hospitals traveled 22 miles, on average, to the hospital of their choice, compared 6 miles for patients who used non-urban hospitals. Rural and small urban hospital patients were less seriously ill, as measured by the DRG weight, than patients who traveled to obtain care in urban hospitals. Twenty-two percent of privately insured patients used rural hospitals, compared with 30 percent of Medicare patients, 28 percent of Medicaid patients, and 28 percent of uninsured patients.

Conditional Logit Models

Table 4 presents selected coefficients from the conditional logit models of hospital choice. (A full set of model coefficients is available on request.) The negative signs for the rural and small urban indicator variables indicate that patients were significantly less likely to choose rural and small urban hospitals than urban hospitals, even after controlling for all measurable hospital characteristics, services and technologies. This is a striking and important finding that suggests that rural patients prefer urban hospitals for reasons above and beyond their larger size and more extensive technological capabilities. Consistent with the earlier literature, we found that distance to the hospital was an important predictor of choice; other things equal, hospitals

located farther away from the patient's residence were less likely to be chosen (negative signs in Table 4). The effect of hospital ownership type was somewhat mixed across models. For instance, nonprofit ownership increased the likelihood that a hospital was chosen among medical adult patients and among children, but reduced it among surgical adult patients. The availability of particular services and technologies generally increased the probability that a hospital would be chosen, but there were exceptions (e.g., inpatient psychiatric services for surgical patients and children).

Patients with public insurance (Medicare or Medicaid) and patients without health insurance were more likely than patients with private insurance to choose a rural or small urban hospital. This result holds for medical, surgical, and obstetric adult cases, as well as for children.

Table 5 presents the results of our simulation analyses. The top line in the table reports the observed proportions of patients in each group who used rural, small urban, and urban hospitals. Each subsequent line shows the proportions that would choose rural, small urban, and urban hospital under a different simulation scenario. For instance, the second line shows what would happen if every rural and small urban hospital were publicly owned by a city or county, whereas the third line shows what would happen if every rural and small urban hospital were a private nonprofit. The key finding in Table 5 is that although offering more services and technologies, in general, would increase the use of rural and small urban hospitals, the effects are small. Therefore, for example, although offering alcohol and drug abuse services, cardiac services, pediatric medical/surgical services, and burn care services significantly increase rural and small urban hospitals' probability of being chosen, in most cases, the increase would amount to only a few percentage points. Notably, some services are associated with a decrease in the probability of choice; for instance, offering psychiatric services would reduce the probability that

rural and small urban hospitals would be chosen by adult surgical patients and by children. It is possible that patients have an aversion to hospitals that treat many patients with psychiatric problems. Alternatively, hospitals that offer certain types of services may specialize but may not attract other types of patients.

Availability of obstetrical services is of particular importance to rural residents. Table 5 shows if every rural and small urban hospital offered obstetrical services, their probability of being chosen by obstetrics patients would rise by 5 percentage points. About 60 percent of rural hospitals already have obstetrics units, however, so this simulation represents only a moderate change in the status quo.

The simulations in table 5 also show that residents with Medicaid or Medicare are more likely to use rural hospitals. If all residents had Medicare, 21 percent of surgical patients and 35 percent of medical patients would use rural hospitals. In comparison, if all residents had private insurance, only 18 percent of medical cases and 32 percent of surgical cases would use rural hospitals.

DISCUSSION

The closure of rural hospitals can impede access to health care for rural residents who are the most reliant on these hospitals. We found that rural patients without private insurance, older patients, and patients with urgent cases are most likely to choose rural hospitals in California. These patient groups are relatively vulnerable and may be unlikely to have ready access to transportation to reach alternative hospitals. We would expect that these patients would be the most likely to suffer reductions in access when rural hospitals close.

