



## Original Research

## State Healthcare Regulations and Total Knee Arthroplasty Prices Across the United States

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## ABSTRACT

**Background:** The cost of healthcare services in the United States is subject to various regulatory influences, yet the impact of state-level healthcare policies and political affiliations on total knee arthroplasty (TKA) prices remains underexplored.

**Methods:** Using data from the Turquoise Health Database and publicly available sources, TKA prices were analyzed across states to examine the influence of Medicaid expansion, Certificate of Need (CON) laws, and state partisan lean. Multivariable regression models controlled for Gross Domestic Product per capita, Area Deprivation Index, and urbanization.

**Results:** Among 64,402 TKAs from 2455 hospitals (\$18,164 median, interquartile range: \$10,806), states with Medicaid expansion and CON laws demonstrated lower TKA prices. Republican-leaning states had significantly reduced TKA prices compared to Democrat-leaning states, even after adjusting for economic factors ( $P < .0001$ ).

**Conclusions:** Medicaid expansion and CON laws were associated with lower TKA prices across the United States. Additionally, states with Republican political leanings tended to have lower listed prices for TKA compared to Democrat-leaning states. These findings underscore the substantial influence of state healthcare policies and political factors on healthcare costs, highlighting the complexities of pricing dynamics in the US healthcare system.

**Level of evidence:** IV

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## Introduction

The cost of healthcare services in the United States has been a topic of intense scrutiny and debate, particularly following the implementation of new regulations by the Centers for Medicare and Medicaid Services [1]. These regulations require hospitals to publicly disclose their pricing information, offering a new way to explore how price can be impacted by various factors. As one of the most common orthopaedic procedures, with more than 700,000 performed annually, total knee arthroplasty (TKA) serves as an ideal case study for understanding how various factors influence healthcare costs [2,3].

Despite its prevalence, the cost of TKA can vary dramatically depending on geographic location and the specific healthcare setting [4]. This variability raises questions about the underlying factors that drive these differences. Previous research has identified several potential determinants, including hospital characteristics, patient demographics, and regional economic conditions [4]. However, the influence of state-level policies and political affiliations on healthcare costs has not been thoroughly explored.

State political affiliation can have a profound impact on healthcare policy and regulation. Historically, states led by Democratic administrations have been more likely to implement laws aimed at controlling healthcare utilization and costs [5,6]. One such policy is the Certificate of Need (CON) program, which requires healthcare providers to obtain state approval before expanding services or facilities. The rationale behind CON laws is to prevent

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overutilization and ensure that new services are necessary and cost-effective.

Another significant policy affecting healthcare costs is the Medicaid expansion under the Affordable Care Act [7,8]. The impact of Medicaid expansion on healthcare pricing has been debated, with some studies suggesting that it leads to higher costs due to increased demand, while others argue that it results in lower costs through cost-sharing mechanisms and improved access to preventive care.

This study seeks to explore the relationship among state partisanship lean, healthcare regulations, and the cost of TKA procedures. By examining these factors, we aim to provide a comprehensive understanding of how state-level policies can influence healthcare costs and inform strategies to enhance cost containment and access to care. We hypothesize that Medicaid expansion and CON laws are associated with lower TKA prices, and that partisanship lean would have an association with prices.

## Material and methods

### Data source

Hospital payer-specific rates for TKA were extracted from the Turquoise Health Database using Current Procedural Terminology code 27447 [9]. For this study, TKA prices refer to the listed hospital prices as reported in the Turquoise Health Database. These represent posted rates rather than final reimbursements or total episode-of-care costs. To account for variability in the dataset, prices below the 10th percentile and above the 90th percentile were excluded. The database included information about the corresponding hospital, city, and state for each TKA price.

State healthcare policy data, including CON status and Medicaid expansion status, were sourced from publicly available information [10,11]. Additional data, such as Gross Domestic Product (GDP) [12], Area Deprivation Index (ADI) [13,14], population urbanization, population size, and land area, were gathered from the US census [15–17]. The ADI, which reflects factors like income, education, employment, and housing quality, serves as a proxy for socioeconomic status and resource availability, ranking areas nationally from 1 to 100, with 100 indicating the most underserved communities [7,18,19]. A hospital's summary ADI was calculated as the weighted mean ADI based on county data. Population density was dichotomized rural and urban destinations based on the US census. This study used publicly available data and did not involve any patient data, thereby qualifying for an institutional review board exemption.

### State partisanship

State partisan lean was characterized using several factors: the composition of the state House and Senate [20], the political affiliation of the 2020 governor [21], the political affiliation of each state's 2020 Insurance Commissioner [22], and the results of the most recent presidential election in the state. Consistent with prior research, a state was classified as “Republican leaning” if 3 of 5 factors—the majority in the state House and Senate, the governor, the presidential vote, and the Insurance Commissioner—were Republican, and “Democrat leaning” if 3 of 5 were Democrat [23].

