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RESEARCH ARTICLE

Patient Safety

Medicaid Markets and Pediatric Patient Safety in Hospitals

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Objective. To examine the association of Medicaid market characteristics to potentially preventable adverse medical events for hospitalized children, controlling for patient- and hospital-level factors.

Data Sources/Study Setting. Two carefully selected Agency for Healthcare Research and Quality (AHRQ) pediatric patient safety indicators (decubitus ulcers and laceration) are analyzed using the new pediatric-specific, risk-adjusting, patient safety algorithm from the AHRQ. All pediatric hospital discharges for patients age 0–17 in Florida, New York, and Wisconsin, and at risk of any of these two patient safety events, are examined for the years 1999–2001 ($N = 859{,}922$).

Study Design. Logistic regression on the relevant pool of discharges estimates the probability an individual patient experiences one of the two PSI events.

Data Extraction Methods. Pediatric discharges from the 1999 to 2001 State Inpatient Databases (SIDs) from the AHRQ Healthcare Cost and Utilization Project, merged with hospital-level data from the American Hospital Association's Annual Survey, Medicaid data obtained from the Centers for Medicare and Medicaid Services and state Medicaid offices, and private and Medicaid managed care enrollment data obtained from InterStudy, are used in the estimations.

Principal Findings. At the market level, patients in markets in which Medicaid payers face relatively little competition are more likely to experience a patient safety event (odds ratio [OR] = 1.602), while patients in markets in which hospitals face relatively little competition are less likely to experience an adverse event (OR = 0.686). At the patient-discharge and hospital levels, Medicaid characteristics are not significantly associated with the incidence of a pediatric patient safety event.

Conclusions. Our analysis offers additional insights to previous work and suggests a new factor—the Medicaid-payer market—as relevant to the issue of pediatric patient safety.

Key Words. Medicaid, patient safety, child health

In 1999, the Institute of Medicine's (IOM), *To Err is Human: Building a Safer Health System*, estimated that preventable medical errors were responsible for

between 44,000 and 98,000 deaths and that the total costs of preventable errors (including lost income, lost household production, disability, and health care costs) were as high as $17 billion, or approximately 2 percent of U.S. health care expenditures (Kohn, Corrigan, and Donaldson 2000). Much of the attention to patient safety in hospitals has largely focused on adult populations, who represent the vast majority of hospitalized patients. However, while children are disproportionately underrepresented as hospitalized patients, approximately 40 percent of all pediatric hospitalizations are charged to public insurance programs, primarily Medicaid, the joint state and federal program that finances health care for low-income families. In contrast, only 17 percent of adult inpatient visits are covered by Medicaid (Owens et al. 2003). Thus, the care and safety of children in hospitals may well be influenced by the policies of state governments through their prominent role as payer of inpatient pediatric services.

The awareness of the extent of medical error in hospitals has occurred during a time of tremendous change in the Medicaid program. Since the early 1990s, most states, with increasing flexibility granted by the federal government, have transferred Medicaid-eligible children into managed care programs as a way to improve access to preventive services and to reduce health care expenditures. Between 1991 and 2004, the proportion of Medicaid recipients enrolled in managed care plans increased from under 10 to over 60 percent (Centers for Medicare and Medicaid Services; CMS 2005a, b, c). However, this overall rate underestimates the proportion of children covered by Medicaid managed care plans because low-income disabled and senior enrollees, the other populations covered under Medicaid, have tended to remain in the traditional fee-for-service Medicaid programs (Smith 1998).

The organization of managed care potentially may improve care, but financial incentives increase the potential for reduced access and quality. A recent study finds that increased financial pressure on hospitals and reduced profits are associated with an increased likelihood of a preventable medical error (Encinosa and Bernard 2005). One possible source of this financial

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pressure is the consolidation of commercial health insurance plans. In recent years, mergers and acquisitions in private insurance markets (Robinson 2004), and withdrawal among commercial plans serving Medicaid enrollees (Felt-Lisk, Dodge, and McHugh 2001; Long and Yemane 2005) have reduced the number of competitors in local markets.

