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Variation in Emergency Department Admission Rates Across the United States

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Abstract

There were more than 19 million hospitalizations in 2008 from hospital-based emergency departments (EDs), representing nearly 50% of all U.S. admissions. Factors related to variation in hospital-level ED admission rates are unknown. Generalized linear models were used to assess patient-, hospital-, and community-level factors associated with ED admission rates across a sample of U.S. hospitals using Healthcare Cost and Utilization Project data. In 1,376 EDs, the mean ED admission rate, when defined as direct admissions and also transfers from one ED to another hospital, was 17.5% and varied from 9.8% to 25.8% at the 10th and 90th percentiles. Higher proportions of Medicare and uninsured patients, more inpatient beds, lower ED volumes, for-profit ownership, trauma center status, and higher hospital occupancy rates were associated with higher ED admission rates. Also, hospitals in counties with fewer primary care physicians per capita and higher county-level ED admission rates had higher ED admission rates.

Keywords

variation, local practice, emergency, emergency department, admission

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Introduction

According to data from the Healthcare Cost and Utilization Project (HCUP), there were 124.9 million emergency department (ED) visits in the United States in 2008 (HCUPnet, 2012). Of those, 19.4 million were admitted to an inpatient hospital unit. Hospital-level ED admission rates (i.e., the proportion admitted of overall ED visits) have remained relatively stable over the past two decades; however, steady increases in overall ED utilization have outpaced population growth (Tang, Stein, Hsia, Maselli, & Gonzales, 2010). This has increasingly made the ED hospitals' "front door": in 2008, nearly 50% U.S. hospital admissions originated in the ED compared to 36% in 1996 (HCUPnet, 2012; Schuur & Venkatesh, 2012).

There are several potential reasons for the increasing role of the ED in hospital admissions. First, patients may increasingly prefer the ED compared to primary care settings. This also may be a result of a fraying primary care infrastructure that may not provide timely access for acute care or, alternatively, that primary care physicians may be sending more planned inpatients to the ED for evaluation and admission. In addition, what previously were planned admissions to the hospital may have now moved into outpatient settings, such as ambulatory surgical centers.

As the ED has become an increasingly common source of admission, exploring variation in ED admission rates is important. In other studies that have included admissions from all sources, variation in hospital care intensity (HCI) and inpatient utilization have been shown to be major contributors to the variation in health care costs for Medicare beneficiaries (Fisher et al., 2003). The EDs' role in this variation has not been thoroughly explored using large U.S. databases; however, micro-level studies have documented large variations in the decision to admit through the ED (Hack, O'Brien, & Benson, 2005; Mutrie, Bailey, & Malik, 2009). One recent study found twofold variation in emergency physicians' decision to admit patients with pneumonia (Dean et al., 2012). Some differences in ED admission rates have been attributed to variation in risk tolerance by ED physicians, where physicians who take fewer personal risks are more likely to hospitalize their patients (Nightingale, 1988; Pearson et al., 1995; Pines et al., 2010). One study attributed variation in ED admissions for chest pain to malpractice fear (Katz et al., 2005).

Certain ED encounters are clear-cut admissions when critical illness is present or clear-cut discharges when the illness is minor. However, a large middle group of "gray-area" patients exist where one physician or hospital would admit and another might discharge depending on practice style, local standards of care in the hospital, or community resources, such as the ability to ensure close follow-up.

In this study, we explored factors associated with variation in ED admission rates across a geographically diverse sample of U.S. hospitals that provide ED data to HCUP. We examined patient-mix and hospital-level factors and local economic and system factors outside the ED that may drive differences across hospitals.

New Contribution

The ED is increasingly becoming the major source of hospital admissions in the United States, but little is known about the characteristics of EDs that are more likely to admit patients than others. To our knowledge, no studies have examined characteristics associated with ED admission rates in a broad sample of U.S. hospitals. This is the first study to examine the association between ED admission rates and two particularly important factors thought to be associated with them—local practice patterns and the availability of primary care—across a geographically diverse group of EDs. The HCUP ED databases contain many hospital and patient-level variables suited to answer this type of research question. The findings offer new insights into the extent of ED admission rate variation and the factors associated with higher and lower ED admission rates.

Data and Method

Data

We conducted a retrospective study of ED encounters to explore hospital-level ED admission rates in acute care, community hospitals in states that provide both a State Emergency Department Database (SEDD) and a State Inpatient Database (SID)[1] to the Agency for Healthcare Research and Quality's (AHRQ) HCUP in 2008.

