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Size, Not Hospital Quality and Performance, Influences Commercial Prices

Evidence from Total Joint Arthroplasty

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Background: Total joint arthroplasty (TJA), including total hip and knee arthroplasty (THA/TKA), exhibits substantial price variation across hospitals. The 2022 Centers for Medicare & Medicaid Service Transparency in Coverage (TiC) Rule now requires public disclosure of negotiates commercial prices. This study sought to investigate the following: (1) association between hospital and market characteristics on commercial prices for TJA and (2) the relationship between prices and hospital quality and performance metrics.

Methods: We analyzed 2,455 commercial negotiated prices from March 2024 between 950 hospitals and 5 major insurers for Medicare Severity Diagnosis Related Group 470. Hospitals were categorized by size, system affiliation, teaching status, ownership, state, and THA/TKA surgical volume. Market concentration was assessed using the Herfindahl-Hirschman Index. Hospital quality and performance metrics included Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey ratings, overall star ratings, and THA/TKA complication and readmission rates. A multivariate, log-transformed linear regression model with standardized beta coefficients was used to examine associations.

Results: Healthcare quality and performance measures were not associated with commercial prices (HCAHPS star ratings β = 0.03, p = 0.55; overall star rating β = 0.02, p = 0.48). Similarly, complication rates and readmission rates were also not significant (β = -0.02, p = 0.65 and β = 0.01, p = 0.78, respectively). In contrast, higher prices were associated with hospital size (β = 0.11, p = 0.002) and system size (β = 0.12, p < 0.001). State-level effects on prices were also evident. Insurer was not associated with price differences (all, p > 0.05). The multivariate model explained 39% of price variability (Adjusted R^2 = 0.39).

Conclusions: Hospital and system size, rather than hospital quality and performance metrics, are significantly associated with commercial prices for THA/TKA.

Level of Evidence: Level III. See Instructions for Authors for a complete description of levels of evidence.

Introduction

Total joint arthroplasty (TJA), including total hip arthroplasty (THA) and total knee arthroplasty (TKA) exhibit substantial price variation across hospitals[1-4]. In health economics literature, this variation is strongly associated with hospital market structure, as hospitals with limited competition (monopolies or highly consolidated markets) command higher prices[5,6]. In addition, hospital size, reputation, and service specialization contribute to pricing power, with major teaching hospitals and large health systems consistently obtaining higher prices[5,6]. Compounding this issue is the unclear relationship between price and quality in TJA, with studies demonstrating that higher costs do not consistently result in better outcomes[2,7,8].

The 2022 Centers for Medicare & Medicaid Services (CMSs) Transparency in Coverage Rule (TiC) requires commercial insurers to publicly disclose negotiated prices[9]. As a result, these data have yet to be extensively analyzed within orthopaedic surgery, and little is known about commercial pricing for THA and TKA.

Previous studies have explored the relationship between prices and quality in TJA; however, much of the existing research has relied on hospital charge data derived from administrative claims, which do not reflect the actual negotiated prices[10,11]. Alternatively, others have used hospital-reported price transparency data, though this has been shown to be largely incomplete with a reporting rate of around 18 to 20%[4,12]. In addition,

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several studies examine Medicare reimbursement for TJA providing insight into public payer behavior, but not commercial markets[13].

This study uses newly available price transparency data to examine the following: (1) the association of hospital and market characteristics on commercial prices for TJA and (2) explore whether prices are aligned with publicly reported hospital quality and performance measures, including patient safety and patient experience. We hypothesize that pricing is driven primarily by hospital and market characteristics and less influenced by measures of hospital quality and performance.

Methods

Data

Price

We used commercial price transparency data from Turquoise Health (March 2024)[14], a third-party platform that compiles publicly disclosed commercial negotiated prices between hospitals and insurers under the CMS TiC rule[9,15]. This data set has been used in multiple studies on healthcare pricing[16-20]. We focused on Medicare Severity Diagnosis Related Group 470 (MS-DRG 470), which includes major hip and knee joint replacement without major complications. Outliers, specifically the highest and lowest 1% of prices, were excluded to minimize potential inaccuracies in the data, such as data entry errors or unique contracting arrangements[21-23]. A detailed description of pricing definitions, preprocessing steps, and insurer representation is provided in Appendix A.

Hospital Quality and Performance Measures

Hospital quality and performance were measured using CMS data that included Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores, Overall Hospital Quality Star Ratings, and procedure-specific 30-day readmission and 90-day complication rates[22,23]. Details on variable definitions, sources, and preprocessing are outlined in Appendix A.

