Factors Associated With Closures of Emergency Departments in the United States

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Context Between 1998 and 2008, the number of hospital-based emergency departments (EDs) in the United States declined, while the number of ED visits increased, particularly visits by patients who were publicly insured and uninsured. Little is known about the hospital, community, and market factors associated with ED closures. Federal law requiring EDs to treat all in need regardless of a patient's ability to pay may make EDs more vulnerable to the market forces that govern US health care.

Objective To determine hospital, community, and market factors associated with ED closures.

Design Emergency department and hospital organizational information from 1990 through 2009 was acquired from the American Hospital Association (AHA) Annual Surveys (annual response rates ranging from 84%-92%) and merged with hospital financial and payer mix information available through 2007 from Medicare hospital cost reports. We evaluated 3 sets of risk factors: hospital characteristics (safety net [as defined by hospitals caring for more than double their Medicaid share of discharges compared with other hospitals within a 15-mile radius], ownership, teaching status, system membership, ED size, case mix), county population demographics (race, poverty, uninsurance, elderly), and market factors (ownership mix, profit margin, location in a competitive market, presence of other EDs).

Setting All general, acute, nonrural, short-stay hospitals in the United States with an operating ED anytime from 1990-2009.

Main Outcome Measure Closure of an ED during the study period.

Results From 1990 to 2009, the number of hospitals with EDs in nonrural areas declined from 2446 to 1779, with 1041 EDs closing and 374 hospitals opening EDs. Based on analysis of 2814 urban acute-care hospitals, constituting 36 335 hospital-year observations over an 18-year study interval (1990-2007), for-profit hospitals and those with low profit margins were more likely to close than their counterparts (cumulative hazard rate based on bivariate model, 26% vs 16%; hazard ratio [HR], 1.8; 95% confidence interval [CI], 1.5-2.1, and 36% vs 18%; HR, 1.9; 95% CI, 1.6-2.3, respectively). Hospitals in more competitive markets had a significantly higher risk of closing their EDs (34% vs 17%; HR, 1.3; 95% CI, 1.1-1.6), as did safety-net hospitals (10% vs 6%; HR, 1.4; 95% CI, 1.1-1.7) and those serving a higher share of populations in poverty (37% vs 31%; HR, 1.4; 95% CI, 1.1-1.7).

Conclusion From 1990 to 2009, the number of hospital EDs in nonrural areas declined by 27%, with for-profit ownership, location in a competitive market, safety-net status, and low profit margin associated with increased risk of ED closure.

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As the only place in the US health care system that serves all patients, emergency departments (EDs) are the "safety net of the safety net."[1] Federal law requires hospital EDs to evaluate and treat all patients in need of emergency care regardless of ability to pay.[2] Although only 4% of US physicians work in a hospital ED, it is estimated that they provide more acute care to Medicaid beneficiaries and the uninsured than the rest of US physicians combined.[3]

The US Congress recently enacted legislation to promote regionalization of emergency care, to increase efficiency, and to improve outcomes.[4] Despite recognition that emergency care is an essential health benefit,[2] no federal law ensures the availability of hospital EDs.

The total number of hospital-based EDs declined 3.3%, from 4771 to 4613, between 1998 and 2008. In this same period, ED visits increased by 30%, from 94.8 million visits to 123 million visits annually.[5] ED use by publicly insured and uninsured patients increased at an even faster pace, largely driven by loss of access to care in other settings.[3]

Market forces strongly influence access to health care in the United States; however, little is known about risk factors associated with ED closures. We hypothesized that market forces are associated with the ability of an ED to remain open. We analyzed factors that might be associated with the closure of hospital EDs, including hospital, community, and market characteristics.

METHODS

Study Design and Data Sources

We determined the numbers of EDs in operation in the United States from 1990 to 2009, and we also performed a survival analysis of ED closures for

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all general, acute, nonfederal short-stay hospitals in the United States from 1990 to 2007. We excluded hospitals that were not in metropolitan statistical areas because rural hospitals are sometimes designated "critical access hospitals" and operate under different federal mandates and supports.[6]

ED and hospital organizational information was obtained from the American Hospital Association (AHA) Annual Surveys.[7] Response rates differ by year (eg, 92% for 1990-1994, 85% for 1995-1999, 86% for 2000-2007, and 84% for 2008-2009) and vary depending on data item.[8] Because financial data are not available from AHA surveys, we obtained these data from the Healthcare Cost Report Information System (HCRIS) from the Centers for Medicare & Medicaid Services (CMS). CMS programs internal consistency checks within its cost report software to reduce the incidence of obvious inconsistencies and missing data.[9,10]

