

Profile of Insurance Coverage in a National Inpatient Sample

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Abstract To identify the hospitals most strongly impacted by health insurance trends, this study investigated the relationships between hospital characteristics and patterns of insurance coverage in a national inpatient sample. Data from the 2007 Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project were used to examine hospital characteristics, aggregated patient characteristics, and payer mix (defined as rates of Medicare, Medicaid, private insurance, and uninsured). Medicare was expected to cover nearly half of all inpatient admissions; however, hospitals showed a wide range of percentages for all payers, and some facilities reported up to 61.5% of visits from uninsured patients. Significant multivariate differences in insurance coverage resulted from bed size, location, region, and patient age, gender, racial, and socioeconomic distributions. Results suggest that reimbursement policy changes may disproportionately impact certain hospitals based on their characteristics and/or patient distribution and may be particularly informative in the current era of potential system-wide reform.

Keywords: *Insurance Coverage, Hospital Characteristics, Inpatient, Healthcare Cost and Utilization Project, Payer Mix*

1. Introduction

The past two decades have seen notable changes in health insurance coverage for Americans [1,2,3]. Rising healthcare costs have created great difficulties for consumers and payers to sustain equivalent service coverage. U.S. health care expenditures increased from \$255 billion in 1980 to \$2.5 trillion in 2009, accounting for 17.6 percent of the Gross National Product [4]. This increase in costs has resulted in a reduction of covered services and a shift of financial burden toward the consumers, evidenced in higher deductibles and out-of-pocket payments [1,5]. The system-wide implementation of cost-containment strategies has led to more stringent approval and utilization of services as well as restriction in choices (such as prescription drug formulary) [6]. Lower payments and restrictive billing from Medicaid and other public programs due to federal and state budgetary constraints have dis-incentivized providers, effectively limiting medical care capacity for publicly insured patients and thereby increasing the need for supplemental coverage.

These changes have generated an unprecedented increase in the number of uninsured Americans, reaching almost 50 million in 2010 [7]. Perhaps more significantly, the situation has created a general increase of "underinsured" amongst working age adults, from 16 million in 2003 to 25 million in 2007 [2]. Many

individuals encounter difficulties accessing care due to partial or temporary loss of coverage; more still may have a "functional" loss in coverage as a result of high co-payments relative to their income.

The Patient Protection and Affordable Care Act was signed in 2010 to address these concerns through a series of policy revisions over several years [8]. These reforms will result in an expansion of service coverage for patients with Medicaid and Medicare while working towards filling gaps amongst the underinsured. For example, young adults who may normally be unable to afford adequate health insurance due to their financial situation and/or lack of employer-based health insurance may now be covered by a parent's health insurance plan until the age of 26; other changes will expand Medicaid eligibility, increase reimbursement rates for Medicaid visits, and improve access to preventive health care [8]. Such changes will affect not only patients, but also their providers, as the likelihood of having a medical home is increased by having health insurance [9].

Factors associated with individual insurance coverage and access to healthcare, including socio-demographic factors (sex, race/ethnicity, age, marital status, number of children, education, work status, immigration status, income and/or poverty status), health factors (health status, severity of symptoms and morbidity, and risk behavior), and institutional factors (usual source of care, urban setting), have been examined in depth domestically [10,11,12,13,14,15] and globally [16]. However, a provider-level analysis to determine potential effects of

policy reforms on healthcare institutions has not been conducted. As such, federal policy reforms are frequently debated, legislated, and implemented with little consideration given to whether the recommended programmatic changes may have a disproportional or potentially unintended impact on certain hospitals based on the hospitals' own characteristics (for example, regional differences) and/or the types of patients they primarily serve. Based on the existing literature documenting associations between patient insurance status and various patient characteristics, we hypothesize that payer mix – that is, the distribution of a hospital's visits covered by various forms of insurance or self-pay – varies by hospital setting and status as well as by characteristics of the patients in their catchment area. Such systematic variation would illustrate how the effects of policies and interventions to alter health insurance coverage could predictably differ by type of hospital. Therefore, this study aims to examine correlates of payer mix among hospitalized patients in a national inpatient sample. By understanding the relationships between hospital characteristics and patterns of insurance coverage, this study may provide information on the potential impact of programmatic or policy changes to hospitals across the U.S.

