

Maximizing Value for Patients: Robotic versus Conventional Total Knee Arthroplasty in a Hospital Outpatient Setting

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INTRODUCTION: The United States has the highest healthcare expenditure per capita amongst developed nations. Two-thirds of US annual expenditure is spent on specialty care like orthopaedic surgery. Because of this, orthopaedic surgery is transitioning to value-based care to combat rising costs. Value-based specialty care seeks to maximize patient outcomes while minimizing costs. Total knee arthroplasty (TKA) is one of the most common surgeries performed, and the volume of TKA is expected to continuously increase with the aging US population. This study aims to compare the value of performing robotic TKA and conventional TKA in a hospital outpatient setting (HOPD).

METHODS:

Patients undergoing primary unilateral robotic TKA or conventional TKA through the HOPD were enrolled through four physicians at a Midwest tertiary care institution. Patients had to be over 18, must have received spinal anesthesia, and be discharged the same day.

Costs were categorized as direct (supply, labor, and fixed costs) and indirect (administration, marketing, and EHR). A healthcare system-based costing methodology that included Time-Driven Activity-Based Costing (TDABC), Activity-Based Costing (ABC), and the hospital finance department were used. Direct variable labor (DVL) costs were determined using TDABC and were calculated by tracking the total time the personnel spent providing care. Direct variable supply (DVS) costs were assessed via ABC and were determined by the supplies used. Direct fixed costs were sourced from hospital accounting data, while indirect costs followed the same methodology.

Quality was measured using Knee Injury and Osteoarthritis Outcome Score Joint Replacement (KOOS JR) scores preoperatively and at 12 months postoperatively. KOOS JR scores were converted into KOOS JR Quality Adjusted Life Years (QALY_K) by normalizing the change in score over time and multiplying it by the estimated length of effectiveness. For comparison of outcomes, patients were matched based on various demographic information to mitigate confounding bias. Value was assessed as cost per QALY_K. Lower Value indicated greater cost effectiveness.

RESULTS:

Preliminarily, 26 robotic TKA and 21 conventional TKA have been collected. The average total costs of robotic TKA and conventional TKA were \$13,899.69 and \$12,871.95, respectively (p = 0.41).

At 12 months post-operation, average improvement in KOOS for robotic TKA was 26.95 and 25.03 for conventional TKA (p = 0.72). This results in an average QALY_K for robotic TKA at 2.94 and conventional TKA at 2.63 (p = 0.72). The robotic TKA Value was lower compared to the conventional TKA Value (\$4,722.99/ QALY_K versus \$4,896.89/ QALY_K).

DISCUSSION AND CONCLUSION:

While robotic TKA average total cost was greater than that of conventional TKA, robotic TKA's outcomes outperformed that of conventional TKA, shifting the Value equation to favor robotic TKA. Therefore, robotic TKA is more cost-effective than conventional TKA in the HOPD. However, the differences in cost and outcomes were not statistically significant.

Based on our preliminary findings, as the volume of TKA procedures increases, we propose that emphasizing a value-based approach can enhance value for patients, providers, and healthcare systems.

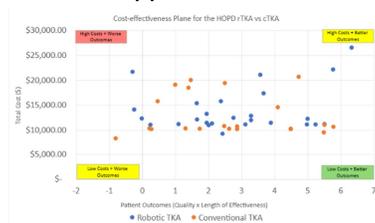


Figure 2. Plot of the total cost of care versus KOOS gained at 12 months post-operation. Data points lower and to the right of the scatterplot indicate greater value. N= 26 for robotic n = 21 for conventional.

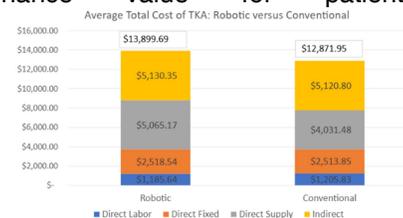


Figure 1. Average total cost and breakdown based on each cost category of robotic TKA and conventional TKA. N= 26 for robotic n = 21 for conventional.

Location and Technique	Sample Size (n)	Average Total Cost	KOOS JR Change (12 months)	QALY _K (12 months)	Value (12 months) (\$/QALY _K)
Robotic HOPD	26	\$13,899.69	26.95	2.94	4,722.99
Conventional HOPD	21	\$12,871.95	25.03	2.63	4,896.89

Table 1. Summary of total cost, change in KOOS-JR scores and QALY_K (higher is better) at 12 months post-operation, and value for robotic TKA and conventional TKA.