Our model of hospital choice found that hospital size, distance, and technical capabilities affect rural Californians' choice of hospital. However, two specific findings of our study merit discussion. First, we found that even after we accounted for all measurable patient and hospital characteristics, rural and small urban hospitals continued to be less favored by patients. Unmeasured factors may play a role in explaining the propensity to bypass rural and small urban hospitals. For instance, our study lacked information on hospital quality of care. Patients may have perceptions about the quality of care in rural and small urban hospitals that lead them to bypass these hospitals when they have a choice. Rural patients may be poorly informed about the services and technologies offered by their local hospitals and, therefore, may bypass these hospitals even though they are adequate for the patients' needs.[34] Rural and small urban hospitals may need to provide their local community with better information about their capabilities and outcomes. In the last decade, many rural hospitals have adapted and innovated in order to survive in the modern health care market.[1] Rural hospitals have updated their management techniques, implemented systems of coordination and networking, and adopted information technology in their bid to survive. These innovative strategies are likely to continue to be important in maintaining the viability of rural hospitals.

Second, and quite striking, as a consequence of patients' propensity to bypass rural and small urban hospitals, increasing the number of services and technologies offered by these hospitals would have only a small effect on patients' decisions to them. In particular, substantial numbers of patients would continue to bypass rural and small urban hospitals to use urban hospitals. Of course, even a small increase in patients could enhance the viability of many rural and small urban hospitals. The crucial question is whether the hospitals could afford to provide expanded services and whether these could be provided with high quality.

The major limitation of this study is the lack of measures of hospital quality of care. Published studies suggest that patients are more likely to choose hospitals that generate better outcomes for their patients.[28-30] Valid measures of quality of care might have helped us to understand rural patients' propensity to bypass rural and small urban hospitals that could not be explained by measurable hospital characteristics. We are also unable to take account of the role of the contracting arrangements between hospitals and insurance providers in hospital choice, since we do not have any information on the insurance networks for the patients in our sample. Additional limitations include the lack of data on the qualifications of hospital staff and the lack of information on road conditions and actual travel distances to hospitals, which may deviate from straight-line distances in rural areas. On the other hand, given the consistency of our findings regarding the effects of services and technologies on choice, it is unlikely that incorporating actual travel distances would change the findings about rural patients' propensity to bypass rural and small urban hospitals.

Finally, our analysis is limited to hospitals in California. California is a large state with a sizeable rural population (2.6 million) and over 60 rural hospitals. Therefore, it provides us with a sufficiently large sample of discharges to enable us to conduct our analysis. However, the generalizability of our findings may be limited by the focus on a single state. Further research focusing on rural patient behavior in other states would be useful to establish that the effects observed for California hold for the rest of the country.

Despite these limitations, this study provides important new information on choice of hospital by residents of rural areas in California. Our findings regarding patients' propensity to bypass rural hospitals and the small effects of offering additional services and technologies have important implications for the efforts of rural hospitals to attract patients and remain viable.

ENDNOTES

i. The legal literature has also considered the determination of choice sets. As noted by Hammer and Sage (2003), courts have stretched the geographic boundaries of markets to strip merging hospitals of market power, and in some cases have included 16 counties in a catchment area.[35] Our goal is to define a reasonable patient choice set for the hospital, and in that sense, differs from the methods used in litigation.

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TABLE 1: HOSPITAL MEANS, BY TYPE OF HOSPITAL

Variable	All Hospitals	Hospital Type Rural	Small Urban	Non-Urban*	Urban
Number of Hospitals	381	55	12	67	313
Hospital Characteristics					
For Profit Ownership	23.7%	7.3%	25.0%	10.4%	26.5%
Public (City or County) Ownership	5.8%	5.5%	0.0%	4.5%	6.1%
Nonprofit Ownership	58.4%	47.3%	25.0%	43.3%	61.7%
District Ownership	11.9%	40.0%	50.0%	41.8%	5.4%
Teaching Hospital	29.0%	0.0%	0.0%	0.0%	35.3%
Pediatric Hospital	0.5%	0.0%	0.0%	0.0%	0.6%
Number of Beds	181.09	37.38	63.50	42.06	211.13
Services and Technologies					
Alcohol/Drug Abuse Out-Patient Services	18.7%	1.8%	0.0%	1.5%	22.4%
Cardiac Cath Lab Services	51.7%	16.4%	27.3%	18.2%	59.1%
Cardiac ICU Services	48.9%	16.4%	36.4%	19.7%	55.4%
Emergency Department Services	93.4%	100.0%	90.9%	98.5%	92.3%
Medical/Surgical ICU Services	79.0%	45.5%	45.5%	45.5%	86.5%
Open Heart Surgery Services	30.9%	1.8%	0.0%	1.5%	37.5%
Psychiatric Services	31.3%	1.8%	0.0%	1.5%	37.7%
Transplant Services	7.7%	0.0%	0.0%	0.0%	9.5%
Trauma Center Services	17.6%	7.3%	0.0%	6.0%	20.1%
Neonatal (Intensive) ICU Services	43.6%	9.1%	9.1%	9.1%	51.4%
General Pediatric Medical/Surgical Services	61.6%	76.4%	83.3%	77.6%	58.1%
Burn care unit	13.8%	3.8%	20.0%	6.3%	15.5%
Obstetrical Services	73.9%	61.8%	75.0%	64.2%	76.0%
Surgical Services	97.9%	85.5%	100.0%	88.1%	100.0%