County population characteristics were obtained from the Area Resource File (ARF)[11] and a wage index (a proxy for the cost of living) from Prospective Payment System (PPS) impact files.[12] To quantify local hospital competition, we used a widely accepted measure, the Herfindahl index.[13] The Herfindahl index measures the amount of competition among hospitals within the same market. It is calculated as the sum of the squares of the market share among hospitals that are within a 15-mile radius, where market share is measured using hospital discharges. For example, if a hospital is the only hospital within the market it is serving, it has 100% market share, so the Herfindahl index for a monopolistic market is 10 000. Our analysis of risk factors for ED closure was based on data through 2007, the latest year of full data from all data sources. This study was exempt from review by the committee on human research at the University of California, San Francisco.

Outcome Measure

Guided by previous literature,[14,15] the definition of the opening year of an ED was set as the first year of the first consecutive 2 years in which a hospital reported operation of an ED. Closure year was defined as the year after the last year in which the hospital indicated on its AHA survey that it operated an ED. Our goal was to identify risk factors related to closures of emergency services to a community. We therefore evaluated closures of EDs as a whole, whether they resulted from closures of hospitals that offered ED services or from hospitals that remained open but closed their EDs as a service line.

Statistical Methods

The analysis only included hospitals with an ED at any point in the study period. Hospitals that had an ED prior to 1990 entered the model that year, and hospitals that opened EDs later entered the model in the year of the opening. The study interval (1990-2007) provided 18 one-year intervals during which ED closure could occur.

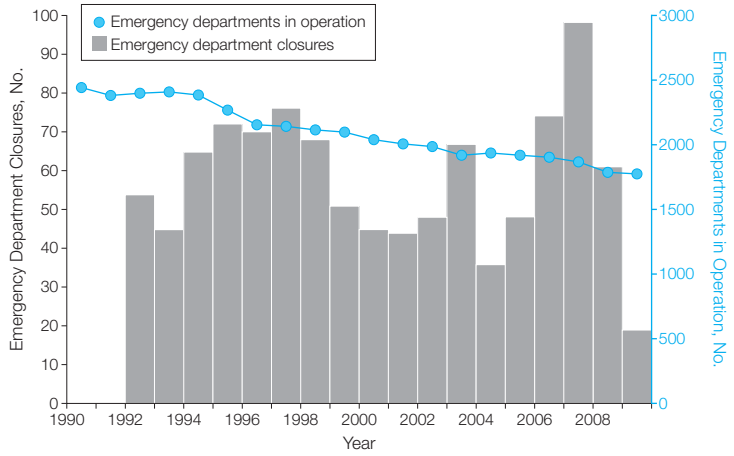
To identify possible risk factors for ED closure, we used discrete-time proportional hazard models.[16,17] We first analyzed bivariate relationships of the risk factors to the outcome of closure and then included all covariates for a fully adjusted model, using Stata version 11 (StataCorp, College Station, Texas) for all analyses. We used the conventional 5% level of significance with 2-sided testing. The independent variables are noted next; a summary of the data source for the variables appears in eFigure 1 (available at http://www.jama.com).

Hospital-Specific Characteristics. We described each hospital according to characteristics used in other analyses examining service provision, including ownership status (for-profit, not-for-profit, and government), teaching status, system membership, ED size (annual visits to the hospital's ED as proxy), and case-mix index.[15,18] All aforementioned variables were obtained from the AHA surveys, with the exception of case-mix index, which was obtained from PPS impact files. The latter captures the average severity of illness among patients that the hospital receives. A case-mix index of 1 indicates the hospital's patient population's sickness level is at the national average. A higher case-mix index represents a sicker patient population. For ease of interpretation, we grouped hospitals into 3 categories: those in the lower one-third of the case-mix index distribution (healthier patients than the average), middle one-third, and upper one-third (sicker patients than the average).

