

TO COMPLY OR NOT TO COMPLY:
A STUDY OF THE FACTORS AFFECTING COMPLIANCE WITH THE 2021
HOSPITAL PRICE TRANSPARENCY MANDATE

by
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DEDICATION

This thesis is dedicated to Everett Michael, who was birthed alongside this project and will probably appreciate a break from looking at R code.

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ABSTRACT

This analysis uses hospital-level aggregation of prices of outpatient procedures from 1,595 hospitals along with hospital price transparency data to identify the market-level and hospital-level factors associated with compliance with the 2021 CMS hospital price transparency mandate. I find that the largest hospitals are about 25% more likely to comply with the mandate than the median hospital, suggesting a fixed cost burden to compliance. I also find some evidence that hospitals in less competitive markets are more likely to comply, and there does not appear to be any connection between the price of a hospital's services and its compliance with the mandate.

INTRODUCTION

The Hospital Pricing Clarity Crisis

Prices of hospital services rose almost 30 percent between 2015 and 2019¹, more than 4 times faster than inflation over the same period. Critically, before hospitals were required to publish prices in 2021, hospitals were guarded about their prices to researchers and even potential patients. Therefore, little is known about hospital prices, impeding efforts to address the accelerating rise in prices of procedures. One of the barriers to consumers who wish to price-shop for medical procedures is the near impossibility of receiving a complete price for a procedure. The price of the procedure itself is not always the relevant price for an insured patient. In addition, a visit for a procedure often involves layers of services, several doctors, and undisclosed hospital fees.² Improving price transparency is a critical first step to understanding the problems in hospital services pricing.

In response to this long-recognized problem, the Center for Medicaid and Medicare Services issued a mandate requiring hospitals to disclose their prices for all procedures by January 2021. The promise of requiring price transparency is to lower prices by facilitating competition through price comparison. Despite the difficulty patients face in directly using the prices, disclosure of procedure prices is essential for movement towards a more functional market for healthcare services, and will allow regulators, health insurers, and researchers to understand pricing trends and evaluate potential policy changes.

The effects of this recent mandate are not yet known, but a likely precondition for a strong effect is near-universal compliance. This analysis uses hospital-level price transparency compliance data alongside a measure of prices of hospital services and a new calculation of market competitiveness to understand the factors affecting hospital compliance. This paper will consider only outpatient procedure prices since those services are the least complex and easiest to price-compare.

¹“2019 Health Care Cost and Utilization Report”, Health Care Cost Institute, 2021

²Some possible reforms that are gaining attention are reference pricing (discussed at length in the Background section) and insurer negotiations and regulatory measures to cap prices on procedures.

The Policy

Until two years ago, hospitals were reticent to disclose their prices even to potential patients, and studying their pricing was extremely difficult. In 2019, the Centers for Medicaid and Medicare Services (hereafter CMS) issued the following mandate requiring hospitals to disclose their prices: Starting January 1, 2021, hospitals are required to “disclose the rates they privately negotiate with health plans, as well as their self-pay [cash] and charge master [list-price] rates, and provide an online patient cost estimator tool or negotiated rate information for at least 300 ‘shoppable’ services, or face penalties ranging from \$300 to \$5,500 per day, depending on the hospital’s size.”³

The stated purpose of the mandate is to facilitate a patient’s ability to observe prices ahead of receiving a procedure.⁴ In late 2019, shortly after the mandate was announced, several large hospital trade organizations sued to block the implementation of the mandate, arguing that “Hospitals and commercial health insurers keep the rates they privately negotiate confidential for good reason: it would undermine competition if they were required to be disclosed publicly...”⁵ The lawsuit was unsuccessful, but the tenacity with which hospitals have tried to avoid disclosing prices is noteworthy.⁶ Hospitals are subject to potential fines based on hospital bed count (size of hospital) though only two hospitals have been charged fines as of June, 2022 and the maximum possible fine is only two million dollars, a modest sum to hospitals that on average generate \$200 million a year.⁷ *Health Affairs* reports that “the fines to the two affected hospitals amounted to only 0.04 percent of the hospitals’ net patient revenue.”⁸ According to the American Hospital Association News blog, “CMS, the only true arbiter of compliance, has indicated about 160 hospitals (out of about 7,000 in the U.S.) remain out of compliance.”⁹ In contrast, a June 2022 *Journal of American Medical Association* (JAMA) research letter found a 6% rate of full adherence

³“CMS announces first penalties under hospital price transparency rule” American Hospital Association News. June 9, 2022

⁴“Hospital Price Transparency” at CMS.gov <https://www.cms.gov/hospital-price-transparency>

⁵<https://www.fiercehealthcare.com/hospitals-health-systems/hospitals-sue-cms-over-price-transparency-rule-they-call-heavily-unlawful>

⁶Hospitals have more leverage in negotiations with health insurers if the insurance companies do not know what other insurers are paying for each procedure, a likely motivation for hospitals to fight price transparency.

⁷“Revenue trends at U.S. hospitals” from Definitive Healthcare, 2021. <https://www.definitivehc.com/blog/revenue-trends-at-u.s.-hospitals>

⁸“Hospital And Insurer Price Transparency Rules Now In Effect But Compliance Is Still Far Away”

⁹“Hospitals and Health Systems Are Working to Implement Price Transparency Policies and Help Patients Understand Costs” AHA News. June 16, 2022

to the law (Haque and Hsiehchen (2022)). My analysis found 81.5% of hospitals were at least somewhat compliant and 69% are highly compliant (discussed at length in the Data section of this analysis). Regulators would be able to improve compliance and better support hospitals to follow the law if they had a better idea of what factors are affecting compliance.

Hypotheses

This paper attempts to identify what is different about hospitals that comply with the price transparency mandate (i.e. publish their prices) and hospitals that do not comply with the mandate.

This project will consider three possible margins that may affect hospital compliance: hospital size, price for services compared to Medicare reimbursement rates for the region, and competitiveness of that hospital market.

Hypothesis 1: Smaller hospitals are less likely to publish their prices because of compliance costs.¹⁰

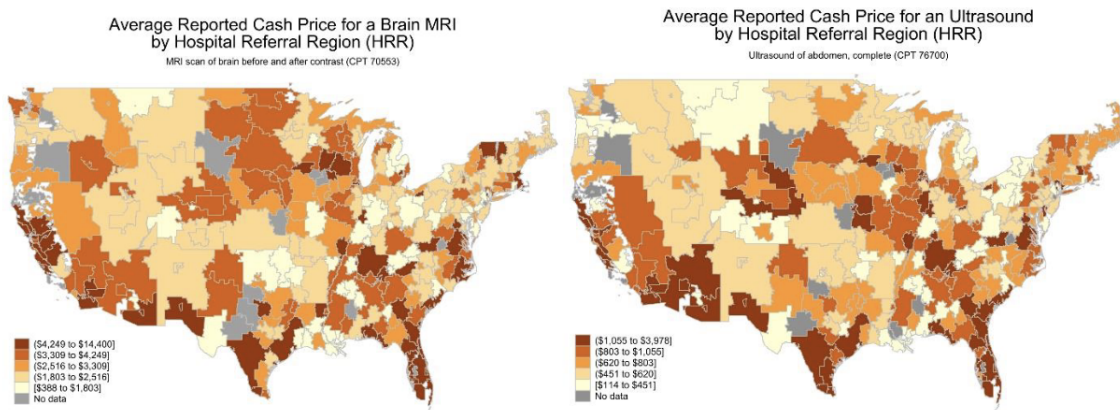
Hypothesis 2: Hospitals that have higher prices are less likely to publish their prices because they do not want consumers to know.