Notes: * Non-urban refers to rural and small urban.

TABLE 2: PATIENT DISCHARGE MEANS, BY PATIENT TYPE

Variable	Surgical	Medical	Obstetrics	Children
Age: 5-9	0.00%	0.00%	0.00%	79.87%
Age: 10-14	0.00%	0.00%	0.00%	20.13%
Age:15-24	4.40%	3.36%	42.35%	0.00%
Age: 25-34	6.24%	4.16%	44.82%	0.00%
Age: 35-44	12.93%	8.66%	12.66%	0.00%
Age: 45-54	16.37%	12.73%	0.17%	0.00%
Age: 55-64	16.27%	14.73%	0.00%	0.00%
Age: 65-74	21.24%	20.90%	0.00%	0.00%
Age: 75 plus	22.55%	35.46%	0.00%	0.00%
Female	55.44%	52.73%	100.00%	43.27%
Asian	0.89%	1.22%	1.94%	1.55%
Black	1.27%	1.95%	1.68%	2.91%
Hispanic	12.97%	13.58%	44.44%	31.38%
Other Race	2.01%	2.31%	2.89%	3.78%
Medicaid	10.46%	13.23%	51.12%	41.30%
Private Insurance	42.85%	25.17%	45.84%	53.15%
Uninsured	2.52%	3.54%	2.65%	4.05%
Medicare	44.17%	58.06%	0.38%	1.51%
Urgent Admission	42.39%	95.83%	68.52%	85.80%
MDC: Nervous System	4.14%	8.92%	0.00%	8.59%
MDC: Eye	0.15%	0.11%	0.00%	0.62%
MDC: Ear, Nose, Mouth, Throat	1.10%	1.04%	0.00%	4.69%
MDC: Respiratory System	2.32%	19.08%	0.00%	15.73%
MDC: Circulatory System	16.54%	26.87%	0.00%	1.94%
MDC: Digestive System	13.23%	12.56%	0.00%	24.62%
MDC: Hepatobiliary System & Pancreas	6.81%	4.03%	0.00%	1.06%
MDC: Musculoskeletal System	27.28%	3.97%	0.00%	14.15%
MDC: Skin and Breast	3.57%	2.78%	0.00%	3.28%
MDC: Endocrine and Metabolic Disorders	2.24%	5.10%	0.00%	6.56%
MDC: Kidney and Urinary Tract Disorders	3.00%	5.23%	0.00%	4.10%
MDC: Male Reproductive Diseases	3.07%	0.19%	0.00%	0.47%
MDC: Female Reproductive Diseases	13.59%	0.48%	0.00%	0.86%
MDC: Pregnancy and Childbirth	0.00%	0.00%	100.00%	0.00%
MDC: Blood & Immunological Diseases	0.23%	1.57%	0.00%	3.01%
MDC: Myeloproliferative Diseases & Neoplams	0.57%	1.19%	0.00%	3.32%
MDC: Infectious Diseases	0.95%	2.87%	0.00%	2.99%
MDC: Injuries, Poisonings	1.07%	2.29%	0.00%	3.18%
MDC: Other	0.01%	0.18%	0.00%	0.06%
Number comorbidities	0.62	0.99	0.02	0.12
DRG weight	2.01	0.97	0.52	0.96
Surgical Conditions	100.00%	0.00%	0.00%	35.92%
Distance to Hospital	20.08	13.54	15.31	23.37
Number of patient discharges	58158	101847	39028	25957