We also included each hospital's total profit margin, as in previous literature.[18] Using HCRIS, we calculated total profit margin as the ratio of the net revenue (total revenue, including disproportionate share payments, minus total costs) divided by the total costs. To smooth year-to-year variations in the measurement of financial data and to account for the fact that financial considerations that would influence the decision to close an ED were likely to occur a few years preceding the actual closure, we constructed the profit margin variable as a 3-year moving average (ie, the profit margin value for a 2003 observation is the average from 2001-2003). Based on the empirical distribution of this profit margin, we created 2 binary indicators to depict each hospital's financial status: hospitals whose profit margin was at the upper quartile of the profit distribution (profit margin >8.9%) and those with a profit margin at the lower quartile of the distribution (<0%).[18]

We included safety-net status as a characteristic because it has been reported that these hospitals carry a disproportionate burden of unreimbursed care.[19] The Institute of Medicine described safety-net hospitals as those that "organize and deliver a significant level of health care and other related services to uninsured, Medicaid and other vulnerable patients."[20] Although the Institute of Medicine did not propose a specific operational definition, others have.[18,19,21-24] Many use hospital characteristics (such as teaching or county-owned facilities); others focus on the amount of charity care provided compared with a given standard

Figure 1. Trends in Emergency Department Operation and Closures in Urban Areas, 1990-2009



(eg, by state or nationwide).[21,22,24] We opted for an index that is service-oriented rather than one based on organizational characteristics.[19,21] Many economists have used proportions of Medicaid patients served (or hospital days) as a more straightforward approach to determine safety-net designation.[23,25,26]

We defined a safety-net hospital dichotomously as one that provides more than double the Medicaid share (measured by number of discharges as recorded in HCRIS) compared with competing hospitals within a 15-mile radius of the facility.[27,28] For example, if the average Medicaid share in the hospital market is 15%, a hospital that has 30% or more Medicaid discharges is considered a safety-net hospital. We believe this is a more conservative and accurate approach in that it accounts for the population of Medicaid-eligible patients. For example, in a highly insured community, there may not be a hospital that qualifies as safety net based on a static metric (eg, defined as 1 SD above the state average Medicaid caseload)[19,23,25] but could indeed be the safety-net hospital for that area if it provides the greatest share of care for the population in need. The 15-mile radius is a standard measure of a hospital market.[29-32] We also conducted a sensitivity analysis using a narrower (10-mile) market radius.

County-Level Characteristics. In each hospital's county, we calculated the percentages of the population that were minority, poor, elderly, and uninsured based on ARF data—groups associated with ED use.[19] Minority was defined as nonwhite race based on the ARF, which is derived from the yearly county census population. Poor was defined as the percentage of the population living below the poverty level. Each categorical variable was divided into low, medium, and high based on the tertiles of the distribution of the characteristics. We also controlled for the size of each county's population and the local cost of living (ie, wage index as reported by PPS impact files).

Market Characteristics. We selected market factors associated with the likelihood of offering certain services: presence of another ED located within a 15-mile radius, whether the hospital was located in a competitive market (defined as Herfindahl index <2500), and whether there was another for-profit or government-owned hospital within the 15-mile radius.[27,28] Each of these variables was dichotomized.

RESULTS

In 1990, our sample included 2446 hospitals with EDs in nonrural areas. By 2009, that number had declined by 27%, to 1779 across the United States (FIGURE 1 and eFigure 2). During the study interval, 1041 EDs closed, an average of 89 per year. Of the 1041 ED closures, the majority (66%, or n=690) were due to the closure of an entire hospital that operated the ED. For the remaining 34% (n=351), the EDs were closed but the hospital stayed open. During the study interval, 374 EDs were opened. There was therefore a net loss of 667 nonrural EDs during 1990-2009. The overall sample analyzed (1990-2007) included 2814 hospitals, contributing a total of 36 335 hospital-years to the analysis.

We found significant differences in the characteristics of local hospital markets and the facilities (TABLE 1). Ten percent of hospitals that closed their EDs met our criteria for safety-net centers, compared with 6% of those that kept their EDs open. Closed EDs were more likely to be at for-profit hospitals than EDs that stayed open (26% vs 16%, $P<.001$). Smaller facilities were more likely to close their ED (closed EDs reported a mean of 22 404 annual visits, compared with 33 691 in open facilities, $P<.001$); and twice as many hospitals that closed their EDs were in the lowest quartile of the profit margin distribution, compared with those that kept their EDs open ($P<.001$). We also found that EDs that closed tended to be located in counties with high shares of minority populations (36% vs 31%, $P=.005$), high shares of populations in poverty (37% vs 31%, $P<.001$), and more than 15% of its individuals without insurance (42% vs 36%, $P=.002$). Thirty-four percent of hospitals that closed their EDs were in highly competitive markets, compared with 17% of those with EDs that did not close ($P<.001$).

