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VARIATION IN HEALTH CARE PRICES ACROSS PUBLIC AND PRIVATE PAYERS

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ABSTRACT

We study a unique all-payer data set spanning 38 states to examine the differences in inpatient reimbursement rates paid by traditional Medicare (TM), Medicare Advantage (MA), Medicaid, and private (under-65) insurers, and the differences in negotiated rates across the 60 largest private insurers. After controlling for enrollee and hospital mix, we find that private insurers pay 37 percent more than TM, and MA pays 10 percent more than TM for the five most common inpatient diagnoses. The correlation in risk-adjusted payments by private insurers and by TM at the same hospital for the same diagnosis is only 0.10. There is significant variation in negotiated prices within and across private payers. Among the five largest US insurers, the most expensive insurer negotiates prices that are 5-26 percent higher than the mean price for the 20 most common inpatient diagnoses. Additionally, we find a 10 percent increase in insurer market share corresponds to a 7 percent decrease in inpatient negotiated prices and a 10 percent decrease in the standard deviation of prices. This finding suggests that increased insurer market power allows payers to negotiate prospective payment contracts – rather than the more common fee-for-service payments – thereby offloading financial risk to providers.

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Variation in Health Care Prices Across Public and Private Payers

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Abstract

We study a unique all-payer data set spanning 38 U.S. states to examine the differences in inpatient reimbursement rates paid by traditional Medicare (TM), Medicare Advantage (MA), Medicaid, and private (under 65) insurers, and the differences in negotiated rates across the 60 largest private insurers. After controlling for enrollee and hospital mix, we find that private insurers pay 37 percent more than TM, and MA pays 10 percent more than TM for the five most common inpatient diagnoses. National MA insurers reimburse hospitals at rates similar to TM, but smaller, regional MA insurers pay more than TM. The correlation in mean risk-adjusted payments by private insurers and by TM at the same hospital for the same diagnosis is only 0.10. There is also significant variation in negotiated prices within and across private payers. For the five largest U.S. insurers, the least expensive insurer negotiates prices that are 6-27 percent lower on average than the mean price and the most expensive insurer negotiates prices that are 5-26 percent higher than the mean price for the 20 most common inpatient diagnoses. Additionally, we find that a 10 percent increase in insurer market share corresponds to a 7 percent decrease in inpatient negotiated prices. Furthermore, a 10 percent increase in insurer market share is associated with a 10 percent decrease in the standard deviation of inpatient prices paid by the insurer at a given hospital for a specific diagnosis. This finding suggests that increased insurer market power allows payers to negotiate prospective payment contracts—rather than the more common fee-for-service payments—thereby offloading financial risk to providers. (JEL: G22, I11, I13)

1 Introduction

The prices hospitals negotiate with insurers are shrouded in secrecy. Recently, the Centers for Medicare and Medicaid Services (CMS) introduced regulations compelling hospitals to publish the reimbursement rates they negotiate with private insurers (CMS 2019). The rule is slated to go into effect at the beginning of 2021, but hospitals are appealing the court's decision to uphold the rule, arguing that price transparency violates the First Amendment and may lead to insurer collusion (AHA 2020). Given hospitals' aversion to revealing the secret payer-specific reimbursement rates, there have been little data to date available to the consumers and researchers on the discounts

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resulting from hospital-insurer bargaining. In the past few years, researchers (e.g., Cooper et al. 2019) have taken advantage of new nationwide data on negotiated prices, though these data do not include a representative panel of payers.

In this paper, we analyze newly accessible data—the American Hospital Utilization Database (AHUD)—on the universe of patients from 474 hospitals across 38 U.S. states from 2009 to 2016, accounting for $1.8 trillion in hospital charges. This novel data set has a number of unique advantages over previously available data for studying health care prices. Most importantly, the data contain the actual transaction prices and the discounts negotiated by insurers off the hospital's charges.[1] Additionally, this all-payer database does not obscure the names of private insurers, allowing for an examination of the variation in the negotiated prices for the 60 largest private insurers in the 38 states in the data. To our knowledge, there has been no prior study examining variation in negotiated prices across private insurers with data with a scope greater than the state-level. Lastly, the data set is large, encompassing more than 300 million patient encounters over eight years. Given that much remains unknown about private insurers' negotiated prices, we present descriptive statistics about the variation in negotiated prices across private insurers and compare prices negotiated by private firms to those paid by Medicare and Medicaid. The analysis in this paper is organized into three areas of inquiry.

First, we describe the variation in risk-adjusted inpatient prices across common types of insurance coverage (traditional Medicare, Medicare Advantage, Medicaid, and private insurance).[2] We find that, on average, Medicare Advantage (MA) pays 10 percent more than traditional Medicare (TM) for the five most common Medicare Severity Diagnosis Related Groups (MS-DRGs),[3] after controlling for enrollee and provider mix. The disparity in reimbursement rates varies significantly depending on the diagnosis and treatment. Further, for national insurers, MA prices are similar to TM prices, but for smaller, regional insurers, MA prices tend to be higher than TM prices. For instance, for inpatient psychoses cases, the five largest MA insurers pay 6 percent *less* than TM, while the remaining insurers in the data pay 17 percent more than TM on average.

Private (under 65) plans consistently pay substantially more than both TM and MA for the same services. Private (under 65) insurers pay 37 percent more than TM and 25 percent more than MA on average for the five most common MS-DRGs. The distribution of private payments features high variance, driven by large outlier payments. This is consistent with the fact that many private insurers negotiate prices based on a percentage of hospital charges, rather than negotiating prospective payment contracts, in which insurers pay a fixed amount for each diagnosis. The distribution of Medicare Advantage negotiated prices, however, does not exhibit a similarly long

[1] Payers rarely pay the standard charges billed by hospitals; nearly always, payers will negotiate their own reimbursement rates with hospitals.

[2] In this paper, private insurance will refer to insurance covering enrollees under the age of 65 with group or individual coverage.

[3] MS-DRG codes are a system for classifying inpatient hospital claims based on diagnoses, procedures, and/or treatment; severity; and comorbidities. They are used for Medicare's prospective payment system as the main method of reimbursing inpatient care.

right tail. This suggests that private insurers tend to negotiate the structure of MA contracts with hospitals as a percentage of Medicare reimbursements (a prospective payment system), partially offloading the risk of outlier payments onto the provider. The correlation in mean risk-adjusted prices for private (under 65) and MA across hospitals ranges from 0.60 to 0.67 for the five most common MS-DRGs, after controlling for patient severity. For TM and Medicaid, the correlation ranges from -0.11 to 0.34 for different diagnoses.

Second, we examine the between-payer price variation for the 60 largest private insurers.[4] For the five largest U.S. insurers, the least expensive insurer negotiates prices that are 6-27 percent lower on average than the mean price and the most expensive insurer negotiates prices that are 5-26 percent higher than the mean price for the 20 most common MS-DRGs. We find there exists high variation in negotiated prices across insurers within the same hospital. For instance, for vaginal deliveries, the bivariate correlations between each of the five largest private U.S. insurance companies within the same hospital range from -0.57 to 0.70. For hip and knee replacements, these correlations range from 0.04 to 0.82. For the 60 largest insurers and for the 20 most common MS-DRGs, the between-payer coefficient of variation ranges from 8 percent to 24 percent. Further, we find that within-hospital variation in prices is sizable for both inpatient and outpatient care. For inpatient care, within-hospital variation is primarily explained by differences in negotiated prices across insurers. For outpatient care, however, insurer contracts do not explain much of the within-hospital variation. These findings imply that contracts between insurers and providers are more prospective for inpatient care than for outpatient care.

Third, we add to the literature on the determinants of negotiated health care prices by investigating the relationship between insurer market share and negotiated reimbursement rates. While there has been ample research on other determinants of health care prices (including hospital market concentration), lack of accessible data has constrained research on the relationship between insurer market concentration and negotiated prices. We find that a 10 percent increase in insurer market share is associated with a 6-7 percent decrease in negotiated prices. In addition, we explore the relationship between insurer market share and the extent to which hospitals and insurers bear risk in their negotiated price contracts. There is an inverse relationship between insurer market share and the variance in payments for services treating a given diagnosis. This finding implies that, when insurers hold greater market power, they are more likely to be able to negotiate prospective payment contracts, paying providers based on the diagnosis rather than the actual treatments the patient receives.

The paper proceeds as follows. In Section 2, we give an overview of the existing literature on health care prices. In Section 3, we describe the data, variable construction, sample selection, and provide descriptive statistics. In Section 4, we compare the price of care received by the privately-insured and publicly-insured and examine the variation in prices negotiated by different private payers. In Section 5, we examine the association between insurer market share and negotiated

[4]For a complete list of the private insurers examined in this paper, consult Appendix Table 17.

prices. Section 6 concludes.

2 Background

2.1 Comparisons of Public and Private Payer Prices

Public and private payers reimburse providers for their services using different methods of payments. Traditional Medicare's inpatient payments are set administratively by the Centers for Medicare and Medicaid Services (CMS), and are organized according to Medicare Severity Diagnosis Related Groups (MS-DRGs). Some adjustments to MS-DRG reimbursement rates are made based on geographic marketplace and hospital type, with additional outlier payments reimbursing providers for especially costly patients. In contrast, Medicaid payment structures vary widely across states, with most Medicaid programs using fee-for-service or prospective payments to reimburse providers. Private prices are primarily market-driven and are set based on complex contract negotiations between each provider-insurer pair. The negotiated prices may be set based on a share of a hospital's chargemaster price, or prospectively as a percentage of Medicare reimbursements. These contract structures, and the actual private negotiated prices, have historically remained highly confidential and are considered trade secrets.

Surprisingly little is known about the variation in prices across types of insurance coverage. The Congressional Budget Office reports that MA plans pay slightly more than TM plans (CBO 2013). Recently, using data from three national insurers provided by the Health Care Cost Institute (HCCI),[5] researchers have been able to compare inpatient prices for MA and TM nationwide. Baker et al. (2016), Maeda and Nelson (2018), Pelech (2018), and Curto et al. (2019) all use the HCCI data to compare prices, utilization, or spending differences between TM and MA. Baker et al. find that, from 2009 to 2012, MA plans paid 5.6 percent less for hospital services than TM plans. Maeda and Nelson estimate that MA and TM prices are roughly equal for hospital services and Pelech finds that this is also true for physician service payments. Similarly, Curto et al. find that MA plans pay only about 1 percent more than TM on average. These findings run counter to conventional wisdom, which suggests that MA would pay significantly higher prices than TM given the ability of the public sector's monopsony power to constrain prices.

In a survey of senior hospital and health plan executives, Berenson et al. (2015) find that commercial plans pay significantly more than MA plans, which, in turn, tend to pay 100-105 percent of TM rates. Pelech (2018) and White and Whaley (2019) also find that average commercial prices are substantially higher than traditional Medicare prices for physician and hospital services, respectively. Using the IBM MarketScan data, Romley et al. (2015) find that a 10 percent lower commercial price is associated with 3 percent higher Medicare spending per member. Using a large administrative change in TM reimbursement rates for surgical versus medical care, Clemens and

[5] See Subsection 3.1 for more details on the HCCI data.

Gottlieb (2017) find that, for BCBS of Texas, private negotiated prices tend to be tied to TM reimbursements, although Clemens, Gottlieb, and Molnár (2017) show that these prices deviate when there is significant value at stake.

2.2 Variation in Private Payer Prices

Recent literature has focused on the variation in health care prices for the privately-insured across geographic markets and across providers (e.g., Cooper et al. 2019). However, there has been little examination of between-payer price variation. The HCCI data on private prices does not differentiate between insurers and therefore does not allow for cross-payer comparisons. The prices negotiated by private payers have a significant effect on consumer welfare and thus are of immense importance to employers and consumers. Save for the few states that have established all-payer databases, however, these negotiated prices cannot be observed by outsiders. Even in states with all-payer databases, these data are unlikely to be decipherable to the average consumer. Higher negotiated prices may be passed on to consumers in the form of out-of-pocket costs and, potentially, higher premiums. Given the rise of high-deductible plans and increased cost-sharing via coinsurance, the prices negotiated by insurers are especially relevant to customers. *Ceteris paribus*, in the presence of perfect information on prices, consumers would prefer to be insured by insurance firms negotiating lower prices with providers.

A significant portion of the variation in prices can be attributed to market dynamics based on hospital monopoly power and insurer monopsony power. The past two decades have been characterized by increasing consolidation on both sides of this market. There is strong evidence documenting the positive relationship between provider market power and negotiated prices (e.g., Brooks, Dor, and Wong 1997; Town and Vistnes 2001; Ginsburg 2010; Robinson 2011) and the inverse relationship between insurer market power and negotiated prices (e.g., Wu 2009; Moriya, Vogt, and Gaynor 2010; Melnick, Shen, and Wu 2011; McKellar et al. 2013; Scheffler and Arnold 2017). An insurer's ability to control the flow of patients to specific providers also tends to result in lower negotiated prices (Staten, Umbeck, and Dunkelberg 1987, 1988; Pauly 1998; Cutler, McClellan, and Newhouse 2000; Sorenson 2003). Cooper et al. (2019) find that, even within hospitals, there is significant variation in payments for a given procedure, and hypothesize that this can be primarily attributed to differences in negotiated prices across insurers. Using Massachusetts's All-Payer Claims Database, Craig, Ericson, and Starc (2018) provide the first picture of variation in prices across private payers, focusing on Blue Cross Blue Shield of MA, Tufts Health Plan, and Harvard Pilgrim. Their study finds substantial variation in prices paid by different payers to the same hospitals for the same service in Massachusetts. Further, they present a model of provider-insurer negotiations in which consumer response to negotiated provider prices is a crucial determinant of payers' negotiation efforts.

2.3 New Contributions

This paper leverages a novel proprietary data set that allows researchers to lift the veil of secrecy surrounding provider-insurer negotiations. Building off the recent HCCI findings, we expand the scope of private insurers studied from UnitedHealthcare, Aetna, and Humana (insurers in the HCCI studies) to 60 of the largest U.S. insurers. The findings presented here differ in some notable ways from the HCCI findings, especially since these three national insurers are not representative of the private insurance market as a whole, as we show in Subsection 4.2. Other than the HCCI and MarketScan data, no data has previously allowed for a comparative analysis of MA and private (under 65) negotiated prices across the U.S. The analysis of the data in this paper allows for a descriptive study of prices negotiated by private insurers that captures the universe of insurers at a given provider. Additionally, this paper provides a look at between-payer variation for private negotiated prices across the country. To our knowledge, between-payer variation has only been examined in Massachusetts. Understanding of variation in prices across private payers is important in the context of the federal government's proposed health care price transparency laws. Lastly, the paper contributes to a growing literature on the determinants of private prices by examining the relationship between insurer market power and hospital-insurer negotiations.

3 Data and Variables

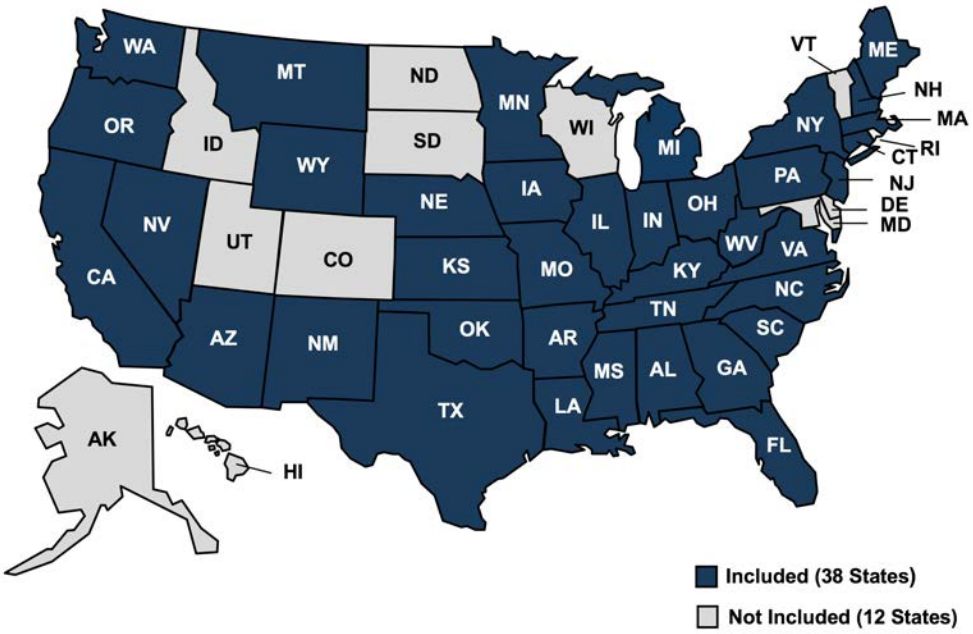
3.1 American Hospital Utilization Database

The data for this study come from the American Hospital Utilization Database (AHUD), which consists of electronic medical record (EMR) data provided by a large healthcare services company. This paper is the first analysis of the AHUD data examining health care pricing. The data come from 474 providers in 38 U.S. states using this service. Included in the data are encounter-level claims for inpatient and outpatient services. The proprietary data span 2009 to 2016 (inclusive) and document over 300 million patient encounters with providers from over 80 million individual patients. 278 million of the encounters are outpatient visits and 25 million are inpatient visits. These encounters come from patients of all insurance types (i.e., traditional Medicare, Medicare Advantage, Medicaid, CHIP, private, no insurance). The mix of hospitals consists of large and small facilities in both urban (87 percent) and rural (13 percent) locations. Roughly 98 percent of providers submit both inpatient and outpatient data. The vast majority of facilities in the data are hospitals but the data also includes skilled nursing facilities, home health, and clinics.

The unique aspect of the AHUD data is the inclusion of the actual reimbursement paid by the insurer and patient, the provider's billed charges for the encounter, and the negotiated discount and contractual adjustments for the insurer. The data also include the estimated cost for the encounter based on the cost-to-charge ratio for that hospital from the Centers for Medicare and Medicaid Services (CMS) hospital cost reports. Some providers report the amount of the payment that is

the patient's responsibility, including the patient's copay and deductible amounts.

Figure 1: States in the AHUD Data



To our knowledge, there are only two other alternative data sources available to researchers that are larger than the state level and include prices negotiated by private insurers. One is the Health Care Cost Institute (HCCI) data.[6] HCCI provides claims-level data for employer-sponsored insurance from UnitedHealthcare, Aetna, and Humana (masking the individual insurers) and contains 42 to 46 million lives per year (Cooper et al. 2019). The other alternative data source is the IBM MarketScan Commercial Database. The MarketScan data come primarily from large employers, but also contain some data from mid-size and smaller employers as well as health plans. It contains several million individuals, encompassing employees and their dependents who are covered by employer-sponsored private insurance. Unlike the HCCI and MarketScan data, the AHUD data are sourced from the providers rather than employers or health plans. This allows for one distinct advantage over the other two data sources. Namely, the AHUD data contain people with all types of insurance (public and private) and with no insurance, rather than strictly employer-sponsored insurance. Within private claims, HCCI and MarketScan only have data on a handful of insurers and obscure any connection between a specific payer and a claim, while AHUD contains claims-level data for hundreds of insurers and identifies the payer for each claim.