In this article, we examine whether consolidation in Medicaid-payer markets is associated with preventable medical error for hospitalized children, using a measure of Medicaid-payer market power we have developed for this study. In the wake of the IOM report, the Agency for Healthcare Research and Quality (AHRQ 2005) sponsored the development of quality indicators, and an algorithm using hospital administrative data to identify potentially preventable adverse events during a patient's hospitalization (Miller et al. 2001). In our analysis, we apply the latest release (version 3.0b, May 2006) of pediatric-specific indicators and algorithm that, for the first time, allows for risk adjustment at the patient-discharge level.

To date, the most comprehensive analyses of pediatric patient safety in hospitals are in Miller, Elixhauser, and Zhan (2003) and Miller and Zhan (2004). They used earlier versions of the PSI algorithm, which were developed for a more general (not pediatric) population and did not provide the means for patient-level risk adjustment. In these studies, the results were mixed on the relationship of Medicaid payer status, at the patient-discharge level, to the incidence of a patient safety event. While the focus of our study is on the market-level effects of Medicaid, we estimate the model at the patient-discharge level to determine whether the new, risk-adjusting PSI algorithm accounts for any unobserved heterogeneity between Medicaid and non-Medicaid patients that may not have been accounted for in previous studies. We also account for the influence of Medicaid at the hospital level, specifically looking at the association of disproportionate share hospital (DSH) payments, which are supplemental state and federal funds intended to reduce the financial burden of hospitals treating large numbers of Medicaid and uninsured patients, to the incidence of patient safety events.

Sedman et al. (2005) applied the AHRQ PSI methodology to the administrative data of children's hospitals and combined this analysis with a clinical review of records to determine, for an event that occurred, whether it was, indeed, preventable. Guided by these findings, we conservatively choose two PSIs to include in our analysis: decubitus ulcer (i.e., severe pressure sore) and accidental puncture or laceration. As Sedman et al. (2005) note, decubitus ulcers are subjects in evidence-based best practices for adult populations and therefore should always be investigated, while accidental puncture or laceration is an

event that is fairly unambiguously defined, and therefore should be less subject to miscoding by hospital personnel. In ongoing work, Sedman et al. find that 33 percent of the cases for the 11 PSIs analyzed are preventable, with decubitus ulcer and accidental puncture having the highest preventability scores.[1]

METHODS

Data

Our data consist of all pediatric hospital discharges, ages 0–17, of patients in Florida, New York, and Wisconsin, for which any of the two selected PSI events could occur. We choose these states because they have residents of diverse socioeconomic backgrounds, and because there is variation across characteristics of the state Medicaid programs. For example, data from the CMS show that, in 2000, about one in four children under the age of 19 in Florida and New York were Medicaid beneficiaries, while closer to one in five children in Wisconsin received Medicaid benefits. Of those, 8 percent of Medicaid children in Florida, and 11 percent in New York, had an inpatient stay, while only about 4 percent of Medicaid children in Wisconsin had an inpatient stay. However, Wisconsin spent the most per Medicaid pediatric hospital stay (about $6,000, compared with $4,300 and $5,200 in Florida and New York, respectively) and had a much greater proportion of its Medicaid population enrolled in health maintenance organizations (HMOs; Health Leaders—InterStudy's Managed Market County Surveyor 2005).

Our primary data sources are the 1999–2001 State Inpatient Databases (SID) from the Healthcare Cost and Utilization Project (HCUP), sponsored by the AHRQ, for Florida, New York, and Wisconsin. Over the 3-year period of our analysis, the relevant sample sizes for each of the two PSI events in these three states are 168,818 (decubitus ulcer) and 859,902 (laceration). These discharges represent the total number of cases, or risk pool, for each patient safety event, as selected by the PSI algorithm, and comprise about 35 percent of all pediatric inpatient discharges in the three states between 1999 and 2001. The combined risk pool consists of 859,922 observations.