FIGURE 2 shows the observed Kaplan-Meier survival curves of EDs by safety-net status, ownership status, poverty level, and profit margin. At the end of the study period, the cumulative probability of an ED remaining open among safety-net hospitals was about 50%, compared with 74% among non–safety-net hospitals. In terms of hospital ownership, the cumulative probability for

an ED to remain open was 50% among for-profit hospitals compared with 75% for the other 2 ownership types. Similarly, EDs at hospitals with negative profit margin (ie, the lowest quartile of profit margin distribution) had a 50% cumulative probability of remaining open compared with the 75% cumulative probability of remaining open for EDs at hospitals in the other 3 quartiles. EDs in hospitals in counties with a high share of the population in poverty (upper tertile) had a lower cumulative probability (70%) of remaining open compared with hospitals serving a low share of population in poverty.

TABLE 2 presents the results of the unadjusted (bivariate) hazard ratios (HRs) as well as the adjusted (multivariate) HRs. The third column of Table 2 reports the HR based on the bivariate model, while the second column reports the corresponding cumulative hazard rate from that model. By default, the reference group has an HR of 1. In the unadjusted analysis, EDs at safety-net hospitals were more likely to be closed than EDs at non–safety-net hospitals (HR, 1.6; 95% confidence interval [CI], 1.3-2.0). EDs in counties with higher percentages of minority populations were at higher risk of closure (HR, 1.3; 95% CI, 1.1-1.6), as were those located in counties with higher shares of populations in poverty (HR, 1.4; 95% CI, 1.2-1.7). EDs serving communities of uninsured patients, defined dichotomously as communities with more than 15% of its individuals uninsured, were also at higher risk of closure (HR, 1.2; 95% CI, 1.1-1.4). In addition, EDs at for-profit hospitals and hospitals in more competitive markets were more likely to close (HR, 1.9 and 1.7; 95% CI, 1.6-2.2 and 1.5-2.0, respectively). EDs at hospitals in the lowest quartile of profit margin (<0%) also were more likely to close than EDs at hospitals with profit margins in the other 3 quartiles (HR, 2.5; 95% CI, 2.1-3.0).

The last column of Table 2 displays the adjusted HRs of each risk factor. The adjusted HRs are the results of a fully adjusted model that includes variables listed in the table (hospital, com-

Table 1. Descriptive Statistics of Hospital and Market Characteristics by ED Closure Status, 1990-2007

	No. (%)			
		ED Closure Status		
	Total Sample (N = 2814)[a]	No ED Closure (n = 1881)	ED Closed (n = 933)	*P* Value
Hospital-Specific Characteristics				
Safety-net hospital	208 (7)	114 (6)	95 (10)	<.001
Teaching hospital	298 (11)	225 (12)	73 (8)	<.001
Not-for-profit hospital	1917 (68)	1312 (70)	604 (65)	.004
For-profit hospital	544 (19)	305 (16)	238 (26)	<.001
Government hospital	353 (13)	263 (14)	90 (10)	.001
Profit margin in lowest quartile	679 (24)	343 (18)	336 (36)	<.001
Profit margin in highest quartile	567 (20)	422 (22)	145 (16)	<.001
Member of a system	1761 (63)	1187 (63)	574 (62)	.35
Case-mix index[b]				
Low	897 (32)	574 (31)	323 (35)	.008
Medium	899 (32)	595 (32)	304 (33)	.48
High	885 (31)	639 (34)	246 (26)	<.001
Average annual visits to ED, No.	29 949	33 691	22 404	<.001
County Population Characteristics[c]				
Share of minority population				
Low	926 (33)	659 (35)	267 (29)	<.001
Medium	937 (33)	622 (33)	314 (34)	.72
High	928 (33)	589 (31)	339 (36)	.005
Share of poverty population				
Low	923 (33)	663 (35)	260 (28)	<.001
Medium	938 (33)	623 (33)	315 (34)	.67
High	930 (33)	585 (31)	346 (37)	<.001
>15% population was uninsured in 2000	1075 (38)	681 (36)	394 (42)	.002
Share of elderly population				
Low	927 (33)	642 (34)	285 (31)	.05
Medium	918 (33)	617 (33)	301 (32)	.75
High	947 (34)	612 (33)	335 (36)	.06
Average population size in the county, No.	1 084 586	1 019 699	1 216 821	.009
Average cost of living index	1.1	1.0	1.1	<.001
Market Characteristics				
Another ED within 15-mile radius	2526 (90)	1646 (87)	880 (94)	<.001
Located in competitive market (Herfindahl index <2500)[d]	639 (23)	323 (17)	316 (34)	<.001
≥1 for-profit hospital within 15-mile radius	1355 (48)	847 (45)	508 (54)	<.001
≥1 government hospital within 15-mile radius	1274 (45)	765 (41)	509 (55)	<.001