To de-identify the data, all protected health information (PHI) elements are removed except for the admission and discharge dates, which are reported on a monthly, rather than daily, basis. Furthermore, patient zip codes are truncated to three digits and reported only if the population

[6] https://healthcostinstitute.org/data

of the three-digit zip code was greater than 20,000 as reported in the 2010 Census. Ages greater than 89 are truncated to 90 for reporting purposes. Patient characteristics included in the data are age, gender, and employment status. For each patient encounter, the AHUD data include a list of primary and secondary diagnoses from ICD-9 and ICD-10 codes; procedures, treatments, and prescriptions from ICD, CPT, and HCPCS codes; length of stay; and whether or not the patient died during hospitalization. In addition, the data contain information submitted in UB92/UB04 billing forms, including admission source, admission type, and discharge status. For inpatient visits, we also include CMS Medicare Severity Diagnosis Related Groups (MS-DRGs).

For the analysis comparing public and private prices, we classify payers as traditional Medicare, Medicare Advantage, private (under 65), and Medicaid and CHIP. For more information on the classification of payers, consult Appendix C and Appendix D. Within the private (under 65) category, we identify claims from the 60 largest private insurance firms and their subsidiaries. A list of the private insurance firms we study with the AHUD data is provided in Appendix Table 17.

3.2 Sample Selection

We include only patient encounters for which there are data on the actual price received by the hospital for the encounter. Unless otherwise specified, we include only inpatient admissions. For the analysis of private and Medicare Advantage prices, we restrict the sample to encounters covered by the 60 largest insurers in the data. In the analysis comparing prices by public and private payers, we restrict the sample to the five most common MS-DRGs that are not related to births, so as to include data from the elderly population for MA and TM. For the examination of private (under 65) prices, we restrict the analysis to the 20 most common MS-DRGs for patients between 18 and 65 years old.

3.3 Limitations of Data

The data are not nationally representative of hospitals. Hospitals in the AHUD data tend to be larger and in more populated areas. According to the American Hospital Association's 2017 Annual Survey, 64 percent of U.S. hospitals are in urban locations. In the AHUD data, 83 percent of hospitals are in urban locations. In addition, 44 percent of U.S. hospitals have 100 or more beds, while in the AHUD data, 78 percent of hospitals have 100 or more beds. Hospitals in the South are overrepresented in the AHUD data. The data also only include providers using an EMR system. Further, there may be selection bias in providers that employ the healthcare services company from which the data are sourced (e.g., hospitals in wealthier areas). However, overall demographic information including the distribution of patient ages and gender and pricing data including average charges and average costs are nearly identical to nationally representative data.[7]

[7] We compare the AHUD inpatient data to the HCUP National Inpatient Sample in Appendix B.

While AHUD has information on the payer for a patient's encounter with a provider, it does not provide any further information about the type of plan the patient has (e.g., HMO, PPO, or PFFS). Additionally, patient and hospital location data is not fine-grain. The location of a patient's residence is only provided at the three-digit zip code level, which is a relatively broad geographic area.[8] While distinct hospitals are identifiable in the data, they can not be linked to more detailed external hospital data. Therefore, only rough approximations of a hospital's local market share can be estimated with these data. While other data sets include both claims and denominator populations (eligible enrollees), the denominator population is not available in the AHUD data. Lastly, five of the 38 states in the data only have data from one provider. Thus, we avoid any state-level analysis and comparisons in prices between states.

3.4 Constructing Risk- and Hospital-Adjusted Prices

Differences in reimbursement rates across payers may indicate differences in the enrollee mix (e.g., MA beneficiaries may be more healthy on average compared to TM beneficiaries). Further, differences in reimbursement rates could be driven by differences in the geographic locations and the hospitals at which the payer covers patients. Thus, we control for these differences across payers by constructing hospital- and risk-adjusted prices that remove variation due to patient characteristics and comorbidities as well as any year- and hospital-specific variation.

We estimate the hospital- and risk-adjusted prices paid by each payer for a number of high-volume MS-DRGs. Each of MS-DRG is defined by a particular set of patient attributes, including principal diagnosis, specific secondary diagnoses, procedures, sex, and discharge status. MS-DRGs are used to code the payment of inpatient services for Medicare beneficiaries.

We construct the adjusted price estimate in two stages. First, we estimate the following equation separately for each MS-DRG:

$$p_{i,j,h,t} = \mathbf{X}_i\beta + \gamma_{h,t} + \epsilon_{i,j,h,t} \tag{1}$$

where $p_{i,j,h,t}$ is price paid for patient encounter i covered by payer j at hospital h in year t. $\mathbf{X}_i$ is a vector of patient-specific characteristics: age, an indicator for male, length of stay, and indicators for the 17 comorbid conditions defining the Charlson comorbidity index. $\gamma_{h,t}$ is a vector of year-specific hospital fixed effects. Lastly, $\epsilon_{i,j,h,t}$ is a vector of the residuals accounting for all variation in $p_{i,j,h,t}$ not explained by $\mathbf{X}_i$ and $\gamma_{h,t}$.

From equation (1), we obtain the vector of residuals from the model, $\hat{\epsilon}_{i,j,h,t}$. These residuals can be interpreted as the variation in price not explained by age, gender, comorbidities, year, or the hospital which the patient visited. A positive residual means the payment for the encounter was higher than expected, conditional on these covariates.

[8] For reference, California has 58 three-digit zip codes.

We then obtain hospital- and risk-adjusted prices, $\tilde{p}_{i,j,h,t}$:

$$\tilde{p}_{i,j,h,t} = \overline{p} + \hat{\epsilon}_{i,j,h,t} \tag{2}$$

where $\overline{p}$ is simply a constant across all observations and scales the residual to match the mean of the data for the given MS-DRG. The only term that differentially affects $\tilde{p}_{i,j,h,t}$ is $\hat{\epsilon}_{i,j,h,t}$. The mean hospital- and risk-adjusted price for each payer is then given by $\overline{\tilde{p}}_j = 1/N \sum_{i=1}^{N} \tilde{p}_{i,h,t}$ where N is the number of enrollees in plans by payer j. This price measure allows for an analysis of prices paid by different payers after controlling for observable differences in enrollee mix, encounter severity, and hospital-specific differences.

For certain analyses, such as those presented in Table 4 and Table 6, we also construct measures of risk-adjusted prices using the method described above that do not control for differences across providers (γ is now a vector of year fixed effects, rather than year-specific hospital fixed effects). This allows for a comparison of risk-adjusted prices paid by payers within the same hospital.

The interpretation of this adjusted price relies on the assumption that there are no unobservable differences in the average patient severity or level of treatment for each payer. Unlike some other DRG classifications, MS-DRGs indicate the presence and severity of comorbidities and complications. Thus, the stratification across MS-DRGs further controls for differences in patient severity.

We estimate several different versions of risk-adjusted and hospital- and risk-adjusted prices. For the analysis in Subsection 4.1, j indexes the type of coverage a patient receives (TM, MA, Medicaid and CHIP, and private). For the analysis in Subsection 4.2, we first subset the data to only the encounters covered by the largest 60 private insurers for patients under 65 years of age. In this analysis, the prices are constructed such that j indexes the private insurers (e.g., Anthem). Further, we also construct risk-adjusted and hospital- and risk-adjusted discounts for payers, as measured by the percent discount off the chargemaster price for the encounter. The adjusted prices and adjusted percent discounts track each other closely. To further evaluate the adjusted price measures, we run versions of equations (1) and (2) where the outcome variable is the hospital's billed charges, rather than the price. With this outcome measure, we observe little variation across private payers, implying that the adjusted price measures are likely not biased by any unobserved differences in patient severity or level of care across payers.

3.5 Descriptive Statistics

Table 1 displays summary statistics for the hospitals in the data. Table 2 presents summary statistics describing patient characteristics. We also compare the AHUD data to the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample, a nationally representative sample, in Appendix B. The levels and trends in inpatient charges and costs are similar between the AHUD and HCUP data. Further, the distribution of patient ages is nearly identical for the AHUD and HCUP data. The AHUD has 9 percent more hospitals in the South Atlantic region and 8 percent

more in the West South Central region relative to the geographic distribution of U.S. hospitals.

Table 1: Hospital Characteristics

			Cost to charge ratio	
	N	Percent	Mean	Std. Dev.
Teaching Status				
Non-Teaching	302	64%	0.26	0.08
Teaching	152	32%	0.26	0.06
Unknown	20	4%	0.27	0.07
Number of Beds				
Less Than 100 Beds	106	22%	0.28	0.09
100-199 Beds	125	26%	0.25	0.08
200-299 Beds	64	14%	0.25	0.08
300-499 Beds	87	18%	0.25	0.07
500 or More Beds	70	15%	0.24	0.06
Unknown	22	5%	0.27	0.07
Urban or Rural Status				
Rural	62	13%	0.29	0.08
Urban	392	83%	0.25	0.08
Unknown	20	4%	0.27	0.07
Region				
East North Central	56	12%	0.29	0.08
East South Central	25	5%	0.25	0.06
Middle Atlantic	37	8%	0.22	0.07
Mountain	13	3%	0.29	0.07
New England	19	4%	0.36	0.11
Pacific	64	14%	0.23	0.08
South Atlantic	140	30%	0.25	0.06
West North Central	24	5%	0.27	0.08
West South Central	96	20%	0.25	0.07

Table 2: Patient Characteristics

	N	Percent
Patient Type		
Outpatient	278,271,652	91.66
Inpatient	25,326,425	8.34
Patient Age		
Age < 18	40,160,935	13.23
Age 18-24	19,390,300	6.39
Age 25-34	31,727,338	10.45
Age 35-44	32,228,165	10.62
Age 45-54	43,596,816	14.36
Age 55-64	48,782,047	16.07
Age > 65	87,458,066	28.81
Unknown	254,410	0.08
Gender		
Male	117,170,775	38.59
Female	186,427,302	61.41
Length of Stay		
1	249,345,370	82.13
2	15,036,230	4.95
3	7,925,148	2.61
4	5,422,263	1.79
5	3,122,377	1.03
> 5	22,746,683	7.49

4 Variation in Hospital-Insurer Negotiated Prices

4.1 Variation Across Public and Private Plans

In this section, we examine the variation in prices paid to providers by traditional Medicare, Medicaid and CHIP, Medicare Advantage insurers, and private (under 65) insurers. For the analysis of prices across public and private insurers, we first compare the mean hospital- and risk-adjusted price for each of the five most common MS-DRGs. We present the results in Table 3. Private (under 65) insurers pay significantly more than all other types of coverage, MA pays slightly more than TM, and Medicaid and CHIP pay significantly less than TM. The average discount off the chargemaster price negotiated by private insurers ranges from 52 to 62 percent. Figure 2 presents prices as a percent of traditional Medicare's reimbursement for the five most common MS-DRGs. Medicaid pays 21.1 percent less than TM on average. In contrast, private (under 65) insurers pay 37.4 percent more than TM and 24.5 percent more than MA on average.

Medicare Advantage (MA) pays 10.4 percent more than traditional Medicare (TM) on average for the five most common Medicare Severity Diagnosis Related Groups (MS-DRGs), after controlling for enrollee and provider mix. However, the disparity in reimbursement rates varies significantly depending on the diagnosis and treatment. For cases with diagnoses of psychoses, MA payers only pay 6.9 percent more than TM. For hip and knee replacements, MA payers pay 15.2 percent more than TM.

The finding that MA pays more than TM stands differs from the findings analyzing HCCI data (Baker et al. 2016; Maeda and Nelson 2018; Pelech 2018; Curto et al. 2019), which all find that MA pays providers similar or lower rates on average relative to TM. These HCCI studies examine data from UnitedHealthcare, Aetna, and Humana—three of the five largest insurers in the U.S—whereas we examine data from the 60 largest insurers. Indeed, when we consider only these three large insurers with the AHUD data, the results are largely consistent with the HCCI studies. On average across the five most common MS-DRGs, the HCCI insurers pay only 2.1 percent more for MA than TM, while the remaining 57 non-HCCI insurers pay 17.5 percent more than TM (see Appendix Figure 8 and Appendix Figure 9). These findings suggest that the HCCI data is not representative of the insurance market as a whole. It is possible that these three national insurers are able to extract significantly higher discounts relative to smaller, regional insurers. In fact, the five largest U.S. insurers (Aetna, Anthem, Cigna, Humana, and UnitedHealthcare) pay only 5.6 percent more for MA than TM on average, while the remaining 55 insurers in the data pay 15.5 percent more than TM (see Appendix Figure 10 and Appendix Figure 11).

Table 3: Adjusted Prices by Payer Type for Five Most Common MS-DRGs

		Price				Percent Discount off Charge				
		Mean				Mean				
Medicare Severity Diagnosis Related Group	Payer	Residuals	Adj. Price	Std. Dev.	CV	Residuals	Adj. Discount	Std. Dev	CV	N
Esophagitis, gastroent & misc digest disorders w/o MCC	Private (under 65)	1,386.04	6,799.49	6,222.33	0.92	-5.43	61.94	35.88	0.58	37,971
	Medicare Advantage	-99.85	5,313.60	3,236.45	0.61	-0.19	67.19	20.07	0.30	9,871
	Medicare	-613.43	4,800.02	2,584.58	0.54	1.78	69.15	69.72	1.01	42,523
	Medicaid and CHIP	-1,591.30	3,822.16	9,342.85	2.44	8.23	75.61	37.47	0.50	15,981
Major joint replacement or reattachment of lower extremity w/o MCC	Private (under 65)	3,717.41	20,067.30	10,028.17	0.50	-7.26	59.55	22.57	0.38	51,593
	Medicare Advantage	312.12	16,662.02	7,252.81	0.44	-1.69	65.11	175.84	2.70	27,910
	Medicare	-1,885.35	14,464.54	4,436.95	0.31	4.08	70.89	70.37	0.99	87,936
	Medicaid and CHIP	-7,704.18	8,645.71	7,476.77	0.86	13.85	80.65	17.62	0.22	4,507
Cellulitis w/o MCC	Private (under 65)	1,409.01	7,391.65	5,687.21	0.77	-6.20	55.41	31.39	0.57	21,357
	Medicare Advantage	37.96	6,020.60	3,781.47	0.63	-0.26	61.35	24.44	0.40	5,852
	Medicare	-564.38	5,418.26	2,607.51	0.48	1.44	63.05	36.29	0.58	26,929
	Medicaid and CHIP	-1,235.40	4,747.24	18,359.61	3.87	7.78	69.39	66.66	0.96	12,213
Septicemia or severe sepsis w/o mv 96+ hours w MCC	Private (under 65)	7,193.09	21,392.51	27,017.28	1.26	-8.90	52.25	50.38	0.96	17,111
	Medicare Advantage	323.73	14,523.16	10,276.53	0.71	1.58	62.73	41.24	0.66	20,577
	Medicare	-735.27	13,464.15	6,294.04	0.47	0.42	61.57	130.70	2.12	98,646
	Medicaid and CHIP	-4,261.54	9,937.88	14,204.46	1.43	5.85	67.00	417.08	6.23	13,406
Psychoses	Private (under 65)	630.68	6,990.26	5,186.54	0.74	-3.63	58.53	36.81	0.63	38,807
	Medicare Advantage	354.05	6,713.63	5,266.15	0.78	-1.41	60.75	151.81	2.50	3,710
	Medicare	-77.10	6,282.48	4,091.06	0.65	2.29	64.45	83.03	1.29	56,626
	Medicaid and CHIP	-468.88	5,890.70	3,702.53	0.63	0.27	62.43	315.79	5.06	44,737

Notes: A unit of analysis is an inpatient admission. Prices and percent discounts are adjusted using equations (1) and (2) to control for differences in patient severity and year-specific hospital effects.