2. Methods

2.1 Data Source

This study is a secondary analysis of data from the 2007 Nationwide Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP) [17]. Maintained by the Agency for Healthcare Research and Quality, the NIS is the largest all-payer inpatient care database in the United States, a stratified probability sample representing approximately 20% of community hospitals throughout the U.S. [18]. The 2007 NIS database contains de-identified data on more than eight million inpatient stays from a sample of 1,044 hospitals in 40 states. Two types of data elements from the 2007 NIS database were used: visit-specific measures pertaining to patient demographic and financial information and measures pertaining to hospital characteristics. Patient- or discharge-level data were aggregated by hospital to produce hospital-level means summarizing the patients seen in that hospital in 2007. This study was approved by the Committee on Clinical Investigations at Children's Hospital Los Angeles.

2.2 Measures

Hospital characteristics reported by HCUP at the hospital level included: bed size (small, medium, or large); location (rural or urban); teaching status (non-teaching or teaching); U.S. region (Northeast, Midwest, South, or West) [18]. The NIS team determined bed size based on the combination of a hospital's region, location, and teaching status to ensure an even distribution of hospitals within each category. Although hospital control or ownership was reported by HCUP, the categories were not mutually exclusive and could not be distinguished adequately, and this variable was excluded.

Socio-demographic summary measures were constructed from data originally reported at the patient

level, as follows: Patient age was categorized and aggregated into three variables representing percentage of patients aged < 21 years, percentage of patients between 21 and 64 years old (inclusive), and percentage of patients aged 65 years or more. Patient sex was aggregated into a variable representing percentage of female patients. The patient's primary race/ethnicity was aggregated into a set of six variables representing the percentages of patients who were white, non-Hispanic Black, Hispanic, Asian or Pacific Islander, Native American, or other race. As a proxy for socioeconomic status, the income quartile for the patient's zip code was aggregated into four variables representing the percentage of patients in each (Q1: less than or equal to \$38,999; Q2: \$39,000-\$47,999; Q3: \$48,000-\$62,999; Q4: \$63,000 or more).

The NIS included only the primary expected payer for each visit. Thus, the dependent variables were created by aggregating this patient-level expected payer into four variables representing the hospital's percentage of patients who expected to rely primarily on Medicare, Medicaid, private/commercial (HMO and non-HMO), or their own payment out-of-pocket (i.e., without insurance coverage for the visit). Due to skew in the distribution of the latter three percentage variables (Medicaid, private, and uninsured), these variables were transformed using Box-Cox transformations prior to multivariate analysis [19].

2.3 Statistical Analysis

Descriptive statistics summarized characteristics of patients and hospitals included in the NIS data. We used multivariate analysis of variance (MANOVA) to assess the relationships between hospital characteristics (including aggregated patient characteristics) and expected payer, as MANOVA includes all hospitals in simultaneous analyses of all four expected payer outcomes without the inflated Type I error rates associated with a series of individual ANOVA or regression analyses. All statistical analyses were conducted using the IBM SPSS Statistics software package [20]. Categorical independent variables included bed size, location, teaching status, and region. Continuous independent variables (i.e., covariates) included percent of patients between 21 and 64 years old, percent of patients 65 years or older, percent of patients who were female, percent of patients who were Black, Hispanic, Asian/Pacific Islander, Native American, or other, and percent of patients from zip codes in the second, third, and fourth income quartiles. Percent of patients younger than 21 years old, percent of patients who were white, and percent of patients from zip codes in the lowest income quartile were excluded to avoid linear dependency.

In keeping with conventional practice, the multivariate significance tests (e.g., Wilks' Lambda) corresponding to each predictor were reviewed first. Only predictors that demonstrated significant multivariate differences were subject to further review. For these predictors, the specific outcome(s) displaying significant differences and the direction of those differences are reported. A p-value of 0.05 or less was chosen as the criterion for statistical significance in all analyses.