Abbreviation: ED, emergency department.
[a] Total sample is all hospitals with EDs at some point during the study period, an 18-year study interval that constituted 36 335 hospital-year observations.
[b] We grouped hospitals into 3 categories of case-mix index distribution: those in the lower one-third (healthier patients than national average), middle one-third, and upper one-third (sicker patients than national average).
[c] Each categorical variable was divided into low, medium, and high based on the tertiles of the distribution of the characteristics.
[d] Herfindahl index is calculated as the sum of the squares of the market share among hospitals that are within a 15-mile radius, where market share is measured using hospital discharges. If a hospital is the only hospital within the market it is serving, it would have 100% market share, so the Herfindahl index would be 10 000.

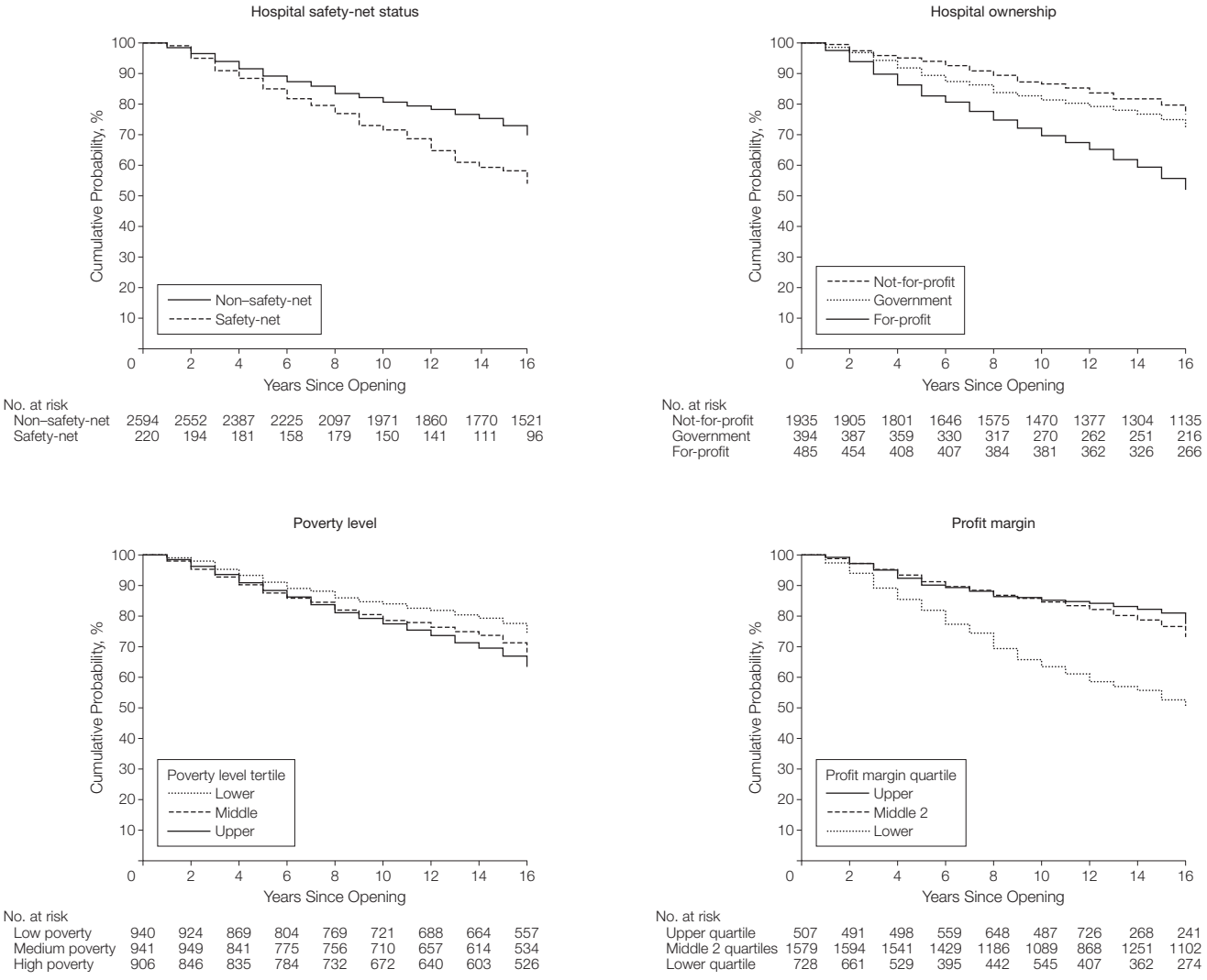
munity, and market factors). Three hospital-specific characteristics were associated with an increased risk of ED closures, including safety-net status (HR, 1.4; 95% CI, 1.1-1.7), for-profit status (compared with not-for-profit or government hospitals; HR, 1.8; 95% CI, 1.5-2.1), and hospitals with profit margins in the lowest quartile (HR, 1.9; 95% CI, 1.6-2.3).