Figure 2: Prices as a Percent of Medicare Reimbursements

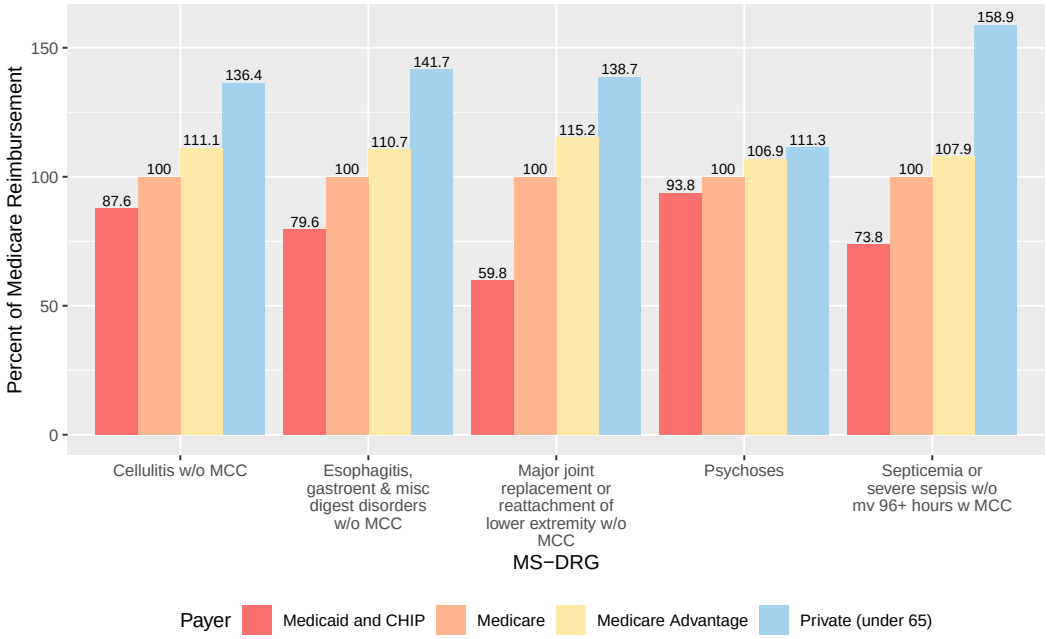
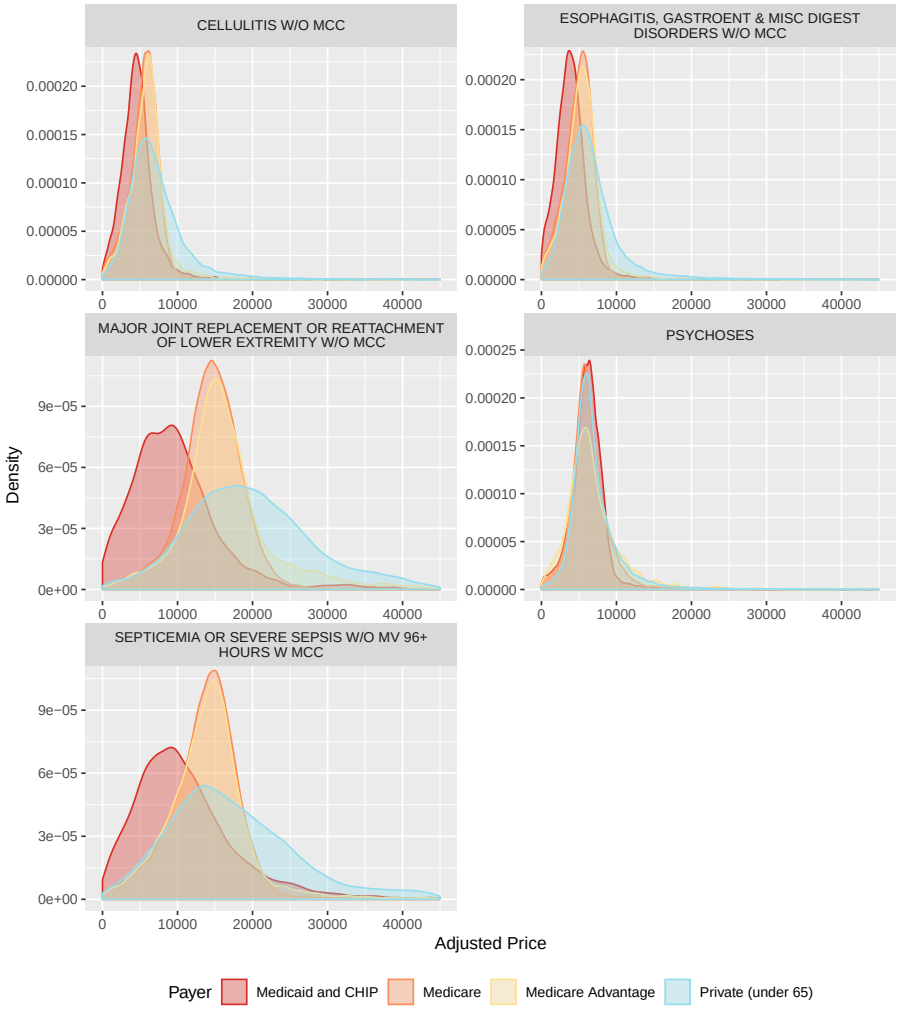


Figure 3 shows that the high mean prices negotiated by private payers and the high variation in prices exhibited in Table 3 are driven primarily by large outlier payments. This is expected given that commercial plans tend to pay providers a share of the billed charges. Interestingly, the distribution of MA prices does not have the long right tail present for the private (under 65) prices. This suggests that MA plans tend to not make payments as a share of charges, but instead they pay prospectively based on diagnosis, following TM.

As shown in Table 3, the coefficient of variation for private prices is substantially larger relative to that of traditional Medicare and Medicare Advantage. However, the coefficient of variation for the percent discount off the chargemaster price is *smaller* in all cases than that of traditional Medicare. Medicare's prospective payment system reimburses providers independently of the providers' billed charges. In contrast, private payers tend to pay providers a share of the billed charge. Thus, for many MS-DRG-payer-provider combinations, the percent discount is relatively constant, explaining the smaller variation relative to Medicare. Medicaid's reimbursement methodology and rates vary by state, explaining why Medicaid tends to exhibit the highest coefficient of variation of all types of insurance coverage.

Lastly, we compare payments by MA, TM, Medicaid, and private (under 65) insurers at the *same* provider with the *same* MS-DRG to examine the correlation between payments across these types of insurance coverage within a provider. The unit of analysis for this analysis is the mean risk-adjusted payment for admissions covered by a type of insurance at a specific hospital for a specific MS-DRG. Table 4 presents the bivariate correlations in mean inpatient risk-adjusted price

Figure 3: Density Plots of Adjusted Prices by Payer Type and MS-DRG



residuals between MA, TM, Medicaid, and private insurers. Note that here we use the price residuals obtained from equation (1) rather than the residuals linearly-transformed by the mean price for each MS-DRG from (2), allowing for the correlations to be unaffected by differences in the average price *level* of each of the MS-DRGs. We find a low correlation (0.10) between the prices paid by private insurers and traditional Medicare. Medicare Advantage is similarly correlated with private plans (0.55) and traditional Medicare (0.53). Risk-adjusted prices for Medicaid are, perhaps surprisingly, more correlated with private and MA plans than with TM. The correlation between TM and Medicaid prices for the same MS-DRG at the same hospital is only 0.12. Notably, for hip and knee replacements, the correlation between TM and Medicaid prices across hospitals is -0.11. The correlation matrices for specific MS-DRGs are presented in Appendix Table 23.

Table 4: Pearson Correlation in Mean Inpatient Risk-Adj. Price Residuals between Types of Coverage
(*Observations at MS-DRG-provider-payer level*)

	Private (under 65)	Medicare	Medicare Advantage
Medicare	0.10***		
Medicare Advantage	0.55***	0.53***	
Medicaid and CHIP	0.39***	0.12***	0.33***

Notes: *p<0.1; **p<0.05; ***p<0.01. The p-values are reported for a two-tailed test. A unit of analysis is a MS-DRG-provider-payer. Price residuals are obtained by equation (1), which removes variation in prices due to differences in observable patient severity and year-specific hospital effects. Includes the five most common MS-DRGs.

4.2 Variation Across Private Payers

As both prior studies and the descriptive analysis in Subsection 4.1 have shown, prices paid to hospitals by private health care plans vary widely. While it is well documented that, across hospitals, private insurers pay drastically different prices, little is known about the differences in prices paid by different private payers within the same hospital. In this section, we help to fill this gap in the literature by describing the variation in health care prices across private payers and decomposing the variation in negotiated prices.

Table 5: Private-Payer Negotiated Prices and Discounts

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Vaginal delivery w/o complicating diagnoses							
Insurer D	488.96	5,856.40	2,992.38	-4.62	51.66	18.95	12,085
Insurer C	413.78	5,781.21	2,491.09	-4.21	52.06	28.84	21,748
Insurer B	190.07	5,557.51	3,486.34	0.71	56.99	31.51	28,933
Insurer E	24.16	5,391.60	2,071.24	-0.17	56.11	18.86	2,255
Insurer A	-129.52	5,237.92	2,447.21	0.42	56.70	18.83	35,166
Cesarean section w/o CC/MCC							
Insurer D	1,067.14	9,133.76	3,885.97	-5.18	54.45	15.68	5,627
Insurer C	470.58	8,537.21	3,175.87	-3.57	56.06	47.78	9,678
Insurer B	-54.03	8,012.60	3,852.42	1.83	61.46	14.98	11,514
Insurer E	-59.88	8,006.74	3,297.94	-0.19	59.45	17.47	1,018
Insurer A	-266.66	7,799.97	3,349.32	0.61	60.25	24.92	14,277
Cesarean section w CC/MCC							
Insurer D	1,280.62	12,086.97	10,003.82	-2.88	51.82	78.98	3,122
Insurer C	556.38	11,362.74	7,923.13	-2.23	52.47	82.05	5,370
Insurer B	-26.45	10,779.90	11,024.82	2.59	57.29	27.58	6,756
Insurer E	-267.83	10,538.52	10,490.19	5.02	59.72	116.32	657
Insurer A	-426.58	10,379.77	35,202.02	-3.09	51.61	595.58	8,415

Table 5: Private-Payer Negotiated Prices and Discounts *(continued)*

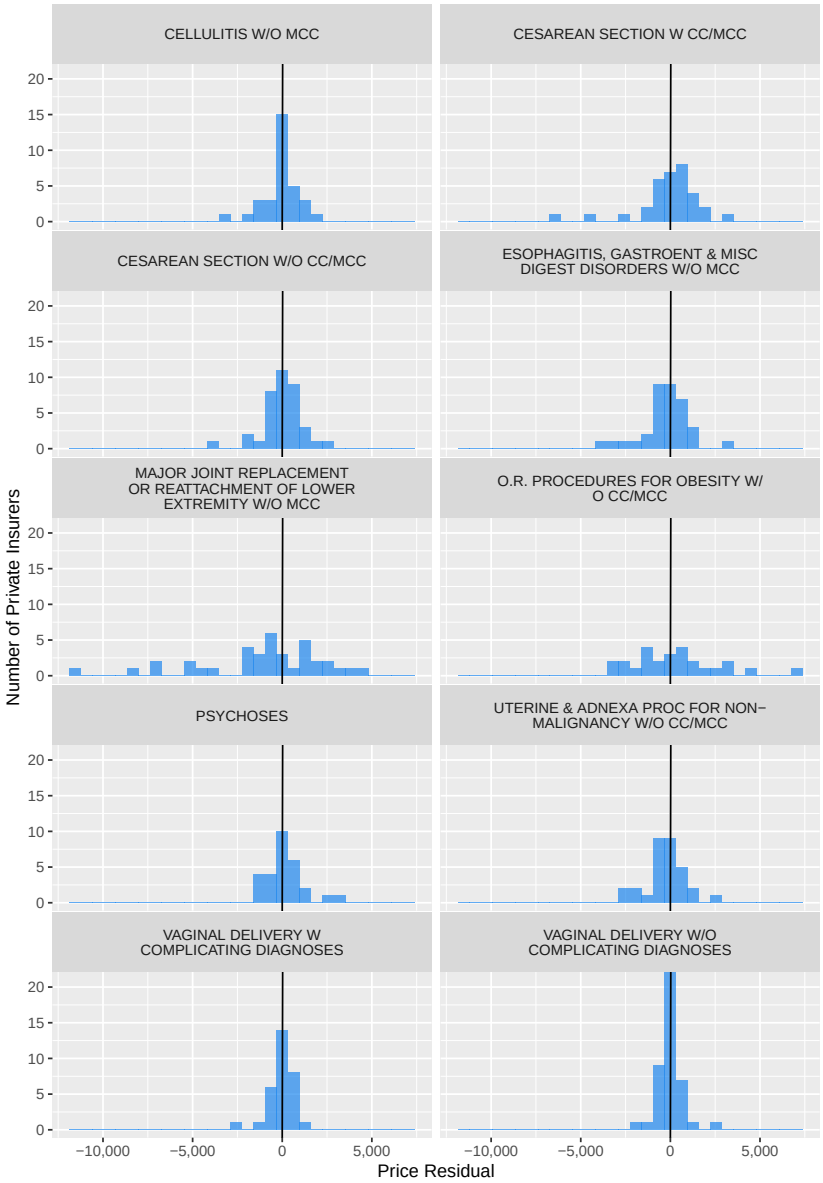
	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Major joint replacement or reattachment of lower extremity w/o MCC							
Insurer D	3,591.56	27,179.60	10,666.88	-4.91	48.07	17.69	3,404
Insurer C	2,291.69	25,879.73	9,225.60	-4.42	48.56	17.07	5,411
Insurer B	-663.92	22,924.11	8,878.84	1.79	54.77	14.86	8,516
Insurer A	-682.58	22,905.46	9,052.46	1.23	54.21	30.76	8,152
Insurer E	-4,140.69	19,447.35	11,894.92	7.90	60.88	27.30	1,887
Psychoses							
Insurer C	1,021.55	7,027.73	6,061.38	-6.61	48.69	35.88	3,579
Insurer B	47.23	6,053.41	6,687.59	0.81	56.11	27.05	5,474
Insurer D	-261.50	5,744.68	5,257.46	3.24	58.54	24.25	2,578
Insurer A	-1,002.98	5,003.20	3,183.45	8.56	63.85	19.00	7,445
Insurer E	-1,195.32	4,810.86	4,940.73	8.75	64.05	27.01	1,423

Notes: The unit of analysis is an inpatient admission. Prices and percent discounts are adjusted using equations (1) and (2) to control for differences in patient severity and year-specific hospital effects. Insurers A-E mask the names of the five largest U.S. private insurers (Aetna, Anthem, Cigna, Humana, and UnitedHealthcare). The data use agreement enabling our access to the AHUP data does not permit us to uniquely identify insurers by name.

Table 5 presents statistics on the negotiated price and discounts by Aetna, Anthem, Cigna, Humana, and UnitedHealthcare for the five most common MS-DRGs for patients between ages 18 and 65. The names of the insurers are masked randomly as Insurers A-E. These prices are adjusted by equations (1) and (2), which control enrollee mix and year-specific hospital fixed effects. For the five major U.S. insurers, the least expensive insurer negotiates prices that are 6-27 percent lower on average than the mean price and the most expensive insurer negotiates prices that are 5-26 percent higher than the mean price for the 20 most common MS-DRGs. It is clear that certain insurers are able to consistently negotiate lower reimbursement rates across MS-DRGs. In four of the five diagnoses presented in Table 5, Cigna has the highest negotiated prices. For the most common MS-DRG, vaginal delivery without complicating diagnoses, the discounts range from 51.66 to 56.99 percent off the chargemaster price on average. For a diagnosis of psychoses, the percent discount ranges from 48.69 percent to 64.05 percent. The adjusted prices and adjusted discounts track each other closely. The discount measure is more robust to unobserved differences across insurers that are not captured by the risk- and hospital-adjustments. However, the high correlation between discount and price suggests that the adjusted prices are not meaningfully biased by unobserved differences across insurers.

For the corresponding tables for the five most common MS-DRGs with all 60 insurers in the data, consult Appendix E.1. As is evident in these extended tables, the variation in prices negotiated by the five largest national insurers does *not* capture the extent of the variation in prices across all insurers. For instance, for a hip or knee replacement without major complicating conditions,

Figure 4: Histograms of Mean Adjusted Residuals for Private Payers
(*Observations at payer-provider level*)



Notes: Unit of analysis is a payer-provider. Price residuals are obtained by equation (1), which removes variation in prices due to differences in observable patient severity and year-specific hospital effects.

WellCare negotiates a price of $11,766 (73 percent discount) on average while Harvard Pilgrim Health Care negotiates an average price of $27,786 (39 percent discount). Figure 4 presents a histogram of the mean risk- and hospital-adjusted price residuals for all insurers in the data for the 10 most common MS-DRGs. Here, it is clear that, when comparing all 60 insurers, there is relatively large variation in average negotiated price across insurers. For the 20 most common

Table 6: Pearson Correlation in Mean Inpatient Risk-Adj. Price Residuals between Private (under 65) Payers (*Observations at MS-DRG-provider-payer level*)

	Insurer A	Insurer B	Insurer C	Insurer D
Insurer B	0.54***			
Insurer C	0.49***	0.43***		
Insurer D	0.40***	0.33***	0.60***	
Insurer E	0.01	0.48***	0.45***	0.10

Notes: *p<0.1; **p<0.05; ***p<0.01. The p-values are reported for a two-tailed test. A unit of analysis is a MS-DRG-provider-payer. Price residuals are obtained by equation (1), which removes variation in prices due to differences in observable patient severity and year-specific hospital effects. Insurers A-E mask the names of the five largest U.S. private insurers (Aetna, Anthem, Cigna, Humana, and UnitedHealthcare). Includes the 20 most common MS-DRGs.

MS-DRGs, the *between-payer* coefficient of variation ranges from 5 percent to 17 percent, after controlling for enrollee and provider mix, for the five largest insurers. For all 60 insurers studied, the between-payer coefficient of variation ranges from 8 percent to 24 percent. For comparison, the *between-provider* coefficient of variation ranges from 24 percent to 48 percent.

Overall, Table 5 suggests that the prices negotiated by national insurers tend to be relatively similar on average, after controlling for hospital and enrollee mix (although this is not the case for regional insurers). However, this does not necessarily imply that these large insurers are getting similar discounts at each hospital, only that the discounts *on average* are relatively similar. To examine the within-hospital variation in payments across insurers, we compare insurers' mean risk-adjusted prices at the hospital level.

Table 6 presents the bivariate correlations between the mean risk-adjusted prices negotiated by the five largest national insurers—Aetna, Anthem, Cigna, Humana, and UnitedHealthcare—for a specific MS-DRG at a given provider. Included are the 20 most common MS-DRGs for privately-insured patients between ages 18 and 65. Note again that here we use the price residuals obtained from equation (1) rather than the residuals linearly-transformed by the mean price for each MS-DRG from (2), allowing for the correlations to not be affected by differences in the mean price level of each of the MS-DRGs. The correlations in risk-adjusted price residuals for the bivariate comparisons between the five largest insurers range from 0.01 to 0.60. These results are also presented for specific MS-DRGs in Appendix Table 24. The correlation in risk-adjusted prices varies significantly across insurers and across MS-DRGs. For vaginal deliveries without complicating diagnoses, the bivariate correlations between each of the five largest private U.S. insurers range from -0.57 to 0.70. For hip and knee replacements, these correlations range from 0.04 to 0.82. This evidence suggests that, while large insurers tend to negotiate similar prices on average, the prices different large insurers negotiate at any given hospital tend to vary considerably.

4.2.1 Decomposition of Variation in Private Prices

Recently, researchers have found that within-hospital variation in private negotiated prices is high, and speculated that the differences in prices must be driven in no small part by significant differences in insurer-hospital contracts across insurers. However, the extent to which differences in insurer-hospital negotiations explains the variation in within-hospital prices has not previously been measured due to lack of data.

To further investigate the extent to which the variation in prices is explained by variation across private payers at a hospital, we extend the method Cooper et al. (2019) employ to decompose the variation within-markets and within-hospitals. We decompose the variation further to the within-hospital-*payer* level. To examine the variation explained at different levels, we iteratively add various combinations of control variables, and observe the subsequent changes to the R^2. The outcome variable is $p_{i,j,h,t}$, the price of a procedure for patient encounter i, covered by payer j, at hospital h, in year t. Table 7 presents the R^2 from five regressions, each with an additional control included. In column 1, only patient age, an indicator for male, and year-month fixed effects are included. In column 2, we add encounter-specific controls including dummies for each comorbid condition defining the Charlson comorbidity index, length of stay, and a dummy if the MS-DRG indicates a diagnosis with complications or comorbidities (for inpatient procedures only). Column 3 adds year-month-specific provider fixed effects and column 4 adds year-month-specific payer-provider fixed effects. Lastly, in column 5, we include the total charges that the hospital billed for the encounter to further control for the patient-specific amount of care provided at the encounter.