Hypothesis 3: Hospitals in more competitive markets face more pressure to report their prices. Other possible hypotheses are that hospitals in less competitive markets have less to lose by disclosing prices, or hospitals in more competitive markets change their prices more often so compliance costs are higher.

¹⁰Possible measurement issues are that hospitals over 550 beds face a lower per-hospital bed penalty because of the structure of the penalty, and specialty hospitals are expected to offer fewer services than full-service hospitals, so their compliance cost may be lower.

Figures

Figure 1.1: Average reported cash prices for two procedures from Sanchez (2021)



This graph illustrates how widely prices vary regionally for the same procedure. Prices also exhibit dramatic variance within region, suggesting that cost reductions by encouraging patients to visit lower-priced providers can reduce healthcare spending for the same services.

BACKGROUND

This policy has generated significant interest from the press, with many articles noting the low rates of compliance,¹ high price variance between nearby hospitals, and shockingly disparate prices for different insurers for the same procedure at the same hospital.² However, other analyses find the compliance rates are higher than other reports indicate.³

Price Transparency Compliance Literature

There are currently two peer-reviewed papers studying compliance with the price transparency mandate, and a 5-page research brief.

Haque and Hsiehchen (2022) studies compliance with the transparency regulation based on hospital characteristics, and found higher compliance in unconcentrated markets, urban areas, and hospitals with less revenue per patient-day. Younessi et al. (2022) find a small and regional correlation between hospital size and compliance, while Jiang et al. (2022) find that IT resources, size, and how many other hospitals in the region are also complying are all positively correlated with compliance.

Both Younessi et al. (2022) and Jiang et al. (2022) utilize the same Turquoise Health price transparency data as I do, while the researchers in Haque and Hsiehchen (2022) scrape the compliance data from hospital websites themselves. The approach and some covariates of Jiang et al. (2022) and Younessi et al. (2022) are similar to mine, but my novel contribution to the literature is to test if a hospital's relative price for services affects the likelihood of compliance with the price transparency law. I am also using different ways of measuring some of the control variables, including a novel calculation of the Herfindahl–Hirschman index of hospital markets.

Hospital Market Literature

If hospitals were like other markets, we might expect hospitals that charge high prices for services to be less willing to comply with the price transparency mandate, as they might expect that awareness of their high prices would decrease the quantity demanded. However,

¹“Hospital And Insurer Price Transparency Rules Now In Effect But Compliance Is Still Far Away” in Health Affairs, September 12, 2022

²<https://www.nytimes.com/interactive/2021/08/22/upshot/hospital-prices.html>

³<https://carejourney.com/carejourney-and-turquoise-health-release-hospital-price-transparency-data-for-public-use/>

there are a few unusual attributes of hospital markets that could offset this effect. These effects spring from the atypical payment structure of hospital markets where patients only face cost exposure up to their deductibles, which have risen sharply over the last decade but are still lower than the price of many hospital procedures. If a procedure is more expensive than the deductible, the patient often faces small or no additional cost for choosing a more expensive facility (depending on co-insurance rate).

Cooper and Gruber (2022) find that higher price hospitals have lower mortality outcomes only in relatively competitive markets, while in less competitive markets, higher-price hospitals do not have lower mortality outcomes. White et al. (2014) found that high-priced hospitals tend to have good reputations even though they score lower on objective measures of quality. Similarly, Beauvais et al. (2020) find a negative relationship between the ratio of the price of service to cost of providing the service, and measures of hospital quality. Jamalabadi and Schreyögg (2020) find in a meta analysis of 47 studies that there appears to be no consistent connection between price of a hospital and the quality of care.

Another unique aspect of this market that presents a challenge for cost-containment efforts is patients' trust in their physicians. Chernew et al. (2021) find that patients appear to trust their doctors' referrals implicitly, overwhelmingly going to the referred provider for an undifferentiated and very shoppable service (a lower-limb MRI) rather than using a readily accessible price transparency tool to find a more affordable provider. They find that "[i]f patients attended the lowest priced provider within the distance they already traveled for care, they could have reduced their out-of-pocket costs by \$84.37 (27.49 percent) and lowered insurer spending by \$220.49 (40.53 percent). This, in part, reflects that the mean patient in our sample travelled past six lower-priced providers en route to where they ultimately received care" (pg 13). They suspect that changes in the referral pathways would reduce costs, but expecting patients to change their own behavior under the current structure (even with higher deductibles) will not address the problem of rising prices.

Relatedly, only one paper finds patients respond to price transparency, and several others conclude that patients do not seem to care about the prices absent changes in the structure of health insurance (such as reference pricing)⁴ and do not appear to research prices when selecting a hospital, even for scheduled "shoppable" procedures. Brown (2019) finds that prices decrease for procedures on a price transparency platform relative to prices of

⁴Reference pricing is an insurance structure where an insurance company provides a price transparency tool and agrees to pay a certain price for a procedure based on the prices in that area. Patients can choose the provider for the procedure but if the provider's price is greater than the reference price the patient must pay the difference.

procedures not the platform over a 5-year period, leading to an 11 percent decrease in patient out-of-pocket spending. Desai et al. (2016), Robinson and Brown (2013) and Whaley et al. (2019) each find that price transparency alone does not affect behavior, but the introduction of reference pricing significantly shifts patients to lower cost providers.

Another reason patients may be slow to respond to price transparency is because medical service pricing is complicated in ways that are difficult for patients to navigate, even if they can see the sticker price of a procedure. Many procedures involve fees that are difficult for patients to anticipate, like anesthesia, post-procedure care, and out-of-network doctors at in-network hospitals. Insurance providers cover certain services at various percentages, such as some insurers covering preventative services at 100 percent or paying 60 percent of the cost of an out-of-network provider. Many insurance plans have copays alongside coinsurances that take effect after the deductible is reached. So it is rarely clear to patients what the out-of-pocket financial impact of a procedure will be even if they observe a listed procedure price.

Though patients largely do not engage in price-shopping, health insurance companies benefit from observing the prices other insurance companies have negotiated, so a hospital in a state that has a competitive insurance market has more to lose from transparency. If a health insurance company has an overwhelming proportion of the market share in a state, disclosing prices is less costly to hospitals. In 10 U.S. states, the largest health insurance company has greater than 75% market share, according to a Kaiser Family Foundation report. (Kaiser (2019)) States each have different requirements for health insurance plans, so health insurance markets are defined on the state level.

Economic theory generally describes regulatory compliance costs as fixed costs to a firm because the cost of complying with the regulation is similar for small firms as for large ones. It is likely that this price transparency requirement is also a fixed cost, as most general acute care hospitals offer a similar range of services whether they are a small hospital or a large hospital.⁵

⁵Specialty hospitals that offer a more narrow range of services, like an orthopedic hospital, are expected to have a lower fixed cost of compliance. I do not include such hospitals in my analysis (restricting my sample to short-term acute-care hospitals and critical access hospitals) to attempt to compare hospitals that have a similar range of services.

DATA

The study data includes a measure of compliance obtained from Turquoise Health (July 2022), a measure of prices of hospital services obtained from White and Whaley (2019), and an original measure of hospital market concentration created with data from Dartmouth Atlas of Health Care, the American Hospital Directory, and the Compendium of U.S. Health Systems 2018 (updated Jan 2021). The subsections below describe each of these datasets in turn.