Hospital Characteristics

Hospital characteristics were also assessed using the CMS Hospital Downloadable Database, which included bed count, ownership type, teaching status, surgical volume, and health system affiliation[24]. See Appendix A for definitions and variable construction.

Hospital Market Concentration

Hospital market concentration was assessed using the Herfindahl-Hirschman Index (HHI)[25,26], calculated based on hospital bed counts within Core-Based Statistical Areas (CBSAs). Hospitals were classified into unconcentrated (HHI <1,500), moderately concentrated (HHI 1,500-2,500), or highly concentrated (HHI >2,500) markets, following antitrust analysis by the Federal Trade Commission and Department of Justice thresholds[27-31]. Justification for this approach and methodology for HHI calculation are further described in Appendix A.

Statistical Analysis

Multivariate Linear Regression Model

A multivariate linear regression model was constructed to evaluate the relationship between log-transformed pricing and key explanatory variables. An interaction term between hospital overall star ratings and HCAHPS was included. Standardized beta coefficients (β) were reported to assess the relative strength of each variable. Because HCAHPS and overall star ratings measure related but distinct constructs, both were included in the multivariate model. The stability of model estimates was confirmed through sensitivity analyses, which demonstrated that potential multicollinearity between these variables did not materially affect study findings. Analyses were conducted using Stata version 17 (StataCorp). Full model specifications are detailed in Appendix A.

Sensitivity Analyses

We also conducted 3 sensitivity analyses: (1) using HHI calculated by inpatient bed days across payer types[32], (2) recalculating HHI at the hospital system level[32], and (3) calculating HHI using total THA/TKA volume per hospital. We also ran sensitivity analyses to confirm that the inclusion or exclusion of nonsignificant covariates did not affect the strength or interpretation of the model.

Results

Descriptive Statistics

This study included 950 US hospitals, with descriptive statistics summarized in Table I. The mean commercial price for MS-DRG 470 was $18,482 ± $4,160 (range: $12,150 to $29,345). Hospitals averaged 369 ± 295 beds, with 52.3% classified as teaching hospitals. Hospital ownership consisted of 4.9% government owned, 76.8% nonprofit, and 18.3% classified as "Other". Most hospitals were part of health systems (96.9%). The mean procedural volume (over a 3-year period) for elective THA and TKA was 329 ± 227. The mean HHI was 1,720 ± 2,382, with 36.7% of hospitals operated in highly concentrated markets (HHI >2,500).

Quality metrics showed that 52.9% of hospitals received a 3-star HCAHPS rating, while 30% received 4 stars and 0.4% received 5 stars. Overall hospital star ratings were similarly distributed. The mean complication rate was 3.5% ± 0.7%, and the mean 30-day readmission rate was 4.6% ± 0.6%.

The distribution of commercial prices for total hip and knee arthroplasty is presented in a histogram (Fig. 1), which reveals a left-skewed distribution, with mean prices centered around $30,000. A bar chart (Fig. 2) highlights differences in prices by insurance companies, showing that some insurers negotiate higher prices than others. A state-level map (Fig. 3) underscores the substantial geographic variability in prices. A scatterplot (Fig. 4) examines the relationship between complication rates and prices, showing no observable association between these variables. Finally, price variability stratified by hospital characteristics is illustrated in bar charts (Supplementary Fig. 1).

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TABLE I Descriptive Characteristics of 950 Hospitals Included in this Study

