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Less Physician Practice Competition Is Associated With Higher Prices Paid For Common Procedures

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ABSTRACT Concentration among physician groups has been steadily increasing, which may affect prices for physician services. We assessed the relationship in 2010 between physician competition and prices paid by private preferred provider organizations for fifteen common, high-cost procedures to understand whether higher concentration of physician practices and accompanying increased market power were associated with higher prices for services. Using county-level measures of the concentration of physician practices and county average prices, and statistically controlling for a range of other regional characteristics, we found that physician practice concentration and prices were significantly associated for twelve of the fifteen procedures we studied. For these procedures, counties with the highest average physician concentrations had prices 8–26 percent higher than prices in the lowest counties. We concluded that physician competition is frequently associated with prices. Policies that would influence physician practice organization should take this into consideration.

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Over the past decade, there has been a steady shift among physicians away from solo and small-group practices toward larger entities.^{1–3} Larger practices with more resources may be better able to coordinate care by multiple providers, more rapidly implement process improvements, more effectively harness technological advances, and more quickly identify new strategies that benefit more patients.^{4–7} One possible trade-off, however, is greater market power held by fewer provider groups, which may result in higher prices.

Rising market concentration has raised concerns about higher prices in a variety of industries, from airlines to hospitals, and some have grown concerned that the movement toward increasingly consolidated physician practices could also raise prices for health services.⁸ Prior work on the effects of concentration in health care has focused predominantly on hospitals and

insurance companies,⁸ and less is known about physician practices. To date, studies of the relationship between physician concentration and prices have been limited to composite price measures for particular specialties (such as orthopedics or cardiology), to closely defined geographic areas, or to prices for nonprocedural services such as office visits.^{9–11} We set out to examine the relationship between increasing concentration across specialties and prices for medical and surgical procedures, given the importance of procedures as a driver of rising costs in the United States. We focused our attention on high-cost, high-volume procedures, reasoning that these are important for overall spending and, because they may be of particular interest to physicians, would likely be associated with variations in concentration, if such associations exist.

Having a better understanding of how reduced competition among physicians influences payments for medical and surgical procedures will

be valuable, given the likely continuing attention to policy measures focused on changes in delivery system structure.¹² It may also help clarify some of the potential causes of remarkable regional variation in prices for identical medical services across the United States.^{13–15} Two- to threefold variations in average prices across areas have been commonly noted—for example, in knee replacement, where area average prices have been reported to range from a low of less than \$20,000 to highs near \$60,000.¹⁶

Study Data And Methods

We conducted our study by combining county-level measures of prices paid by preferred provider organizations (PPOs) for common procedures with data on the average concentration of physician practices derived from Medicare claims data, and using regression analysis to conduct a cross-sectional analysis of the association between these measures, controlling for a range of possible confounding variables.

PRICES PAID FOR MEDICAL AND SURGICAL PROCEDURES Pricing data for physician services were obtained from the Truven Health Analytics MarketScan Commercial Claims and Encounters database for 2010.¹⁷ The database contains information from adjudicated and paid claims filed for the care of roughly forty-nine million privately insured individuals with employment-based insurance through their employer. The database covers a wide geographic range and variety of insurers and is considered a reliable source for

health care spending and reimbursement data.^{10,15,18–20}

We studied fifteen high-cost, high-volume procedure-specialty combinations, each comprising claims by physicians in a given specialty for the performance of a given procedure (Exhibit 1). After inspecting the number of claims for procedures that appeared in the data, we found that selecting all procedure-specialty combinations with at least 7,000 total bills in 2010 and a mean price of at least \$500 yielded a set of procedure-specialty combinations that each had enough cases for strong statistical analyses and that represented a diverse group of specialties. Further details on the selection of procedures is available in the online Appendix.²¹

In our analysis, we included only claims from health plans identified as PPOs that paid physicians on a fee-for-service basis. We also required that the patient was younger than age sixty-five; the provider of the billed service was identified as an in-network physician; the reported place of service was a physician office, inpatient hospital, hospital outpatient facility, or ambulatory surgery center; the claim was for professional services (as opposed to facility charges); and the claim had no Current Procedural Terminology (CPT) modifier codes, which when present on a claim can affect the amount paid. A small number of claims with prices more than 100 times or less than 0.01 times the national mean for the given CPT code were excluded as outliers. Our analysis was conducted at the county level, and for each procedure-specialty combination we in-