Core Data

Price Index Data

The first source of data for this analysis comes from White and Whaley (2019). This data set is based on self-insured employers, participating health plans, and payment reports to state databases. It includes a price index that compares each hospital's prices to the Medicare reimbursement rates for that area.¹ This dataset includes information on 1,598 U.S. hospitals in 25 states, including roughly 4 million covered lives. White and Whaley make no claims of representativeness of their sample and the heat map (figure 3.2) illustrates gaps in the distribution of these hospitals in the northern plains states and in the southwest. We cannot be sure that this sample of hospitals is representative, however, this is about a quarter of hospitals in the U.S., and their geographic distribution covers about half of states. (See table 3.2 at the end of this section comparing the White and Whaley hospitals to all hospitals in the U.S.)

The White and Whaley hospitals are general acute-care hospitals (excluding specialty hospitals) and critical access hospitals, which are well-suited for this analysis as most general acute-care and critical access hospitals offer a similar range of services regardless of size. This analysis investigates if hospitals with higher prices are more or less likely to comply with the mandate using the outpatient price index (relative to Medicare reimbursement rates) for each hospital in the White and Whaley sample.² Though there are only 1,598 hospitals in this dataset compared to about 5,000 general acute care and critical access hospitals in the United States, this dataset includes pricing information from hospitals that are not

¹providing a built-in control for more expensive and less expensive areas.

²A robustness check to investigate if acute-care and critical access hospitals have differing effects finds that the regression coefficients are essentially the same if critical access hospitals are excluded from the sample. See Regression Table chapter.

publishing their prices, which is critical for this analysis.

To determine which of these hospitals are compliant with the price transparency law, I matched this dataset with the Turquoise Health dataset described in the following paragraph.

Compliance Data

The second data set used is the Turquoise Hospital Pricing Dataset, which is the data scraped from the websites of all semi- or fully-compliant hospitals collected by Turquoise Health (accessed July 2022). This analysis uses the presence of a hospital in this data set as an indication of compliance. A secondary specification considers the extent of compliance more precisely using a hospital compliance measure rated on a scale of 0-5 in this data set, with the lowest-complying hospitals rated a 2. Of the 1,598 hospitals in the White and Whaley dataset, 1,306 are also in the Turquoise Hospital Pricing dataset (deemed “compliant” for the initial specification), and 294 are not (deemed “noncompliant”)³. The Turquoise dataset includes number of beds for each hospital but the Whaley dataset did not, so I added the number of beds for each “noncompliant” hospital from American Hospital Directory data and hospitals’ websites.⁴ A correlation analysis is recorded in table 3.3 and Appendix B to investigate if the price indexes from the White and Whaley data correlate to those hospitals’ prices for the outpatient services in the Turquoise data.⁵

Covariates

Hospital Market Concentration Data

For the Herfindahl-Hirshmann Index (HHI) measure of competitiveness, I used “Hospital Referral Regions by Zipcode” from the Dartmouth Atlas of Health Care as the geographic regions to define a local hospital market, bed count data from the American Hospital Directory to determine market share, and the Compendium of U.S. Health Systems 2018 (updated Jan 2021) to match individual hospitals to their hospital system.

³This study finds 81.5% of White and Whaley hospitals compliant (at all) and 67.5% of White and Whaley hospitals highly compliant (a 4 or 5 on the Turquoise scale). A Turquoise report dated October 2022 found that about a third of all acute-care hospitals are fully compliant, about two thirds are at least somewhat compliant, and about a third are not compliant at all. Turquoise Health (2022)

⁴Turquoise does not specify their source of hospital bed count, though the bed count was the same as the AHD measure for about half of a group of 20 sampled hospitals, and within 10 beds for almost all of those hospitals. Subsequent versions of this paper will use the AHD bed count for all hospitals, eliminating this concern.

⁵The Turquoise data set includes 14 procedures. This analysis uses the 9 most common procedures in the data set, all outpatient, and most relatively inexpensive.

Hospital referral regions (HRRs) are geographic areas defined by the Dartmouth Atlas of Health Care to contain the group of providers that might be considered as competing with one another.⁶ This project uses the 190 hospital referral regions that include all of the hospitals in my data.

My universe of relevant hospitals for this competition measure is the hospitals in the Hospital Statistics by State from the American Hospital Directory⁷ (AHD) combined with all critical access hospitals. Critical access hospitals are small hospitals (typically 25 beds) in rural areas that offer a wide range of patient services⁸ so their inclusion will be helpful for expanding the range of hospital sizes included in my analysis. The final sample includes 4,862 hospitals, essentially all non-specialty short-term acute care hospitals. These hospitals are ideal for this project because short-term acute care hospitals typically have a standard set of procedures, suggesting that compliance costs are roughly similar across all hospitals in the sample. By contrast, a specialty hospital might only offer a subset of typical procedures offered by full-service hospital, and so face a lower compliance cost.

Because rising consolidation of hospital systems is a concern for the competitiveness of hospital markets (Cutler and Morton (2013)), I hand-matched the AHD hospitals (3,528) and critical access hospitals (1,331) to their hospital systems from the “Compendium of U.S. Health Systems 2018” and then treated each hospital in the same referral region and same hospital system as the same hospital for the Herfindahl-Hirschman calculation (that is to say, summed the market shares for the hospitals in the same system and referral region). This reduced the sample to 3,100 distinct hospital units, and increased the average HHI of the referral regions from 2,300 to 3,310 (out of a possible 10,000 for a monopoly). The Compendium of U.S. Health Systems is composed of 637 U.S. health systems, defined in their analysis to “include at least one hospital and at least one group of physicians providing comprehensive care, and who are connected with each other and with the hospital through

⁶“Hospital referral regions (HRR) represent regional health care markets for tertiary medical care. Each HRR contains at least one hospital that performs major cardiovascular procedures and neurosurgery. HRRs were defined by assigning hospital service areas to the region where the greatest proportion of major cardiovascular procedures were performed, with minor modifications to achieve geographic contiguity, a minimum population size of 120,000, and a high localization index. The process resulted in 306 hospital referral regions.” ?

⁷All general short-term acute care hospitals that are not critical access hospitals, which excludes specialty and federal hospitals.

⁸They are also compensated on a cost-basis, which can be financially beneficial for some hospitals. Some hospitals that qualify to be critical access decide not to, and are then represented in the AHD short-term acute care hospital dataset.

common ownership or joint management.” For comparison, the HHI summary statistics considering hospital system and not considering hospital system are in the histograms in figure 3.1. They include the distribution of referral regions with HHIs in the categories of competitiveness defined by the Federal Trade Commission⁹

Hospital Size Measure

The number of beds in each hospital is used for determining hospital market share above, and as the measure of the size of each hospital to identify a compliance cost burden on hospitals. The bed count data comes from Turquoise and the American Hospital Directory (AHD). Hospital bed count is a convenient proxy for size of a hospital, and the Healthcare Cost Institute concluded a strong correlation between various measures of market share and number of beds (Health Care Cost Institute (2020)).

Health Insurer Market Concentration Data

Hospitals in a state where the largest health insurer has a majority of the market share might be more inclined to publish prices because there is less competitive pressure between health insurers to negotiate the best prices from hospitals. The measure of the market share for the largest health insurer in each state is from a Kaiser Family Foundation report.¹⁰ These markets tend to be quite concentrated (10 states have a largest insurer with greater than 75% market share), so the market share of the largest insurer is a reasonable proxy for the competitiveness of the whole market.