Variable	Subcategory	N (%)	Mean ± SD	Mean Price ± SD (USD)
HCAHPS star rating	1 Star	16 (1.7)		19,404.72 ± 7,369.39
	2 Stars	183 (19.3)		33,749.31 ± 10,385.77
	3 Stars	501 (52.9)		31,847.08 ± 10,596.18
	4 Stars	246 (25.8)		29,660.07 ± 9,695.52
	5 Stars	4 (0.4)		29,223.9 ± 9,644.19
Hospital overall quality star rating	1 Star	74 (7.8)		30,970.7 ± 10,409.47
	2 Stars	193 (20.3)		30,436.02 ± 6,101.17
	3 Stars	275 (28.9)		29,181.92 ± 9,644.19
	4 Stars	285 (30.0)		28,724.38 ± 9,695.52
	5 Stars	123 (13.0)		30,868.66 ± 10,385.77
Hip/Knee complication rate			3.5 ± 0.7	
30-d readmission rate			4.6 ± 0.6	
Total bed count			369 ± 294.6	
Teaching hospital		497 (52.3)		30,970.7 ± 10,409.47
	Government	44 (4.9)		29,181.92 ± 9,644.19
	Nonprofit	689 (76.8)		28,724.38 ± 9,695.52
	Other	164 (18.3)		30,868.66 ± 10,385.77
No. of discharges			329.2 ± 227.9	
Market concentration	Unconcentrated market (HHI ≤ 1,500)	443 (46.6)		31,116.82 ± 10,596.18
	Moderately concentrated market (HHI > 1,500, HHI ≤ 2,500)	158 (16.6)		33,749.31 ± 10,385.77
	Highly concentrated markets (HHI > 2,500)	349 (36.7)		29,544.39 ± 9,695.52
Part of a hospital system		921 (96.9)		
No. of hospitals within the health system			40.6 ± 55.6	
State				
	FL	83 (8.7)		37,395.8 ± 9,113.4
	GA	20 (2.1)		30,298.6 ± 10,105.9
	HI	4 (0.4)		27,531.8 ± 2,738.8
	IA	18 (1.9)		26,007.2 ± 5,054.3
	ID	5 (0.5)		35,733.5 ± 5,882.2
	IL	53 (5.6)		23,340.4 ± 5,544.8
	IN	36 (3.8)		34,226.8 ± 8,461.9
	KS	15 (1.6)		26,322.3 ± 8,885.7
	KY	16 (1.7)		23,244.7 ± 6,677.2
	LA	12 (1.3)		23,588.3 ± 7,062.4
	MA	21 (2.2)		25,889.8 ± 10,603.8
	ME	3 (0.3)		37,156.7 ± 9,896.2
	MI	42 (4.4)		29,120.2 ± 7,030.5
	MN	13 (1.4)		30,317.1 ± 5,042.8

continued

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TABLE I (*continued*)

Variable	Subcategory	N (%)	Mean ± SD	Mean Price ± SD (USD)
	MO	36 (3.8)		23,336.1 ± 9,130.9
	MS	14 (1.5)		20,408.1 ± 3,889.7
	MT	8 (0.8)		42,365.7 ± 3,306.3
	NC	45 (4.7)		26,181.7 ± 6,755.5
	ND	3 (0.3)		26,845.0 ± 3,412.7
	NE	6 (0.6)		33,686.7 ± 6,230.6
	NH	11 (1.2)		29,662.6 ± 10,761.8
	NJ	36 (3.8)		31,892.2 ± 9,345.0
	NM	5 (0.5)		27,044.7 ± 6,171.9
	NV	13 (1.4)		30,807.8 ± 9,655.2
	NY	63 (6.6)		41,113.6 ± 17,074.5
	OH	43 (4.6)		27,620.5 ± 6,277.0
	OK	25 (2.6)		25,893.4 ± 4,129.5
	OR	10 (1.1)		39,877.7 ± 7,745.9
	PA	62 (6.5)		29,289.4 ± 9,229.2
	RI	4 (0.4)		27,291.8 ± 2,279.2
	SC	23 (2.4)		39,710.6 ± 12,026.0
	SD	6 (0.6)		40,920.2 ± 9,603.2
	TN	31 (3.3)		30,144.5 ± 11,521.5
	TX	71 (7.4)		27,246.5 ± 11,136.1
	UT	8 (0.8)		37,424.0 ± 10,033.3
	VA	37 (3.9)		33,592.8 ± 6,197.2
	VT	2 (0.2)		40,993.6 ± 9,752.7
	WA	25 (2.6)		36,828.0 ± 9,834.4
	WI	19 (2.0)		38,634.5 ± 4,960.1
	WV	3 (0.3)		30,436.0 ± 6,101.2
Total*		950 (100.0)		30,345.17 ± 9,827.14

HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems, HHI = Herfindahl-Hirschman Index, MS-DRG 470 = Medicare Severity Diagnosis Related Group 470, SD = standard deviation, THA = total hip arthroplasty, and TKA = total knee arthroplasty. *Total row reflects overall sample size (N = 950) and average MS-DRG 470 price.

Multivariate Regression Results

We analyzed 2,455 prices using a multivariate log-transformed regression model (R^2 = 0.39). Compared with hospitals in Mississippi (the referent state), hospitals in all other states had higher prices, with the highest in Wyoming, Montana, and New York, while Kentucky and Missouri having the closest prices. Aside from state effects, the strongest associations with price were the number of hospitals within a hospital system (β = 0.12, p < 0.001, 95% confidence interval [CI] [0.06-0.18]) and hospital size (β = 0.11, p = 0.002, 95% CI [0.04-0.18]). There were no significant relationships between any hospital quality and performance measures and price. The full model output is available in Appendix B.