HCUP data contain patient demographic and clinical and resource use information included in a typical hospital discharge abstract.[2] The SEDD captures discharge information on all treat-and-release ED encounters (i.e., visits that do not result in subsequent admission to the same hospital). The SID captures ED encounters resulting in admission to the same hospital.

We used two measures for the ED admission rate in this study. The "ED admission rate–basic" was the number of ED encounters resulting in admission to the same hospital divided by the number of ED encounters seen at that hospital. In the SEDD, the final disposition of transfers is unknown (i.e., whether transfers are actually admitted); however, one of the major reasons to transfer in clinical emergency medicine practice is admission to another facility because the hospital transferring the patient out does not have the staff or resources necessary to care for a patient. Therefore, we also examined the ED admission rate plus transfer rate at the hospital level. In this article, we will refer to this as the "ED admission rate–expanded."

Our initial sample included ED encounters from states that provided both SID and SEDD in 2008, which resulted in a sample of 2,558 hospital-based EDs across 28 states: Arizona, California, Connecticut, Florida, Georgia, Hawaii, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, and Wisconsin. To make it possible to do an empirical analysis of the effects of local practice patterns on a facility's ED admission rate, we excluded 927 facilities that were the only ED in the county. To

increase the likelihood of comparing similar facilities, we also removed EDs with atypical characteristics from our study sample—specifically those with very low yearly volumes and high ED admission rates. This removed 251 EDs with an annual volume less than 8,408 (the 25th percentile of ED-level volumes) and an additional 4 facilities with an ED admission rate greater than 49%. Thus, our final sample for multivariate analysis included 1,376 EDs.

For our independent variables, we calculated several variables and had to import data from other data sets. To estimate the impact of local practice patterns on an ED's admission rate, for each ED, we calculated the county-level ED admission rate with that ED excluded.[3] In the calculation of this variable, we accounted for differences in the size of EDs by weighting each ED's admission rate by its annual ED volume. We calculated this variable two ways: with transfers not counted as admissions for inclusion in the ED admission rate–basic analysis, and with transfers counted as admissions for inclusion in the ED admission rate–expanded analysis. We calculated a number of facility characteristics, including the percentage of each ED's encounters where the primary expected payer was Medicare, Medicaid, private insurance, uninsured, or other source (i.e., other sources include Worker's Compensation, Civilian Health and Medical Program of the Department of the Uniformed Services/Veterans Affairs, Title V, and other government programs), and annual ED volume. For ED case mix, we used the 2008 HCUP Nationwide Emergency Department Sample (NEDS)[4] to identify the 25 most common conditions by first-listed diagnosis, grouped by Clinical Classification Software (CCS)[5] category, seen in the ED nationally. For each ED, we calculated the percentage of total visits that were in each of those conditions. Other hospital characteristics, including the number of inpatient beds, teaching status, ownership/control, urban–rural location, and hospital occupancy rate came from the 2008 American Hospital Association Annual Survey of Hospitals. Hospital trauma level came from 2008 Trauma Information Exchange Program data.[6] Socioeconomic information came from the Area Resource File. We used 2007 per capita income and 2008 number of primary care physicians (defined as general practice physicians, general internal medicine doctors, and pediatricians) providing non-Federal patient care per 100,000 residents, both of which were measured at the county level.

Analytic Approach

We used multivariate analysis to examine factors associated with the hospital-level ED admission rate, which was our dependent variable. We took the natural log of the dependent variable and the continuous independent variables so that the coefficients on those regressors are elasticities. We present results both for the ED admission rate–basic and ED admission rate–expanded.

A Breusch and Pagan (1979) test indicated the presence of heteroskedastic disturbances. Therefore, we used a generalized linear model (GLM) with a log link with standard errors calculated using the sandwich estimator proposed by Huber (1967) and White (1980). GLM with a log link permits exponentiation of the coefficients on

binary variables to provide a policy-relevant interpretation of associations without heteroskedastic retransformation (Manning & Mullahy, 2001). We used a Park (1966) test to select the Gaussian distributional family in the GLM.

To examine how patient, hospital, and area characteristics might have different associations with the ED admission rate in more isolated EDs, we also ran a GLM on the subset of facilities that were the only ED in the county. We excluded 22 EDs that had one or fewer ED encounters per day, on average. The final sample had 905 facilities. Since hospitals in more isolated areas are less likely to be Level 1 or 2 Trauma Centers, we replaced the individual trauma center level variables in the model with a single binary trauma center variable based on whether the facility was a Level 1, 2, or 3 Trauma Center.