EXHIBIT 1

Fifteen High-Cost, High-Volume Procedure-Specialty Combinations Analyzed, And Sizes Of Samples Used In The Analysis

CPT code	Procedure	Specialty	No. of claims on which analysis is based	No. of counties used in analysis
17311	Mohs surgery for skin tumor	Dermatology	21,916	490
27447	Total knee replacement	Orthopedics	7,930	509
29826	Shoulder arthroscopy and surgery	Orthopedics	7,914	610
29881	Knee arthroscopy and surgery	Orthopedics	16,471	922
30520	Repair of nasal septum	Otolaryngology	15,025	833
44970	Laparoscopic appendectomy	General surgery	12,017	991
45385	Colonoscopy with lesion removal	Gastroenterology	72,627	1,453
47562	Laparoscopic cholecystectomy	General surgery	28,570	1,525
47563	Laparoscopic cholecystectomy with imaging	General surgery	13,730	928
49505	Inguinal hernia repair	General surgery	6,431	609
50590	Fragmenting of kidney stone	Urology	9,170	666
55250	Vasectomy	Urology	21,954	904
66984	Cataract removal and prosthetic lens	Ophthalmology	8,394	661
77418	Intensity-modulated radiation therapy	Radiation oncology	20,625	153
92980	Insertion of intracoronary stent	Cardiology	6,355	546

SOURCE Authors' analysis of Truven Health Analytics MarketScan Commercial Claims and Encounters data for 2010. **NOTE** CPT is Current Procedural Terminology.

Our findings are consistent with the hypothesis that greater market power allows physicians to bargain for higher prices from insurers.

cluded only claims from counties that had at least three claims for that procedure-specialty combination. Finally, we excluded combinations involving either obstetrics and gynecology or pediatrics, since our practice competition measures are derived from Medicare data, in which these specialties are inadequately represented.

For each county, for each procedure-specialty combination, we obtained the number of claims and mean price paid to physicians reporting a practice location in the county, separately by place of service. The payment we studied was the amount the plan agreed to pay the physician for the service, after the application of contractual discount provisions and other plan rules, commonly called the “allowed amount.” We refer to this as the “price” for the service. The physician may have received this partly from the insurer and partly from the patient in the form of applicable copayments or deductibles.

PHYSICIAN PRACTICE COMPETITION The MarketScan data do not contain enough information to measure competition, so we derived our competition measures from Medicare claims filed by physicians for the care of a 20 percent random sample of traditional Medicare enrollees. Medicare claims reflect care delivered by a very large share of active physicians, and the set of physicians who billed traditional Medicare should overlap substantially with the set of physicians who provide services to private PPO patients. Since physician-insurer negotiations over procedure pricing occur prior to enactment of new pricing, practice competition measures from 2009 Medicare data were matched with pricing measures from 2010 MarketScan data.

Consistent with previous work,^{3,10,22–24} we defined physician practices as a group of physicians in the same specialty who billed under the same tax ID (additional discussion of the identification of practices using tax ID can be

found in the online Appendix).²¹

As with other recent studies and consistent with practices of the Federal Trade Commission and the Department of Justice, we used the Herfindahl-Hirschman Index (HHI) for measuring competition among physician practices.^{10,25–28} Higher HHIs indicate less competition. The highest possible HHI of 10,000 indicates a monopoly market, served by a single practice. As the number of practices increases, and the size of each individual practice falls, the amount of competition will increase, and the HHI will decline toward zero.