Hospital Characteristics

Higher bed counts (β = 0.11, p = 0.002, 95% CI [0.04-0.18]) and higher volume of THA/TKA procedures were associated with higher commercial prices (β = 0.06, p = 0.03, 95% CI [0.01-0.12]). Nonprofit hospitals were associated with lower prices in comparison with "Other" ownership (β = –0.06, p < 0.01, 95% CI [–0.09 to –0.02]). Government-owned hospitals were not associated with differences in prices (p > 0.05). No significant variation in prices was found by insurer (all, p > 0.05).

Hospital Quality and Performance Measures

There was no significant association between commercial prices and TJA complication rates (β = –0.02, p = 0.65, 95% CI

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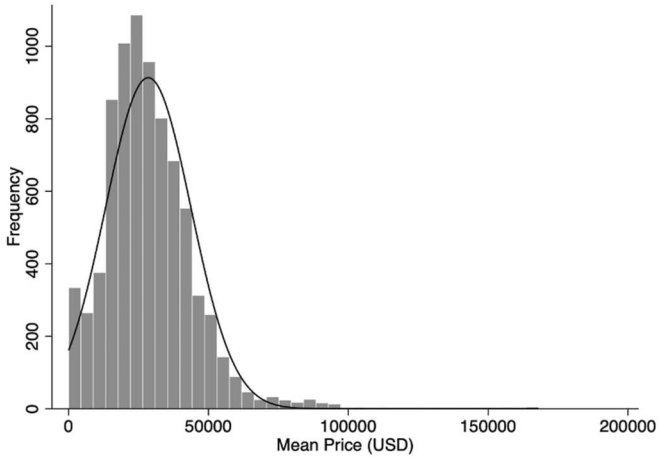

Fig. 1

Distribution of commercial prices for major hip and knee joint replacement. Histogram showing the distribution of commercial negotiated prices for MS-DRG 470 after excluding top and bottom 1% outliers. The x-axis represents prices in US dollars, and the y-axis represents frequency. Prices represent all available insurer-hospital–reported prices in the data set. MS-DRG 470 = Medicare Severity Diagnosis Related Group 470.

[–0.02 to 0.01]) or readmission rates (β = 0.01, p = 0.78, 95% CI [–0.01 to 0.04]). HCAHPS (β = 0.03, p = 0.55, 95% CI [–0.04 to 0.21]) and Overall Hospital Quality Star Ratings (β = 0.02, p = 0.48, 95% CI [–0.03 to 0.29]) showed no significant relationship with commercial prices.

Hospital Market Concentration

There were modest hospital concentration effects on prices. Hospitals in moderately concentrated (β = -0.06, p = 0.004, 95% CI [–0.13 to –0.06]) and highly concentrated markets (β = -0.05, p = 0.008, 95% CI [–0.12 to –0.06]) had lower prices than those in unconcentrated markets.

Discussion

This study examined factors associated with variability in commercial prices for TJA and explored whether these prices aligned with measures of hospital quality and performances. Our findings revealed that the price variation is driven largely by differences in hospital and health system characteristics rather than measures of patient safety or experience, which supports our initial hypothesis. This variability likely reflects institutional leverage, market positioning, regional costs, and other unmeasured contractual factors such as labor rates. Overall, our findings suggest that larger hospitals and those within extensive systems may have increased leverage during negotiations with insurers.

While value in health care often aims to align outcomes and costs incurred, our results suggests that TJA prices still reflect classical market dynamics[33,34]. Transparency may play a critical role in advancing value-based reforms but only if data are relevant, actionable, and accessible in real time[33].

The lack of alignment between price and quality in TJA has also been observed in other studies. Zhuang et al. analyzed payer-specific negotiated prices for TJA within a single large health system and found price differences across payers but no correlation with readmissions or complications[35]. Similarly, D'Amore et al. focused on hospital charges for TJA and their relationship with outcomes, concluding that gross charges do not predict quality or episode-of-care costs[12]. Although the prior studies were limited to single health systems or charges, they offer relevant comparisons across surgical specialties and highlight the disconnection between pricing and hospital quality and performance. Our study expands these findings substantially by analyzing TJA pricing on a national scale while also incorporating multiple hospital-specific variables that have not been assessed in previous studies.