Statistical analysis was conducted with Stata 12.1 MP (College Station, TX). This project, which uses existing data that are publicly available and/or data in which the subjects cannot be identified directly or through identifiers, meets criteria for exemption from AHRQ Institutional Review Board review (Basic HHS Policy for Protection of Human Research Subjects, 2009).

Results

The data included 56,283,816 ED visits in 1,376 hospitals across 28 states in 2008. In terms of insurance characteristics, private insurance was the most common primary expected payer (36.8%). The average number of inpatient beds was 265.5 (*SD* = 225.0), and average ED volume was 40,903.9 (*SD* = 28,463). The majority of EDs were in an urban location (87.3%), were nonprofit hospitals (72.4%), and nontrauma centers (73.8%). Average hospital occupancy rate was 0.66 (*SD* = 0.16). The average per capita income at the county-level was $39,954.11 (*SD* = 13,268.70) and primary care physicians providing patient care per 100,000 population was 50.0 (*SD* = 18.2; Table 1).

The mean ED admission rate–basic was 16.3 (*SD* = 6.9), and it ranged from 7.8% at the 10th percentile to 25.1% at the 90th percentile. There was slightly less variation in the ED admission rate–expanded. The mean ED admission rate–expanded was 17.5% (*SD* = 6.5), and it ranged from 9.8% at the 10th percentile to 25.8% at the 90th percentile. At the county level, the average ED admission rate–basic was 16.7% (*SD* = 7.1) and ranged from 9.0% at the 10th percentile to 22.4% at the 90th percentile. At the county level, the average ED admission rate–expanded was 18.0% (*SD* = 7.1) and ranged from 10.9% at the 10th percentile to 23.1% at the 90th percentile.

Table 2 identifies factors that were associated with significant differences in the ED admission rate–basic including characteristics of patients, characteristics of the hospital, and local community characteristics. Higher proportions of Medicare patients and the uninsured were associated with higher ED admission rates with the elasticity for Medicare patients considerably higher than for the uninsured (0.285 vs. 0.014, respectively). At the hospital level, higher numbers of inpatient beds, lower ED volumes, being in an urban location, being a for-profit institution, having a Level

Table 1. Descriptive Statistics.[a]

Variable	Mean	Median	IQR
Patient characteristics			
% of ED encounters resulting in admission (basic)	16.3	15.8	11.5-20.7
% of ED encounters resulting in admission (expanded)	17.5	16.8	13.0-21.6
% of ED encounters paid by Medicare	21.7	21.3	17.3-25.4
% of ED encounters paid by Medicaid	20.8	20.0	12.5-27.7
% of ED encounters paid by private insurance	36.8	35.2	26.2-46.7
% of ED encounters by the uninsured	15.9	14.6	9.9-20.4
% of ED encounters paid by other source	4.8	3.6	2.5-5.5
Institutional characteristics			
Number of inpatient beds	265.5	210.0	114.0-350.5
ED volume	40,903.9	34,037.0	21,782.5-51,900.0
% teaching hospitals	31.5	NA	NA
% in an urban location	87.3	NA	NA
% public hospitals	12.1	NA	NA
% for-profit hospitals	15.5	NA	NA
% nonprofit hospitals	72.4	NA	NA
% Level 1 trauma centers	8.9	NA	NA
% Level 2 trauma centers	9.7	NA	NA
% Level 3 trauma centers	7.6	NA	NA
% nontrauma centers	73.8	NA	NA
Hospital occupancy rate	0.66	0.70	0.60-0.80
Socioeconomic and market characteristics			
% of ED encounters resulting in admission, subject ED excluded, county level (basic)	16.7	16.8	13.2-19.8
% of ED encounters resulting in admission, subject ED excluded, county level (expanded)	18.0	18.0	14.5-20.7
Per capita income, county level	$39,954.1	$36,687.0	$31,755.0-44,077.0
Primary care MDs providing patient care per 100,000, county level	50.0	47.3	36.3-58.6

Note. IQR = interquartile range; NA = not applicable; ED = emergency department.
a. Results based on 1,376 observations.