TABLE 3: PATIENT DISCHARGE MEANS, BY TYPE OF HOSPITAL USED

	Hospital Type			
Variable	Rural	Small Urban	Non-Urban	Urban
Number of patient discharges	59,926	15,571	75,497	149,493
Proportion of patient discharges	26.6%	6.9%	33.6%	66.4%
Patient Characteristics				
Age: 5-9	22.8%	5.2%	28.0%	72.0%
Age: 10-14	23.4%	5.0%	28.3%	71.7%
Age:15-24	25.2%	8.6%	33.7%	66.3%
Age: 25-34	23.5%	7.1%	30.6%	69.4%
Age: 35-44	26.4%	5.7%	32.1%	67.9%
Age: 45-54	27.1%	5.1%	32.2%	67.8%
Age: 55-64	25.7%	5.2%	30.9%	69.1%
Age: 65-74	26.5%	6.4%	32.9%	67.1%
Age: 75 plus	31.4%	9.5%	40.9%	59.1%
Male	26.3%	6.0%	32.3%	67.7%
Female	26.9%	7.5%	34.4%	65.6%
White	28.8%	6.3%	35.2%	64.8%
Asian	14.4%	5.7%	20.1%	79.9%
Black	33.3%	4.3%	37.6%	62.4%
Hispanic	18.6%	9.6%	28.2%	71.8%
Other Race	30.2%	4.6%	34.8%	65.2%
Medicaid	27.9%	7.5%	35.4%	64.6%
Medicare	30.3%	7.9%	38.3%	61.7%
Private Insurance	21.9%	5.4%	27.3%	72.7%
Uninsured	27.5%	8.6%	36.1%	63.9%
Non-Urgent Admission	16.7%	7.0%	23.7%	76.3%
Urgent Admission	29.8%	6.9%	36.6%	63.4%
Number comorbidities	0.65	0.59	0.64	0.62
DRG weight	1.01	0.98	1.00	1.24
Surgical Conditions	19.2%	4.6%	23.9%	76.1%
Distance to Hospital (Miles)	6.45	4.30	6.00	22.06
MDC: Nervous System	23.3%	5.5%	28.7%	71.3%
MDC: Eye	14.8%	3.1%	17.9%	82.1%
MDC: Ear, Nose, Mouth, Throat	26.2%	4.1%	30.3%	69.7%
MDC: Respiratory System	35.3%	8.2%	43.4%	56.6%
MDC: Circulatory System	24.7%	6.7%	31.5%	68.5%
MDC: Digestive System	31.6%	8.1%	39.7%	60.3%
MDC: Hepatobiliary System & Pancreas	32.1%	6.5%	38.6%	61.4%
MDC: Musculoskeletal System	21.4%	4.9%	26.3%	73.7%
MDC: Skin and Breast	29.7%	6.2%	35.9%	64.1%
MDC: Endocrine and Metabolic Disorders	31.0%	6.6%	37.5%	62.5%
MDC: Kidney and Urinary Tract Disorders	29.2%	6.9%	36.1%	63.9%
MDC: Male Reproductive Diseases	22.0%	5.4%	27.4%	72.6%

TABLE 3 (CONT.): PATIENT DISCHARGE MEANS, BY TYPE OF HOSPITAL USED

	Hospital Type			
Variable	Rural	Small Urban	Non-Urban	Urban
MDC: Female Reproductive Diseases	24.0%	6.3%	30.3%	69.7%
MDC: Pregnancy and Childbirth	21.9%	8.5%	30.3%	69.7%
MDC: Blood & Immunological Diseases	27.13%	5.97%	33.09%	66.91%
MDC: Myeloproliferative Diseases & Neoplams	9.92%	2.49%	12.41%	87.59%
MDC: Infectious Diseases	28.58%	7.40%	35.99%	64.01%
MDC: Injuries, Poisonings	30.27%	6.21%	36.48%	63.52%
MDC: Other	20.00%	5.71%	25.72%	74.28%

Notes: * Non-urban refers to rural and small urban.