One potential criticism of the analysis thus far is that it examines differences in prices across MS-DRG codes, rather than specific procedures. There may be multiple different services provided within an MS-DRG. For instance, the MS-DRG code 471 includes both hip and knee joint replacements. Thus, here we look at specific high-volume procedures as defined by ICD-9 procedure and diagnosis codes. This restricts the sample to only encounters occurring prior to October 1, 2015 to avoid differences in coding resulting from the switch to ICD-10 codes. Using ICD-9 codes also allows for an analysis of both inpatient and outpatient prices, whereas MS-DRGs only classify inpatient visits.

As shown in column 1 of Table 7, we find that patient characteristics explain very little of the differences in prices for each procedure. Adding the encounter-specific controls for length of stay, comorbidities, and complications has varying effects on R^2 across procedures. For colonoscopies, adding these controls results in an R^2 of 0.519, while for knee replacements, the R^2 only rises to 0.074. For outpatient procedures, as one would expect, these controls explain very little variation. The addition of month-specific provider fixed effects raises the R^2 to between 0.492 (cesarean section) and 0.770 (colonoscopy) for inpatient procedures and to between 0.304 (routine medical examination) and 0.444 (screening mammogram) for outpatient procedures.

Table 7: Decomposition of Private-Payer Health Care Prices

	R^2					Percent of variance unexplained within payer-provider-month	Num. Obs.	Within payer-provider-month CV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inpatient Procedures								
Colonoscopy	0.039	0.519	0.770	0.855	0.876	0.124	26,944	0.264
Manually Assisted Delivery NEC	0.074	0.139	0.495	0.707	0.714	0.286	87,166	0.206
Low Cervical C-Section	0.069	0.169	0.492	0.727	0.730	0.270	86,836	0.203
Total Knee Replacement	0.065	0.074	0.602	0.828	0.869	0.131	23,535	0.151
Total Hip Replacement	0.071	0.078	0.686	0.916	0.922	0.078	12,785	0.119
Packed Cell Transfusion	0.012	0.400	0.670	0.843	0.869	0.131	14,337	0.536
PTCA or Coronary Atherectomy	0.054	0.153	0.528	0.814	0.840	0.160	20,549	0.257
Outpatient Diagnoses/Procedures								
Routine Medical Examination	0.004	0.005	0.304	0.490	0.698	0.302	176,552	0.507
Screening Mammogram NEC	0.017	0.018	0.444	0.647	0.726	0.274	756,366	0.220
Routine Gynecological Examination	0.039	0.044	0.309	0.477	0.709	0.291	137,502	0.474
Screening Malignant Neoplasm-Cervix	0.082	0.083	0.349	0.469	0.722	0.278	126,601	0.412
Patient characteristics	Yes	Yes	Yes	Yes	Yes			
Encounter controls	No	Yes	Yes	Yes	Yes			
Provider-month fixed effects	No	No	Yes	—	—			
Payer-provider-month fixed effects	No	No	No	Yes	Yes			
Control for charges	No	No	No	No	Yes			

Notes: Columns 1-5 report the R^2 of OLS regressions in which the outcome variable is an insurer's negotiated price and the independent variables are specified in the lower rows. A unit of observation is a patient encounter. All regressions include month-year dummies. Patient characteristics include age and gender. Encounter controls include dummies for each Charlson comorbid condition, length of stay, and a dummy if the MS-DRG indicates CC or MCC (for inpatient procedures only) to further adjust for any complications or comorbidities. Column 6 = 1 − column 5. Column 8 presents the within-payer-provider-month coefficient of variation, averaged across payer-provider-months.

At the within-hospital level, Cooper et al. (2019) find overall lower variation than we find here. For instance, for a knee replacement, they find 27 percent of variation is unexplained. In contrast, we find that, at the within-hospital level, 40 percent of price variation is still unexplained. There are two potential differences in our analyses that could explain this discrepancy. First, Cooper et al. also include a control for plan type (HMO, PPO, etc.), which is not observable in the AHUD data. However, this explanation is unlikely as Cooper et al. find that plan type only accounts for around 3 percent of variation in prices. Second, Cooper et al. use the HCCI data, which includes claims from three large, national insurers: UnitedHealthcare, Aetna, and Humana. In contrast, we study 60 insurers, many of which are regional or statewide insurance firms. Thus, the most plausible explanation for the discrepancy between our findings and those of Cooper et al. is the differences in insurers. Indeed, we found above that smaller payers exhibit significantly more variation in negotiated prices. When we restrict our analysis to only include UnitedHealthcare, Aetna, and Humana, our results for the within-hospital level are similar to Cooper et al. When we observe encounters covered by all 60 insurers, the percent of within-hospital variation unexplained increases from roughly 17-36 percent (for only the HCCI insurers) to 23-51 percent for the seven inpatient procedures studied. Thus, Cooper et al.'s estimates report within-hospital variation for three large insurers. The variation for a broader set of insurers at the hospital level is substantially higher than they estimate.

The addition of the month-specific provider-payer fixed effects in column 4 is the novel component of this analysis. Prior studies could not decompose to this level as the data did not allow for identification of individual payers. Decomposing to the provider-payer-month level leaves very little unexplained variation for most inpatient procedures. For hip replacements, only 8 percent of the variation in prices at this level is left unexplained. However, for cesarean sections and manually-assisted deliveries, 27 percent and 29 percent of variation remain unexplained within a payer-provider-month, respectively, after controlling for patient characteristics and patient severity. For outpatient procedures, even more variation is left unexplained at the payer-provider-month level.

Overall, this finding confirms anecdotal reports that the majority of within-hospital variation in prices can be attributed to differences in prices across insurers. For some procedures, there still remains a relatively large amount of variation unexplained within a payer-provider-month. This variation could potentially be explained by measurement error, contract negotiations that are updated in the middle of a month, or by fee-for-service or outlier payments that are not based on observable patient severity.

In column 5, we add total charges as a control variable, which leaves 8 to 29 percent of variation unexplained for inpatient procedures and 27 to 30 percent of variation unexplained for outpatient procedures. The minimal effect of the addition of total charges underscores the lack of correlation between billed charges and the transaction price that insurers pay for inpatient care. For outpatient care, however, including the charges as an independent variable has a sizable influence on the R^2.

This suggests that outpatient visits are more likely to be reimbursed as a share of charges for any services rendered during the visit.

5 Monopsony Power and Hospital-Insurer Bargaining

The sizable cross-payer variation in prices at the same hospital for the same procedure may be attributable to differences in leverage in hospital-insurer negotiations. In this section, we examine the relationship between insurer market power and the contracts that insurers negotiate with providers. There are two plausible effects of market power on hospital-insurer negotiations: increased insurer market share may lead to (1) lower negotiated prices and (2) different payment systems that are favorable to insurers. To examine the relationship between insurer market share and negotiated prices, we employ the following specification:

$$\ln(p_{i,d,j,h,t}) = \alpha share_{j,h,t} + \mathbf{X}_i\beta + \delta_d + \gamma_h + \tau_t + \epsilon_{i,d,j,h,t} \tag{3}$$

where $p_{i,d,j,h,t}$ is the negotiated inpatient price for patient encounter i, with MS-DRG d, insured by payer j, at hospital h, in year t. The market share of insurer j at hospital h in year t is measured by $share_{j,h,t}$, and α is the coefficient of interest. $\mathbf{X}_i$ is a vector of patient-encounter characteristics including age, an indicator for male, length of stay, and indicators for the 17 comorbidities defining the Charlson comorbidity index. δ_d, γ_h, and τ_t are MS-DRG, hospital, and year fixed effects, respectively. The sample for this analysis includes all privately-insured patient encounters for the 20 most common MS-DRGs for patients between 18 and 65 years old. The results from this main regression are presented in column 4 of Table 8 Panel A. In addition, as a sensitivity analysis, we also run a version of the regression where the outcome is the risk-adjusted price, as estimated in Section 4. In this specification, $\mathbf{X}_i$ is omitted from the equation, given it is controlled for in the risk-adjustment. The results for this specification are presented in column 4 of Table 8 Panel B. One potential criticism of this approach is that it does not capture the actual procedures being provided, only the diagnosis as defined by the MS-DRG. Thus, we also run the aforementioned specifications with the inclusion of ICD-9/10 code fixed effects rather than MS-DRG fixed effects.[9] The results for these regressions are presented in Appendix Table 25.

Given the lack of transparency surrounding negotiated prices, it is difficult to know what type of reimbursements payers are negotiating with providers. The second effect of increased market share may be that insurers are able to adopt prospective payment systems, similar to that of Medicare, rather than paying a percentage of the hospital's charges. Under a prospective payment contract structure, insurers reimburse based on the expected costs for clinically defined episodes of care, typically some form of a DRG classification system for inpatient claims. When an insurer pays a share of hospital charges, all of the risks of the varying level of intensity of care fall on the insurer.

[9] There are 3,191 ICD 9/10 codes corresponding to the 20 MS-DRGs used in the analysis.

In contrast, under prospective payment, insurers share the risk with providers by agreeing to pay a predetermined payment for a given diagnosis, regardless of the intensity of care. Thus, while risk-averse insurers may prefer prospective payments, hospitals may prefer fee-for-service and only agree to prospective payments when the insurers have significant leverage.

The extent to which private insurers use prospective payment systems has long remained a mystery, given the lack of available data. Recently, with the availability of new data sources, such as the HCCI data, researchers have begun studying the structure of private insurer payments. Burns and Pauly (2018) find a low prevalence of prospective payment models, and Baker et al. (2019) find that commercial insurance payments are less prospective than Medicare payments. Clemens and Gottlieb (2017) and Clemens, Gottlieb, and Molnár (2017) find that BCBS of Texas uses Medicare fee-for-services prices for physician services for simplicity but abandons it when sufficient value is at stake.

To examine the association between insurer market share and type of inpatient payment contract, we estimate the following regression:

$$\ln(s^p_{d,j,h,t}) = \alpha share_{j,h,t} + \delta_d + \gamma_h + \tau_t + \epsilon_{d,j,h,t} \tag{4}$$

where $s^p_{d,j,h,t}$ is the standard deviation of prices for MS-DRG d paid by private insurer j at hospital h in year t. All other variables and parameters retain their meanings from equation (3). The results of this main specification—as well as one where the outcome variable measures s^p rather than its natural logarithm—are presented in Table 8 Panel C.

In Table 8, we find a strong inverse relationship between insurer market share and negotiated inpatient prices. When the outcome variable is log negotiated price, a 10 percent increase in market share is associated with a 6 ($= 10 \cdot 100[e^{0.006} - 1]$) percent decrease in negotiated prices. When the outcome variable is log risk-adjusted negotiated price, a 10 percent increase in market share is associated with a 7 percent decrease in price. Both of these point estimates are statistically significant at the 1 percent level. Additionally, Panel C shows that a 10 percent increase in insurer market share is associated with a 10 percent decrease in the standard deviation of prices paid by the insurer. This finding is also significant at the 1 percent level. This suggests that, when an insurer has more bargaining power, they are able to offload some of their financial risk to hospitals for inpatient care.

The findings presented here on the relationship between insurer market share and prices are consistent with prior studies examining single-state all-payer databases. There is a relatively large body of research that finds larger insurers are able to negotiate greater discounts from hospitals.[10] However, the only other paper to study the association between insurer market share and the type of payment contract is Cooper et al. (2019), which uses the collective share of Aetna, UnitedHealthcare, and Humana as a measure of insurer market share, rather than the market shares of

[10] For a review of this literature, see Gaynor and Town (2011).

Table 8: Relationship between Insurer's Market Share and Insurer-Hospital Bargaining

	Dependent variable:			
	Price		**log(Price)**	
Panel A	(1)	(2)	(3)	(4)
Insurer's Market Share	−66.351***	−78.837***	−0.004**	−0.006***
	(19.229)	(19.873)	(0.002)	(0.002)
Age	−3.606	1.163	0.003***	0.003***
	(7.532)	(3.860)	(0.001)	(0.0004)
Male	216.455***	185.848***	0.005	0.002
	(69.228)	(62.471)	(0.004)	(0.004)
Length of Stay	1,253.091***	1,244.524***	0.065***	0.063***
	(158.958)	(159.959)	(0.007)	(0.007)
Charlson comorbidity dummies	Yes	Yes	Yes	Yes
MS-DRG fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Provider fixed effects	No	Yes	No	Yes
Observations	526,663	526,663	526,663	526,663
R^2	0.461	0.505	0.505	0.592
Adjusted R^2	0.461	0.505	0.505	0.592
	Dependent variable:			
Panel B	**Risk-Adj. Price**		**log(Risk-Adj. Price)**	
Insurer's Market Share	−67.531***	−79.830***	−0.005***	−0.007***
	(18.873)	(19.458)	(0.002)	(0.002)
MS-DRG fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Provider fixed effects	No	Yes	No	Yes
Observations	526,663	526,663	518,038	518,038
R^2	0.408	0.457	0.467	0.564
Adjusted R^2	0.408	0.457	0.467	0.563
	Dependent variable:			
Panel C	**Std. Dev. of Price**		**log(Std. Dev. of Price)**	
Insurer's Market Share	−63.904**	−67.098***	−0.011***	−0.010***
	(28.438)	(17.495)	(0.004)	(0.003)
Year fixed effects	Yes	Yes	Yes	Yes
MS-DRG fixed effects	Yes	Yes	Yes	Yes
Provider fixed effects	No	Yes	No	Yes
Observations	4,460	4,460	4,460	4,460
R^2	0.166	0.261	0.354	0.615
Adjusted R^2	0.162	0.223	0.351	0.595

Notes: *p<0.1; **p<0.05; ***p<0.01
OLS regression results for equations (3) and (4). For Panels A and B, a unit of observation is an inpatient admission. For Panel C, a unit of observation is a MS-DRG-payer-provider-year.

individual insurers. Our findings are consistent with Cooper et al. and show that the association does not exist only for the three large insurers and for employer-sponsored insurance, but also across private plans from many insurers.

On the other side of the market, there is more evidence that provider market share is associated with higher prices and more contracts in which prices are paid as a share of charges. Town, Feldman, and Kralewski (2011) examine physician groups that were in the network for one of Minnesota Blue Cross's plans and find that the share of revenue from capitation is positively associated with physicians' self-reported assessments of their market power. Using the HCCI data, Baker et al. (2019) find that differences in prospective payment across hospitals are positively associated with the extent of hospital competition.

An important limitation of this analysis is that it does not control for differences in the makeup and competitiveness of the other side of the hospital-insurer market. Unfortunately, since the AHUD data cannot be linked to external data on hospitals, there is no way to include more information on providers (e.g., hospital market share or metrics of hospital quality). However, the inclusion of provider fixed effects, as in equations (3) and (4), should control for any differences across hospitals, including hospital market share.

The link between insurer market share and negotiated prices presented here is a correlation; nevertheless the results suggest that insurers may be able to leverage higher market consolidation to improve their position in hospital-insurer bargaining.

6 Conclusion

In this paper, we document the variation in payments across public and private payers. For all MS-DRGs studied, on average, private (under 65) payers pay significantly more than Medicare Advantage payers and traditional Medicare, which both pay substantially more than Medicaid. Large, national MA insurers reimburse at a rate similar to TM, while smaller, regional MA insurers tend to pay more than TM. Both private and Medicaid prices vary much more than MA and TM prices for a given diagnosis. The distribution of Medicare Advantage payments mirrors that of traditional Medicare, though Medicare Advantage plans tend to pay more on average. Most notably, this paper provides, for the first time, a look at variation in negotiated prices across private payers at the national level. Average negotiated prices paid by the largest national insurers do not vary much, but average negotiated prices paid by smaller, regional insurers vary substantially. Further, while average prices for large insurers are similar, within a given hospital, the prices paid by these large insurers vary considerably. For vaginal deliveries, the bivariate correlations between each of the five largest private U.S. insurance companies range from -0.57 to 0.70. For hip and knee replacements, these correlations range from 0.04 to 0.82. Lastly, we find an inverse relationship between insurer market share and negotiated prices. A 10 percent increase in insurer market share is associated with a 7 percent decrease in negotiated prices. Additionally, a 10 percent increase in

insurer market share is associated with a 10 percent decrease in the standard deviation of negotiated prices at a provider. This suggests that insurers with greater market share are able to negotiate favorable payment structures that offload financial risk to the providers.

A Detailed Descriptive Statistics for AHUD Data

Table 9: Charlson Comorbidity Index by Payer and Patient Type

		Charlson Index	
Patient Type	Payer	Mean	Std. Dev.
Inpatient	Medicaid	0.730	1.593
	Medicare	2.208	2.175
	Medicare Advantage	2.096	2.174
	Private	0.704	1.558
Outpatient	Medicaid	0.195	0.728
	Medicare	0.438	1.080
	Medicare Advantage	0.405	1.061
	Private	0.179	0.738

A.1 Summary Statistics by State

Table 10: Summary Statistics by State - All Patients

	Number			Mean				
State	Visits	Patients	Providers	Age	Length of Stay	Payment	Urban	CCR*
TX	27,509,533	7,980,364	56	43.65	2.06	1,645.13	0.90	0.26
VA	25,632,352	6,552,306	30	49.70	3.02	1,280.25	0.93	0.25
NC	24,596,382	5,634,027	34	47.94	2.67	2,078.34	0.89	0.27
CA	20,726,620	6,551,277	44	43.76	3.26	2,395.55	0.96	0.20
GA	19,885,480	5,634,430	21	48.47	4.06	1,823.33	0.84	0.23
FL	16,091,559	5,610,300	32	47.18	2.65	2,376.17	0.98	0.21
SC	14,812,639	3,608,239	20	46.25	2.87	1,795.21	0.86	0.25
WA	14,639,697	3,297,106	12	48.53	2.04	1,279.48	1.00	0.32
PA	12,944,454	3,042,214	16	53.96	2.58	1,464.17	1.00	0.22
NJ	12,915,384	2,916,555	13	48.13	4.01	2,194.67	0.99	0.18
LA	12,578,527	3,274,394	14	48.58	2.19	1,198.30	1.00	0.27
OH	10,200,204	2,365,651	18	50.69	3.42	1,633.59	1.00	0.26
IN	8,773,689	1,493,333	17	51.02	2.13	2,051.81	0.91	0.27
MI	8,260,455	2,279,119	8	47.51	1.30	528.68	0.22	0.38
TN	7,502,752	1,683,218	7	46.70	2.40	2,304.89	0.82	0.26
NY	6,133,303	1,305,587	7	49.76	1.96	1,014.37	1.00	0.27
CT	5,870,907	1,419,052	6	47.79	1.49	1,437.24	1.00	0.24
MO	5,518,023	1,081,677	5	52.92	1.97	3,406.57	0.87	0.28
KY	5,423,821	1,849,116	9	46.75	1.96	NA	0.94	0.24
OK	5,160,937	1,915,902	18	48.93	2.71	2,070.81	0.85	0.25
AL	5,094,017	1,270,015	7	49.29	2.41	1,252.85	0.99	0.23
MA	4,790,115	937,566	7	52.23	2.02	1,043.45	1.00	0.40
AZ	4,482,249	1,014,600	5	39.25	2.04	4,731.86	1.00	0.25
NH	4,424,105	543,252	3	53.39	3.07	NA	0.21	0.34
NE	3,776,924	2,166,965	7	49.55	2.32	1,875.79	1.00	0.26
IL	3,698,031	1,173,964	9	45.95	2.78	1,303.32	1.00	0.27
OR	2,948,598	1,107,718	8	48.84	2.33	1,744.43	0.91	0.34
KS	1,480,557	511,152	5	44.92	2.76	2,375.73	0.51	0.25
WV	1,285,329	152,208	1	52.65	1.91	961.02	1.00	0.42
MT	1,106,127	296,910	3	52.10	3.30	16,885.74	1.00	0.34
AR	1,100,146	322,217	2	48.30	1.96	1,651.93	1.00	0.21
IA	909,221	591,846	2	51.25	2.38	934.67	1.00	0.28
MN	908,300	328,904	3	49.85	2.77	1,428.53	0.84	0.32
NM	712,184	171,657	2	54.31	5.11	1,149.78	1.00	0.28
MS	695,196	195,180	1	36.51	2.01	NA	1.00	0.27
ME	491,243	117,252	1	56.35	2.48	834.84	1.00	0.53
NV	274,089	126,014	1	49.90	2.87	2,537.92	1.00	0.21
WY	207,257	47,836	1	49.16	1.87	NA	0.00	0.43

* CCR stands for cost-to-charge ratio for a hospital.