1 or 2 Trauma Center designation, and having a higher occupancy rate were all associated with higher ED admission rates. The percentage of ED encounters resulting in admission at the county level excluding the subject ED and lower numbers of general practice physicians within a county were associated with a higher ED admission rates. Several variables included in the model to control for variations in case-mix across EDs were also associated with higher or lower ED admission rates (results not shown). The conditions that were found to have the largest positive impact on ED

Table 2. Association of ED Admission Rate–Basic With Patient, Institutional, Socioeconomic, and Market Characteristics.[a,b]

Variable	Coefficient	z
Intercept	1.916**	5.55
Patient characteristics		
% of ED encounters paid by Medicare	0.285**	9.13
% of ED encounters paid by Medicaid	0.006	0.51
% of ED encounters by the uninsured	0.014**	2.91
% of ED encounters paid by other source	0.003	0.46
Institutional characteristics		
Number of inpatient beds	0.237**	15.71
ED volume	−0.132**	−6.59
Teaching	0.020	1.34
Urban location	0.099**	2.88
For-profit ownership	0.112**	3.99
Nonprofit ownership	0.028	1.22
Level 1 trauma center	0.112**	5.07
Level 2 trauma center	0.040*	2.11
Level 3 trauma center	0.022	0.94
Hospital occupancy rate	0.223**	6.66
Socioeconomic and market characteristics		
% of ED encounters resulting in admission, subject ED excluded, county level (basic)	0.202**	7.43
Per capita income, county level	0.016	0.57
Primary care MDs providing patient care per 100,000, county level	−0.044*	−2.25

Note. ED = emergency department.
a. Results based on 1,376 observations.
b. Model controlled for hospital case-mix variables based on patient diagnosis.
**$p < .05$. *$p < .01$.

admission rate were pneumonia, nonspecific chest pain, and spondylosis and other back problems. Conditions that were found to have the largest negative impact on ED admission rates included headache, sprains and strains, and other respiratory infections (e.g., streptococcal sore throat, common cold, and sinusitis).

The magnitude of the association of the binary variables with the ED admission rate can be determined by exponentiating the coefficients on them. The largest effects were for Level 1 Trauma Center and for-profit ownership, each of which was associated with an 11.9% increase in the ED admission rate. Level 2 Trauma Center was associated with a 4.1% increase in the ED admission rate; urban location was associated with a 10.4% increase.

Table 3 identifies factors that were associated with significant differences in the ED admission rate–expanded. The coefficients were very similar to those estimated with

Table 3. Association of ED Admission Rate–Expanded With Patient, Institutional, Socioeconomic, and Market Characteristics.[a,b]

Variable	Coefficient	*z*
Intercept	2.580**	7.98
Patient characteristics		
% of ED encounters paid by Medicare	0.250**	8.59
% of ED encounters paid by Medicaid	0.010	0.91
% of ED encounters by the uninsured	0.010*	2.12
% of ED encounters paid by other source	0.008	1.10
Institutional characteristics		
Number of inpatient beds	0.183**	13.25
ED volume	−0.136**	−7.29
Teaching	0.013	0.86
Urban location	0.026	0.93
For-profit ownership	0.071**	2.88
Nonprofit ownership	−0.000	−0.01
Level 1 trauma center	0.132**	5.93
Level 2 trauma center	0.041*	2.29
Level 3 trauma center	0.001	0.07
Hospital occupancy rate	0.190**	6.22
Socioeconomic and market characteristics		
% of ED encounters resulting in admission, subject ED excluded, county level (basic)	0.196**	8.06
Per capita income, county level	0.005	0.17
Primary care MDs providing patient care per 100,000, county level	−0.041*	−2.27

Note. ED = Emergency department.
a. Results based on 1,376 observations.
b. Model controlled for hospital case-mix variables based on patient diagnosis.
**$p < .05$. *$p < .01$.

the ED admission rate–basic as the dependent variable. Unlike in Table 2, in Table 3, the coefficient on urban location was not significant. In results not shown, nonspecific chest pain also had an insignificant coefficient.

Table 4 presents results on factors associated with ED admission rates in facilities that are the only ED in their county. Given the similarity in the results between the ED admission rate–basic and ED admission rate–expanded, we report only one set of results. We chose to report the results for the expanded definition given the important role that isolated facilities may play in transferring patients to institutions with greater resources.