We constructed an HHI for each practice, reflecting the market area served by the practice, with the same methods used in prior studies of physician groups and hospitals,^{10,26,29} incorporating guidance from the Federal Trade Commission and the Department of Justice for assessing competition among accountable care organizations.²⁴ To allow comparison to the price data, which were measured at the county level, we required a corresponding measure of the amount of competition facing practices in the county. We constructed this as the county-level mean of the practice HHIs of physicians located within each county. The Appendix contains additional information on the computation of the HHIs.²¹

STATISTICAL ANALYSES We used ordinary least squares linear regression to examine the association between HHI and procedure price measures. The main independent variable was the HHI. For each procedure-specialty combination, we grouped counties into quartiles according to the HHI and included dummy variables for quartiles in the models. We also included a set of controls to adjust for characteristics of counties that could influence prices, including county population; the total number of physicians per population; the number of physicians in the given specialty per population; the number of short-term general hospitals and hospital beds per population; the HHI of hospitals serving the county; median household income; the percentage of the population uninsured, older than age twenty-five who completed high school, older than age twenty-five who completed four or more years of college, enrolled in Medicare, or eligible for Medicaid; and a dummy for counties in Metropolitan Statistical Areas, defined by the Census Bureau as groups of counties tied to urban centers of 50,000 people or more. We used the Medicare Geographic Practice Cost Indices to control for practice costs. We estimated models separately for each procedure-specialty combination, which allowed for variation in the association between concentration and prices across procedures and specialties. We report the predicted

prices by HHI quartile, holding the controls fixed at their sample means.

Since the regression models controlled for the number of physicians per capita, the associations between HHI and prices we measured should be interpreted as reflecting differences in the ways physician practices are organized, statistically holding fixed the number of physicians. That is, they may be interpreted as showing, for a given number of physicians, how prices vary when those physicians are organized into larger instead of smaller practices.

We conducted a number of sensitivity analyses (details on the sensitivity analyses are available in the Appendix).²¹ First, we excluded counties not in a Metropolitan Statistical Area and reestimated the model. Second, we added state fixed effects to the model. The fixed effects capture characteristics of states that we did not observe but could have been correlated with competition and prices, although at the risk of “overcontrolling” and causing us to underestimate the true strength of the association between HHI and prices. Third, we included a control for the presence of multispecialty groups, which may be related to market competition factors. Finally, we included a measure of the HHI of area PPOs,³⁰ available for a subset of the counties in our analysis.

Throughout the analysis, we computed robust standard errors to account for variation in the number of claims underlying the dependent variables.

LIMITATIONS This study faced limitations inherent to the study’s design and data, including those that arose from cross-sectional analyses and the corresponding risk that there were omitted regional characteristics and other confounding factors.

One confounder that was potentially important but difficult to observe was the degree of competition between private insurers. Our main models did not control for insurer competition. Although available measures of PPO competition have significant flaws,³¹ we performed sensitivity tests using one such measure.³⁰ We also conducted sensitivity analyses that included state fixed effects, which control for state-level insurer competition (and any other unobserved but relevant characteristics of states). The consistency of our results in these sensitivity tests added additional confidence that our overall conclusions were not as a result of unobserved differences across regions in insurer competition or other state characteristics. (See the Appendix for these sensitivity results.)²¹

An additional consideration was the possibility of reverse causality if variations in physician concentration were driven by variations in prices.

Policies that balance any benefits of larger organizations with the potential for problematic price increases are needed.

While this was possible, we reasoned that practices would be most likely to consolidate in response to lower prices. Since we found more concentration associated with generally higher prices, we believe that the most likely effect of reverse causality, if present, would lead to conservative results that understate the strength of the association between concentration and prices.

Finally, this study used prices paid by PPO plans offered by a group of generally large employers, which might not be representative of other types of insurance coverage.

Study Results

Based upon our price and volume thresholds, we identified fifteen specialty-procedure combinations that spanned a total of nine surgical and medical specialties: dermatology, cardiology, radiation oncology, gastroenterology, otolaryngology, urology, ophthalmology, orthopedics, and general surgery (Exhibit 1). The number of county-level observations varied across the procedure-specialty combinations because of variations in the total number of claims in the database for each and the extent to which physicians in the relevant specialty were geographically dispersed.