Statistical Model

We estimate the probability an individual pediatric patient experiences a PSI event using a logistic regression model. The dependent variable is a dummy variable indicating the occurrence of one of the two PSI events. To facilitate interpretation of the estimated odds ratios (OR), we transform most of the

explanatory variables to categorical or binary variables, with binary variables set equal to 1 if the value of the variable is greater than the median value for the relevant unit of observation (either hospital or market) for the three states and years in our analysis. We account for state and year effects by including corresponding state and year dummy variables. Table 1 displays the means of these variables, while they are described in the next subsections, grouped by level (patient, hospital, or market).

Table 1: Means of Explanatory Variables

	Decube	*Laceration*	*Combined*
Patient			
Age <1	0.186	0.225	0.225
Age 1–4	0.179	0.263	0.263
Age 5–9	0.159	0.168	0.168
Age 10–14	0.253	0.185	0.185
Age >14	0.223	0.160	0.160
Female	0.455	0.448	0.448
White	0.490	0.507	0.507
Black	0.250	0.224	0.224
Hispanic	0.121	0.124	0.124
Other race	0.104	0.103	0.103
Admission source: routine	0.468	0.384	0.384
Admission source: emergency	0.521	0.557	0.557
Admission source: transfer	0.000	0.051	0.051
Admitted on weekend	0.179	0.213	0.213
Privately insured	0.503	0.536	0.536
Uninsured	0.054	0.064	0.064
Medicaid	0.443	0.399	0.399
High risk	0.153	0.066	0.066
Comorbidities			
Cardiovascular/pulmonary	0.093	0.070	0.070
Neurological/immobility	0.070	0.042	0.042
Endocrine	0.011	0.007	0.007
Gastrointestinal	0.005	0.003	0.003
Cancer/immunological	0.020	0.010	0.010
Blood disorders	0.064	0.032	0.032
Weight/obesity	0.025	0.012	0.012
Substance abuse/mental health	0.076	0.037	0.037
Other	0.107	0.103	0.103
Hospital			
Beds	241	226	226
Teaching	0.272	0.250	0.250
Urban (in an MSA)	0.272	0.250	0.250
Nonprofit hospital	0.702	0.697	0.697

Continued

Table 1. *Continued*

	Decube	*Laceration*	*Combined*
Government hospital	0.107	0.106	0.106
For-profit hospital	0.189	0.193	0.193
Children's hospital	0.011	0.011	0.011
Saidin tech index	2.096	1.960	1.960
Nurse–patient ratio	1.015	1.000	1.000
Registered–total nurse staff-ratio	0.864	0.859	0.859
Severity of illness index value (range: 1–4)	1.074	1.098	1.098
Number of diagnoses coded per discharge	5.041	5.097	5.097
Number of procedures coded per discharge	1.314	1.277	1.277
Proportion pediatric discharges	0.158	0.148	0.148
Proportion Medicaid discharges	0.152	0.147	0.147
Per-discharge DSH payment	$247	$262	$262
Market			
County population (in 10,000s)	61	58	58
Overall HMO penetration rate	0.302	0.299	0.299
Concentrated hospital market (hospital HHI > 1,800)	0.230	0.311	0.311
Concentrated Medicaid payer market (Medicaid payer HHI > 1,800)	0.063	0.075	0.075
Proportion Medicaid HMO enrollment	0.313	0.316	0.316
State and year			
Florida	0.329	0.341	0.341
New York	0.536	0.532	0.532
Wisconsin	0.135	0.127	0.127
Year: 1999	0.336	0.333	0.333
Year: 2000	0.335	0.330	0.330
Year: 2001	0.329	0.337	0.337

DSH, disproportionate share hospital; HMO, health maintenance organization; HHI, Herfindahl–Hirschman index; MSA, metropolitan statistical area.