There were several similarities and differences between the results of Table 3 (baseline data set) and Table 4 (isolated EDs). For example, teaching status was significant in the analysis of isolated EDs while trauma status was not. In addition, the number of

Table 4. Association of ED Admission Rate–Expanded With Patient, Institutional, Socioeconomic, and Market Characteristics in Isolated EDs.[a,b]

Variable	Coefficient	*z*
Intercept	1.247	1.12
Patient characteristics		
% of ED encounters paid by Medicare	0.435**	3.34
% of ED encounters paid by Medicaid	−0.074	−1.30
% of ED encounters by the uninsured	0.018*	2.30
% of ED encounters paid by other source	0.027*	2.21
Institutional characteristics		
Number of inpatient beds	0.096**	4.46
ED volume	−0.053*	−2.27
Teaching	0.094*	2.24
Urban location	−0.023	−0.56
For-profit ownership	0.120**	3.20
Nonprofit ownership	0.022	0.66
Trauma center	−0.022	−0.56
Hospital occupancy rate	0.098	1.82
Socioeconomic and market characteristics		
Per capita income, county level	0.033	0.37
Primary care MDs providing patient care per 100,000, county level	0.032	1.24

Note. ED = Emergency department.
a. Results based on 905 observations.
b. Model controlled for hospital case-mix variables based on patient diagnosis.
**$p < .05$. *$p < .01$.

primary care physicians per capita and the hospital occupancy rate did not have statistically significant coefficients in the analysis of isolated EDs. Furthermore, while the coefficients on the Medicare share variable were of the same sign in Tables 3 and 4, the magnitude of the coefficient was nearly 75% greater in the analysis of isolated EDs.

Discussion

In this sample of 1,376 hospitals from 28 states across the United States, we found dramatic hospital-level and county-level variation in the ED admission rate. Comparing the 10th and 90th percentile hospital-level and county-level ED admission rates–expanded, we found 2.6- and 2.1-fold variation, respectively, indicating that there are tremendous hospital- and area-level differences in this very common, increasingly expensive, daily decision in the U.S. health care system.

In our primary analysis, there are two findings we found most interesting: the association of an ED's admission rate with the ED admission rate of the other EDs in the

county and the association with the number of primary care physicians in the community. The former may indicate that local standards of care influence admission decisions, so that a patient may be admitted in one community but discharged in another even with the same condition, primarily as a reflection of how the local physicians practice as a group. Many physicians graduating from training programs tend to practice locally after graduation, so that physicians trained in certain admission practice styles may tend to cluster in the same areas (Barzansky & Etzel, 2005; Seifer, Vranizan, & Grumbach, 1995). Therefore, training programs may be a high-impact point of intervention for educational programs about reducing variation in ED admission rates. It also may represent two other factors that we could not study; specifically, local patient preferences and the preferences of other physicians (who may also have trained locally) about what constitutes legitimate reasons for admission. In a 12-hospital study of ED admission practices for pneumonia patients, several factors were significant in guiding admission decisions, including the desires of consulting and primary care physicians (Aujesky et al., 2009). Other factors that may explain this relationship include local agreements regarding payments for ED admissions between insurers and hospitals, which could affect neighboring hospitals similarly. In addition, local hospital admission rates may also be affected by local disease patterns (e.g., a severe local outbreak). To our knowledge, no other studies have demonstrated a similar local standard of care effect in a large representative sample in the United States. The second important finding was that higher numbers of primary care physicians locally were associated with lower ED admission rates. This may be because some ED physicians' decisions to admit "gray-area" cases may be influenced by how fast a patient may be able to follow-up in the community. Alternatively, more primary care access may reduce the number of patients who come to the ED for routine care and preventable hospitalizations. Both possible explanations provide more evidence that increasing general practice physicians may have beneficial effects on the entire system of care.

Several other factors were also found to be associated with differences in ED admission rates, including characteristics of the patient population seen in the hospital such as the percentage with Medicare insurance. Medicare patients are more likely to have higher numbers of comorbid conditions of more serious presentations, which may put them at higher risk for more severe disease processes requiring inpatient resources. Higher proportions of uninsured patients were also associated with higher admission rates, which may reflect that some admission decisions are made based on the availability of timely outpatient follow-up care, which may be limited in patients without health insurance.