3. Results

Descriptive statistics for the hospital sample are presented in Table 1. The number of visits reported by hospitals ranged from three to nearly 82,000 with an average of 7,700 inpatient visits to the 2007 NIS dataset. Contributing hospitals included those that serve children and adults, though adults accounted for roughly 85% of admissions. Hospitalizations from women were slightly more prevalent in the sample, accounting for nearly 60% of visits. There was extensive variation in the ethnic diversity of the sample, with some hospitals reporting visits only from patients of one ethnicity and others reporting more diverse patient populations. On average, 73% of visits were from white patients, 10% from Black patients, 9% from Hispanic patients, and the remainder from patients of other racial/ethnic backgrounds. Hospitals reported similar diversity in the socioeconomic status of their patients; on average, patients in the lowest income quartile accounted for almost 40% of inpatient stays. The income data closely tracked the payer data, with hospitals reporting an average of 47% of visits expected to be paid by Medicare, 16% by Medicaid, and 29% by private insurance; on average, only 5% of visits were uncovered. However, the data also reflect a wide range of percentages corresponding to each expected payer under consideration, with some hospitals reporting more than 60% of visits from uninsured patients. A fraction of patients did not expect to have charges (0.295%) or had a different expected payer than one of the four categories listed above (3%) and were excluded from the multivariate analysis; however, no hospitals were excluded on this basis.

Table 2 summarizes the MANOVA results. Significant multivariate differences in insurance coverage were found as a result of bed size, location, region, patient age distribution, patient gender distribution, patient racial distribution, and patient socioeconomic distribution. For these variables showing significant multivariate differences, the relationship between the predictor and each payer-related outcome is summarized in Table 3. The direction of significant effects was determined by probing estimated marginal means (data not shown) and described below in relation to each source of visit payment.

3.1 Medicare

Location was associated with percent of Medicare patients, with urban hospitals seeing higher percentages of Medicare patients than their rural counterparts. Region was also associated with Medicare coverage: Hospitals in the western US saw the fewest Medicare patients, followed by the Northeast and Midwest; the most were seen in the South. Relative to its percentage of pediatric patients (under age 21), hospitals serving adult populations (21-64 and 65+), as expected, saw more Medicare patients. Hospitals with greater shares of female and Black patients were less likely to see patients covered by Medicare. Finally, compared to hospitals in the lowest-income locations, hospitals seeing patients living in second, third, or top income quartile areas were less likely to expect charges to be paid by Medicare.

3.2 Medicaid

Medium-sized hospitals saw more Medicaid patients, but fewer privately insured patients, than small or large hospitals. Hospitals in the South saw fewer Medicaid patients than hospitals in the Midwest, while hospitals in

the West and Northeast saw relatively more. The hospital's demographic market also played a role in the insurance coverage of its patients: Hospitals serving proportionally more children, women, Black and Hispanic patients (compared to white patients), and the lowest-income patients, had Medicaid representing a larger proportion of their payer mix.

Table 1. Hospital-level descriptive statistics (total N represented = 8,043,415 inpatient discharges among 1,044 hospitals).