TABLE 4: SELECTED COEFFICIENTS FROM CONDITIONAL LOGIT MODELS OF HOSPITAL CHOICE

	Surgical		Medical		Obstetrics		Children	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Number of Observations (patient discharge x choice set hospitals)	817,451		1,451,882		531,403		232,165	
Type of Hospital								
Urban Hospital (omitted category)	----		----		----		----	
Rural Hospital	-2.10	0.11 **	-0.62	0.10 **	-1.35	0.08 **	-3.16	0.37 **
Small Urban Hospital	-2.42	0.12 **	-1.30	0.10 **	-1.40	0.08 **	-3.50	0.38 **
Distance to hospital (log)	-1.14	0.01 **	-1.32	0.03 **	-1.50	0.03 **	-1.53	0.07 **
Hospital Characteristics								
For Profit (omitted category)	----		----		----		----	
Public (City or County) Ownership	-0.34	0.03 **	-0.02	0.02	-0.07	0.04	0.54	0.10 **
Nonprofit Ownership	-0.05	0.01 **	0.19	0.01 **	-0.05	0.02 *	0.26	0.06 **
District Ownership	-0.48	0.02 **	-0.09	0.02 **	-0.32	0.03 **	0.07	0.09
Teaching Hospital	-0.01	0.01	0.06	0.01 **	0.21	0.02 **	0.05	0.05
Number of Beds (log)	0.33	0.01 **	0.24	0.01 **	-0.08	0.02 **	0.87	0.04 **
Services and Technologies								
Alcohol/Drug Out-Patient	0.44	0.02 **	0.30	0.01 **	0.41	0.02 **	0.19	0.06 **
Cardiac Cath Lab Services	0.24	0.02 **	0.26	0.01 **	0.13	0.02 **	-0.10	0.06
Cardiac ICU Services	0.29	0.01 **	0.17	0.01 **	0.23	0.02 **	0.16	0.05 **
Medical/Surgical ICU Services	1.16	0.02 **	0.97	0.02 **	0.12	0.02 **	0.81	0.07 **
Open Heart Surgery Services	0.32	0.02 **	0.11	0.01 **	0.09	0.02 **	-0.20	0.05 **
Psychiatric Services	-0.14	0.02 **	-0.07	0.01 **	0.38	0.02 **	-0.47	0.06 **
Trauma Center Services	-0.10	0.01 **	-0.21	0.01 **	0.23	0.02 **	0.18	0.05 **
Neonatal (Intensive) ICU	0.05	0.02 **	-0.10	0.01 **	0.25	0.02 **	0.05	0.06
General Pediatric Medical/Surgical Services	0.02	0.02	0.12	0.01 **	0.32	0.02 **	1.27	0.07 **
Burn care unit	0.06	0.02 **	0.14	0.02 **	0.22	0.03 **	-0.09	0.08
Obstetrical Services	0.26	0.02 **	0.26	0.01 **	2.30	0.03 **	-0.75	0.05 **
Surgical Services			1.47	0.06 **				
Patient Insurance Status								
Private Insurance (omitted category)								
Medicaid*Non-Urban Hospital	0.51	0.05 **	0.60	0.03 **	0.92	0.04 **	0.45	0.11 **
Medicare*Non-Urban Hospital	0.50	0.05 **	0.45	0.03 **				
Uninsured*Non-Urban Hospital	0.34	0.08 **	0.38	0.06 **	1.24	0.11 **	1.38	0.26 **

Notes: * $p < .05$, ** $p < .01$ for test of difference from zero.