The average level of concentration varied across the counties studied for each procedure-specialty combination (Exhibit 2). General surgeons, orthopedists, and ophthalmologists had the lowest HHIs, while urologists and radiation oncologists had the highest among the specialties in our study. There was considerable variation across counties within specialties. The mean practice HHI in the ninetieth-percentile county was always more than twice that in the tenth-percentile county and was frequently more than three times higher. The HHI in the seventy-fifth-percentile county was 1,300–2,400 higher than in the twenty-fifth-percentile county. Fourteen of

EXHIBIT 2**Summary Statistics For Herfindahl-Hirschman Indices (HHIs) For Fifteen Procedure-Specialty Combinations**

Procedure (specialty)	No. of counties	Mean HHI	HHI percentile across counties				
			10th	25th	50th	75th	90th
Mohs surgery for skin tumor (dermatology)	490	3,175	1,457	1,902	2,676	4,020	5,867
Total knee replacement (orthopedics)	509	3,187	1,677	2,123	2,847	3,896	5,172
Shoulder arthroscopy and surgery (orthopedics)	610	3,038	1,647	2,026	2,718	3,723	4,923
Knee arthroscopy and surgery (orthopedics)	922	3,149	1,662	2,092	2,803	3,846	5,138
Repair of nasal septum (otolaryngology)	833	4,005	2,143	2,821	3,673	4,876	6,323
Laparoscopic appendectomy (general surgery)	991	3,058	1,757	2,169	2,773	3,676	4,782
Colonoscopy with lesion removal (gastroenterology)	1,453	3,964	1,855	2,567	3,729	5,005	6,472
Laparoscopic cholecystectomy (general surgery)	1,525	3,048	1,729	2,151	2,718	3,648	4,791
Laparoscopic cholecystectomy with imaging (general surgery)	928	3,186	1,780	2,227	2,835	3,770	5,170
Inguinal hernia repair (general surgery)	609	2,974	1,716	2,117	2,597	3,500	4,703
Fragmenting of kidney stone (urology)	666	4,509	2,535	3,242	4,196	5,605	7,011
Vasectomy (urology)	904	4,601	2,604	3,278	4,304	5,683	7,199
Cataract removal and prosthetic lens (ophthalmology)	661	2,535	1,304	1,650	2,213	3,144	4,150
Intensity-modulated radiation therapy (radiation oncology)	153	6,096	3,851	4,804	6,074	7,227	8,344
Insertion of intracoronary stent (cardiology)	546	3,184	1,389	2,016	2,961	3,957	5,314

SOURCE Authors' analysis of HHI measures for analysis counties derived from Medicare claims data for 2009.

the fifteen procedure-specialty combinations examined had HHIs of more than 2,500 in the fiftieth-percentile county, above the threshold used by the Federal Trade Commission and the Department of Justice to classify markets as being highly concentrated.²⁷

Mean prices for the procedures studied varied (Exhibit 3). Total knee replacement and insertion of intracoronary stent were the two most expensive, on average (\$2,301 and \$1,282, respectively), and vasectomy and colonoscopy were the least expensive (\$576 and \$586, respec-

EXHIBIT 3**Summary Statistics For Procedure Prices Across Counties For Fifteen Procedure-Specialty Combinations**

Procedure (specialty)	No. of counties	Mean price (\$)	Price percentile across counties (\$)				
			10th	25th	50th	75th	90th
Mohs surgery for skin tumor (dermatology)	490	724	503	572	672	822	1,028
Total knee replacement (orthopedics)	509	2,301	1,551	1,786	2,119	2,549	3,184
Shoulder arthroscopy and surgery (orthopedics)	610	758	420	538	667	883	1,150
Knee arthroscopy and surgery (orthopedics)	922	936	592	694	838	1,036	1,301
Repair of nasal septum (otolaryngology)	833	755	474	568	680	850	1,136
Laparoscopic appendectomy (general surgery)	991	816	588	666	743	900	1,033
Colonoscopy with lesion removal (gastroenterology)	1,453	586	353	416	537	687	870
Laparoscopic cholecystectomy (general surgery)	1,525	1,034	710	821	930	1,121	1,341
Laparoscopic cholecystectomy with imaging (general surgery)	928	1,091	769	866	1,002	1,196	1,415
Inguinal hernia repair (general surgery)	609	676	482	553	627	751	887
Fragmenting of kidney stone (urology)	666	1,050	601	712	859	1,163	1,463
Vasectomy (urology)	904	576	301	442	564	694	809
Cataract removal and prosthetic lens (ophthalmology)	661	917	626	696	835	1,004	1,283
Intensity-modulated radiation therapy (radiation oncology)	153	881	549	637	769	1,008	1,210
Insertion of intracoronary stent (cardiology)	546	1,282	865	988	1,159	1,449	1,789

