Primary Inpatient Joint Arthroplasty Procedures on Medicare Patients Demonstrate Price Elasticity of Demand and Wide Variability in State-Level Cost Competitiveness

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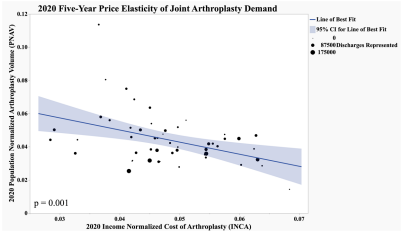
INTRODUCTION:
Patients face a high variability in cost for joint arthroplasty (JA) due to the substantial variability in the cost of performing these surgeries even for patients with similar presentations. Patients have also been shown to travel substantial distances for arthroplasties, raising questions as to how patients decide where to undergo JA surgeries. This study seeks to characterize the state-level variations in costs to JA patients, determine whether the demand for joint arthroplasty exhibits price elasticity, and quantify state-level cost competitiveness.

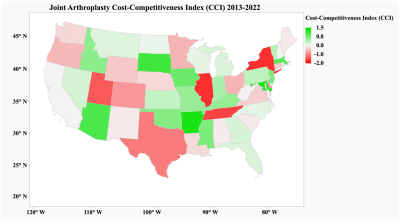
METHODS:
This retrospective study of the Medicare Inpatient Hospitals database studied all Medicare inpatient primary hip and knee arthroplasty procedures (Diagnosis Related Group Codes: 469, 470) from 2013-2022. This amounted to 3,802,041 arthroplasties at 3,884 hospitals across all 50 states and Washington DC. Patient/third-party payments were calculated as the portion of total payment to the hospital not covered by Medicare. Using the numbers of discharges for each hospital, DRG, and year, weighted averages across states and years were calculated. U.S. Census Bureau data on 5-year statewide median income and statewide 2020 decennial census population over 65 (ie. the number of people in each state eligible for Medicare by age) were collected. These metrics were used to generate Income Normalized Cost of Arthroplasty (INCA for 2020 = statewide average cost of arthroplasty 2016-2020/statewide 5-year Estimated Median Household Income for 2020), and 2020 Population Normalized Arthroplasty Volume (PNAV= statewide JA volume 2016-2020/2020 census population 65+). Cost-Competitiveness Index (CCI) for a given state = sum of the percent differences in cost with all of its neighbors (relative to the higher cost of the two states, and negative if the neighboring state is less expensive; a modified graph theory node strength calculation). Analyses of Variance and Linear Regressions were performed to quantify statistical significance.

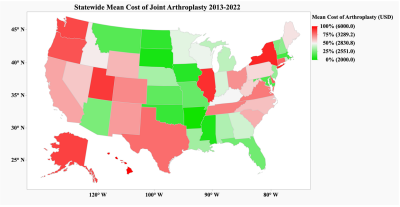
RESULTS:
The mean price of JA was significantly different across the 50 states and Washington DC, ranging from Hawaii where the mean price was $5551.48±208.62 to Arkansas where the mean price was $2052.90±77.35 ($p<0.0001$). The high variability even within regions of the U.S. meant that the average price of an arthroplasty could drastically change by crossing state lines. Strikingly, the average price would decrease almost $2000 for a patient crossing from Washington D.C. into Maryland (-$1936) or from New York into Massachusetts (-$1851) or Vermont (-$1729). Stark differences also existed outside the northeast such as between Illinois and Iowa (-$1665) and Arkansas and Tennessee (-$1236).

If JA patients are price sensitive, these divergent prices may affect surgical volume and patient travel. In fact, during the 5-year retrospective period of 2016-2020, the demand for inpatient Medicare joint arthroplasties exhibited statistically significant price elasticity such that states with higher income-normalized costs per arthroplasty procedure (INCA) had significantly lower surgical volume normalized to the Medicare eligible population (PNAV) ($p = 0.001$). Since, a price sensitive patient population can drive economic competition between states, especially for patients living near state borders, cost competitiveness of each state relative to all neighboring states was calculated. There was a wide variety in competitiveness ranging from Arkansas which was the most cost competitive (CCI=1.38) to New York which was the least cost competitive (CCI=-1.70). Importantly, this analysis highlights that some states, like Nebraska, are below the 50th percentile in cost but are not cost competitive within the local environment of neighboring states. Similarly, states like Pennsylvania and Nevada have higher than 50th percentile costs but are cost competitive due to even higher costs in neighboring states.

DISCUSSION AND CONCLUSION:
Substantial interstate differences in cost exist for patients undergoing primary JA procedures just miles apart across state lines, yielding a wide variation in state-level cost competitiveness. Since states with higher cost JA procedures have lower population adjusted surgical volumes, neighboring cost-competitive states may attract patients across state lines. Given these findings, granular analyses are needed to dissect the economic and social factors that drive patient decision making about where to receive an arthroplasty procedure.


2020 Five-Year Price Elasticity of Joint Arthroplasty Demand
2020 Population Normalized Arthroplasty Volume (PNAV)
0.12
0.10
0.08
0.06
0.04
0.02
0
0.03
0.04
0.05
0.06
0.07
2020 Income Normalized Cost of Arthroplasty (INCA)
p = 0.001
Line of Best Fit
95% CI for Line of Best Fit
0
87500 Discharges Represented
175000


Joint Arthroplasty Cost-Competitiveness Index (CCI) 2013-2022
45° N
40° N
35° N
30° N
25° N
20° N
120° W
110° W
100° W
90° W
80° W
Cost-Competitiveness Index (CCI)
1.5
0.8
0.0
-1.0
-2.0


Statewide Mean Cost of Joint Arthroplasty 2013-2022
45° N
40° N
35° N
30° N
25° N
120° W
100° W
90° W
80° W
Mean Cost of Arthroplasty (USD)
100% (6000.0)
75% (3209.2)
50% (2830.8)
25% (2551.0)
0% (2000.0)