Number of Outpatient Services

This research assumes that all non-specialty hospitals offer a similar range of services, an assumption that has significant implications for compliance cost. To test this assumption, I include the “number of outpatient services” variable from the White and Whaley dataset as a control variable. Unfortunately, this variable only includes the procedures represented in the White and Whaley claims data, a far from comprehensive snapshot of a hospital’s total range of services.

⁹“The Agencies generally classify markets into three types: Unconcentrated Markets: HHI below 1500; Moderately Concentrated Markets: HHI between 1500 and 2500; Highly Concentrated Markets: HHI above 2500” from Horizontal Merger Guidelines (08/19/2010)

¹⁰“Market Share and Enrollment of Largest Three Insurers – Large Group Market” at Kaiser Family Foundation (kff.org), 2019

Urban/Rural Data

The Urban/Rural Index from the CDC is a 1-6 scale of urbanness by county. Noncompliant hospitals are more likely to be rural, so controlling for urbanness with urban fixed effects will prevent rural hospitals from confounding the compliance association with hospital size. See histograms of urbanness distributions of the White and Whaley hospitals, figure 3.4 below.

Figures

Table 3.1: Summary Statistics for the Control Variables

	Overall Sample	Compliers	Non-Compliers
Hospital Count	1595	1300	295
Relative Price Index (Outpatient)	291.2	292.2	286.9
Bed Count	223.0	233.6	176.2
Hospitals in Each Market Structure			
Competitive Market	29%	28%	34%
Mod. Concentrated Market	37%	37%	31%
Highly Concentrated Market	34%	34%	36%
No. of Outpatient Services	3222.86	3520.43	1913.73
Acute Care Hospitals	1325	1093	232
Critical Access Hospitals	269	207	62

This table includes summary stats for the hospitals in the White and Whaley dataset. Relative price index, number of outpatient services, and type of hospital are from White and Whaley. Bed count is from the Turquoise Health dataset and the American Hospital Directory. Author's calculations of the Herfindahl-Hirshmann Index for market structure of each hospital's market.

Table 3.2: White and Whaley Hospitals Compared to Universe of Short-Term Acute Care and Critical Access (STACCA) Hospitals

	White and Whaley Hospitals	All STACCA Hospitals
Number of Hospitals	1595	4862
Compliant (at all)	82%	86%
Highly Compliant	68%	79%
Date Compliance Data Collected	July 2022	October 2022
Mean Bed Count	152	164
% Critical Access	17%	27%

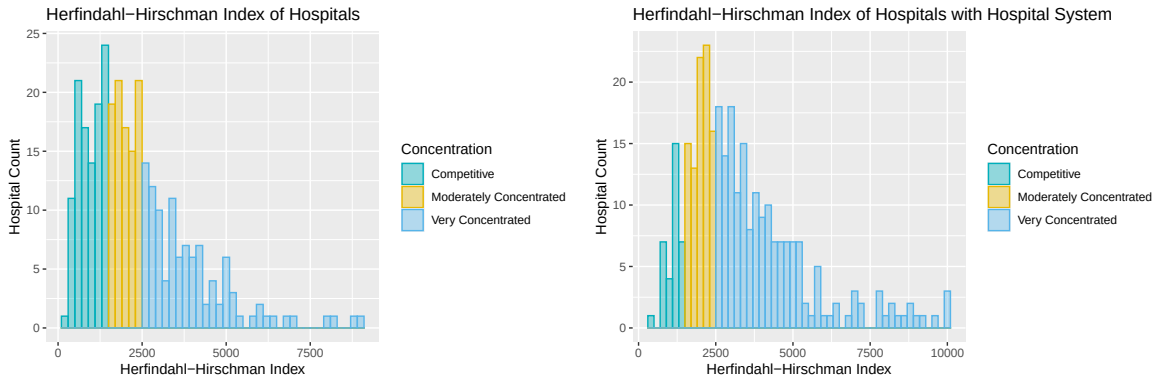
Compliance information for all STACCA hospitals from Turquoise Health (2022). Bed count for all STACCA hospitals from the American Hospital Directory. Critical access percentage for all STACCA hospitals from the American Hospital Directory and Flex Monitoring Team Critical Access Hospital Locations List (Flex Monitoring Team (2023)).

Table 3.3: Correlation Coefficients Between Turquoise Rates and White and Whaley Price Index for 9 Turquoise Procedures

Procedure	Correlation Coefficient	N
Ultrasound of Abdomen	0.24	1251
Brain MRI	0.24	1233
Pelvis CT Scan	0.27	1218
Kidney Function Blood Test	0.20	1203
Emergency Level 3	0.36	1233
Emergency Level 4	0.28	1236
Emergency Level 5	0.32	1233
New Patient Visit, 30 min	0.26	991
Colonoscopy	0.28	976

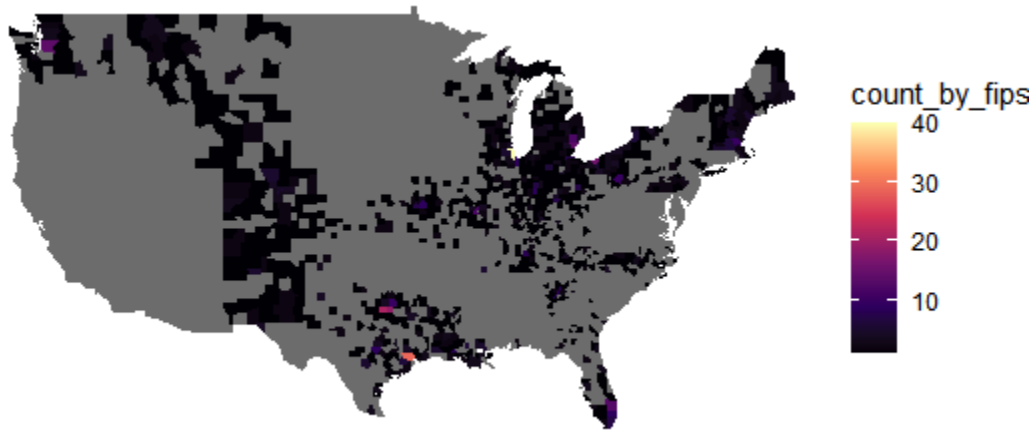
The 9 most common outpatient procedures from the Turquoise are included in this comparison. N = number of hospitals. All correlations are significant to a 0.05 level. For graphs of correlations, see appendix.

Figure 3.1: Hospital Referral Regions by Herfindahl-Hirshmann Index



These graphs show the number of hospital referral regions in each competitiveness category. Note that the left graph treats each hospital as independent while the right graph groups hospitals by system for the HHI calculation. The right graph shows how much more concentrated hospital markets appear when hospital system is considered. Source: Author created.