SOURCE Authors' analysis of Truven Health Analytics MarketScan Commercial Claims and Encounters data for 2010.

tively). There was also considerable variation across counties within each procedure-specialty combination. The mean price in the ninetieth-percentile county was 1.8–2.7 times higher than in the tenth-percentile county. The seventy-fifth-percentile county was commonly \$200–\$300 more than the twenty-fifth-percentile county, and in some cases more.

We examined the characteristics of counties with HHIs above the median HHI and counties at or below the median. Results are available in the Appendix for two representative procedure-specialty combinations²¹ (patterns for other procedure-specialties were similar). Counties where the mean practice HHI was above the median had significantly smaller populations than areas with HHIs below the median and were more likely to be outside of a Metropolitan Statistical Area. This is expected, since more urban and highly populated areas typically have more physicians serving the same area, which can easily foster competition among practices, and this pattern is also seen in hospital competition.³² There are also other less pronounced but still significant differences. Counties with higher physician HHIs tended to have more hospitals per population, lower income and educational attainment, higher Medicare enrollment, higher hospital

HHIs, and lower practice costs compared to counties with lower physician HHIs. The place of service also varied by procedure and with the HHI.

After adjustment for these characteristics, mean prices were frequently higher in areas with more concentration (Exhibit 4). There were significant ($p < 0.05$) variations in prices across the HHI quartiles in twelve of the fifteen procedure-specialty combinations studied. In eleven of these twelve, the price in the highest-HHI quartile, with the most concentration, was higher than the price in the lowest-HHI quartile. In addition to testing whether there were significant variations across all four HHI quartiles, we also separately tested whether the price in the highest-HHI quartile was itself significantly different from the price in the lowest-HHI quartile. The difference was significant ($p < 0.05$) in ten of fifteen procedure-specialty combinations.

Many of the price differences are quite large. In cases where the price in the highest-HHI-quartile counties is significantly different from the price in the lowest-HHI quartile counties, adjusted prices are 13–26 percent higher than in the lowest-HHI-quartile counties, with differences of \$94–\$291 per procedure. Differences between adjusted prices in the lowest- and highest-HHI

EXHIBIT 4

Variations In Prices For Procedure-Specialty Combinations According To Herfindahl-Hirschman Index (HHI) Quartile, After Adjustment For Other County Characteristics

Procedure (specialty)	HHI quartile (\$)				Ratio, quartile 4 to quartile 1
	1 (most competitive)	2	3	4 (least competitive)	
Mohs surgery for skin tumor (dermatology) ^{***}	702	659	737	797	1.13**
Total knee replacement (orthopedics) ^{****}	2,259	2,078	2,428	2,440	1.08*
Shoulder arthroscopy and surgery (orthopedics)*	760	700	816	756	0.99
Knee arthroscopy and surgery (orthopedics) ^{****}	887	849	970	1,036	1.17****
Repair of nasal septum (otolaryngology)**	723	746	732	817	1.13**
Laparoscopic appendectomy (general surgery) ^{***}	779	785	797	904	1.16****
Colonoscopy with lesion removal (gastroenterology) ^{****}	539	548	602	656	1.22****
Laparoscopic cholecystectomy (general surgery) ^{****}	946	992	1,025	1,175	1.24****
Laparoscopic cholecystectomy with imaging (general surgery) ^{****}	972	1,086	1,079	1,225	1.26****
Inguinal hernia repair (general surgery) ^{****}	612	668	660	765	1.25****
Fragmenting of kidney stone (urology)*	1,041	954	1,067	1,139	1.09
Vasectomy (urology) ^{***}	578	554	605	567	0.98
Cataract removal and prosthetic lens (ophthalmology) ^{***}	856	863	919	1,031	1.20***
Intensity-modulated radiation therapy (radiation oncology)	932	813	859	916	0.98
Insertion of intracoronary stent (cardiology) ^{****}	\$1,163	\$1,193	\$1,318	\$1,454	1.25****

SOURCE Authors' analysis of Truven Health Analytics MarketScan Commercial Claims and Encounters data for 2010 and HHIs derived from Medicare claims data for 2009.