Discharge-Level Variable	Categories	Percentage Range	Percentage Mean (SD)
Age (years)	Child (0-20)	0% - 100%	15.1% (13.5)
	Adult (21-64)	0% - 100%	41.4% (12.1)
	Adult (65+)	0% - 96.3%	43.6% (17.5)
Sex	Male	29.6% - 88.8%	40.5% (5.7)
	Female	11.2% - 70.5%	59.5% (5.7)
Race/Ethnicity	White	0% - 100%	73.4% (25.6)
	Black	0% - 87.5%	10.1% (14.3)
	Hispanic	0% - 100%	9.4% (16.9)
	Asian/Pacific Islander	0% - 77.3%	1.8% (6.1)
	Native American	0% - 71.5%	1.2% (6.0)
	Other or Missing Race	0% - 100%	4.0% (12.0)
Income Quartile of Patient's Zip Code	Q1 (\leq \$38,999)	0% - 100%	39.1% (35.3)
	Q2 (\$39,000-\$47,999)	0% - 100%	28.9% (26.2)
	Q3 (\$48,000-\$62,999)	0% - 95.6%	19.4% (20.9)
	Q4 (\$63,000 or more)	0% - 94.9%	12.6% (20.9)
Expected Payer	Medicare	0% - 98.5%	47.0% (19.2)
	Medicaid	0% - 66.0%	16.2% (12.2)
	Private (includes HMO)	0% - 93.7%	28.6% (15.1)
	Uninsured	0% - 61.5%	4.9% (4.6)
Hospital-Level Variable	Range	Mean (SD)	
Number of Discharges	Range: 3 to 81,739	7,704.4 (9,837.1)	
Hospital-Level Variable	Categories	N (%)	
Bed Size	Small	468 (44%)	
	Medium	254 (24%)	
	Large	320 (31%)	
Location	Rural	418 (40%)	
	Urban	624 (60%)	
Region	Northeast	134 (13%)	
	Midwest	302 (29%)	
	South	416 (40%)	
	West	192 (18%)	
Teaching Status	Non-teaching	851 (82%)	
	Teaching	191 (18%)	

Table 2. Summary of multivariate relationships between hospital characteristics and expected payer outcomes.

Predictor	Wilk's λ	F statistic	Partial η^2	p-value
Bed Size *	.920	F(8,1470) = 7.84	.041	<0.001
Location **	.981	F(4,735) = 3.62	.019	0.006
Region ***	.839	F(12,1945) = 11.16	.057	<0.001
Teaching Status	.994	F(4,735) = 1.10	.006	0.355
% Age 21-64 ***	.846	F(4,735) = 33.50	.154	<0.001
% Age 65+ ***	.157	F(4,735) = 988.61	.843	<0.001
% Female ***	.955	F(4,735) = 8.57	.045	<0.001
% Black ***	.906	F(4,735) = 19.09	.094	<0.001
% Hispanic ***	.915	F(4,735) = 17.01	.085	<0.001
% Asian/Pacific Islander	.989	F(4,735) = 1.97	.011	0.098
% Native American **	.982	F(4,735) = 3.28	.018	0.011
% Other Race	.988	F(4,735) = 2.18	.012	0.070
% Income Q2 ***	.950	F(4,735) = 9.74	.050	<0.001
% Income Q3 ***	.926	F(4,735) = 14.59	.074	<0.001
% Income Q4 ***	.713	F(4,735) = 74.14	.287	<0.001

Note: * p < 0.05, ** p < 0.01, *** p < 0.001.

Table 3. Individual relationships between hospital characteristics and expected payer outcomes.

Predictor	Medicare	Medicaid	Private	Uninsured
Bed Size		***		
Location	*			***
Region	***	***		**
% Age 21-64	*	***	**	**
% Age 65+	***	***	***	***
% Female	**	***	*	
% Black	***	**	***	
% Hispanic		***	***	
% Native American			**	
% Income Q2	**	***	***	
% Income Q3	***	***	***	
% Income Q4	**	***	***	***

Note: * p < 0.05, ** p < 0.01, *** p < 0.001.

3.3 Private Insurance

Although no hospital-level characteristics predicted share of patients with private insurance, the demographic variables describing the hospital's market were predictive of extent of private insurance coverage. Hospitals serving proportionally more men; more Black, Hispanic, and Native American patients; and more of the lowest-income patients were all less likely to expect hospital charges to be paid by private insurance.

3.4 Uninsured

The number of uninsured patients was lower in the Midwest and West than in the Northeast and South. Rural

hospitals saw more uninsured patients on average than their urban counterparts. Compared to hospitals primarily serving children, uninsured patients were more common to hospitals primarily serving adult patients age 21-64 and less common among hospitals with more patients ages 65 or older. Gender, race and ethnicity distribution of the hospital's market were unrelated to its share of uninsured patients. Only hospitals serving patients in the top income quartile areas had a significantly lower likelihood of uninsured patients; there were no differences in the share of uninsured patients among hospitals in the lower three income areas.