Figure 3.2: Heatmap of White and Whaley Hospitals



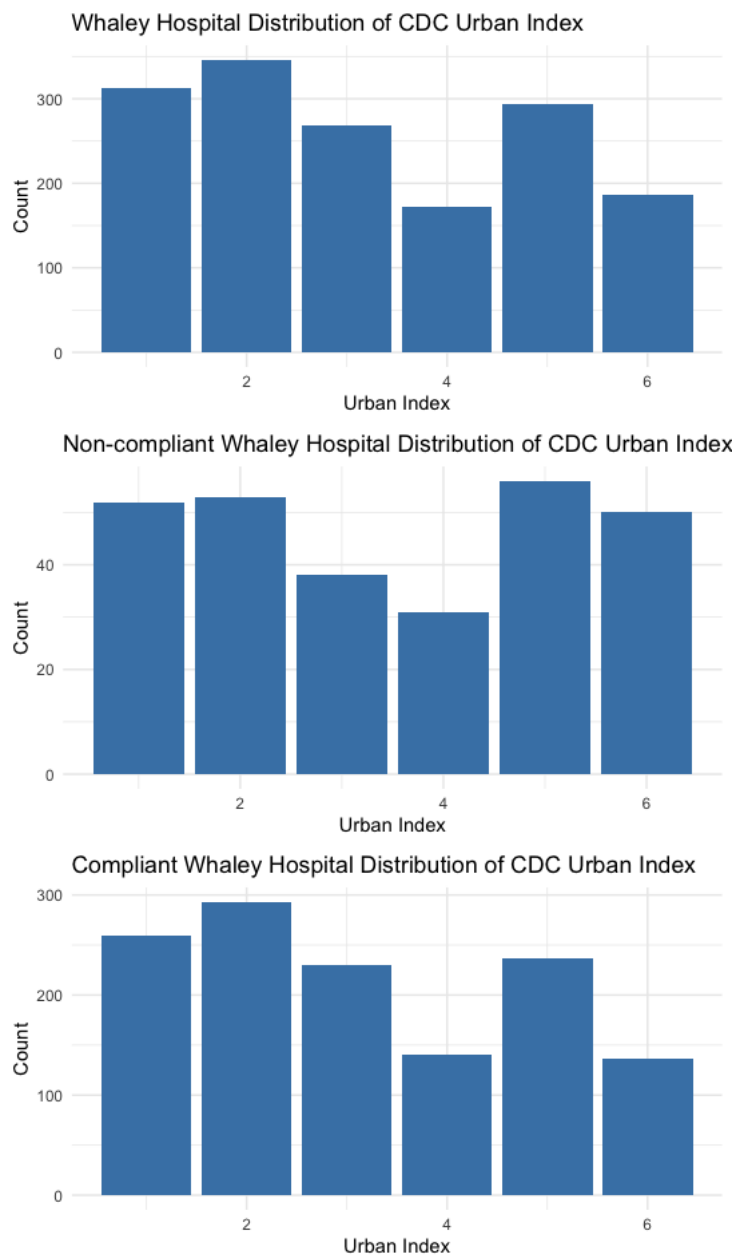
This heatmap shows the distribution of hospitals in the White and Whaley dataset by county. Most of the counties that contain a White and Whaley hospital have just one, and we notice these hospitals are not uniformly distributed by region. Source: Author created.

Figure 3.3: Hospital Referral Regions



This map shows the distribution of hospital referral regions, a geographical designation of local hospital markets. Source: Dartmouth Atlas of Health Care

Figure 3.4: Urbanness Measures of White and Whaley Hospitals



1 is the most urban category, 6 is the most rural. Note that the non-compliant hospitals (middle graph) skew more rural than the compliant hospitals (bottom graph). These histograms show the urbanness of these hospitals. The top graph is the whole sample. Source: Author created.

METHODOLOGY

For this analysis, we only have cross-sectional data so we cannot infer causal relationships such as “being larger causes a hospital to be more likely to comply.” However, I will suggest some possible explanations for the correlations observed which will be helpful for regulators trying to understand the barriers to compliance.

Regression Specifications

The outcome of interest is the compliance rate for hospital H in market M which charges a certain percentage of Medicare prices for outpatient treatments. To identify the correlation with hospital size, market concentration (HHI), and hospital price on the likelihood of a hospital complying with the price transparency mandate, this analysis begins with a linear probability model regression with controls for each. All regressions include urban fixed effects.

This is the baseline regression equation:

$$\text{Compliance of Hospital}_{HM} (0/1) = \beta_1 \text{Bed Count}_H + \beta_2 \text{Bed Count}_H^2 + \beta_3 \text{HHI}_M + \beta_4 \text{Price Index}_H + \beta_5 \text{Health Insurer Market Share}_H + \beta_6 \text{Number of Outpatient Procedures}_H + \epsilon \quad (4.1)$$

A squared term is included for the hospital bed count to determine if there is a non-linear correlation with hospital size. Perhaps very small hospitals struggle with compliance cost, but as hospital size increases, compliance ability increases rapidly leaving little difference in compliance rates between medium-sized hospitals and large hospitals. We would expect to see a negative sign on the coefficient for bed count squared if that is the case.

The second regression equation is the same as above, except the outcome variable is a binary indicator for high compliance.¹

$$\text{Highly Compliant}_{HM} (0-1) = \beta_1 \text{Bed Count}_H + \beta_2 \text{Bed Count}_H^2 + \beta_3 \text{HHI}_M + \beta_4 \text{Price Index}_H + \beta_5 \text{Health Insurer Market Share}_H + \beta_6 \text{Number of Outpatient Procedures}_H + \epsilon \quad (4.2)$$

¹High compliance is a 4 or 5 out of 5 on the Turquoise Health Price Transparency Scorecard, a numerical scale of how well the hospital’s machine-readable file satisfies the disclosure requirements. This variable comes from the Turquoise Hospital Pricing data set.

This regression tests if the hospital or market characteristics are correlated with the hospital's likelihood of being highly compliant.

The third and fourth regression specifications collapse observations to the hospital system level. This allows me to test if compliance is correlated with system-level factors. The third regression has mean compliance rate as the outcome, and the fourth regression has mean highly compliant rate within the hospitals in each hospital system as the outcome.

Mean Compliance Rate of Hospitals in System $_{SM} = \beta_1 \text{Total Bed Count}_H + \beta_2 \text{Total Bed Count}_H^2 + \beta_3 \text{Mean HHI}_M + \beta_4 \text{Mean Price Index}_H + \beta_5 \text{Mean Health Insurer Market Share}_H + \beta_6 \text{Mean Number of Outpatient Procedures}_H + \epsilon$ (4.3)

Mean Highly Compliant Rate of Hospitals in System $_{SM} = \beta_1 \text{Total Bed Count}_H + \beta_2 \text{Total Bed Count}_H^2 + \beta_3 \text{Mean HHI}_M + \beta_4 \text{Mean Price Index}_H + \beta_5 \text{Mean Health Insurer Market Share}_H + \beta_6 \text{Mean Number of Outpatient Procedures}_H + \epsilon$ (4.4)

The final regression specification is the same as regression 4.1 but restricts the sample to just acute-care hospitals because there are potential concerns that the critical access hospitals are different in ways that can be problematic for the analysis.

Compliance of Acute-Care Hospital $_{HM}$ (0/1) $= \beta_1 \text{Bed Count}_H + \beta_2 \text{Bed Count}_H^2 + \beta_3 \text{HHI}_M + \beta_4 \text{Price Index}_H + \beta_5 \text{Health Insurer Market Share}_H + \beta_6 \text{Number of Outpatient Procedures}_H + \epsilon$ (4.5)

RESULTS

Interestingly, price index is not associated with a hospital’s likelihood of compliance or degree of compliance in any of the specifications.