Hospital-level factors were also associated with higher ED admission rates, including indicators of hospitals that tend to be "receiving" facilities such as larger hospitals, teaching facilities, and Level 1 and 2 Trauma Centers. This may reflect a selection effect for more severe cases in these facilities either before ED arrival (i.e., triage by prehospital providers) or after ED arrival as these facilities typically receive transfers because they have more comprehensive resources, such as 24/7 specialists, advanced testing availability, or other services unavailable in smaller nonteaching hospitals. The

association of higher ED admission rates with higher hospital occupancy rates could be regarded as counterintuitive if the expectation is that facilities with lower occupancy rates would feel pressure to admit more "gray-area" patients from the ED. It is possible that higher admission rates from the ED are a reason for higher occupancy rates. Two significant variables in our model also advance the discussion on small area variation in health care that can be caused by either preference-sensitive reasons (i.e., for-profit hospitals have higher admission rates) or supply-constrained reasons (i.e., hospitals with more inpatient beds have higher admission rates; Luft, 2012). Both of these indicate that financial or capacity factors may influence local practice patterns.

For the analysis, we defined two dependent variables: one ED admission rate that included the transfer rate and one that did not. We did this because often the reason for transfer from one ED to another is hospital admission at the second hospital. However, this is not always the case and sometimes transferred patients are discharged from the second hospital after ED evaluation or treatment (e.g., for outpatient specialty care that was unavailable in the first hospital). Interestingly, we found only small differences in the model results between the two variables, indicating that our results are robust to the classification of transfers. However, in the model for isolated EDs, some of the important results changed. For example, the number of local primary care physicians was no longer significant, indicating there may be less variation in primary care supply in more rural, isolated areas or that primary care supply differences have a lower impact when there are fewer EDs in a local market. Also, the coefficient on the Medicare share variable was larger in the analysis of isolated EDs. This may indicate that payer-mix is a more important factor in explaining the variation in ED admission rates in more isolated areas, especially when considered alongside the finding that some hospital and market variables are no longer significant or have smaller coefficients than in the primary analysis.

There are several limitations to this study. First and foremost, hospital-level ED admission rate is a crude measure, and differences may be driven by several factors that we did not measure, such as severity of illness or preferences of other stakeholders. Second, in our baseline analysis, we excluded about half of the hospitals in the sample, mostly by removing isolated facilities and very low volume EDs. This reduces the generalizability to small, rural hospitals; however, our intention was to make our sample more homogenous, increasing the validity of the associated findings. Third, the socioeconomic and physician supply data are only available at the county level in the Area Resource File, so our conclusions about these data in the adjusted analysis do not have the granularity to discern within county differences. Fourth, we only used one year of data, so it is not known whether there would be the same variation if the analysis was conducted with data from other years. Finally, our analytic approach was at the hospital level, not the patient-encounter level, which is the level at which the decision to admit is made. Inferences about the association of characteristics of patients with the decision to admit from the ED based on the results of this analysis are subject to ecological bias. Had we conducted a multi-level regression analysis at the patient-encounter level, some results may have changed.

In conclusion, we found substantial hospital-level and area-level variation in ED admission rates. Decisions to admit patients from the ED are becoming a more common and costly decision. This will become increasingly important with new payment models such as Accountable Care Organizations, payment bundling, and payment policies surrounding hospital readmissions. Therefore, additional work is needed to explore what other factors (such as physician differences or condition-specific differences) may explain the variation in admission rates and what interventions could be implemented to safety reduce them.

Authors' Note

This article does not represent the policy of either the Agency for Healthcare Research and Quality's (AHRQ) or the U.S. Department of Health and Human Services (DHHS). The views expressed herein are those of the authors and no official endorsement by AHRQ or DHHS is intended or should be inferred.

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Notes

1. For more information on the SEDD and SID, see http://www.hcup-us.ahrq.gov/databases.jsp
2. For an overview of HCUP, see http://www.hcup-us.ahrq.gov/overview.jsp
3. The use of county to define hospital market area has known drawbacks. In studies of hospital competition, for example, hospitals in the same county may not compete with one another and hospitals that are in close geographic proximity and compete against one another may be located in separate counties. Nevertheless, county is a commonly used measure of a hospital's market area. Wong, Zhan, and Mutter (2005) find that the use of different definitions of hospital market area to measure hospital competition in an empirical analysis does not affect inferences in studies of the association between hospital competition and cost.
4. The NEDS yields national estimates of ED encounters. For more information, see http://www.hcup-us.ahrq.gov/nedsoverview.jsp
5. The CCS is a diagnosis categorization scheme. It is on the *International Classification of Diseases, 9th Revision, Clinical Modification*. For more information, see http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp
6. For more information, see http://www.hcup-us.ahrq.gov/db/vars/hosp_trauma/nedsnote.jsp

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