Patient Discharge Variables

The SIDs provide information about the patient and hospital visit, including age, gender, race, comorbid conditions, insurance coverage, source of admission (emergency room, transfer from another hospital, or routine admittance), and whether the admission day was on the weekend. We group children's ages according to categories defined and reported annually by the AHRQ (Simpson et al. 2005). We also include among our patient-level variables 29 comorbid indicators developed by Elixhauser et al. (1998) to account for any preexisting health conditions of the patient that might put the patient at risk of sustaining a PSI event. Because some of these individual comorbid conditions are present for a very small number of discharges in which a patient safety event occurs (10 or less), we combine the set of 29 into nine groupings

based on their similarity in diagnosis and patient-safety risk. At the patient discharge level, our Medicaid measure (which also refers to the State Children's Heath Insurance program [SCHIP]) is a dichotomous variable indicating whether Medicaid was the primary payer for the hospitalization.

We also include a dichotomous variable indicating whether the patient would be at high risk of sustaining an adverse event, based on the primary diagnosis at admission and the level of care received. Because the most severe and complicated hospital cases are more likely to have adverse medical outcomes, it is sometimes difficult to separate unambiguously preventable adverse events from those adverse events that are less clearly preventable in more difficult cases. Thus, with the latest release of the PSI software, each adverse event has a set of risk categories to assign patients based on their diagnostic profile and the procedures performed during their hospitalization. For each PSI, we define a high-risk group (High Risk = 1) as one that includes those discharges for which an adverse event would *not* likely be preventable. For decubitus ulcer (Decube), the PSI software assigns patients into one of two categories, high risk or low risk. For accidental puncture or laceration (Laceration), our high-risk group consists of those discharges for which the patient had two or more major therapeutic procedures during the hospitalization. With this control variable, we can more accurately identify the relationship of the other covariates to adverse events that are most likely preventable.

Hospital Data

For hospital-level data, we supplement information from the SID with data from the American Hospital Association's (AHA) *Annual Survey of Hospitals Database*. The AHA data provide information on hospital characteristics such as size, ownership, teaching status, and resource availability (e.g., nurse staff, technology). For availability of technology, we use the "Saidin index" (Spetz and Baker 1999), which is the weighted sum of the number of 11 possible high technology services found in the hospital, with the weights being the proportion of hospitals in the country that do *not* have the technology. To account for the case mix of the hospital, we follow Miller, Elixhauser, and Zhan (2003), employing software developed by the 3M Company (3M Core Grouping Software 2005) to come up with a hospital severity of illness (SOI) index based on the all-patient refined-diagnosis related group (APR-DRG) classification system. As a measure of the pediatric volume of the hospital, we include the proportion of total discharges that are pediatric, to account for a hypothesized volume–outcomes relationship (Jenkins et al. 1995; Hannan et al. 1998), and

standardize for any bias in the way hospitals might code diagnoses and procedures by using two variables that measure the average number of diagnoses and procedures coded per discharge.

At this level, we include two Medicaid variables. The first is a measure of the proportion of the hospital's discharges for which Medicaid is the primary payer. It captures the extent of financial pressure a hospital experiences from serving Medicaid's low reimbursed discharges. The second is the amount of DSH payments each hospital received in 1999, the only year for which this measure is available from the CMS (2005a, b, c). Since the late 1980s, states and the federal government have provided additional funds to hospitals that serve large numbers of indigent (both Medicaid and uninsured) patients. These funds are intended to reduce the financial strain of hospitals that are otherwise not reimbursed for services provided to these populations, and thus potentially decrease the likelihood of medical error that would result from such strain. Although we have only 1 year for this measure, disproportionate share payments are unlikely to have changed significantly for each hospital over the 3-year period of our analysis.