Across all specifications, smaller hospitals are less likely to be compliant. For context, the coefficient on hospital beds is 0.065 per hundred beds, which is 6.5%. For each additional hundred hospital beds, the hospital is expected to be 6.5% more likely to comply with the regulation. The median hospital size is 152 beds, so that hospital is 8.25 percentage points more likely to comply than a 25 bed hospital (9.88%-1.63%). A hospital at the 90th percentile of hospital size, 534.7 beds, is 24.3 percentage points more likely to comply than the median hospital (34.8%-9.88%). This provides suggestive evidence for suspicion that compliance cost is part of the reason for lagging compliance.

The regressions by hospital system are the only regressions that indicate a (weakly) significant connection between number of outpatient procedures recorded in the White and Whaley data for the hospitals and their compliance. This data does not include a comprehensive list of all outpatient procedures offered by the hospitals, and so is not an ideal measure of compliance cost. Future use of the updated larger White and Whaley data set will provide a number of procedures that is more representative of how many different procedures a hospital offers.

The competitiveness measure shows an inconsistent association with compliance depending on the specification. In the baseline regression for compliance rate, hospitals in less competitive markets are more likely to comply. This finding is counterintuitive and contradicts the finding in Haque and Hsiehchen (2022), but is consistent with the finding in Jiang et al. (2022). The effect size is also very small. The hospitals in the 90th percentile (HHI of 4689.370) are 2.9 percentage points more likely to comply than the median hospital (HHI of 2000.8), while hospitals in the 10th percentile (HHI of 1020.272) are 1.04 percentage points less likely to comply than the median hospital (2.12-1.08).

In the regressions at the hospital system level, we find that the results are in line with the other regressions. It does appear that hospitals are complying (or not) along with their affiliated hospitals.

CONCLUSION

Using price indices from health insurance claims and employer-provided health plans in 25 states, this analysis finds no relationship between those price indices and hospital compliance. The existing literature has not been able to consider the impact of price of hospital services on compliance because if hospitals do not publish their prices, another source of pricing information is required to determine if high-price hospitals are withholding their prices. We might expect that hospitals with high priced services will attempt to hide their high prices (standard competition theory), but my results indicate that hospitals with high prices for services do not appear to be any less likely to comply. This makes some sense when we consider that the literature finds patients largely do not respond to price transparency, for a number of reasons.¹

The most robust and large finding of this analysis is a correlation between small size of hospital and lower likelihood of publishing prices, suggesting that compliance fixed costs for small hospitals may be a significant barrier to hospitals publishing their prices. A large hospital is about 33 percentage points more likely to comply than a small hospital, indicating that there is potential for improvement by focusing on supporting small and midsize hospitals to comply. This finding contradicts the finding of Haque and Hsiehchen (2022) and is consistent with Jiang et al. (2022). I also find no evidence that the competitiveness of the health insurer market affects compliance rate except in the logit models.

This analysis has a few limitations that I hope to address with future research. The White and Whaley data includes only about a quarter of acute-care hospitals in half of the states in the U.S., and only 4 million patients. I plan to update my results with an expanded (2022) release of the White and Whaley data, which contains almost three times as many hospitals. Because my current sample only includes 1/3 of U.S. hospitals and the geographical spread is not comprehensive, the representativeness of my analysis' findings is questionable.

This analysis is unable to make causal claims because it is based on cross-sectional data, so we can only show that smaller hospitals are less compliant rather than assert that being small causes difficulty complying with the law. A study of mergers to investigate how

¹Price sensitivity may be low because the hospital pricing system is complicated even with price transparency (see "Background" for further discussion), patients trust their provider's recommendations, the structure of insurance discourages price-shopping (Chernew et al. (2021)), and because insurance pays the bulk of the price for many procedures. My finding is also consistent with the finding of Chernew et al. (2021) that only a small percent of patients who had access to a price transparency tool ever even looked at the website.

increasing some measure of size of the hospital system (like patient-days or bed count) affects compliance would be interesting and would have more explanatory power.

For regulators trying to understand the barriers to compliance, this analysis strongly suggests that the compliance cost is meaningful especially for small hospitals. This is also an opportunity for entrepreneurs to develop software to aid hospitals in publishing their prices and updating them smoothly.

There is no evidence of high price hospitals refusing to publish prices. So though high-price hospitals are concerning for other reasons (White and Whaley (2019)), this finding suggests that price competition is not a significant part of hospitals' decision calculus. This is not a surprising finding, but it does highlight the extent to which hospital markets are shielded from the market forces that drive price reductions and quality improvements in other markets. One way to increase the competitive behavior in markets is to change the insurance structure so that patients care about prices. The literature indicates that reference pricing and changing referral pathways encourages price-sensitivity while increased deductibles do not appear to affect price-sensitivity. (Chernew et al. (2021))

This study is unable to identify the causes of the unexpected finding that hospitals in more competitive markets are less likely to comply, but some possible explanations are higher profit margins in more monopolized markets that make compliance cost easier to bear, less potential harm for hospitals from disclosing prices if there are no significant competitors, or hospitals in more competitive markets change their prices more often and so have a higher cost to publishing them. Data about hospital profit margins would allow us to test the suspicion that profitability affects compliance ability. The modest evidence of a correlation between more monopolized markets and lower compliance rates raises interesting questions about the mechanisms that might discourage hospitals in competitive markets from publishing prices. Future research can explore the robustness of this finding and attempt to disentangle the intertwined impacts of profit margins, market size, and market competitiveness on compliance.

ROBUSTNESS

A logit regression with the same covariates is included in the appendix to test for marginal effects.

In light of some concerns about the difference between general acute care hospitals and critical access hospitals¹, I include a specification that excludes critical access hospitals.

An early regression with Hospital Referral Region fixed effects indicates that they are not significant, and are undesirable because they absorb all the variation.

Earlier versions of this regression included an interaction between price and the competition measure attempt to identify a correlation between high-price hospitals in more competitive markets and now publishing prices. It is possible that a high-price hospital in a more competitive market finds disclosing their prices to be more harmful than if that hospital was in a less competitive market, but the interaction term did not appear to have any explanatory power so it was removed from the regressions.

¹Critical access hospitals are small, typically 25 bed hospitals that are in rural underserved areas. Qualifying hospitals that opt to become critical access hospitals are reimbursed by Medicare on a cost basis, though this is not always advantageous to a hospital, and many small hospitals do not qualify to be critical access hospitals or choose to remain general acute care hospitals.

REGRESSION TABLES

See Appendix A for logit regression tables and analysis.

Table 8.1: Factors Affecting Hospital Compliance With Price Transparency Mandate

	Compliant (0/1)	Highly Compliant (0/1)
Price Index	0.000 (0.000)	0.000 (0.000)
Bed Count (hundreds)	0.065** (0.013)	0.044** (0.011)
Bed Count Squared	-5.6×10^{-5} ** (1.1×10^{-5})	-3.5×10^{-5} ** (8.00×10^{-6})
Outpatient Services (thousands)	0.001 (0.001)	0.002 (0.001)
HHI (thousands)	0.01* (0.001)	0.000 (0.000)
Insurer Market Share	0.001 (0.001)	0.001 (0.001)
Num.Obs.	1564	1564
R2	0.037	0.015
Mean Compliance	81.5%	67.5%
FE: Urban	X	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table notes: Estimates are from the linear probability model specification described in equations 4.1 and 4.2. The unit of observation is the hospital. The dependent variable for “Compliant” is 1 if the hospital is present in the Turquoise data (indicating any degree of compliance with the price transparency law), and 0 otherwise. The dependent variable for “Highly Compliant” is 1 if the hospital has a Turquoise compliance score of 4 or 5 (out of 5), and 0 otherwise. Standard errors are clustered by urbanness.