TABLE 5: PREDICTIONS OF HOSPITAL CHOICE FROM CONDITIONAL LOGIT MODEL

	SURGICAL			MEDICAL			OBSTETRICS			CHILDREN		
	Rural	Small Urban	Urban	Rural	Small Urban	Urban	Rural	Small Urban	Urban	Rural	Small Urban	Urban
Observed Proportions	19.6%	4.5%	75.8%	34.3%	8.1%	57.6%	22.1%	8.4%	69.4%	21.3%	4.9%	73.8%
Change All Rural and Small Urban Hospitals To												
For profit Ownership	20.8%	5.2%	74.1%	33.6%	8.0%	58.4%	22.9%	9.3%	67.8%	20.4%	4.7%	74.9%
Public Ownership	18.2%	4.3%	77.5% **	33.5%	8.0%	58.6%	22.5%	9.0%	68.5%	23.1%	5.8%	71.1% **
Nonprofit Ownership	20.4%	5.0%	74.6% **	35.0%	8.5%	56.4% **	22.6%	9.1%	68.3% *	21.7%	5.2%	73.1% **
District Ownership	17.3%	4.0%	78.8% **	33.0%	7.8%	59.3% **	20.9%	8.0%	71.0% **	20.7%	4.9%	74.4%
Teaching Hospital	19.5%	4.5%	76.1%	34.8%	8.3%	56.9% **	24.2%	10.5%	65.4% **	21.4%	4.8%	73.8%
Add Services to All Rural and Small Urban Hospitals												
Alcohol/Drug Abuse Services	22.9%	5.7%	71.4% **	36.5%	8.9%	54.6% **	24.6%	10.0%	65.4% **	22.3%	5.3%	72.4% **
Cardiac Cath Lab Services	21.3%	4.8%	73.9% **	35.7%	8.4%	56.0% **	22.7%	9.3%	68.0% **	21.0%	5.2%	73.8%
Cardiac ICU Services	21.8%	4.8%	73.5% **	35.3%	8.1%	56.6% **	23.2%	9.5%	67.3% **	22.0%	5.5%	72.5% **
Medical/Surgical ICU Services	22.5%	6.0%	71.5% **	37.2%	9.4%	53.4% **	22.5%	9.3%	68.2% **	23.2%	6.5%	70.3% **
Open Heart Surgery Services	22.3%	5.1%	72.7% **	35.1%	8.1%	56.8% **	21.6%	8.7%	69.7% **	20.4%	4.9%	74.7% **
Neonatal (Intensive) ICU Services	19.9%	4.4%	75.7% **	33.7%	7.5%	58.8% **	23.4%	9.9%	66.7% **	21.6%	5.4%	73.0%
General Pediatric Medical/Surgical Services	19.6%	4.6%	75.8%	34.4%	8.1%	57.4% **	22.3%	8.6%	69.0% **	21.9%	5.3%	72.7% **
Burn care unit	20.0%	4.7%	75.3% **	35.3%	8.3%	56.4% **	22.5%	7.5%	69.9% **	20.4%	4.2%	75.4%
Obstetric Services	20.2%	4.6%	75.2% **	35.2%	8.1%	56.7% **	27.3%	9.6%	63.1% **	20.0%	4.7%	75.3% **
Psychiatric Services	18.7%	4.2%	77.1% **	33.9%	7.9%	58.3% **	24.5%	9.9%	65.6% **	19.1%	4.0%	76.9% **
Trauma Center Services	19.0%	4.3%	76.7% **	33.0%	7.5%	59.6% **	23.4%	9.3%	67.3% **	22.2%	5.3%	72.5% **
Surgical Services				34.8%	8.0%	57.2% **						
Change Insurance Status for All to:												
Private Insurance	17.5%	3.9%	78.6%	31.7%	7.1%	61.2%	19.1%	6.4%	74.4%	20.2%	4.5%	75.4%
Medicaid	21.2%	5.1%	73.6% **	36.1%	8.7%	55.2% **	24.7%	9.8%	65.5% **	22.5%	5.4%	72.2% **
Medicare	21.3%	5.1%	73.6% **	35.0%	8.3%	56.7% **						
Uninsured	19.9%	4.7%	75.4% **	34.5%	8.1%	57.4% **	26.7%	11.1%	62.3% **	27.7%	7.4%	64.8% **

Notes: * $p < .05$, ** $p < .01$ for test of difference from observed proportions.