### State-specific analysis

In addition to examining price differences between states, regional price variations were also analyzed [24]. North Carolina was chosen for a detailed case study due to its swing state status in the 2020 presidential election, marked by a narrow Republican margin

of victory [25,26]. In 2020, although the Republican party held a majority in both the House and the Senate, the state had a Democratic governor [27–29]. The state's diverse demographic, geographic, and political characteristics made it an ideal case for investigating the impact of political factors on healthcare pricing. Factors considered included a balanced number of Democrats and Republicans, a mix of rural and urban areas, and the expansion of Medicaid in 2023. TKA price data from the Turquoise Health Database were filtered to include only hospitals within North Carolina for this analysis. County-level data from the US census were used to classify counties as rural or urban. Hospitals were categorized based on their location in urban or rural communities, and ADI was used to classify counties into 2 groups: those with ADI > 85 and those below. Hospitals were similarly categorized based on the county's ADI.

### Data analyses

For univariable analysis, Pearson's correlation was used to compare continuous variables, and point-biserial correlation was used to compare continuous variables against dichotomous variables. The Chi-squared test was employed for categorical variables. For multivariable analysis, a regression model was used to account for Medicaid expansion, state partisan lean, CON status, and GDP per capita. A separate multivariable analysis was conducted for prices within North Carolina, controlling for ADI and urban versus rural status. All statistical analyses were performed using R version 4.2.3, with statistical significance set at  $P < .05$ .

## Results

### State healthcare policy

Among the 50 states, 35 had enacted CON regulations, while Medicaid had been expanded in 40 states, and 28 states leaned toward Republican governance. Specifically, Republican majorities controlled the state senate in 32 states, while 18 states had Democratic majorities. In state houses, 30 states had Republican majorities, 19 states had Democratic majorities, and 1 state operated under a coalition. Republican governors held office in 28 states, while Democrats led in 22 states. Insurance Commissioners were affiliated with Republicans in 27 states and Democrats in 23 states. The results of the 2020 presidential election were evenly split, with 25 states voting Republican and 25 voting Democrat. Additionally, 4 states were classified as weak leaning based on meeting 3 of 5 criteria.

### Total knee arthroplasty price

The study analyzed 64,402 TKA rates from 2455 unique hospitals within 410 distinct hospital systems. The median listed rate was \$18,164 (interquartile range: \$10,806). Multivariable analysis revealed significant findings: hospitals in states that expanded Medicaid had notably lower listed prices compared to those without expansion ( $P = .0001$ ) (Table 1). Similarly, states with CON

**Table 1**  
Multivariate regression for total knee arthroplasty price across the United States while controlling for GDP per capita.

Variable	Estimate	95% confidence interval	P value
Medicaid expansion:yes	−293.01	(−440.78 to −145.24)	.0001
Republican party affiliation	−834.92	(−996.58 to −673.27)	<.0001
CON status: yes	−978.71	(−1109.78 to −847.64)	<.0001

CON, Certificate of Need; GDP, Gross Domestic Product.  
All analyses include covariate controls of Medicaid expansion, party affiliation, CON, and GDP per capita.

laws showed a substantial reduction in TKA prices by  $-\$978.71$  (95% confidence interval:  $-\$1109.78$  to  $-\$847.64$ ) compared to those without CON regulations ( $P < .0001$ ). Additionally, TKA prices were significantly lower in states leaning Republican compared to Democrat-leaning states, with a reduction of  $-\$834.92$  (95% confidence interval:  $-\$996.58$  to  $-\$673.27$ ) ( $P < .0001$ ). These factors independently influenced TKA pricing while controlling for state GDP per capita.

#### Area Deprivation Index

North Carolina was chosen to explore the impact of resource availability, measured by the ADI on TKA prices. The state comprises 100 counties, with 19% classified as having an ADI  $> 85$  and 81% as having an ADI  $< 85$ . Among these, 46 counties were urban and 54 were rural. Multivariable analysis indicated that an ADI  $> 85$  was associated with a  $\$1655$  increase in TKA prices ( $P = .0314$ ) (Table 2). Notably, there was no significant difference in prices based on urbanization.

#### Discussion

Our findings suggest that Medicaid expansion and the presence of CON laws were associated with lower TKA costs. Additionally, the analysis revealed that states leaning Republican tend to have lower listed prices for TKA compared to Democrat-leaning states. The impact of party affiliation can be attributed to the interplay of healthcare policies that promote free market dynamics and higher procedure volumes in Republican-governed states. Republican-leaning states often espouse policies that support free market principles, such as limited regulation potentially leading to greater competition among healthcare providers [30]. These states are less likely to enforce stringent regulatory frameworks which can restrict the expansion of healthcare services and limit market competition. Consequently, hospitals in these states may operate more freely in setting prices, potentially leading to lower costs for procedures like TKA [31,32]. Lower listed prices may reflect improved hospital efficiency, reduced reimbursement rates, or market competition. Additional analysis is needed to determine the direct impact on hospital operations and patient access. Although this study does not directly evaluate surgeon compensation, price variations may influence hospital revenue structures, ultimately affecting provider reimbursement.