4. Discussion

We found that significant variations in the distribution of insurance coverage for hospitalized patients across the country were associated with hospital characteristics. Thus, federal or state policy and/or reimbursement changes may disproportionately impact certain types of hospitals, as these systematic changes affect hospital finances and service burden. For example, the expansion of public coverage through Medicaid may have a higher financial impact for hospitals that currently serve a higher percentage of uninsured patients, such as rural hospitals and facilities in the southern U.S., as these patients may become Medicaid eligible. Hospitals serving a high percentage of existing Medicaid patients may also face a substantial influx of newly-eligible Medicaid patients, resulting in a higher workload for physicians and system burden [21]. At the same time, some states are instead proposing cuts to their Medicaid programs in order to balance their budgets, potentially impacting hospitals that serve large percentage of children, women, minority, and low-income patients.

Similarly, changes in Medicare payments may have more regional impact in southern states and in urban areas. Although current and planned reforms propose to increase reimbursement rates for primary care providers of Medicaid patients, tertiary care centers will receive a lower reimbursement rate for their Medicare patients. Proposed reductions in Disproportionate Share Hospital adjustment payments may also pose a significant financial burden to those facilities with a high Medicare burden. Our results indicate that nearly half of all hospital admissions are paid by Medicare, with hospitals serving low-income, adult populations seeing even greater proportions of Medicare patients. These hospitals may be pressured to supplement lost revenue. Participation in the Centers for Medicare and Medicaid Services Shared Savings Program is one possible option, meant to incentivize providers to reduce the costs of their patient panel while preserving quality. If this program works as planned, there may be a net decrease in the number of Medicare hospitalizations, potentially supporting a more balanced payer mix.

This study has several limitations. Our data captured only one expected payer for each hospital visit, so we cannot determine or model coverage from multiple payers. In addition, as private insurance takes many different forms ranging from full coverage to plans with very high deductibles, the interpretation of individual findings about private insurance may vary by insurance carrier. The data

presented here are cross-sectional and limited to one year (2007), so we are unable to gauge trends in coverage, ascertain the stability of results over time, or examine any national changes that may have occurred in the last five years. Finally, the dataset does not provide sufficient clinical detail to determine the medical necessity or preventability of hospitalizations, so results may not address the likely outcomes of cost-saving policy reforms focused on visit urgency or other clinical matters.

5. Conclusions

In summary, this study identified characteristics of hospitals associated with payer mix in a national sample. Significant multivariate differences in insurance coverage resulted from bed size, location, region, and patient age, gender, racial, and socioeconomic distributions. Findings from this study can help determine the extent to which hospitals may be impacted by policy and/or programmatic changes, as policy makers and hospital executives may be able to anticipate policy impact based on known hospital characteristics and address potential consequences prior to implementation of healthcare policy reforms. Specifically, state policy makers may need to assess the impact of Medicaid reimbursement changes on hospitals with high Medicaid patient mix as these hospitals are likely community or safety-net hospitals. Hospital executives may consider adjusting their current payer-mix to compensate for revenue loss in one insured population with revenue gain in another population. Additionally, the Affordable Care Act will incorporate a “payment modifier” to allow for differential Medicare fee-for-service reimbursements based on quality metrics. With more extensive adoption of pay-for-performance in Medicare and potentially Medicaid patients, hospitals with a high mix of those patients should consider an investment in quality metrics tracking, monitoring, and reporting. In 2009, about 250 pay-for-performance programs existed in the U.S.; nearly half of these programs targeted hospital-based services. It is estimated that after 2011, 85 percent of state Medicaid programs will be based on some form of pay-for-performance structure[22].

As this was a single cross-section of hospitals across the U.S., additional research is needed to understand changes in the national profile of insurance coverage over time. Additionally, future studies should directly address changes to inpatient insurance status and hospital payer mix resulting from the still-unfolding nationwide reforms contained in the Patient Protection and Affordable Care Act.

Statement of Competing Interests

The authors have no competing interests.

List of Abbreviations

NIS = Nationwide Inpatient Sample; HCUP = Healthcare Cost and Utilization Project; MANOVA = Multivariate Analysis of Variance.

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