Market Data

As mentioned, recent years have witnessed the withdrawal of commercial managed care plans from Medicaid markets (Felt-Lisk 2000), making them more concentrated. However, hospital markets have also become more concentrated (Cuellar and Gertler 2003), as an apparent response to the increased penetration (Dranove, Simon, and White 2002), as well as consolidation (Robinson 2004), of managed care plans. To account for these effects, and in particular, to measure the impact of commercial insurance plans in Medicaid, we create two measures of market competition (or concentration), for the Medicaid-payer and hospital markets.

For the hospital market, we construct a modified Herfindahl–Hirschman index (HHI) for each hospital, as developed by Zwanziger, Melnick, and Mann (1990). The index is a weighted-average hospital HHI across zip codes, with the weights being the percent of a hospital's discharges in that zip code. For the Medicaid-payer market, we construct a similar measure. Using data obtained from the Medicaid offices of each state on the number of enrollees in each county, by health plan, we construct for each hospital a payer HHI, using the hospital's county as the definition of the market, multiplying this measure by the proportion of Medicaid discharges in that hospital to reflect the hospital's exposure to the Medicaid market. Thus, our Medicaid-payer

concentration index for each hospital reflects two dimensions of a market area: the concentration of Medicaid managed care payers in that market area and the distribution of Medicaid enrollees among hospitals in that area. For instance, if there is only one Medicaid payer in a particular market area but its enrollees are evenly distributed among several hospitals, the value of the payer HHI for each of these hospitals will be relatively low, reflecting the limited market power the payer has over each hospital. On the other hand, if the same single-payer market has Medicaid enrollees concentrated in a small number of hospitals, those hospitals will be more vulnerable to the monopsony power of the Medicaid payer, so the payer HHI of these hospitals will be relatively high. We use the hospital and payer HHI indices to construct two dummy variables, set equal to zero or one based on whether the HHI value is less or >1,800, the threshold used by the Department of Justice as a guide for becoming concerned about potential market power.

We also include at the market level the proportion of Medicaid enrollees that are in commercial HMO plans, a measure to capture the variation of Medicaid organization type across markets. There has been an increase in the number of *Medicaid-dominated* plans since restrictions on these types of plans were lifted in the Balanced Budget Act of 1997 (Felt-Lisk, Dodge, and McHugh 2001). A Medicaid-dominated plan is defined as having at least 75 percent of its enrollees in Medicaid, and because most are either provider based or government owned, they represent a type of plan that is different from commercial plans in terms of ownership, and perhaps also in terms of service level and quality. Many states also continue to serve their enrollees in the traditional Medicaid program, where there is a direct relationship between the state and providers. Thus, using InterStudy HMO enrollment data, we construct a measure of the proportion of Medicaid enrollees in commercial managed care (i.e., HMO) plans for each of the hospital counties in our sample, multiplying, again, by the proportion of Medicaid discharges of each hospital to reflect the hospital's exposure to the Medicaid market.

To capture other market-level effects, we include the hospital county's population and a measure of overall-managed care, or HMO, penetration in the county. As mentioned, Dranove, Simon, and White (2002) found managed care penetration to be associated with consolidation in hospital markets. Thus, this measure may partly account for concentration on both the payer and the provider sides of the market, as well as reflect the ability of managed care organizations to influence local-market standards and quality of care.

FINDINGS

PSI Means by Medicaid Characteristics

Table 2 presents the mean PSI rates for Medicaid characteristics at the patient-discharge, hospital, and market levels. They are comparable with previous research on pediatric PSI rates (Miller and Zhan 2004), and reveal that the rate of preventable adverse events in hospitals are at least an order of magnitude lower for children than for adults (Encinosa and Bernard 2005). Significant differences at the 5 percent level are indicated by an asterisk, and at the patient-discharge level, we see no statistically significant difference in the rate of PSI occurrence for decubitus ulcer (Decube) between privately insured and Medicaid patients. For accidental puncture or laceration (Laceration), Medicaid is significantly lower by .0003. Overall (i.e., Combined), Medicaid patients experience two fewer adverse events than privately insured patients for every 10,000 discharges of each type of patient at risk, with this difference statistically significant.