Table 11: Summary Statistics by State - Traditional Medicare Patients

	Number			Mean				
State	Visits	Patients	Providers	Age	Length of Stay	Payment	Urban	CCR*
CA	4,306,843	848,852	39	71.85	2.77	2,308.38	0.95	0.19
VA	3,337,721	800,606	26	72.12	2.42	825.55	1.00	0.25
NC	3,153,617	552,685	12	68.55	2.25	1,872.77	0.98	0.27
GA	3,098,593	581,515	14	70.44	4.34	1,411.82	0.95	0.23
TX	2,622,324	580,260	50	66.46	2.77	2,069.22	0.80	0.25
NJ	2,572,981	433,559	11	72.12	3.59	2,069.30	0.99	0.17
FL	1,998,556	546,865	19	72.09	3.44	2,163.22	1.00	0.21
IN	1,622,036	194,627	14	71.23	1.70	1,266.14	0.88	0.27
PA	1,550,145	313,796	12	71.99	2.54	1,534.24	1.00	0.25
LA	1,485,871	286,870	10	69.90	1.69	1,029.64	1.00	0.25
OK	1,427,908	420,534	18	68.64	3.02	2,156.98	0.79	0.26
SC	1,421,897	242,682	11	67.15	2.02	1,459.91	0.95	0.28
OH	1,145,718	214,937	11	68.81	2.99	1,533.45	1.00	0.26
MA	1,094,531	162,106	7	70.49	2.19	1,287.64	1.00	0.40
NY	710,547	91,037	6	72.49	2.38	961.97	1.00	0.30
NE	565,511	466,980	6	71.96	2.61	1,400.27	1.00	0.29
WA	541,558	107,379	3	73.65	2.94	1,119.23	1.00	0.28
WV	410,880	33,851	1	72.18	1.90	963.54	1.00	0.42
MI	381,892	212,423	6	69.76	1.43	388.21	0.33	0.39
AR	345,453	63,289	2	71.08	2.19	1,403.75	1.00	0.21
AL	339,718	61,048	2	69.06	2.13	1,686.07	1.00	0.22
CT	301,650	62,764	4	73.76	2.18	1,131.73	1.00	0.23
OR	286,912	70,704	5	69.78	2.78	1,678.54	1.00	0.35
IA	230,624	183,507	1	71.10	2.25	809.79	1.00	0.30
IL	228,922	57,764	8	66.89	2.91	1,712.24	1.00	0.34
ME	218,288	31,213	1	68.52	2.54	550.50	1.00	0.53
TN	179,900	66,025	5	68.80	4.95	2,855.05	1.00	0.28
AZ	147,842	40,676	1	73.50	2.27	2,848.37	1.00	0.37
NH	137,583	20,809	2	71.63	1.47	NA	0.00	0.33
KY	135,376	59,340	5	68.11	2.46	NA	0.83	0.21
NV	72,408	27,937	1	69.41	3.15	2,842.18	1.00	0.21
MO	70,666	23,434	1	68.54	2.28	3,354.67	1.00	0.18
KS	45,355	11,711	1	72.25	3.26	2,497.21	0.00	0.29
NM	25,454	9,244	2	68.91	2.23	872.71	1.00	0.23
MT	20,941	11,340	2	71.87	3.61	8,874.65	1.00	0.32
MN	10,000	3,720	2	71.74	2.31	1,310.00	1.00	0.25

* CCR stands for cost-to-charge ratio for a hospital.

Table 12: Summary Statistics by State - Medicare Advantage Patients

	Number			Mean				
State	Visits	Patients	Providers	Age	Length of Stay	Payment	Urban	CCR*
PA	1,457,931	235,043	15	75.60	3.12	1,409.56	1.00	0.24
LA	1,166,894	272,299	14	75.39	2.44	1,412.76	1.00	0.26
TX	1,124,732	317,760	53	72.77	2.41	2,222.95	0.81	0.25
OH	801,948	179,538	18	74.51	3.99	1,647.19	1.00	0.25
NC	799,909	206,418	27	73.22	3.23	2,127.23	0.97	0.27
CA	788,914	261,159	41	74.15	3.14	3,453.24	0.87	0.20
VA	777,842	233,296	29	73.28	3.10	1,448.58	0.99	0.24
NJ	718,085	175,719	13	74.95	4.69	2,543.07	1.00	0.18
GA	710,187	206,423	21	72.41	4.00	1,968.62	0.91	0.23
FL	638,386	210,384	27	74.38	3.29	3,603.37	1.00	0.19
MI	524,019	181,208	8	74.56	1.31	572.46	0.33	0.38
IN	422,882	74,942	14	74.04	2.02	1,939.21	0.94	0.27
WA	418,385	106,133	11	72.56	2.48	1,694.03	1.00	0.31
SC	404,963	108,652	19	72.59	3.01	1,804.78	0.85	0.24
MA	398,061	65,834	7	74.84	2.06	1,130.10	1.00	0.39
TN	374,386	87,691	7	72.84	2.41	3,160.68	0.90	0.26
OR	306,190	78,488	6	75.69	2.52	1,757.57	0.92	0.35
CT	236,676	50,506	6	73.00	1.56	1,466.58	1.00	0.23
OK	213,065	69,513	18	73.19	3.16	2,617.95	0.87	0.22
NE	202,792	160,735	7	77.11	2.63	1,742.84	1.00	0.28
AL	183,751	45,496	7	72.60	2.59	1,567.33	1.00	0.23
KY	178,899	56,518	9	72.60	1.97	NA	0.91	0.24
NY	177,603	26,404	6	75.93	2.22	1,199.98	1.00	0.31
MO	162,217	54,278	4	83.42	1.58	3,321.15	1.00	0.28
IL	123,169	37,718	9	72.87	3.03	1,728.95	1.00	0.28
WV	117,367	12,587	1	74.37	2.13	1,048.64	1.00	0.42
IA	66,963	51,833	2	77.12	2.49	1,015.63	1.00	0.29
AR	63,297	15,429	2	73.45	2.28	1,842.17	1.00	0.21
AZ	42,351	17,283	5	73.37	3.88	6,842.87	1.00	0.29
NM	41,148	10,230	2	73.11	6.34	1,068.58	1.00	0.28
NH	16,730	3,277	3	70.20	1.30	NA	0.94	0.31
ME	14,716	4,285	1	71.98	2.81	1,060.38	1.00	0.53
MN	13,827	4,174	3	75.45	2.91	1,922.81	0.29	0.41
NV	10,563	5,200	1	72.67	3.39	3,373.22	1.00	0.21
KS	7,831	2,973	5	70.20	5.24	3,424.21	0.26	0.26
MT	6,378	3,058	3	72.58	2.14	7,559.98	1.00	0.37
WY	2,075	456	1	75.26	2.21	NA	0.00	0.43

* CCR stands for cost-to-charge ratio for a hospital.

[1] Patients 65 years of age or older with Medicare Advantage plans from the 60 largest insurers in the AHUD data.

Table 13: Summary Statistics by State - Private (under 65) Patients

	Number			Mean				
State	Visits	Patients	Providers	Age	Length of Stay	Payment	Urban	CCR*
GA	6,357,239	2,502,358	21	40.03	3.94	2,585.33	0.92	0.23
TX	5,621,813	2,252,150	54	39.22	1.94	2,612.13	0.87	0.25
CA	5,170,674	2,098,097	42	37.46	2.84	3,327.51	0.93	0.20
NJ	4,699,899	1,549,162	13	33.68	3.19	2,246.59	0.99	0.18
VA	4,324,696	1,728,394	29	39.39	2.47	2,032.16	0.99	0.26
NC	3,872,629	1,191,476	27	40.93	2.61	2,967.23	0.98	0.27
WA	3,694,299	1,096,533	11	40.34	1.75	1,449.76	1.00	0.32
LA	3,591,584	1,240,940	14	42.10	1.96	1,634.91	1.00	0.27
PA	3,198,536	966,338	16	43.77	1.87	1,408.60	1.00	0.24
SC	2,969,462	944,044	20	40.03	2.46	2,504.02	0.89	0.26
OH	2,880,539	986,661	18	43.12	2.82	2,202.99	1.00	0.24
TN	2,666,145	771,431	7	33.96	2.05	2,127.67	0.81	0.27
IN	2,366,744	579,112	14	42.34	1.96	2,897.25	0.95	0.27
FL	2,302,238	1,017,862	28	40.69	2.12	2,795.80	0.98	0.21
MI	2,112,058	746,630	8	39.35	1.20	811.64	0.22	0.38
MA	1,692,891	451,725	7	42.15	1.92	826.22	1.00	0.39
CT	1,664,805	514,826	6	40.52	1.34	1,646.29	1.00	0.24
NE	1,360,423	921,080	7	36.75	2.10	2,316.00	1.00	0.26
OK	1,311,455	611,498	18	42.65	2.38	2,600.89	0.84	0.25
AL	1,243,970	421,811	7	41.29	1.83	871.08	1.00	0.23
IL	1,008,641	398,806	9	40.33	2.14	1,333.99	1.00	0.26
KY	946,827	355,343	9	42.00	1.61	NA	0.99	0.24
MO	825,165	227,263	5	39.54	1.73	3,571.82	0.99	0.27
OR	613,952	291,983	6	38.18	2.23	2,447.68	0.95	0.35
NY	603,712	192,845	6	42.28	1.83	1,259.33	1.00	0.28
AZ	413,922	174,903	5	38.13	2.66	7,196.89	1.00	0.28
WV	357,319	67,061	1	38.99	1.83	1,140.08	1.00	0.42
AR	315,114	131,672	2	38.37	1.98	1,888.21	1.00	0.21
IA	256,372	181,982	2	41.31	2.43	1,170.95	1.00	0.28
NH	247,725	72,037	3	41.14	1.29	NA	0.89	0.32
ME	196,505	71,506	1	42.86	2.35	1,126.91	1.00	0.53
NM	165,045	58,886	2	44.38	4.28	1,820.30	1.00	0.28
KS	142,398	59,909	5	40.18	2.92	2,402.23	0.23	0.26
NV	72,327	42,363	1	39.78	2.53	2,878.49	1.00	0.21
MN	68,338	31,249	3	35.13	3.06	1,333.66	0.43	0.38
MT	61,229	33,266	3	39.94	1.63	9,657.85	1.00	0.38
WY	8,318	3,858	1	33.47	1.58	NA	0.00	0.43

* CCR stands for cost-to-charge ratio for a hospital.

[1] Patients younger than 65 years of age with private plans from the 60 largest insurers in the AHUD data.

Table 14: Summary Statistics by State - Medicaid Patients

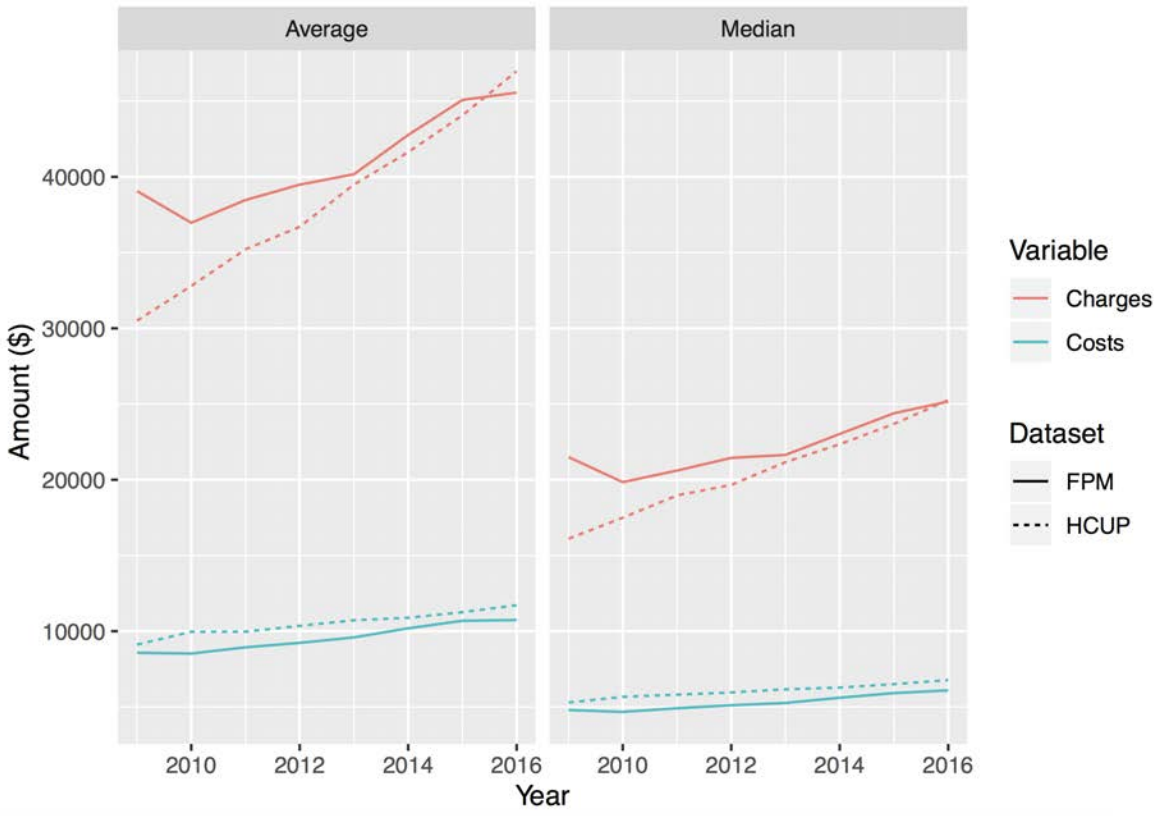
	Number			Mean				
State	Visits	Patients	Providers	Age	Length of Stay	Payment	Urban	CCR*
CA	4,219,974	1,619,940	41	25.46	2.92	1,253.90	1.00	0.20
TX	3,813,730	1,159,642	51	24.76	1.84	738.14	0.88	0.26
NC	2,043,293	556,145	20	24.50	2.44	1,201.66	0.97	0.28
GA	1,731,304	525,317	20	27.08	3.06	1,017.41	0.79	0.24
FL	1,314,472	527,324	24	21.75	1.86	1,143.35	0.99	0.21
LA	1,294,896	469,162	14	24.25	1.92	534.91	1.00	0.27
SC	1,283,144	332,178	16	20.71	3.19	1,435.33	0.89	0.27
MI	1,091,191	378,000	8	24.46	1.39	233.26	0.16	0.38
OH	1,053,661	323,844	17	35.16	2.87	1,088.97	1.00	0.24
OK	1,018,249	428,071	17	24.41	2.39	972.52	0.87	0.24
VA	1,010,273	415,085	30	27.86	2.70	1,082.27	0.94	0.25
WA	944,007	300,868	10	33.19	2.25	786.45	1.00	0.31
IN	753,439	169,575	14	26.77	2.15	1,475.49	0.95	0.27
NJ	718,461	264,517	13	28.53	5.18	1,542.04	0.99	0.18
CT	648,837	191,101	6	33.49	1.52	1,414.51	1.00	0.25
MO	570,070	116,975	5	45.57	1.61	1,410.89	0.82	0.29
AL	518,291	157,436	7	25.89	2.93	1,588.51	1.00	0.23
IL	479,725	183,959	8	27.90	2.89	341.55	1.00	0.33
TN	355,412	77,728	7	25.47	2.31	1,017.68	0.96	0.22
PA	348,831	137,375	16	34.53	2.26	1,877.26	1.00	0.20
NY	288,303	92,077	6	32.29	2.64	585.20	1.00	0.26
MA	280,077	88,804	7	36.34	1.62	762.73	1.00	0.41
NE	276,822	192,030	7	32.80	2.83	1,101.96	1.00	0.24
OR	197,391	96,912	6	36.77	2.06	920.75	0.99	0.35
AR	138,611	53,048	2	20.41	1.61	1,038.99	1.00	0.21
IA	127,853	109,528	2	25.63	1.90	613.26	1.00	0.30
KY	94,615	41,937	8	40.68	2.33	NA	0.99	0.20
WV	81,959	17,793	1	34.62	1.94	500.95	1.00	0.42
NH	61,930	16,744	3	34.27	2.33	NA	0.65	0.33
NM	61,694	24,728	2	29.92	2.23	780.62	1.00	0.25
NV	54,918	23,678	1	33.84	2.59	810.93	1.00	0.21
KS	48,173	19,115	4	31.81	2.65	848.66	0.55	0.25
AZ	42,960	26,384	4	26.47	2.44	4,038.49	1.00	0.28
MT	36,847	15,636	3	23.67	1.96	NA	1.00	0.39
WY	23,104	6,414	1	23.76	1.64	NA	0.00	0.43
MN	17,980	8,386	3	30.73	2.27	795.04	0.52	0.37
MS	982	704	1	14.87	2.01	NA	1.00	0.27
ME	442	302	1	38.76	3.17	2,394.98	1.00	0.53

* CCR stands for cost-to-charge ratio for a hospital.