We are not aware of any studies specifically examining the relationship between hospital/health system size and prices or charges for TJA. A 2024 study by Rochlin et al., however, explored the topic of market concentration vs. pricing in the context of surgical oncologic care[36]. Using price transparency data, the authors evaluated negotiated price for cancer surgery and found that higher market concentration was associated with significantly higher price for oncology services[36]. By contrast, in case of TJA, we found there were modest prices increases in hospitals in less concentrated (more competitive) markets. However, these effects were muted compared with geography and hospital and health system size, which were the dominant influencers of price, compared with hospital market concentration. For instance, New York city hospitals had some of the highest prices, despite being a highly competitive or "unconcentrated" market, reflecting the higher cost of providing care in that market.

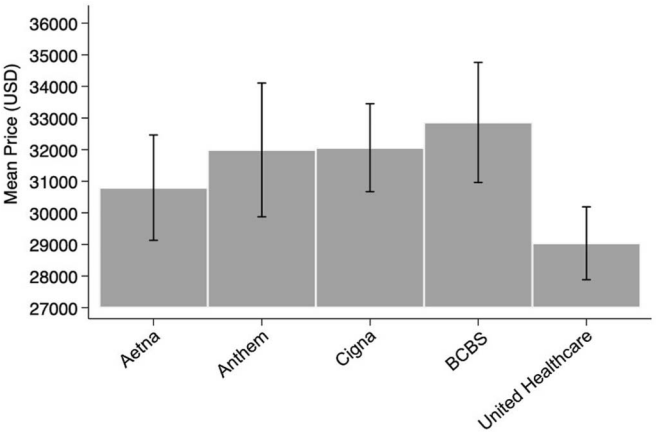

Fig. 2

Mean commercial prices for total hip and knee arthroplasty by insurance company. Bar chart showing the mean commercial negotiated prices for MS-DRG 470 by 5 major insurance companies. Mean prices (± standard deviation) were as follows: Aetna: $31,921.57 (±$13,482.76); Anthem: $33,435.15 (±$12,601.36); Cigna: $32,468.68 (±$13,770.39); BCBS: $32,857.86 (±$13,602.50); and United Healthcare: $29,647.85 (±$12,376.16). Error bars represent 1 standard deviation above and below the mean. BCBS = blue cross blue shield, and MS-DRG 470 = Medicare Severity Diagnosis Related Group 470.

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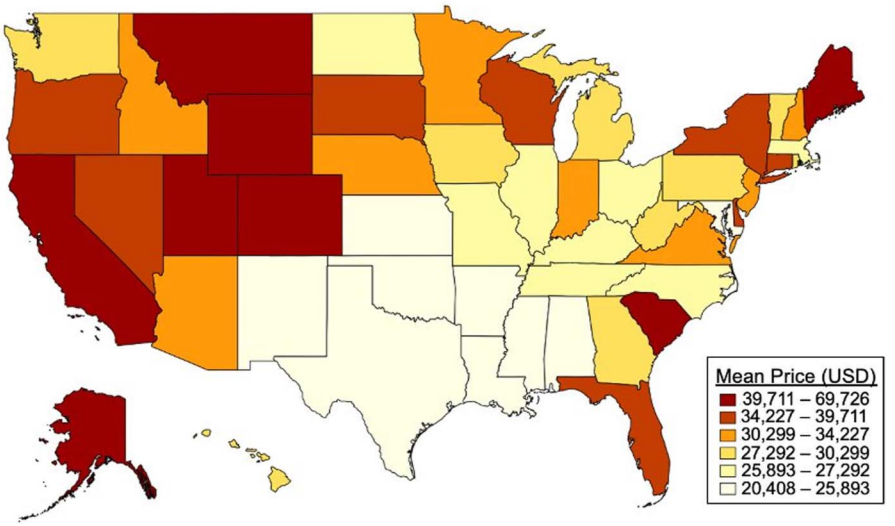

Fig. 3

US map of commercial prices for total hip and knee arthroplasty by state. This map depicts the mean commercial negotiated prices for THA/TKA across US states, with states shaded to reflect price tiers. Darker shades indicate higher prices, while lighter shades represent lower prices. Prices are based on all available insurer-hospital–reported prices in the data set, averaged at the hospital level before computing state-level means. THA = total hip arthroplasty, and TKA = total knee arthroplasty.

