Does Surgical Setting Matter? A Site-of-Service Comparison for Robotic Total Knee Arthroplasty

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INTRODUCTION: Although the United States leads globally in healthcare spending, it continues to experience underwhelming health outcomes across many metrics. This disconnect has driven the push toward value-based care, which emphasizes cost-effective delivery without sacrificing quality. Total knee arthroplasty (TKA), particularly robotic TKA (rTKA), has seen increasing demand due to an aging population and rising rates of osteoarthritis. To address escalating healthcare costs, procedures are increasingly being shifted from hospital outpatient departments (HOPDs) to ambulatory surgical centers (ASCs), which are generally less resource-intensive. However, whether ASCs deliver equivalent value, defined by both cost and outcomes, remains uncertain. This study aims to compare the value of rTKA performed in ASCs versus HOPDs, with the hypothesis that ASCs can achieve greater value in the form of similar clinical outcomes at a lower overall cost.

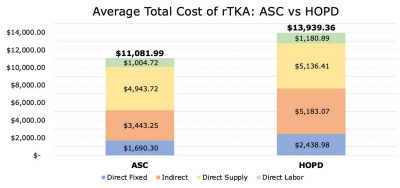
METHODS:

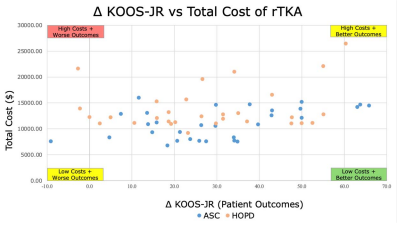
We conducted a prospective cohort study involving 60 patients undergoing robotic total knee arthroplasty. Participants were divided into two groups: 30 treated in an ASC and 30 treated in an HOPD, with the goal of reaching a sample size of 35 in each cohort as determined by power analysis. Inclusion criteria required patients to be undergoing primary rTKA, while exclusion criteria included ineligibility for ASC procedures, use of general anesthesia, revision surgeries, or need for post-operative hospital admission. Both cohorts were demographically matched and monitored for 12 months following surgery.

Cost analysis was performed using a combination of time-driven activity-based costing (TDABC), activity-based supply costing (ABC), and claims-based facility data. The time each personnel spent per patient was tracked and multiplied by their per-minute salary to calculate direct variable labor costs. Direct variable supply costs were based on intraoperative supply usage, while direct fixed costs included building and utility fees. Indirect costs, accounting for miscellaneous expenses such as marketing and administration, were also included. Outcome effectiveness was assessed using the Knee Injury and Osteoarthritis Outcome Score – Joint Replacement (KOOS-JR) taken preoperatively and at 12 months postoperatively. These values were then adjusted for the implant's functional lifespan to derive KOOS-JR-adjusted life-years ($QALY_K$s). Costs were divided by $QALY_K$s gained to determine overall value for each cohort. Statistical comparisons were made using independent t-tests, with significance defined as $p < 0.05$.

RESULTS: The average total cost of rTKA was significantly lower when performed in an ASC compared to an HOPD ($11,081.99 vs. $13,939.36; $p = 0.003$). Functional outcomes, measured as KOOS-JR and $QALY_K$s improvement, slightly favored rTKA in ASC, however, were insignificantly different between the two groups (30.13 vs. 27.68; $p=0.604$) and (3.16 vs. 2.91; $p = 0.604$). The ASC cohort demonstrated a lower cost per quality ($3,502.85/$QALY_K$) than the HOPD cohort ($4,796.35/$QALY_K$), indicating a higher value associated with the ASC setting.

DISCUSSION AND CONCLUSION: This study provides evidence that robotic total knee arthroplasty (rTKA) conducted in ambulatory surgical centers (ASCs) can deliver greater overall value than procedures performed in hospital-based outpatient departments (HOPDs). Driven by significantly lower costs and better patient-reported outcomes, ASCs demonstrated dominance as the higher-value setting for rTKA. These findings support the transition of rTKA to ASC environments as a cost-effective approach that maintains high-quality patient care and aligns with broader value-based healthcare goals.





TKA Value	Total Cost	Avg KOOS Jr Change	Avg $QALY_K$	Value ($/$QALY_K$)
ASC	$11,081.99	30.13	3.16	$ 3,502.85
HOPD	$13,939.36	27.68	2.91	$ 4,796.35