Table 8.2: Factors Affecting Hospital Compliance With Price Transparency Mandate, by Hospital System

	Compliant (0/1)	Highly Compliant (0/1)
Price Index	0.000 (0.000)	0.000 (0.000)
Sum Bed Count (hundreds)	0.004* (0.001)	0.003** (0.001)
Bed Count Squared	0.000 (0.000)	0.000 (0.000)
Outpatient Services (thousands)	0.003* (0.001)	0.004* (0.001)
HHI (thousands)	0.000 (0.000)	0.000 (0.000)
Insurer Market Share	0.000 (0.002)	0.001 (0.001)
Num.Obs.	760	760
R2	0.030	0.020
Mean Compliance	72.6%	60%
FE: Urban	X	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table notes: Estimates are from the linear probability model specification described in equations 4.3 and 4.4. The unit of observation is the hospital system. The dependent variable for “Compliant” is 1 if the hospital is present in the Turquoise data (indicating any degree of compliance with the price transparency law), and 0 otherwise. The dependent variable for “Highly Compliant” is 1 if the hospital has a Turquoise compliance score of 4 or 5 (out of 5), and 0 otherwise. Standard errors are clustered by urbanness.

Table 8.3: Acute Care Only, Factors Affecting Hospital Compliance With Price Transparency Mandate

	Compliant 0/1)	Highly Compliant (0/1)
Price Index	0.000 (0.000)	0.000 (0.000)
Bed Count (hundreds)	0.070** (0.012)	0.046* (0.015)
Bed Count Squared	$-5 \times 10^{-7**}$ (1×10^{-7})	$-4 \times 10^{-7*}$ (1×10^{-7})
Outpatient Services	0.001 (0.001)	0.002 (0.001)
HHI (thousands)	0.012* (0.004)	-0.008 (0.014)
Insurer Market Share	0.001 (0.001)	0.002 (0.001)
Num.Obs.	1309	1309
R2	0.044	0.017
Mean Compliance	82.5%	67.6%
FE: Urban	X	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table notes: Sample is restricted to acute-care hospitals. Estimates are from the linear probability model specification described in equations 4.1 and 4.2. The unit of observation is the hospital system. The dependent variable for “Compliant” is 1 if the hospital is present in the Turquoise data (indicating any degree of compliance with the price transparency law), and 0 otherwise. The dependent variable for “Highly Compliant” is 1 if the hospital has a Turquoise compliance score of 4 or 5 (out of 5), and 0 otherwise. Standard errors are clustered by urbanness.

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APPENDICES

APPENDIX A

LOGIT REGRESSIONS

We see in these logit regressions that the signs and significant coefficients are generally consistent with the coefficients for the OLS regressions. The second regression shows no significance on bed size, and high significance on number of outpatient services and insurer market share, the only regression in this analysis to do so.

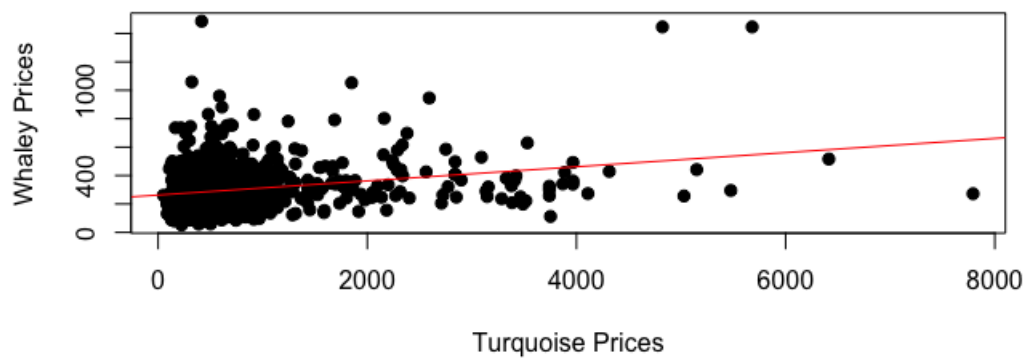
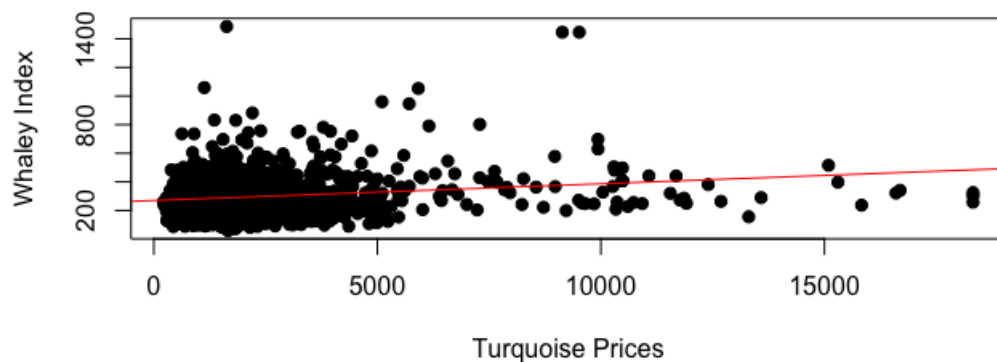
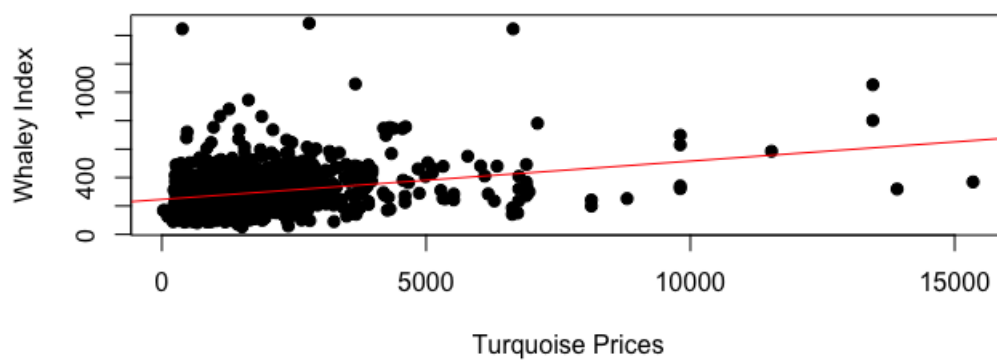
Table A.1: Logit Regressions