Table 2: PSI Means by Medicaid Characteristics

Medicaid Characteristics	*Decube Mean*	*Laceration Mean*	*Combined Mean*
Discharge level			
Privately insured	0.0030	0.0009	0.0015
Uninsured	0.0013*	0.0004*	0.0006*
Medicaid	0.0033	0.0006*	0.0013*
Hospital level			
Below-median Medicaid discharges	0.0029	0.0006	0.0011
Above-median Medicaid discharges	0.0031	0.0008*	0.0014*
No DSH payments	0.0027	0.0006	0.0010
Below-median per-discharge DSH payment	0.0038*	0.0006	0.0013*
Above-median per-discharge DSH payment	0.0028	0.0009*	0.0015*
Market level			
Unconcentrated hospital market (hospital HHI $\leq$ 1,800)	0.0034	0.0009	0.0017
Concentrated hospital market (hospital HHI $>$ 1,800)	0.0019*	0.0003*	0.0006*
Unconcentrated Medicaid payer market (Medicaid payer HHI $\leq$ 1,800)	0.0031	0.0007	0.0013
Concentrated Medicaid payer market (Medicaid payer HHI $>$ 1,800)	0.0024	0.0010	0.0013
Below-median Medicaid HMO enrollment	0.0030	0.0007	0.0013
Above-median Medicaid HMO enrollment	0.0050*	0.0019*	0.0030*

DSH, disproportionate share hospital; HHI, Herfindahl–Hirschman index; HMO, health maintenance organization.

At the hospital level, we see a fairly consistent pattern, with hospitals reflecting higher Medicaid service levels, either in terms of the proportion of Medicaid patients or the amount of DSH payments received, having higher PSI rates. Most of the differences between "low" and "high" Medicaid hospitals are statistically significant, as well.

At the market level, there is a substantial difference of PSI rates among hospitals. In hospital markets where there is high concentration (hospital HHI $>$ 1,800), we see rates about one-half, or less, than those found in unconcentrated, or more competitive, markets (hospital HHI $\leq$ 1,800), with all differences statistically significant. In contrast, in Medicaid-payer markets, the difference in PSI rates between concentrated and unconcentrated markets is much smaller, and in no case is the difference statistically significant. However, there are statistically significant higher PSI rates in markets with relatively high versus low enrollment in Medicaid HMOs.

Logistic Regressions

Table 3 presents the predicted effects of the explanatory variables from the logistic regression. Here, because of the relatively small sample size for Decube, we focus on and present results for only the combined risk pool.[2] We present two columns of results, the first column lists the OR and the second column the *Z*-scores. Inferences are based on robust standard errors (SE) to correct for possible correlation of observations within the same hospital or market.

Looking to the market-level first, the odds of an adverse event (Decube or Laceration) are 60 percent higher in a concentrated than in an unconcentrated payer market (OR = 1.602). In contrast, we find that hospital concentration tends to be protective of adverse events. For the combined risk pool, the odds of an adverse event are 31.4 percent lower (OR = 0.686) in a concentrated than in an unconcentrated hospital market. We also find the interaction of the two concentration measures to be substantially negative and significant (OR = 0.546), indicating that introducing hospital concentration into a market that is already concentrated on the payer side reduces the likelihood of an adverse event in that market.

In addition, at the market level, we find neither Medicaid HMO enrollment nor overall HMO penetration to be statistically significant. We also do not find a statistically significant relationship among the discharge-level or hospital-level Medicaid variables.