B Comparison of AHUD Data to Nationally Representative Data

We compare AHUD inpatient data used in this paper to weighted national estimates from the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample, provided by the Agency for Healthcare Research and Quality. The HCUP NIS has roughly 7 million inpatient hospital stays each year, while AHUD has roughly 2-4 million inpatient stays each year. Weighted, the NIS estimates more than 35 million hospitalizations nationally.

Figure 5: Trends in Inpatient Charges and Costs in AHUD and HCUP Data



Notes: Costs are an estimate of the actual costs of providing care. They are estimated by multiplying the charge by cost-to-charge ratios from CMS hospital cost reports. Charges are what the hospital bills for its services, before adjusting for negotiated discounts and other contractual adjustments. The HCUP data do not contain information on actual payments hospitals receive after these discounts so there is no way to compare the actual price data from the AHUD data set.

Table 15: Comparison of AHUD and HCUP Inpatient Data, 2016

	Percent		
	AHUD	HCUP	Difference
Patient Age			
Age <1	11.49	11.82	-0.33
Age 1-17	3.94	3.54	0.4
Age 18-44	25.24	24.41	0.83
Age 45-64	24.67	24.62	0.05
Age 65-84	26.64	27.63	-0.99
Age >85	7.93	7.96	-0.03
Unknown	0.1	0.02	0.08
Patient Gender			
Male	41.85	43.25	-1.4
Female	58.15	56.69	1.46
Unknown	0.00	0.06	-0.06
Payer*			
Medicare	19.72	39.57	-19.85
Medicaid	11.63	23.1	-11.47
Private	19.19	30.05	-10.86
Self-pay	1.89	4.18	-2.29
Other	23.93	2.97	20.96
Census Division			
East North Central	11.81	15.33	-3.52
East South Central	5.27	6.84	-1.57
Middle Atlantic	7.81	13.87	-6.06
Mountain	2.74	6.23	-3.49
New England	4.01	4.63	-0.62
Pacific	13.5	13.74	-0.24
South Atlantic	29.54	20.6	8.94
West North Central	5.06	6.91	-1.85
West South Central	20.25	11.85	8.4

* For the AHUD data, our method of classifying payers (see Appendix D) leaves 24 percent of inpatient admissions unclassified. This explains the discrepancy between HCUP and AHUD for this metric.

C Variable Construction

In the data, information on payers and insurance plan descriptions is as entered by providers. This entry procedure is not standardized across providers and often is not standardized within providers (e.g., "BCBSMA" and "Mass. BlueCross BlueShield" are both used to describe the same insurer). Below we discuss how we classify public and private payers.

Classifying public payers—Only plans that contained the name "Medicare" or some variant (e.g,. "MCARE") were classified as Medicare plans. Similarly, Medicaid plans were identified from plan names that contained the name "Medicaid" or some variant (e.g., "MCD"). However, the classification of Medicaid plans was more involved than that of Medicare given that most states have their own names for their respective Medicaid and CHIP programs (e.g., the SoonerCare is Oklahoma's Medicaid plan and PeachCare for Kids is Georgia's CHIP plan). We include Medicaid and CHIP plan names for all 38 states in the AHUD data, based on information from the U.S. Department of Health & Human Services (2009), the American Council of Aging (2017), the U.S. Centers for Medicare & Medicaid Services (2020), and from our review of state Medicaid websites. For a list of all Medicaid and CHIP names by state included in the classification see Appendix Table 16.

Classifying private payers—For this analysis, we classify only a subset of the largest health insurance companies. In order to determine the largest private payers, we used data on the market share of insurers in each state from the Kaiser Family Foundation (KFF). The selection mechanism is as follows: insurers with a market share of over 10 percent in either the large-group market or the individual market in each state in the AHUD data which were one of the three largest insurers in that state in 2011. In addition, we include all relevant subsidiaries for each of these insurers (e.g., UniCare, RightCHOICE, Empire Blue Cross Blue Shield, Blue Cross of California, Blue Cross Blue Shield of Georgia, Comp-Care, and CareMore are all subsidiaries of Anthem).[11] Furthermore, we include any other BCBS affiliated company (e.g., BCBS's Federal Employee Program). This resulted in a total of 60 insurance firms. For a complete list of private insurers and their subsidiaries included in the analysis, see Appendix Table 17. The distinction between Medicare Advantage plans and other private plans is made by simply classifying private plans as Medicare Advantage if the patient's age at the time of the encounter is 65 or older and as a standard private plan otherwise. This procedure introduces a misclassificaiton error that will tend to reduce measured differences between private and public plans. For more information on the procedure of classifying private insurers, see Appendix D.

Charlson comorbidity index—To classify comorbidities, we rely on the methodology described in Quan et al. (2005). Quan et al. define an "Enhanced ICD-9" coding scheme for deriving Charlson comorbidities from ICD-9 billing codes. We implement the computation of both Enhanced ICD-9

[11] Relevant subsidiaries are defined as subsidiaries that sold health insurance in the states present in the AHUD data and that were wholly owned by the company between 2009 and 2016 according to U.S. Securities and Exchange Commission Form 10-K filings.

codes (for all diagnoses prior to October 1, 2015) and ICD-10 codes (for all diagnoses starting on October 1, 2015).

D Details on Construction of Payer Variables

In order to classify the payer for each patient encounter, we account for a certain degree of human error or other variation in the hospital's identification of the insurance plan names. To do so, we include multiple variations of an insurer's name. As an example, let us consider the insurance firm GuideWell and its subsidiary, Blue Cross and Blue Shield of Florida (also operating under the name Florida Blue). We classify any patient encounter as being covered by GuideWell if the insurance plan name or payer name entered by the hospital contains any of the following phrases: "GUIDEWELL"; "GUIDE WELL"; "GUIDE-WELL"; ("FLORIDA" or "FL") and ("BLUE", "BCBS", "BC BS", or "BC AND BS"). Note that the classification of insurance firms is case insensitive.

D.1 Public Payers

Table 16: Included State Public Plan Names

State	Medicaid Plans	CHIP Plans
Alabama	Medicaid	Alabama ALL Kids
Arizona	Arizona Health Care Cost Containment System (AHCCCS)	AHCCCS-KidsCare
Arkansas	Medicaid TEFRA	ARKids First
California	Medi-Cal	Medi-Cal
Connecticut	HUSKY Health	HUSKY B
Florida	Statewide Medicaid Managed Care Program	Florida KidCare
Georgia	Medical Assistance	PeachCare for Kids
Illinois	Medical Assistance	Illinois All Kids
Indiana	Hoosier Healthwise Hoosier Care Connects M.E.D. Works Health Indiana Plan (HIP)	Hoosier Healthwise Package C
Iowa	IA Health Link MediPASS	Healthy and Well Kids in Iowa (Hawk-I)
Kansas	KanCare Medical Assistance Program HealthWave	CHIP
Kentucky	KYHealth Choices KYMMIS	Kentucky Children's Health Insurance Program (KCHIP)

Louisiana	HealthyLouisiana Bayou Health	Louisiana Children's Health Insurance Program (LaCHIP)
Maine	MaineCare	CubCare
Massachusetts	MassHealth	MassHealth
Michigan	MI Choice Michigan Dept. of Health and Human Services	Michigan MIChild
Minnesota	MinnesotaCare	CHIP
Mississippi	Mississippi Coordinated Access Network (MississippiCAN)	CHIP
Missouri	MO HealthNet	MO HealthNet for Kids
Montana		Healthy Montana Kids
Nebraska	ACCESSNebraska	CHIP
Nevada	Medicaid	Nevada Check Up
New Hampshire	Medicaid	Healthy Kids
New Jersey	Medicaid	NJ FamilyCare
New Mexico	Centennial Care	New Mexi-Kids
New York	Medicaid Managed Care	Child Health Plus
North Carolina	Division of Medical Assistance (DMA) Community Care of North Carolina/Carolina Access	Health Choice Health Check
Ohio	Medicaid	Healthy Start
Oklahoma	SoonerCare	SoonerCare Soon-To-Be-Sooners
Oregon	Oregon Health Plan	Oregon Health Plan
Pennsylvania	Medical Assistance	CHIP
South Carolina	Healthy Connections	Healthy Connections Children
Tennessee	TennCare	CoverKids
Texas	STAR Medicaid Managed Care	CHIP TexCare
Virginia	Medicaid	Family Access to Medical Insurance Security (FAMIS)
Washington	Apple Health	Apple Health for Kids
West Virginia	Mountain Health Choices	West Virginia Children's Health Insurance Program (WVCHIP)
Wyoming	EqualityCare	Kid Care CHIP

D.2 Private Payers

Table 17: Included Private Insurers and Subsidiaries

Private Insurance Company	**Included Subsidiaries and Products**[1]
UnitedHealth	TouchPoint Care
	Oxford Health Plans
	PacifiCare
	Sierra Health
	Evercare
	AmeriChoice
	Mid Atlantic Medical Services
	Ovation
	Unison Health Plan
	Arnett HealthPlans
WellPoint/Anthem	UniCare
	RightCHOICE
	Empire Blue Cross Blue Shield
	Blue Cross of California
	Blue Cross Blue Shield of Georgia
	Comp-Care
	CareMore
Aetna	
Cigna	Allegiance
	Great-West Healthcare
Humana	Solicare Health Plans
	CarePlus Health Plans
	Cariten Healthcare
	Emphesys
Centene	Ambetter
	Allwell Health Net
Molina	
WellCare	
Health Care Service Corporation (HCSC)	Blue Cross and Blue Shield of Illinois
	Blue Cross and Blue Shield of New Mexico
	Blue Cross and Blue Shield of Oklahoma
	Blue Cross and Blue Shield of Texas
	Blue Cross and Blue Shield of Montana
HealthSpring	BravoHealth
Coventry	First Health
	Advantra
	Altius Health Plans
	HealthAmerica Pennsylvania
	HealthCare USA of Missouri
	HealthCare USA of Tennessee
	WellPath of South Carolina

Amerigroup	
Kaiser	
EmblemHealth	
Harvard Pilgrim	
Tufts Health Plan	
HealthPartners	
Medica	
PacificSource	
Assurant	
Cambia Health Solutions	Regence
	Asuris Northwest Health
	BridgeSpan Health
	LifeMap
	Blue Cross and Blue Shield of Oregon
	Blue Shield of Idaho
	Blue Shield of Washington
Highmark	Blue Cross of Northeastern Pennsylvania
	Blue Cross and Blue Shield of West Virginia
Blue Cross and Blue Shield of Alabama	
Blue Cross and Blue Shield of Arizona	
Blue Cross and Blue Shield of Arkansas	
QualChoice	
Blue Shield of California	
GuideWell	Florida Blue (Blue Cross and Blue Shield of Florida)
Advantage Health Solutions	
Wellmark BCBS	Blue Cross and Blue Shield of Iowa
Blue Cross and Blue Shield of Kansas City	
Blue Cross and Blue Shield of Kansas	
Louisiana Health Service	Blue Cross and Blue Shield of Louisiana
HealthMarkets	
Blue Cross and Blue Shield of Massachusetts	
Blue Cross and Blue Shield of Minnesota	
Blue Cross and Blue Shield of Michigan	
Henry Ford Health System	Health Alliance Plan (HAP)
Spectrum Health Group	Priority Health
Mississippi Insurance Group	
New West Health Services	
Blue Cross and Blue Shield of Maine	
Horizon Blue Cross Blue Shield of New Jersey	
Aegon	
Presbyterian Health Plan	
Ardent Health Services	
Lifetime Healthcare Companies	Excellus BlueCross BlueShield
	Univera Healthcare
Blue Cross and Blue Shield of North Carolina	
Medical Mutual of OH	

CommunityCare	
Providence	
Independence Blue Cross	Keystone Health Plan East
Capital Blue Cross	Keystone Health Plan Central
Blue Cross and Blue Shield of South Carolina	
Blue Cross and Blue Shield of Tennessee	
Tennessee Rural Health Group	Farm Bureau Health Plans
CareFirst	
Premera Blue Cross	
Blue Cross and Blue Shield of Wyoming	
Blue Cross and Blue Shield Federal	
Blue Cross and Blue Shield (Unclassified)	

[1]Subsidiaries that sold health insurance in the states present in the AHUD data and that were wholly owned by the company between 2009 and 2016 based on SEC Form 10-K filings.

E Additional Tables and Figures

Figure 6: Density Plots for Adjusted Discount by Payer Type and MS-DRG

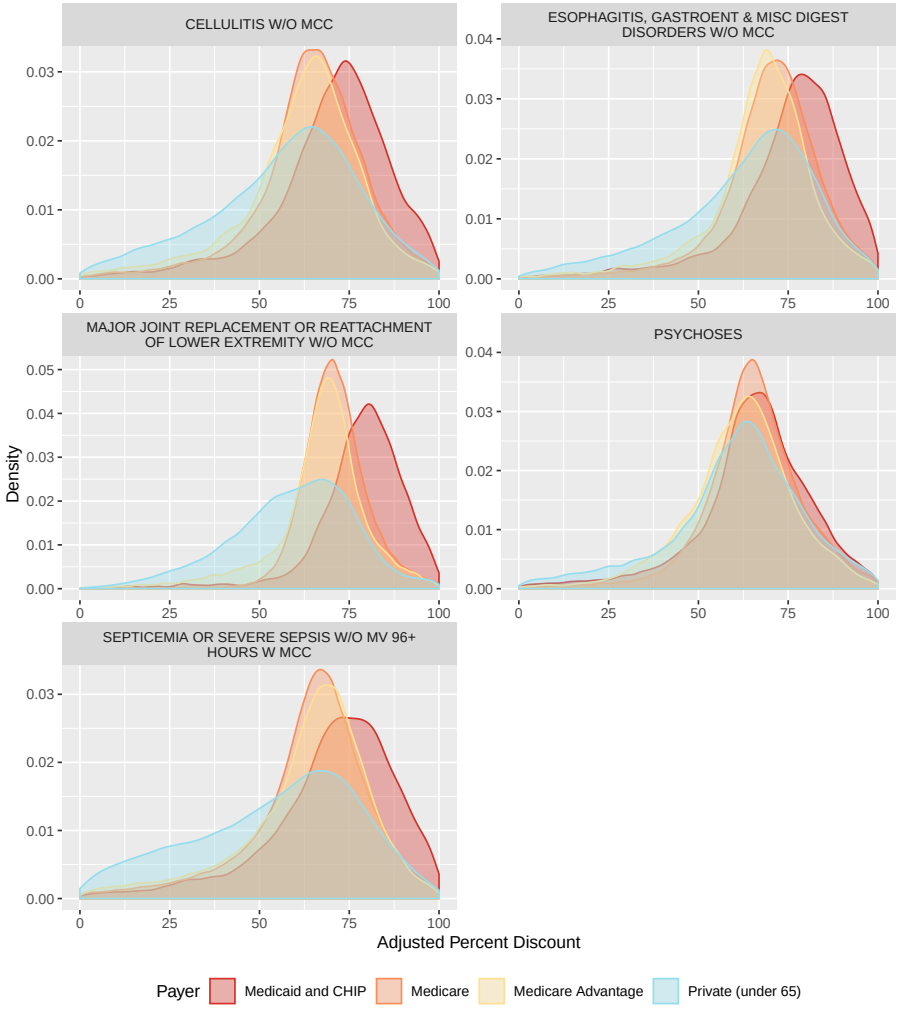


Figure 7: Conditional Density Plots for Adjusted Discount by Payer Type and MS-DRG