In analyzing community demographic risk factors, the bivariate associations of communities with high proportions of minority populations and lack of insurance with closure were attenuated and no longer statistically significant after multivariate adjustment, suggesting that there may be partial mediation of these factors with profit margin and hospital ownership. However, even after fully adjusting for all factors in the model, EDs in communities with the highest percentage of population in poverty were at increased risk of closure (HR, 1.4; 95% CI, 1.1-1.7).

In our analysis of market factors, we found that presence of another ED within a 15-mile radius also was associated with increased risk of ED closure (HR, 1.8; 95% CI, 1.3-2.5). Similarly, hospitals in areas with high levels of competition as measured by a lower Herfindahl index were at higher risk of closure (HR, 1.3; 95% CI, 1.1-1.6).

In our sensitivity analyses, we estimated our model using an alternative safety-net definition (ie, >30% of inpatient discharges belong to Medicaid, which is 1 criterion of the Centers for Disease Control and Prevention definition[19]) with very similar results. In addition, the 15-mile radius is a standard definition for a hospital market[29-32]; we repeated the model using a more conservative 10-mile radius estimate with no significant departure from our results.

Figure 2. Kaplan-Meier Survival Curves of Emergency Departments by Selected Hospital and Market Characteristics



COMMENT

Our nationwide analysis of ED closures between 1990 and 2007 identified several risk factors that suggest economic drivers are associated with ED closures. Hospital-specific characteristics related to higher risk of closure were safety-net status, for-profit ownership, and low profit margin. After controlling for demographic and market factors, safety-net hospitals are at higher risk of closing their EDs compared with non–safety-net hospitals, suggesting that safety-net hospital status reflects other pressures that, although less measurable, are associated with ED closure. For example, some EDs have difficulty maintaining a full on-call panel of specialty physicians because of unwillingness of specialists to cover emergency calls, especially for poorly insured patients.[33-35] While this finding deserves more study, it signals that safety-net hospitals may require particular attention if emergency care access is to be sustained.

Hospitals in counties where a high proportion of residents live in poverty were more likely to close their EDs than hospitals in more economically secure communities. Factors such as crowding and the increasing challenges of providing high-quality care in the face of burgeoning demand could contribute to difficulty in recruiting and maintaining staff at all levels. These community-characteristic findings are especially compelling given that vulnerable populations, including those in minority groups and both uninsured and underinsured patients, use EDs for acute care at greater rates than other populations.[36,37] As more of these patients lose access to primary care, an increasing number of EDs are meeting criteria as safety-net facilities,[37] which suggests that more EDs may be at risk of closing in the future. ED closures can have substantial effects on vulnerable communities, causing a decline in care as hospitals serving poor and minority populations select to provide services based on profitability rather than community health needs.[38]

Local market competition is strongly associated with the ability of an ED to remain open. The presence of other EDs

Table 2. Proportional Hazard Model of ED Closures in the United States, 1990-2007