NOTES Prices reported are derived from regression models that hold fixed the county characteristics listed in the text and shown in the Appendix (see Note 20 in text). Significance in procedure-specialty categories is for tests of equality across quartiles; significance in the ratio column indicates difference from a ratio of 1.00. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$ **** $p < 0.001$

counties are further illustrated in the Appendix.²¹

Discussion

More concentration among physician practices, which implies less competition, is associated with higher prices paid by private PPOs to physicians for most of the fifteen common and costly procedures we examined. The price variations we observed were statistically, as well as financially, significant. Across the procedure-specialty combinations we studied, our estimates imply that the level of competition observed in the highest quartile of the HHI distribution was associated with prices often 20 percent higher than in the lowest quartile of the HHI distribution. Our findings are consistent with the hypothesis that greater market power allows physicians to bargain for higher prices from private insurance companies.

A relationship between competition and price was not apparent for all procedures, most notably intensity-modulated radiation therapy performed by radiation oncologists. We speculate that this may be associated with the relative rarity of providers of this therapy. While our database contained information about more than 20,000 intensity-modulated radiation therapy procedures, these were performed in only 153 counties. Competition between radiation oncologists may vary, but variation in competition for intensity-modulated radiation therapy specifically may be much more limited, and this may limit the relationship we observed between physician HHI and price. The relationship between HHI and price was also statistically insignificant for fragmenting of kidney stones and shoulder arthroscopy, although in both of these cases there was still a general upward trend in prices from the lower- to the higher-HHI-quartile categories.

The overall finding of higher prices associated with more concentrated markets spanned a variety of very common and expensive procedures across several specialties, both surgical and medical. This extends previous results that have focused on prices for evaluation and management services¹⁰ and orthopedics and cardiology services.⁹ The prevalence of the patterns observed here makes clearer the breadth of the association across a range of procedures and settings and its presence in high-price services.

Although this was not our main focus, we fre-

quently found market concentration levels that appear high relative to the commonly encountered view that HHI levels above 2,500 are concerning. HHIs were 2,500 or more in more than half of counties studied among the chosen procedures and specialties.

This analysis did not directly address the issue of insurer competition, which may also affect prices for physician services. Sensitivity analyses suggested that variations in insurer competition were not likely to significantly affect our conclusions about relationships between physician competition and prices. Nonetheless, insurer competition may independently influence prices,⁸ and it is possible that rising levels of insurer concentration could contribute to inefficient outcomes for the health care system and deserve policy scrutiny.

We were unable to measure quality of care in this study, and further information about quality would be important for a complete interpretation of the results. If larger physician organizations systematically produce higher-quality care and have higher HHIs, then a positive association between HHIs and prices may be justified.⁴ Evidence from other sources examining links between practice organization and quality is evolving and not entirely clear. Some studies suggest that larger practices may have better outcomes or be better able to take actions such as adopting potentially beneficial practice technologies or process improvements, but this literature is not unanimous, and relationships may vary from one case to another.^{4-7,33}

Conclusion

The existence of an association between concentration and prices should underscore the importance of continued attention to the challenges posed by provider consolidation, especially given that consolidation among physician groups is likely to continue.^{12,34} Increased health care expenditures attributable to higher prices without improved outcomes for patients would generate inefficiency in the US health care system at a time when the opposite is badly needed. Policies that balance any benefits of larger organizations with the potential for problematic price increases, possibly including appropriate antitrust oversight, are needed as the country seeks to ensure efficient, high-quality patient care. ■

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NOTES

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Queries

1. Baker bio, in your June 2015 article we mentioned your NBER affiliation. Do you want that to be mentioned here as well?