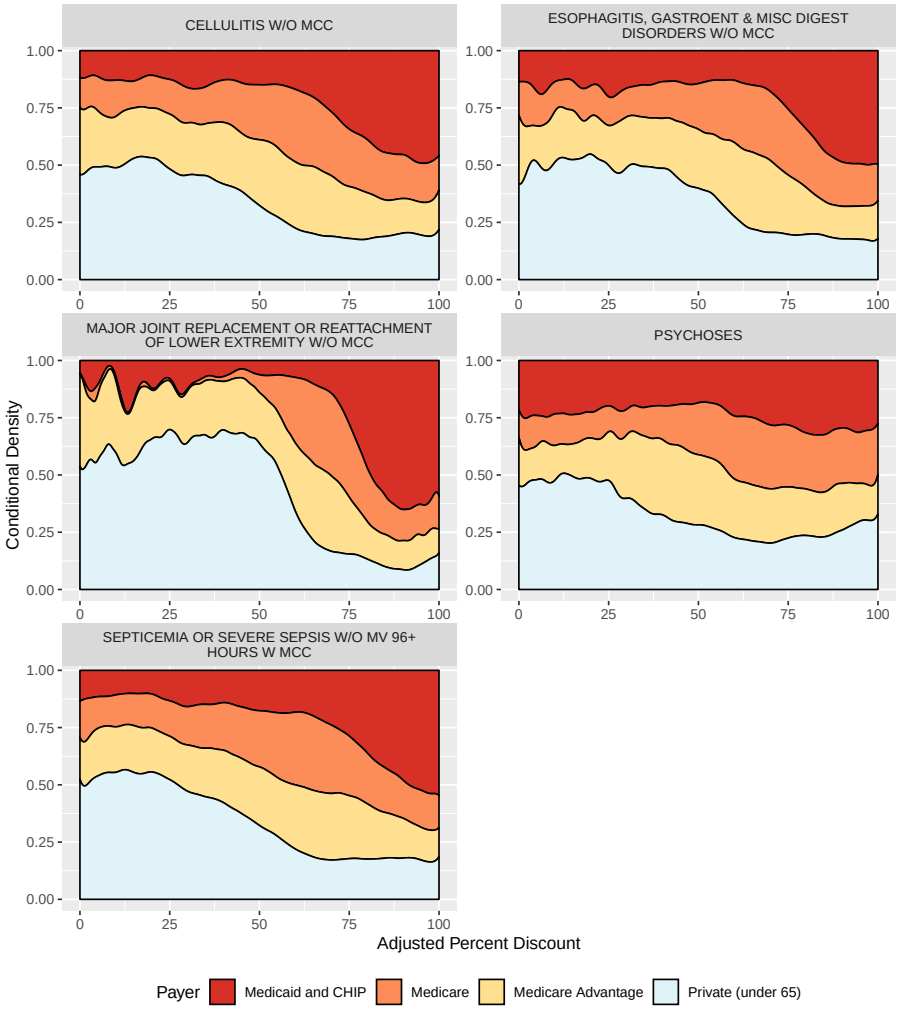


Figure 8: Prices as a Percent of Medicare Reimbursements — *HCCI Insurers*

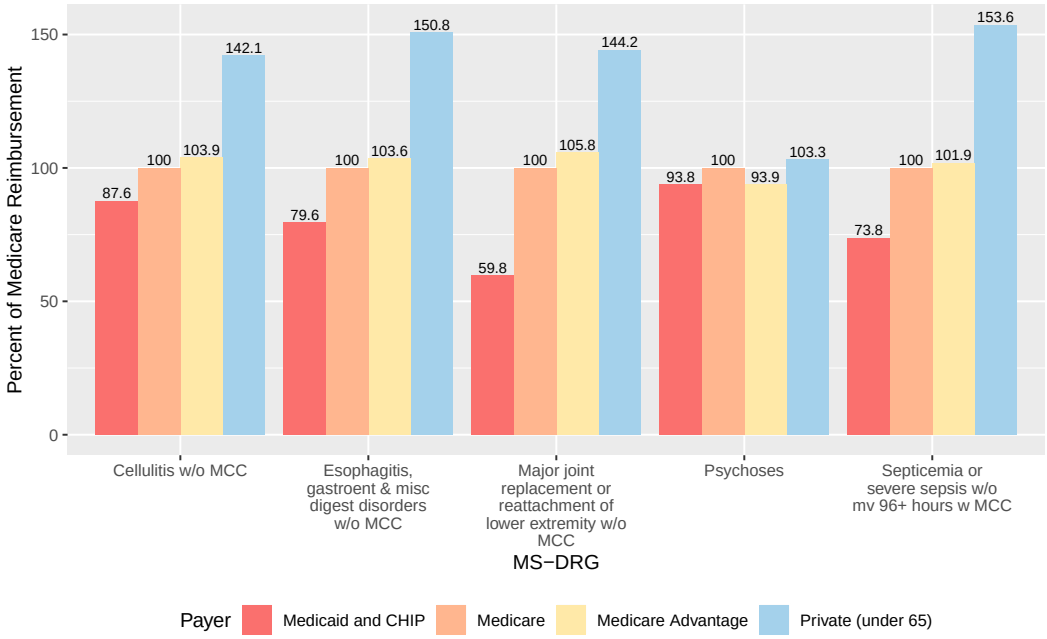


Figure 9: Prices as a Percent of Medicare Reimbursements — *Non-HCCI Insurers*

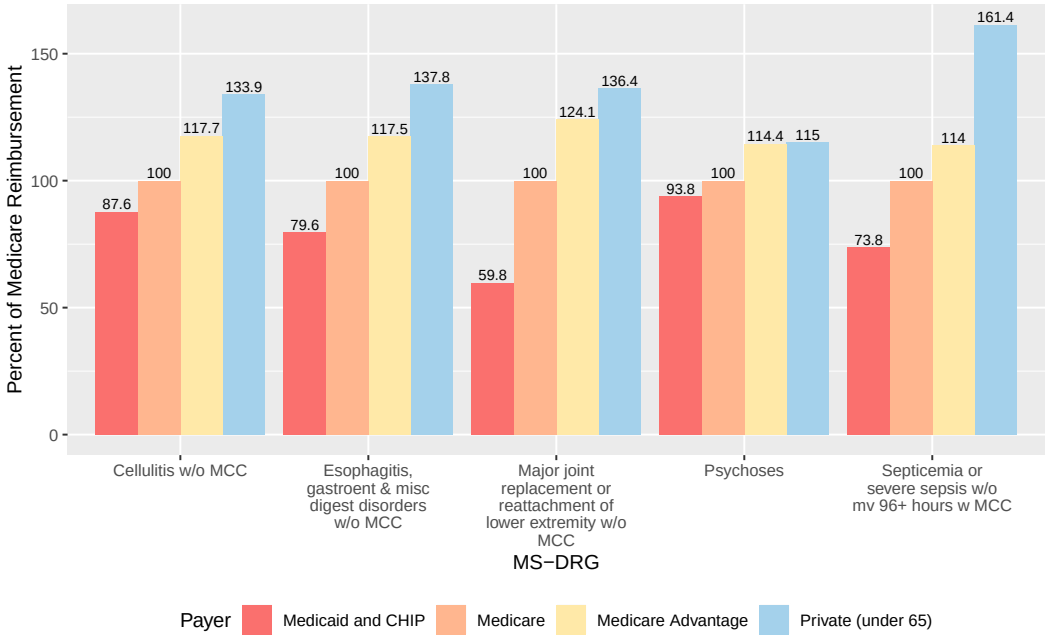


Figure 10: Prices as a Percent of Medicare Reimbursements — *Top 5 Insurers*

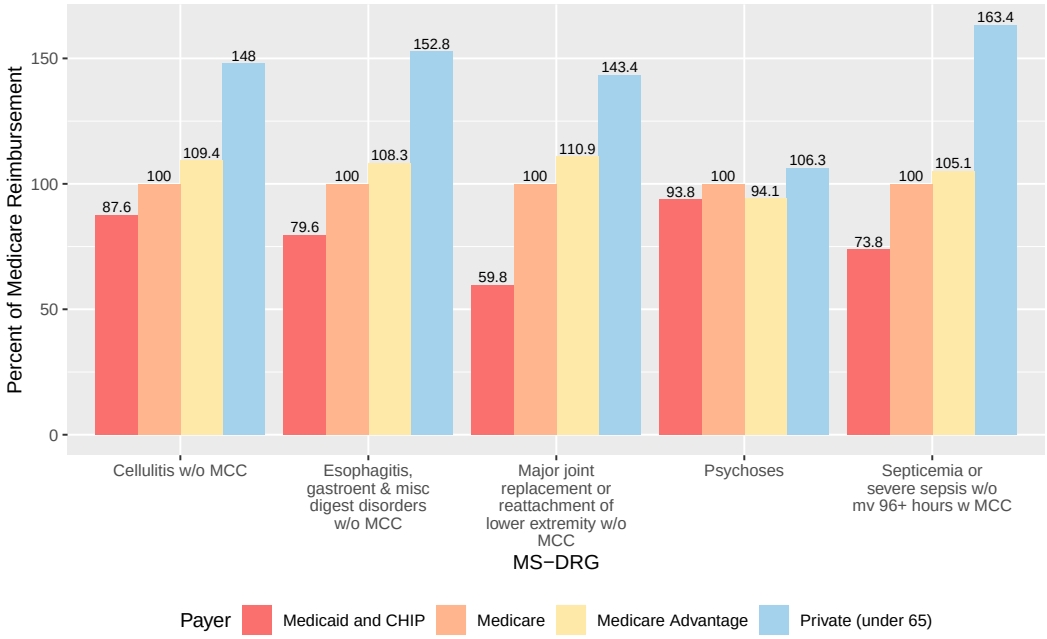
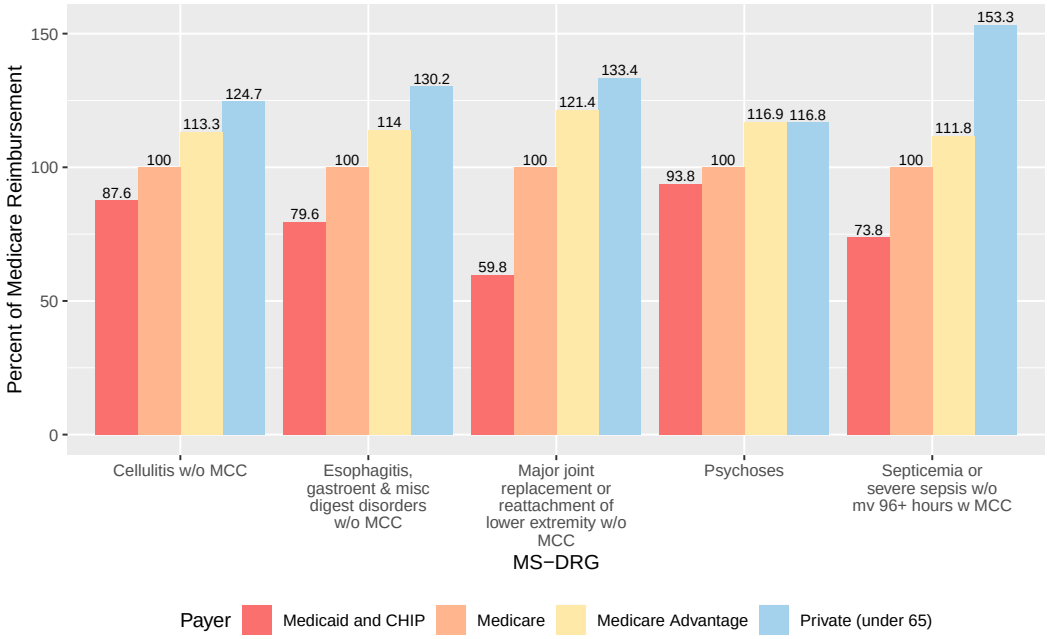


Figure 11: Prices as a Percent of Medicare Reimbursements — *Bottom 55 Insurers*



E.1 Hospital- and Risk-Adjusted Negotiated Prices by Private-Payers

In the following tables, Insurers 1-60 mask, at random, the names of the insurers we study. For a complete list of the insurers—and their subsidiaries—included in the analysis, see Appendix Table 17.

Table 18: Vaginal Delivery w/o Complicating Diagnoses

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Insurer 58	2,557.40	7,924.84	3,390.08	-19.03	37.24	19.46	89
Insurer 29	1,221.17	6,588.61	2,599.46	-6.29	49.99	19.65	204
Insurer 16	938.72	6,306.16	3,554.23	-5.47	50.81	19.86	1,729
Insurer 13	689.39	6,056.83	1,739.28	-4.64	51.63	17.53	554
Insurer 47	537.11	5,904.55	1,485.89	-2.09	54.19	17.43	2,746
Insurer 1	488.96	5,856.40	2,992.38	-4.62	51.66	18.95	12,085
Insurer 21	477.73	5,845.17	2,030.69	-7.90	48.37	26.04	955
Insurer 46	461.22	5,828.66	1,283.03	-2.65	53.63	28.04	434
Insurer 30	413.78	5,781.21	2,491.09	-4.21	52.06	28.84	21,748
Insurer 12	284.10	5,651.54	1,274.51	-5.21	51.07	25.76	1,960
Insurer 40	248.79	5,616.23	1,369.15	-3.15	53.12	15.87	4,647
Insurer 56	246.20	5,613.64	1,431.99	-2.74	53.54	19.65	880
Insurer 37	240.29	5,607.73	1,334.59	-2.39	53.89	15.08	1,554
Insurer 20	190.07	5,557.51	3,486.34	0.71	56.99	31.51	28,933
Insurer 35	166.66	5,534.10	2,588.93	-1.05	55.23	17.35	2,041
Insurer 42	158.58	5,526.02	1,184.27	-2.14	54.14	16.45	710
Insurer 23	123.43	5,490.87	2,292.31	-0.37	55.91	18.31	110
Insurer 51	74.92	5,442.36	1,459.23	-1.09	55.19	13.20	1,160
Insurer 54	24.16	5,391.60	2,071.24	-0.17	56.11	18.86	2,255
Insurer 32	23.24	5,390.67	2,847.12	-0.43	55.85	17.05	2,853
Insurer 44	10.04	5,377.48	1,640.57	-0.63	55.65	23.34	291
Insurer 26	-34.95	5,332.49	2,508.84	-0.13	56.14	22.77	4,178
Insurer 3	-129.52	5,237.92	2,447.21	0.42	56.70	18.83	35,166
Insurer 4	-131.57	5,235.87	1,417.03	0.79	57.06	14.70	1,921
Insurer 19	-132.48	5,234.96	1,656.19	1.20	57.48	17.17	2,648
Insurer 52	-133.84	5,233.60	2,311.26	3.39	59.67	25.22	76
Insurer 41	-141.58	5,225.85	2,260.36	0.53	56.81	18.10	13,410
Insurer 9	-151.09	5,216.35	1,074.64	0.95	57.23	13.10	173
Insurer 61	-186.04	5,181.40	1,935.97	2.26	58.53	19.44	6,449
Insurer 38	-203.95	5,163.49	1,729.96	2.58	58.86	15.65	71
Insurer 28	-318.77	5,048.67	1,035.02	4.48	60.75	12.23	175
Insurer 17	-335.34	5,032.10	3,821.13	4.32	60.60	16.22	5,399
Insurer 53	-432.88	4,934.56	2,388.92	6.82	63.09	17.93	2,115
Insurer 15	-457.98	4,909.46	2,171.04	2.41	58.69	21.44	18,375
Insurer 24	-484.36	4,883.07	1,591.91	5.01	61.29	13.67	2,881
Insurer 59	-576.55	4,790.89	2,732.33	6.09	62.37	19.47	117
Insurer 45	-587.09	4,780.35	1,181.11	6.96	63.24	21.08	593
Insurer 2	-706.11	4,661.33	1,363.07	8.56	64.84	23.36	700
Insurer 18	-743.01	4,624.43	1,680.87	6.39	62.67	13.44	1,603
Insurer 49	-915.08	4,452.36	1,771.42	7.45	63.72	12.64	2,628
Insurer 50	-1,319.75	4,047.69	2,192.45	9.41	65.69	12.28	1,103
Insurer 11	-2,226.09	3,141.35	1,682.43	9.58	65.85	8.29	426

Table 19: Cesarean Section w/o CC/MCC

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Insurer 29	2,531.43	10,598.06	2,832.83	-10.50	49.14	15.53	83
Insurer 16	1,724.78	9,791.41	5,898.26	-5.30	54.33	18.00	419
Insurer 13	1,536.69	9,603.32	2,560.78	-8.47	51.17	16.86	131
Insurer 46	1,224.16	9,290.79	1,789.97	-11.66	47.97	20.43	194
Insurer 1	1,067.14	9,133.76	3,885.97	-5.18	54.45	15.68	5,627
Insurer 42	883.28	8,949.90	1,990.87	-4.60	55.04	12.09	217

Table 19: Cesarean Section w/o CC/MCC *(continued)*

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Insurer 47	707.49	8,774.11	1,941.35	-1.92	57.71	15.76	1,364
Insurer 12	505.91	8,572.54	1,623.10	-5.70	53.93	21.82	790
Insurer 21	494.11	8,560.73	2,153.78	-5.35	54.28	22.49	467
Insurer 30	470.58	8,537.21	3,175.87	-3.57	56.06	47.78	9,678
Insurer 40	457.71	8,524.34	2,715.82	-0.60	59.04	45.22	1,666
Insurer 32	446.89	8,513.52	7,932.98	-1.26	58.37	11.61	1,391
Insurer 37	417.94	8,484.57	1,784.90	-2.77	56.87	9.40	638
Insurer 51	334.78	8,401.40	2,170.54	-2.60	57.04	12.11	439
Insurer 35	189.57	8,256.20	1,569.13	-0.57	59.07	11.63	1,099
Insurer 19	122.47	8,189.10	2,341.29	-0.96	58.67	13.57	1,065
Insurer 44	103.88	8,170.51	1,834.84	-1.25	58.38	13.78	118
Insurer 24	79.92	8,146.54	2,624.76	-0.62	59.02	12.44	1,806
Insurer 20	-54.03	8,012.60	3,852.42	1.83	61.46	14.98	11,514
Insurer 56	-54.39	8,012.24	1,886.17	0.44	60.07	14.26	231
Insurer 54	-59.88	8,006.74	3,297.94	-0.19	59.45	17.47	1,018
Insurer 26	-88.20	7,978.42	3,629.58	-0.26	59.37	21.73	1,710
Insurer 41	-205.81	7,860.82	2,643.62	0.42	60.05	15.95	5,977
Insurer 17	-233.79	7,832.84	6,069.64	2.98	62.61	13.09	2,279
Insurer 3	-266.66	7,799.97	3,349.32	0.61	60.25	24.92	14,277
Insurer 15	-337.05	7,729.58	2,827.63	1.16	60.79	9.40	8,416
Insurer 45	-367.96	7,698.66	1,633.23	2.69	62.32	14.29	142
Insurer 9	-421.41	7,645.21	1,558.72	2.61	62.24	9.94	114
Insurer 28	-438.73	7,627.89	1,591.77	3.85	63.49	10.59	59
Insurer 4	-628.25	7,438.37	2,083.34	2.23	61.86	12.47	651
Insurer 61	-683.68	7,382.94	2,384.45	4.86	64.49	14.80	2,449
Insurer 53	-775.25	7,291.37	2,485.20	5.99	65.62	34.62	872
Insurer 2	-869.39	7,197.23	2,121.56	8.57	68.20	22.68	278
Insurer 18	-1,163.87	6,902.76	1,622.27	9.09	68.73	9.96	582
Insurer 49	-1,713.00	6,353.62	1,978.71	9.10	68.74	11.57	924
Insurer 50	-1,888.85	6,177.77	2,129.07	9.81	69.44	13.84	400
Insurer 11	-4,128.31	3,938.31	2,388.80	12.58	72.21	7.07	193

Table 20: Major Joint Replacement or Reattachment of Lower Extremity w/o MCC

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Insurer 2	4,198.25	27,786.28	5,855.70	-14.32	38.66	22.93	213
Insurer 1	3,591.56	27,179.60	10,666.88	-4.91	48.07	17.69	3,404
Insurer 4	2,909.08	26,497.12	5,238.84	-9.22	43.76	14.18	743
Insurer 13	2,388.54	25,976.57	6,401.91	-7.09	45.89	19.31	82
Insurer 30	2,291.69	25,879.73	9,225.60	-4.42	48.56	17.07	5,411
Insurer 47	2,095.92	25,683.96	5,283.01	-4.55	48.43	11.48	1,647
Insurer 19	1,938.39	25,526.43	5,680.97	-4.44	48.54	14.59	689
Insurer 41	1,350.78	24,938.82	7,649.60	-2.54	50.44	14.26	4,416
Insurer 42	1,288.81	24,876.85	4,059.48	-1.92	51.06	10.10	161
Insurer 51	1,181.56	24,769.60	5,420.12	-2.56	50.42	9.57	356
Insurer 40	1,134.37	24,722.41	4,958.97	-2.51	50.47	22.83	787
Insurer 16	1,116.55	24,704.59	7,379.41	-6.36	46.62	18.04	108
Insurer 12	393.99	23,982.03	4,430.45	-1.60	51.38	19.03	530
Insurer 61	144.48	23,732.52	6,360.69	-0.16	52.82	15.74	2,766
Insurer 37	-44.94	23,543.10	4,508.34	-0.17	52.81	8.29	635
Insurer 21	-145.01	23,443.03	4,989.29	-1.37	51.61	20.03	329
Insurer 56	-322.24	23,265.80	4,814.28	1.53	54.51	15.21	197
Insurer 53	-359.34	23,228.70	8,056.13	1.45	54.43	13.91	834
Insurer 32	-503.47	23,084.56	11,038.77	3.95	56.92	16.60	547
Insurer 35	-567.35	23,020.68	5,212.38	1.54	54.52	9.75	593
Insurer 20	-663.92	22,924.11	8,878.84	1.79	54.77	14.86	8,516
Insurer 3	-682.58	22,905.46	9,052.46	1.23	54.21	30.76	8,152
Insurer 15	-1,075.43	22,512.61	5,342.92	1.08	54.06	30.25	1,846
Insurer 45	-1,139.32	22,448.72	3,130.19	3.38	56.36	13.57	167