Table 3: Results of Logistic Regression[†]

	Combined Risk Pool	
Independent Variables	*Odds Ratio*	*Z-Score*
Patient		
Age <1	—	—
Age 1–4	0.714	−3.150*
Age 5–9	0.933	−0.650
Age 10–14	1.407	3.530*
Age >14	1.615	4.750*
Female	0.995	−0.070
White	—	—
Black	1.093	1.010
Hispanic	1.104	0.870
Other race	1.134	1.130
Admission source: routine	—	—
Admission source: emergency	0.800	−3.080*
Admission source: transfer	0.777	−1.820
Admitted on weekend	1.046	0.520
Privately insured	—	—
Uninsured	0.841	−0.950
Medicaid	1.079	1.060
High risk	30.425	41.180*
Hospital		
Small beds	—	—
Medium beds	1.366	2.080*
Large beds	1.216	1.290
Teaching	1.132	0.980
Nonprofit hospital	—	—
Government hospital	1.124	1.180
For-profit hospital	0.571	−2.250*
Children's hospital	1.439	2.400*
Above-median Saidin tech index	1.465	2.180*
Above-median nurse–patient ratio	1.089	0.830
Above-median registered–total nurse staff ratio	0.756	−3.020*
At or below 50th percentile APR-DRG severity of illness	—	—
51–75 percentile APR-DRG severity of illness	0.841	−0.860
76–90 percentile APR-DRG severity of illness	0.908	−0.540
Above 90 percentile APR-DRG severity of illness	1.158	0.840
Above-median number of diagnoses coded per discharge	1.211	2.200*
Above-median number of procedures coded per discharge	0.962	−0.260
Above-median proportion pediatric discharges	1.180	1.460
Above-median proportion medicaid discharges	1.164	1.200
No DSH payments	—	—
Below-median per-discharge DSH payment	0.894	−0.990
Above-median per-discharge DSH payment	0.937	−0.530

Continued

Table 3. *Continued*

	Combined Risk Pool	
Independent Variables	*Odds Ratio*	*Z-Score*
Market		
County population (in 10,000s)	0.998	– 2.510*
Above-median overall HMO penetration rate	0.951	– 0.430
Concentrated hospital market (hospital HHI > 1,800)	0.686	– 3.090*
Concentrated Medicaid payer market (Medicaid payer HHI > 1,800)	1.602	2.530*
Interaction of concentration measures	0.546	– 2.260*
Above-median Medicaid HMO enrollment	1.358	1.720
Observations		859,922
Pseudo R^2		0.238

†Not shown are the results for combordities, and the state and year dummy variables. These results can be obtained from the contact author.

*Significant at the 5%, two-tail level.

APR-DRG, all-patient refined–diagnosis related group; DSH, disproportionate share hospital; HMO, health maintenance organization; HHI, Herfindahl–Hirschman index.

Because of the way we have defined Medicaid payer HHI, the positive relationship between payer concentration and the occurrence of an adverse event indicates that in a market characterized by the presence of relatively few Medicaid payers, and in which the proportion of Medicaid enrollees in each hospital tends to be high, the likelihood of an adverse event is much greater than in hospitals with either a low proportion of Medicaid enrollees, or in markets with more competition among payers. As Table 4 shows, the average proportion of Medicaid discharges in hospitals that we define as being in concentrated Medicaid payer markets is comparable to hospitals that fall within the 25th and 75th percentile of the Medicaid payer HHI. However, what makes the hospitals in the payer-concentrated markets standout is the unadjusted payer HHI (the payer HHI before multiplying by the proportion of Medicaid discharges) associated with their markets (i.e., the hospitals' counties). Thus, Medicaid-payer market power is correlated with a greater occurrence of adverse medical events when there tends to be very little competition among Medicaid payers.