Previous research has documented higher prices for total shoulder arthroplasty (TSA) in Republican-leaning states [23]. Unlike TKA, TSA procedures are less common and typically performed at lower volumes [33]. This lower procedural volume diminishes the impact of free market dynamics that drive down prices through competition and economies of scale [31,32]. Consequently, TSA procedures may be more susceptible to cost inflation in settings where market competition is less pronounced.

The negative association between Medicaid expansion and TKA prices is consistent with studies suggesting that Medicaid expansion can lead to improved healthcare access for low-income individuals [8]. This decrease can partly be attributed to reduced overall healthcare costs supported by previous studies on cost

sharing [7,8,34,35]. Similarly, the presence of CON laws, which aim to control healthcare costs by restricting the construction or expansion of healthcare facilities, was linked to reduced TKA prices. [36] This is particularly significant in the context of TKA's high procedural volume, where CON regulations may exert substantial influence in constraining healthcare expenses and ensuring cost-effective delivery of services.

The observed relationship between ADI and TKA prices within North Carolina highlights the impact of socioeconomic factors on healthcare pricing. It is possible that regions experiencing higher deprivation possess fewer healthcare resources or contend with increased competition, resulting in lower TKA costs [37]. Alternatively, areas with a high ADI could implement policies that restrict surgical expenses or rely more heavily on government insurance, potentially driving down prices [38]. Nevertheless, while hospital charges were lower in high ADI areas, overall patient expenses may vary due to perioperative costs and insurance coverage. Research on patients undergoing procedures such as anterior cervical discectomy and coronary artery bypass grafting suggests that a high ADI correlates with increased total costs, possibly due to more frequent emergency room visits and complications stemming from poorer overall health [39,40].

This study has several limitations that warrant consideration. The generalizability of findings may be constrained due to variations in healthcare policies and economic conditions across states not fully accounted for in the analysis. Additionally, reliance on hospital-reported prices from the Turquoise Health Database may introduce biases, as these data points may not fully reflect negotiated or discounted rates. The complexity of healthcare pricing, influenced by hospital-specific strategies and regional economic disparities, was not comprehensively addressed. While this study captures a cross-sectional snapshot, the timing of price-setting regulations may be influenced by political shifts and policy changes over time. Future research could examine these longitudinal trends. Temporal factors could affect the stability of observed associations given the study's snapshot approach to pricing trends. While associations were observed among Medicaid expansion, CON laws, and TKA prices, the cross-sectional design limits causal inference, and other unmeasured variables could contribute to observed price differences. Furthermore, regional variations within states and the potential limitations of using ADI as a proxy for socioeconomic status further underscore the need for nuanced interpretation. Finally, evolving healthcare policies and their dynamic impacts on costs over time and across jurisdictions necessitate ongoing research to validate and contextualize these findings comprehensively. This study focuses on price variations and does not include patient outcome data. Future research should explore the relationship between pricing structures and surgical outcomes.

#### Conclusions

Medicaid expansion and the presence of CON laws were associated with lower TKA prices across states in the United States. Additionally, states with Republican political leanings tended to have lower listed prices for TKA compared to Democrat-leaning states. These findings highlight the significant role of state-level healthcare policies and political factors in influencing healthcare costs, underscoring the complexity of healthcare pricing dynamics in the United States.

#### Conflicts of interest

Christian Pean received speakers bureau/paid presentations for Arthrex, Inc. and is a paid consultant for Kaizen Clinical Partners and Azra Care Inc. Thorsten M. Seyler received royalties from Lippincott

**Table 2**  
Multivariate regression for total knee arthroplasty prices in North Carolina.

Variable	Estimate	95% confidence interval	P value
ADI $> 85$	1654.67	(148.56 to 3160.77)	.0314
Urban	-253.04	(-1386.01 to 879.93)	.6610

ADI, Area Deprivation Index.

All analyses include covariate controls of ADI and urbanization status.

Williams & Wilkins; is a paid consultant for Peptilogics, Smith & Nephew, and Restor3d; holds stock or stock options in Amedica; received research support from Smith & Nephew, Zimmer Biomet, and DePuy, A Johnson & Johnson Company as a Principal Investigator; and is a board member in the American Association of Hip and Knee Surgeons and Musculoskeletal Infection Society. All other authors declare no potential conflicts of interest.

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### CRedit authorship contribution statement

**Kevin A. Wu:** Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Katherine M. Kutzer:** Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Christian A. Pean:** Writing – review & editing, Supervision, Software, Resources, Project administration, Investigation, Funding acquisition, Data curation. **Thorsten M. Seyler:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization.

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