We found that hospitals in less concentrated markets had slightly higher prices, diverging from conventional theory, that less competition leads to higher prices. One explanation may be that a single dominant insurer may have enough bargaining power to negotiate lower rates; for example, insurers in the least competitive markets have been shown to pay 15% less than those in more competitive areas[37]. Other contributing factors include state-level regulations, such as the implementation of All-Payer Claims Databases (APCDs)[38,39], IT capacity[39], and vertical integration between hospitals and physician groups, may consolidate market power and reduce transparency, resulting in higher prices without clear improvements in hospital quality and performance[40,41].

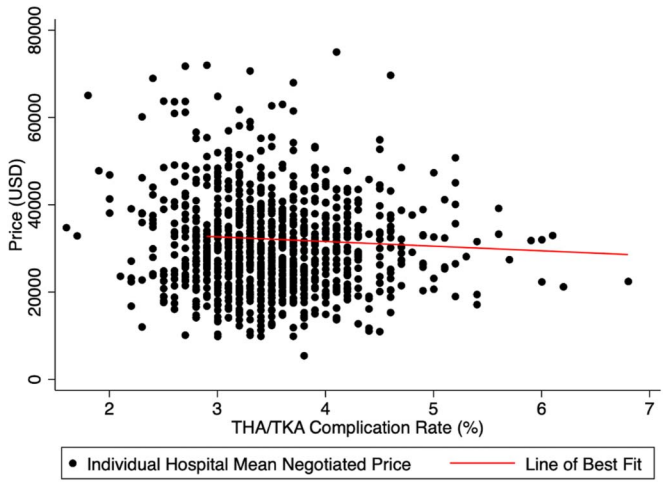

Fig. 4

Scatterplot of THA/TKA complication rate vs. mean commercial price. This scatterplot illustrates the relationship between THA and TKA complication rates (%) and mean commercial negotiated prices (USD) for individual hospitals. Each dot represents a hospital's mean price relative to its complication rate. THA = total hip arthroplasty, and TKA = total knee arthroplasty.

Furthermore, we did not analyze commercial insurance concentration and payor market power, which may largely influence the ability of hospitals to exert their market power in a given market[42]. While these data were unavailable at the hospital or CBSA level, we did observe meaningful price differences across payors.

These findings have various implications for providers, patients, and policymakers. More access to negotiated rates may potentially shift referrals to lower-priced hospitals in an open market, increase payer scrutiny under bundled payments, or encourage the shift of TJA procedures to ambulatory surgical centers (ASCs). At a policy level, our results may support ongoing efforts to explore CMS price benchmarks and strengthen antitrust review of hospital consolidation.

Limitations

This study has several limitations. First, our study focused on negotiated prices for MS-DRG 470, which captures inpatient reimbursement only, potentially underestimating broader pricing trends and introducing selection bias as an increasing number of TJA shifts to ASC settings. It should also be noted that the representativeness of our 950 hospital sample is uncertain due to lack of a standardized national denominator for hospitals reporting complete and validated commercial pricing data under the TiC rule.

While our study explored multiple hospital and market, unmeasured variables (i.e., payer-specific contractual terms,

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local labor costs, or supply expenses) may also play a role. In addition, regional cost of living and wage variation were not directly included in our model due to lack of standardized hospital-level data. The TiC data used in this study rely on commercial insurer disclosures, which may be subject to inaccuracies or inconsistencies in reporting and do not capture the actual cost of care or the value delivered. Only a minority of hospitals are fully compliant with these rules[43]. Data also lack granularity at the physician practice type, subspecialty training, advanced care provider staffing, hospital system accreditations, and contract duration, all of which may influence negotiated prices. Furthermore, even though HCAHPS and CMS star ratings are widely used, these may not be sensitive to orthopaedic-specific quality. Last, this study focuses on US healthcare system and may not be generalizable to international settings. Future studies could address these limitations by integrating longitudinal data and incorporating additional metrics to provide a more comprehensive understanding of pricing dynamics in TJA.

Conclusion

Significant variability exists in negotiated prices for THA and TKA, with no statistically significant relationship to hospital quality and performance metrics. Prices were associated with hospital and health system size primarily. These results highlight a disconnection between pricing and publicly reported hospital quality and performance measures that warrant further exploration, especially as transparency reforms evolve. Furthermore, the observed associations do not imply causality, and future work should explore the complex dynamics underlying hospital-insurer negotiations.

Appendix

eA Supporting material provided by the authors is posted with the online version of this article as a data supplement at jbjs.org (http://links.lww.com/JBJSOA/B42). This content was not copyedited or verified by JBJS. ■

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