In addition to estimating the model by computing robust SE to correct for correlation of observations within the same hospital or market, we also estimated the model by cluster correcting the SE by hospital (accounting for within-hospital correlation) and using county-year dummy variables (an indicator variable for each county-year combination in our sample) to account for any within-county (i.e., market) correlation of the observations. This

Table 4: Average Hospital Proportion of Medicaid Discharges, by Medicaid Payer HHI Percentiles (Combined Sample)

	*Mean**	*Standard Deviation*	*Mean Unadjusted Payer HHI*
Medicaid payer HHI at 25th and lower percentile	0.047	0.038	2,989
Medicaid payer HHI greater than 25th and less than or equal to 75th percentile	0.183	0.148	3,720
Medicaid payer HHI greater than 75th percentile	0.188	0.114	7,255
Concentrated Medicaid payer market (Medicaid payer HHI > 1,800)	0.168	0.097	9,599

*Proportion is total Medicaid discharges (adult and children) over total hospital discharges.
HHI, Herfindahl–Hirschman index.

alternative, statistically less efficient, model produced results for the market-level variables that were similar in magnitude to the results we present, although with the effect of Medicaid-payer concentration statistically significant at only the 10 percent (two-tail) level, but with the interaction of the two concentration measures significant at the 5 percent level (the effect of hospital concentration alone was statistically insignificant).

DISCUSSION

The development of pediatric-specific indicators of patient safety represents an extension of hospital outcomes measurement that is particularly relevant to children. Owing to data limitations, most previous research on hospital quality and safety has focused on mortality as an outcome. However, the new indicators shine a light on processes of care and events that can lead to serious morbidity as well as mortality. Because children are less likely than adults to die as a result of adverse events in the hospital (Miller, Elixhauser, and Zhan 2003), the true scope and magnitude of the consequences of medical error for children have perhaps been previously underestimated because of the focus on mortality as an outcome measure. The relationship between Medicaid payer status, which accounts for approximately 40 percent of all pediatric hospitalizations, and the likelihood of a patient safety event has not been well established in previous studies. This study takes a comprehensive look at this association by examining the relationship of Medicaid patient, hospital, and market characteristics to the likelihood of an adverse event for two carefully

chosen indicators. Consistent with our expectation, we find that, at the market level, the concentration of Medicaid managed care payers is positively related to the occurrence of an adverse event for hospitalized children.

An important question this finding raises is how to properly define a Medicaid-payer market area. Medicaid enrollees enter plans operating within their resident counties, but county jurisdiction does not necessarily define the effective market area in which these plans compete against one another. For instance, three Medicaid plans may each have exclusive access to all enrollees in three adjacent counties, although enrollees might cross county lines for hospital services. Thus, there could be a fair amount of competition among the three plans across counties. As such, our measure of payer concentration could overstate the market power of each plan. To determine whether this might be the case, we calculated, for year 2001, the proportion of all Medicaid hospital discharges in each county that consisted of county residents. The average proportions for each of the three states in our analysis were: 0.91 (SD = 0.10), 0.89 (SD = 0.20), and 0.87 (SD = 0.11). Thus, the county serves as a reasonable means to define the Medicaid-payer market area.

Nonetheless, one should interpret the results of this analysis with caution. First, we look at only three states, which, while reflecting variation of Medicaid characteristics, may not be representative of other states in the country. In addition, the sample of Medicaid markets (i.e., counties) that we determine as having market power is quite small, and so also may not be representative of all Medicaid markets. Moreover, while our analysis reveals a clear link between Medicaid market concentration and pediatric patient safety, the cross-sectional framework of our analysis does not explain the mechanism by which they are related. For instance, our framework does not account for unobservable factors that could be related to both Medicaid market concentration and patient safety, so the results do not establish a causal relationship. Further study, employing analytic models that address the limitations of this framework, will be required to better understand the mechanisms at work. However, our findings point to a factor—the Medicaid market—that policy makers have heretofore not generally considered in their efforts to improve pediatric patient safety.

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NOTES

1. Based on conversation with Aileen Sedman (December 7, 2005).
2. Estimations were conducted using *Stata* 9.2. In separate regressions, the likelihood of Laceration is 73 percent higher in a concentrated than in an unconcentrated payer market, and statistically significant. The likelihood of Decube is 27 percent higher in a concentrated than unconcentrated payer market, but not significant. In these regressions, discharge- and hospital-level Medicaid variables have statistically insignificant effects.

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