	Cumulative Hazard Rate[a]	HR (95% CI) Bivariate	HR (95% CI) Multivariate[b]
Hospital-Specific Characteristics			
Non–safety-net	0.37	1 [Reference]	1 [Reference]
Safety-net	0.59	1.6 (1.3-2.0)	1.4 (1.1-1.7)
Nonteaching	0.40	1 [Reference]	1 [Reference]
Teaching	0.24	0.6 (0.4-0.7)	0.6 (0.5-0.9)
Not-for-profit	0.34	1 [Reference]	1 [Reference]
For-profit	0.65	1.9 (1.6-2.2)	1.8 (1.5-2.1)
Government	0.27	0.8 (0.6-1.0)	0.9 (0.7-1.1)
Break-even (no profit)	0.27	1 [Reference]	1 [Reference]
Profit margin in lowest quartile	0.68	2.5 (2.1-3.0)	1.9 (1.6-2.3)
Profit margin in highest quartile	0.25	0.9 (0.7-1.1)	0.9 (0.7-1.1)
Not member of a system	0.37	1 [Reference]	1 [Reference]
Member of a system	0.41	1.1 (0.9-1.2)	1.0 (0.8-1.1)
Low case-mix index[c]	0.48	1 [Reference]	1 [Reference]
Medium case-mix index[c]	0.38	0.8 (0.7-0.9)	0.8 (0.7-0.9)
High case-mix index[c]	0.29	0.6 (0.5-0.7)	0.8 (0.6-1.0)
Total visits to ED, log-transformed[d]		0.8 (0.8-0.8)	0.8 (0.8-0.8)
County Population Characteristics[e]			
Share of minority population			
Low	0.32	1 [Reference]	1 [Reference]
Medium	0.41	1.3 (1.1-1.5)	1.3 (1.1-1.6)
High	0.41	1.3 (1.1-1.6)	1.1 (0.9-1.4)
Share of poverty population			
Low	0.31	1 [Reference]	1 [Reference]
Medium	0.37	1.2 (1.0-1.5)	1.2 (1.0-1.5)
High	0.44	1.4 (1.2-1.7)	1.4 (1.1-1.7)
≤15% population uninsured in 2000	0.36	1 [Reference]	1 [Reference]
>15% population uninsured in 2000	0.43	1.2 (1.1-1.4)	0.9 (0.7-1.1)
Share of elderly population			
Low	0.36	1 [Reference]	1 [Reference]
Medium	0.36	1.0 (0.8-1.2)	1.0 (0.9-1.3)
High	0.43	1.2 (1.0-1.4)	1.2 (1.0-1.5)
Population size, log-transformed[d]		1.1 (1.1-1.2)	1.1 (1.0-1.1)
Cost of living[d]		1.2 (0.8-1.8)	0.5 (0.2-1.0)
Market Characteristics			
Only ED within 15-mile radius	0.21	1 [Reference]	1 [Reference]
Another ED present within 15-mile radius	0.40	1.9 (1.5-2.5)	1.8 (1.3-2.5)
Located in concentrated market	0.34	1 [Reference]	1 [Reference]
Located in competitive market (Herfindahl index <2500)[f]	0.57	1.7 (1.5-2.0)	1.3 (1.1-1.6)
No for-profit hospital within 15-mile radius	0.34	1 [Reference]	1 [Reference]
≥1 for-profit hospital within 15-mile radius	0.44	1.3 (1.1-1.4)	1.0 (0.8-1.2)
No government hospital within 15-mile radius	0.33	1 [Reference]	1 [Reference]
≥1 government hospital within 15-mile radius	0.43	1.3 (1.2-1.5)	1.1 (0.9-1.3)

Abbreviations: CI, confidence interval; ED, emergency department; HR, hazard ratio.
[a] Based on bivariate model.
[b] The multivariate model is adjusted for all covariates listed in this table as well as indicators for 4 census regions.
[c] We grouped hospitals into 3 categories of case-mix index distribution: those in the lower one-third (healthier patients than national average), middle one-third, and upper one-third (sicker patients than national average).
[d] Annual ED visits were measured by number of visits, population was measured by counts of people, and wage index was an index produced by the Centers for Medicare & Medicaid Services capturing the relative labor cost of the hospital's geographical market relative to the national average labor cost for hospital. The index ranges from 0.66-1.93 in the sample. ED visits and population counts were log-transformed.
[e] County population characteristics are determined yearly from the Area Resource File; during the study period, the average proportions of each characteristic (lower tertile, middle tertile, upper tertile) were as follows: poverty (7%, 13%, 19%), minority (5%, 16%, 36%), and elderly (9%, 12%, and 16%). Each categorical variable was divided into low, medium, and high based on the tertiles of the distribution of the characteristics.
[f] Herfindahl index is calculated as the sum of the squares of the market share among hospitals that are within a 15-mile radius, where market share is measured using hospital discharges. If a hospital is the only hospital within the market it is serving, it would have 100% market share, so the Herfindahl index would be 10 000.

within a 15-mile radius and highly competitive markets are both associated with increased risk of ED closures. Previous literature reported that emergency services in areas with poor payer mix are often money losers.[18] Our study extends this finding, showing that market forces, beyond profit margin alone, are substantially related to the ability of an ED to remain open.