Table 20: Major Joint Replacement or Reattachment of Lower Extremity w/o MCC *(continued)*

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Insurer 33	-1,602.03	21,986.01	6,468.17	2.84	55.82	9.50	93
Insurer 26	-1,704.06	21,883.97	5,901.67	3.44	56.42	12.48	2,330
Insurer 44	-1,767.84	21,820.20	3,590.54	4.34	57.32	8.31	161
Insurer 29	-2,061.20	21,526.84	13,725.74	4.95	57.93	27.77	54
Insurer 24	-2,172.38	21,415.66	5,325.83	3.66	56.64	8.79	1,892
Insurer 54	-4,140.69	19,447.35	11,894.92	7.90	60.88	27.30	1,887
Insurer 17	-4,506.37	19,081.67	12,394.97	5.22	58.20	10.64	1,192
Insurer 11	-5,118.84	18,469.20	8,629.51	10.43	63.41	16.11	120
Insurer 49	-5,292.07	18,295.97	7,575.93	9.67	62.65	24.29	102
Insurer 46	-6,779.57	16,808.47	4,707.35	20.03	73.01	15.34	141
Insurer 50	-6,856.93	16,731.11	6,876.61	10.68	63.66	10.33	86
Insurer 6	-8,215.15	15,372.89	10,403.25	12.85	65.83	18.53	98
Insurer 18	-11,822.51	11,765.53	7,512.23	19.68	72.66	16.95	88

Table 21: Cesarean Section w CC/MCC

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Insurer 16	2,947.92	13,754.28	13,919.87	-4.94	49.76	21.34	344
Insurer 51	1,689.24	12,495.60	6,841.95	-8.97	45.73	17.34	407
Insurer 13	1,669.47	12,475.82	3,394.22	-3.79	50.91	17.79	175
Insurer 47	1,475.83	12,282.18	5,581.54	-5.33	49.37	18.87	907
Insurer 21	1,320.13	12,126.49	13,163.90	-5.09	49.61	26.19	204
Insurer 1	1,280.62	12,086.97	10,003.82	-2.88	51.82	78.98	3,122
Insurer 42	1,024.46	11,830.81	2,884.96	-5.87	48.83	17.03	104
Insurer 32	937.89	11,744.25	14,105.55	-0.32	54.38	14.42	597
Insurer 12	796.84	11,603.19	2,931.39	-6.08	48.62	26.48	265
Insurer 4	757.23	11,563.58	2,930.01	-3.00	51.70	12.81	395
Insurer 37	693.89	11,500.24	3,685.35	-3.64	51.06	14.61	306
Insurer 24	607.98	11,414.34	5,008.88	-2.93	51.77	16.65	730
Insurer 30	556.38	11,362.74	7,923.13	-2.23	52.47	82.05	5,370
Insurer 40	555.51	11,361.86	5,759.50	-4.53	50.17	73.22	1,218
Insurer 35	324.09	11,130.44	4,125.14	-1.27	53.43	16.74	510
Insurer 19	255.90	11,062.25	5,165.75	-0.49	54.21	17.31	893
Insurer 44	81.32	10,887.67	2,853.34	-3.50	51.20	46.08	59
Insurer 20	-26.45	10,779.90	11,024.82	2.59	57.29	27.58	6,756
Insurer 41	-166.78	10,639.57	9,820.60	2.75	57.45	109.68	3,755
Insurer 2	-226.60	10,579.76	2,718.70	0.14	54.84	27.95	81
Insurer 54	-267.83	10,538.52	10,490.19	5.02	59.72	116.32	657
Insurer 15	-282.63	10,523.72	5,179.66	1.05	55.75	10.26	4,581
Insurer 26	-397.24	10,409.11	6,830.31	-0.33	54.37	20.18	1,285
Insurer 46	-425.94	10,380.41	2,319.74	4.76	59.46	31.36	71
Insurer 3	-426.58	10,379.77	35,202.02	-3.09	51.61	595.58	8,415
Insurer 53	-526.38	10,279.97	5,623.73	5.38	60.08	18.28	490
Insurer 61	-526.51	10,279.84	5,363.14	2.59	57.29	24.92	1,774
Insurer 56	-691.85	10,114.50	1,992.46	4.49	59.19	12.08	95
Insurer 17	-1,018.63	9,787.72	15,006.35	7.22	61.92	23.19	1,120
Insurer 49	-1,585.75	9,220.60	6,431.96	8.21	62.91	15.69	820
Insurer 18	-2,847.80	7,958.55	7,317.81	17.85	72.55	15.22	498
Insurer 50	-4,521.60	6,284.76	6,161.24	13.65	68.35	13.50	389
Insurer 11	-6,127.42	4,678.93	2,496.59	13.23	67.93	7.29	81

Table 22: Psychoses

	Price			Percent Discount from Charge			
	Mean			Mean			
Payer	Residuals	Adj. Price	Std. Dev.	Residuals	Adj. Discount	Std. Dev	N
Insurer 24	2,917.01	8,923.19	7,209.27	-18.93	36.37	25.06	559
Insurer 13	2,695.34	8,701.52	6,341.58	-20.53	34.77	31.95	201
Insurer 30	1,021.55	7,027.73	6,061.38	-6.61	48.69	35.88	3,579
Insurer 12	962.24	6,968.42	2,933.69	-13.27	42.02	36.36	1,154
Insurer 32	812.93	6,819.11	9,160.66	-0.15	55.15	18.13	175
Insurer 35	792.81	6,798.99	5,447.39	-11.39	43.90	53.25	515
Insurer 15	550.31	6,556.49	4,188.37	-1.42	53.87	11.39	2,549
Insurer 44	501.65	6,507.83	2,246.61	-8.37	46.93	42.48	674
Insurer 19	332.79	6,338.97	4,265.64	-1.23	54.06	107.86	883
Insurer 16	324.85	6,331.03	3,320.16	-1.64	53.66	11.89	1,919
Insurer 51	271.58	6,277.76	3,340.69	-4.28	51.02	20.88	543
Insurer 41	185.13	6,191.31	3,127.50	-3.25	52.05	32.47	2,682
Insurer 26	139.62	6,145.80	3,057.76	-7.54	47.76	49.65	1,357
Insurer 61	138.77	6,144.95	7,033.08	-2.40	52.90	35.07	1,805
Insurer 17	65.10	6,071.28	4,920.12	-3.39	51.90	14.92	517
Insurer 20	47.23	6,053.41	6,687.59	0.81	56.11	27.05	5,474
Insurer 4	-18.18	5,988.00	11,233.61	0.40	55.69	21.33	95
Insurer 53	-45.38	5,960.80	4,654.74	8.31	63.60	28.94	158
Insurer 47	-239.65	5,766.53	3,809.43	4.77	60.07	16.74	380
Insurer 1	-261.50	5,744.68	5,257.46	3.24	58.54	24.25	2,578
Insurer 50	-591.94	5,414.24	3,542.65	-3.74	51.56	26.71	177
Insurer 21	-634.63	5,371.55	2,967.99	5.43	60.73	13.47	484
Insurer 18	-692.54	5,313.64	3,862.42	-0.71	54.59	47.78	244
Insurer 49	-702.23	5,303.94	3,429.02	0.90	56.19	28.39	588
Insurer 3	-1,002.98	5,003.20	3,183.45	8.56	63.85	19.00	7,445
Insurer 6	-1,098.25	4,907.92	3,157.84	10.54	65.83	26.44	279
Insurer 54	-1,195.32	4,810.86	4,940.73	8.75	64.05	27.01	1,423
Insurer 46	-1,417.87	4,588.31	1,979.35	15.59	70.88	18.87	158

Table 23: Pearson Correlation in Inpatient Risk-Adj. Residuals between Types of Coverage by MS-DRG
(*Observations at provider-payer level*)

	Private (under 65)	Medicare	Medicare Advantage
Esophagitis, gastroent and misc digest disorders w/o MCC			
Medicare	0.32***		
Medicare Advantage	0.62***	0.54***	
Medicaid and CHIP	0.64***	0.34***	0.46***
Major joint replacement or reattachment of lower extremity w/o MCC			
Medicare	0.13*		
Medicare Advantage	0.64***	0.45***	
Medicaid and CHIP	0.26**	-0.11	0.18
Cellulitis w/o MCC			
Medicare	0.21***		
Medicare Advantage	0.60***	0.63***	
Medicaid and CHIP	0.57***	0.21**	0.32**
Septicemia or severe sepsis w/o mv 96+ hours w MCC			
Medicare	0.51***		
Medicare Advantage	0.67***	0.71***	
Medicaid and CHIP	0.49***	0.26***	0.42***
Psychoses			
Medicare	0.56***		
Medicare Advantage	0.66***	0.50***	
Medicaid and CHIP	0.27**	0.22*	0.36*

Notes: *p<0.1; **p<0.05; ***p<0.01. The p-values are reported for a two-tailed test. A unit of analysis is a provider-payer. Price residuals are obtained by equation (1), which removes variation in prices due to differences in observable patient severity and year-specific hospital effects.

Table 24: Pearson Correlation in Inpatient Risk-Adj. Residuals between Private Payers by MS-DRG
(*Observations at provider-payer level*)

	Insurer A	Insurer B	Insurer C	Insurer D
Vaginal delivery w/o complicating diagnoses				
Insurer B	0.56***			
Insurer C	0.61***	0.63***		
Insurer D	0.58***	0.60***	0.61***	
Insurer E	0.62***	-0.57	0.63***	0.70***
Cesarean section w/o CC/MCC				
Insurer B	0.36**			
Insurer C	0.47***	0.45***		
Insurer D	0.72***	0.26	0.66***	
Insurer E	0.64**	0.55	0.85***	0.85***
Major joint replacement or reattachment of lower extremity w/o MCC				
Insurer B	0.34**			
Insurer C	0.65***	0.07		
Insurer D	0.55***	0.29	0.53***	
Insurer E	0.04	0.08	0.82***	0.39
Cesarean section w CC/MCC				
Insurer B	0.39**			
Insurer C	0.22*	0.54***		
Insurer D	0.01	0.04	0.63***	
Insurer E	0.04	0.94**	0.76***	0.75**
Psychoses				
Insurer B	0.42*			
Insurer C	0.48***	0.85***		
Insurer D	0.33*	-0.45	0.10	
Insurer E	0.19	-0.20	-0.12	-0.09
Esophagitis, gastroent and misc digest disorders w/o MCC				
Insurer B	0.82***			
Insurer C	0.46***	0.64***		
Insurer D	0.57***	0.63**	0.81***	
Insurer E	0.44*	-0.63	0.67**	0.72**
Vaginal delivery w complicating diagnoses				
Insurer B	0.23			
Insurer C	0.74***	0.60***		
Insurer D	0.61***	0.36	0.77***	
Insurer E	-0.27	0.97**	0.81**	0.79
Uterine and adnexa proc for non-malignancy w/o CC/MCC				
Insurer B	0.48**			
Insurer C	0.39**	0.67***		

	Insurer A	Insurer B	Insurer C	Insurer D
Insurer D	0.08	-0.55	0.74***	
Insurer E	0.33	0.66	0.93***	0.89***
Cellulitis w/o MCC				
Insurer B	0.74***			
Insurer C	0.16	0.74*		
Insurer D	0.57**	0.64	0.83***	
Insurer E	0.47	—	0.62	0.94
Perc cardiovasc proc w drug-eluting stent w/o MCC				
Insurer B	0.08			
Insurer C	0.76***	0.28		
Insurer D	0.57**	0.99*	0.62**	
Insurer E	-0.18	0.45	0.18	-0.39
O.R. procedures for obesity w/o CC/MCC				
Insurer B	0.33			
Insurer C	0.57***	-0.25		
Insurer D	0.52*	0.34	0.31	
Insurer E	0.51	—	0.81*	0.65

Notes: *p<0.1; **p<0.05; ***p<0.01. The p-values are reported for a two-tailed test. A unit of analysis is a provider-payer. Price residuals are obtained by equation (1), which removes variation in prices due to differences in observable patient severity and year-specific hospital effects. Insurers A-E mask the names of the five largest U.S. private insurers (Aetna, Anthem, Cigna, Humana, and UnitedHealthcare).

Table 25: Relationship between Inpatient Prices and Insurer's Market Share — Robustness to Medical Classification Code Specificity

	Dependent variable:			
	Price		log(Price)	
Panel A	(1)	(2)	(3)	(4)
Insurer's Market Share	-72.360^{***}	-81.478^{***}	-0.005^{**}	-0.006^{***}
	(17.486)	(19.769)	(0.002)	(0.002)
Age	2.937	5.316	0.003^{***}	0.003^{***}
	(6.511)	(3.972)	(0.001)	(0.0004)
Male	228.526^{***}	203.912^{***}	0.005	0.002
	(67.682)	(61.057)	(0.005)	(0.004)
Length of Stay	$1{,}229.932^{***}$	$1{,}223.609^{***}$	0.066^{***}	0.065^{***}
	(167.579)	(168.932)	(0.008)	(0.008)
Charlson comorbidity dummies	Yes	Yes	Yes	Yes
ICD-9/10 fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Provider fixed effects	No	Yes	No	Yes
Observations	496,737	496,737	496,737	496,737
R^2	0.471	0.512	0.495	0.579
Adjusted R^2	0.468	0.509	0.492	0.577
	Dependent variable:			
Panel B	Risk-Adj. Price		log(Risk-Adj. Price)	
Insurer's Market Share	-72.302^{***}	-81.823^{***}	-0.005^{***}	-0.007^{***}
	(17.185)	(19.487)	(0.002)	(0.002)
ICD-9/10 fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Provider fixed effects	No	Yes	No	Yes
Observations	496,737	496,737	488,684	488,684
R^2	0.415	0.461	0.445	0.537
Adjusted R^2	0.411	0.457	0.441	0.534
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$			

Table 26: 25 Most Common MS-DRGs for Inpatient Visits

All Patients		TM and MA Patients		Private (under 65) patients	
	N		N		N
Normal newborn	1,566,635	Major joint replacement or reattachment of lower extremity w/o MCC	195,754	Normal newborn	484,298
Vaginal delivery w/o complicating diagnoses	1,447,989	Septicemia or severe sepsis w/o mv 96+ hours w MCC	136,247	Vaginal delivery w/o complicating diagnoses	474,276
Major joint replacement or reattachment of lower extremity w/o MCC	639,975	Heart failure & shock w MCC	94,257	Cesarean section w/o CC/MCC	197,940
Psychoses	603,193	Esophagitis, gastroent & misc digest disorders w/o MCC	88,524	Neonate w other significant problems	132,441
Cesarean section w/o CC/MCC	559,804	Heart failure & shock w CC	87,435	Cesarean section w CC/MCC	121,419
Neonate w other significant problems	463,049	Psychoses	86,657	Major joint replacement or reattachment of lower extremity w/o MCC	119,673
Esophagitis, gastroent & misc digest disorders w/o MCC	446,179	Kidney & urinary tract infections w/o MCC	70,649	Psychoses	99,718
Septicemia or severe sepsis w/o mv 96+ hours w MCC	385,411	Rehabilitation w CC/MCC	65,673	Esophagitis, gastroent & misc digest disorders w/o MCC	89,371
Cesarean section w CC/MCC	359,725	Renal failure w CC	64,879	Vaginal delivery w complicating diagnoses	77,617
Cellulitis w/o MCC	275,122	Simple pneumonia & pleurisy w CC	62,452	Uterine & adnexa proc for non-malignancy w/o CC/MCC	66,028
Vaginal delivery w complicating diagnoses	250,247	G.I. hemorrhage w CC	61,657	Cellulitis w/o MCC	49,313
Heart failure & shock w CC	234,977	Chronic obstructive pulmonary disease w MCC	57,400	Perc cardiovasc proc w drug-eluting stent w/o MCC	40,097
Kidney & urinary tract infections w/o MCC	232,406	Pulmonary edema & respiratory failure	56,205	O.R. procedures for obesity w/o CC/MCC	35,764
Heart failure & shock w MCC	226,609	Simple pneumonia & pleurisy w MCC	55,584	Full term neonate w major problems	35,707
Simple pneumonia & pleurisy w CC	208,468	Cellulitis w/o MCC	52,485	Prematurity w/o major problems	35,651
Misc disorders of nutrition, metabolism, fluids/electrolytes w/o MCC	206,522	Intracranial hemorrhage or cerebral infarction w CC or tpa in 24 hrs	52,343	Spinal fusion except cervical w/o MCC	34,215
Renal failure w CC	201,105	Renal failure w MCC	50,844	Other antepartum diagnoses w medical complications	32,823
Perc cardiovasc proc w drug-eluting stent w/o MCC	190,429	Misc disorders of nutrition, metabolism, fluids/electrolytes w/o MCC	50,818	Circulatory disorders except ami, w card cath w/o MCC	32,785
Rehabilitation w CC/MCC	189,546	Septicemia or severe sepsis w/o mv ¿96 hours w MCC	50,185	Seizures w/o MCC	32,618

Table 26: 25 Most Common MS-DRGs for Inpatient Visits *(continued)*

All Patients		TM and MA Patients		Private (under 65) patients	
	N		N		N
Circulatory disorders except ami, w card cath w/o MCC	187,142	Chronic obstructive pulmonary disease w CC	49,773	Septicemia or severe sepsis w/o mv 96+ hours w MCC	29,544
Chest pain	183,901	Syncope & collapse	49,230	Misc disorders of nutrition, metabolism, fluids/electrolytes w/o MCC	29,339
G.I. hemorrhage w CC	173,674	Circulatory disorders except ami, w card cath w/o MCC	49,044	Bronchitis & asthma w/o CC/MCC	28,784
Pulmonary edema & respiratory failure	171,560	Perc cardiovasc proc w drug-eluting stent w/o MCC	47,695	Alcohol/drug abuse or dependence w/o rehabilitation therapy w/o MCC	27,725
Red blood cell disorders w/o MCC	166,322	Cardiac arrhythmia & conduction disorders w/o CC/MCC	45,862	Chest pain	27,524
Septicemia or severe sepsis w/o mv 96+ hours w/o MCC	156,381	Cardiac arrhythmia & conduction disorders w CC	45,529	Laparoscopic cholecystectomy w/o c.d.e. w/o MCC/MCC	24,916

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