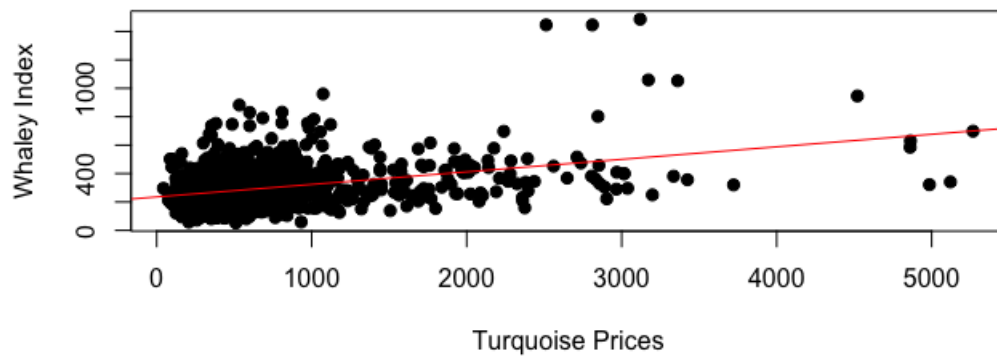
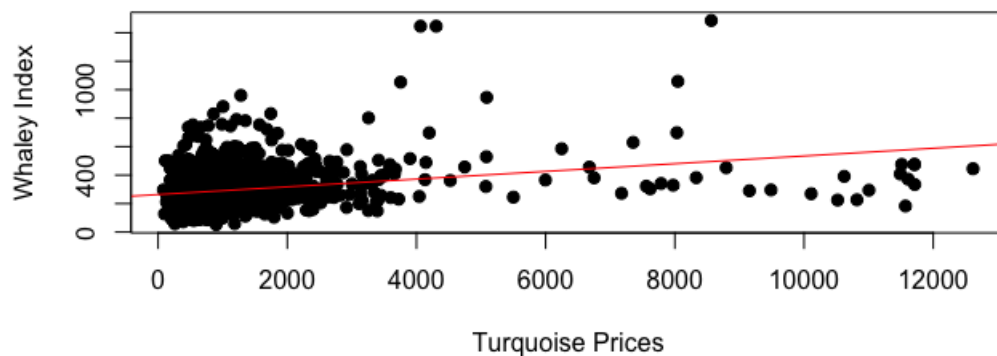
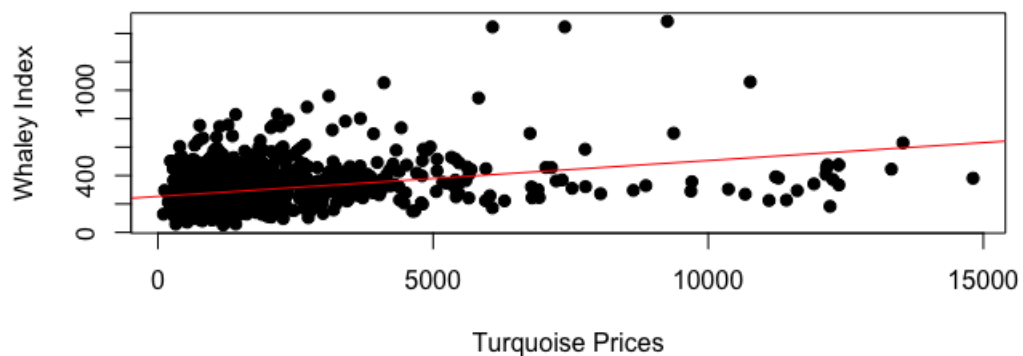
	<i>Dependent variable:</i>			
	Compliance Rate (Hospital) (1)	Highly Compliant (Hospital) (2)	Compliance Rate (System) (3)	Highly Compliant (System) (4)
Price Index	-0.0001 (0.0004)	-0.0001 (0.0003)	-0.001 (0.0005)	0.0001 (0.0004)
Bed Count (Hundreds)	0.07*** (0.01)	0.04*** (0.01)	0.004*** (0.001)	0.003** (0.001)
Beds Squared	--6e-05*** (1e-05)	--3e-05*** (1e-05)	-0.00000 (0.00000)	-0.00000 (0.00000)
Number of Services (Thousands)	0.001 (0.0009)	0.002* (0.001)	0.004** (0.00002)	0.003** (0.00001)
HHI (Thousands)	0.01* (0.00005)	0.003 (0.00003)	0.0001 (0.001)	-0.00001 (0.00005)
Insurer Market Share	0.005 (0.004)	0.001* (0.0008)	0.0003 (0.001)	0.001 (0.001)
Constant	0.408 (0.288)	-0.767*** (0.228)	0.251 (0.342)	-1.337*** (0.317)
Observations	1,580	1,580	760	760
Log Likelihood	-729.292	-1,083.238	-429.846	-500.021
Akaike Inf. Crit.	1,472.584	2,180.476	873.692	1,014.042

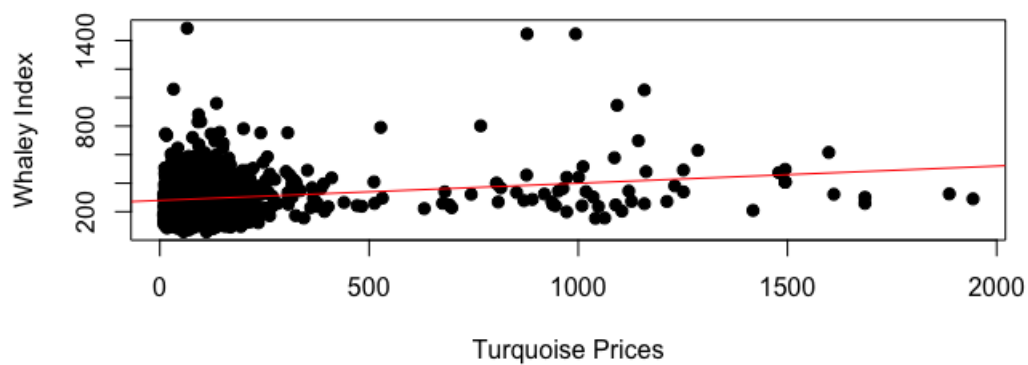
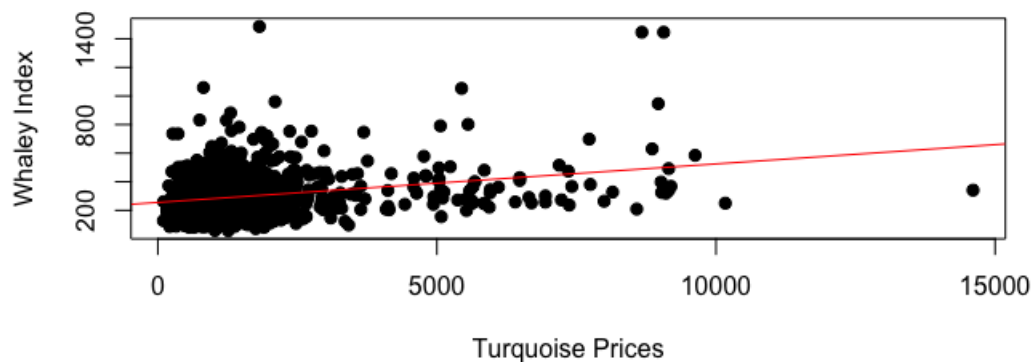
Note: *p<0.1; **p<0.05; ***p<0.01

APPENDIX B

CORRELATION GRAPHS

Abdominal Ultrasound: Turquoise and Whaley Rates Correlation**Brain MRI: Turquoise and Whaley Rates Correlation****Colonoscopy: Turquoise and Whaley Rates Correlation**

Emergency Room Level 3: Turquoise and Whaley Rates Correlation**Emergency Room Level 4: Turquoise and Whaley Rates Correlation****Emergency Room Level 5: Turquoise and Whaley Rates Correlation**

Kidney Blood Panel: Turquoise and Whaley Rates Correlation**Pelvis CT Scan: Turquoise and Whaley Rates Correlation****New Patient Visit, 30min: Turquoise and Whaley Rates Correlation**