Our findings expand the evidence base by showing that economic factors related to ED closures are similar to those related to hospital closures and may be even stronger.[18,39] All factors (except for the increased risk of hospitals serving a higher proportion of patients in poverty) identified in our study can be shown to be market-driven. Profit margin, for example, is influenced by a number of factors ranging from patient payer mix, reimbursement decisions from payers (and negotiated discounts between hospitals and payers), to competition. Market factors may also be the reason that many for-profit hospitals choose not to provide emergency services.

In some areas, the episodic closure of EDs may be of little consequence, particularly in competitive health care markets where nearby facilities can deliver the needed clinical care for patients who seek ED treatment. Some might assert that such "creative destruction" is a manifestation of a healthy marketplace. However, the market economics of US health care, particularly emergency care, are distorted by the fact that 51 million Americans lack health insurance, and another 48 million are covered by Medicaid and other forms of public insurance that reimburse well below cost.[40] With health care reform, the numbers of individuals covered by Medicaid and other forms of public insurance are likely to increase substantially, with far-reaching implications if these patients cannot access timely and adequate care. In most of the US health care system, an effective business strategy is to minimize uncompensated costs by declining to treat these patients, but EDs cannot do so.

The economic challenge of operating an ED in the face of a federal obligation may explain, in part, why for-profit hospitals were twice as likely to close their EDs as facilities that are nonprofit or publicly owned. It may also explain why hospitals in the lowest quartile of profitability (essentially, negative profitability) and those in highly competitive markets were more likely to close their EDs. Yet even after controlling for these and other characteristics, we observed that safety-net hospitals were significantly more likely to close their EDs than hospitals that did not serve this role.

The closure of an ED can have profound repercussions for a community.[41-43] Closures can adversely affect access to emergency care for everyone—insured and uninsured alike.[41] Hospital closures significantly affect access to care not only by increasing the distance to the nearest hospital but also by increasing the patient load at neighboring hospitals.[44] ED crowding degrades quality of care, not only by prolonging patient waiting times and increasing the rate of patients who leave without being seen, but also in terms of outcomes, including increased rates of morbidity and mortality.[45-47] Because Medicaid, SCHIP, and uninsured patients are highly reliant on hospital EDs for acute care,[3] ED closure can displace tens of thousands of uninsured and low-income patients to other EDs, worsening crowding and potentially setting the stage for additional closures.[48-50]

Our analysis has several limitations. We were only able to analyze factors that are regularly quantified across hospitals and communities. A decision to open or close a hospital or its ED may depend on a wide range of factors, including political considerations, community pressures, local philanthropic support, and a hospital's ability to fill its bed with non-ED admissions. We also did not examine federal hospitals, such as those operated by the Veterans Administration, which provide ED access to certain populations. Also, our financial data and analysis of risk factors associated with ED closures are based on data through 2007, the most recent year for which complete data were available. We suspect that with the economic recession that followed in subsequent years, some hospitals most likely faced increased financial pressures that may have influenced decisions regarding maintaining or closing their EDs.

It is critical to determine whether and how to engage society in decisions to maintain or close EDs and other safety-net services. Should such decisions be dictated strictly by market forces, or should other considerations apply?[51] Calls for legislation to regulate the closure of hospital EDs were first made more than 2 decades ago.[52] Experience has shown that such measures are difficult to enact and even harder to implement.[53] Although some might consider it prudent to require detailed patient outcome data before taking action to regulate ED closures, waiting to quantify these potential adverse consequences is far from ideal, especially because no government or nongovernmental body is charged with monitoring and reporting these trends.

Our findings underscore that market-based approaches to health care do not ensure that care will be equitably distributed.[54] In fact, the opposite may be true. As long as tens of millions of Americans are uninsured, and tens of millions more pay well below their cost of care, the push for "results-driven competition"[55] will not correct system-level disparities that markets cannot—and should not—be expected to resolve.

In summary, this study demonstrated that from 1990 to 2009, the number of hospital EDs in nonrural areas declined by 27%, with for-profit ownership, location in a competitive market, safety-net status, and low profit margin associated with increased risk of ED closure.

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Study concept and design: Hsia, Shen.
Acquisition of data: Shen.
Analysis and interpretation of data: Hsia, Kellermann, Shen.
Drafting of the manuscript: Hsia.
Critical revision of the manuscript for important intellectual content: Kellermann, Shen.
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