Value-Based Care in Joint Arthroplasty: What is the Formula?

Mithil Gudi¹, Raghav Rajesh, Carter Lee Dunaway, Zachary Chen, Charles S Day² ¹Wayne State University School of Medicine, ²Henry Ford Health System INTRODUCTION:

Medicine is experiencing a paradigm shift from traditional fee-for-service models towards value-based care to optimize cost and quality outcomes that lead to a sustainable healthcare system. The 2023 American Joint Replacement Registry Annual Report reports that 3,149,042 primary and revision hip and knee arthroplasty procedures were performed between 2012 and 2022, which is notable as hip and knee replacements are some of the most common procedures for Medicare beneficiaries. This higher procedural volume increases demand and strain on our healthcare system, supporting the need for value-based care and placing orthopaedic joint specialists at the forefront of this transition. Value is a combined measure of both cost and quality across the full episode of patient care. While many studies seek to calculate and compare value, they often only consider cost and quality individually. Of the studies that capture value, most are based on simulated models of data which provide valuable insight but are difficult to derive clinical indications from. As we continue to transition towards translating value-based care into clinical practice, it is crucial to evaluate how value is calculated and compared in studies based on real clinical data.

This study aims to provide a comprehensive review of how value, as a function of both cost and quality, is calculated and compared from real world data in total hip arthroplasty and total knee arthroplasty. In addition, we hope to highlight the inconsistencies that exist in this space.

METHODS:

A key-word search was conducted using electronic databases (e.g., PubMed, Embase) from 1/1/2003 to 9/6/23. Any orthopaedic arthroplasty study comparing at least two treatment groups or two patient cohorts, while utilizing cost/quality measures from real patient data, was included. Following PRISMA guidelines, articles were selected by 2 blinded, independent reviewers with a third for tie-breaks.

Costs and their sources were allocated into healthcare costs (direct fixed, direct variable, indirect, and out-of-pocket costs) and societal costs (out-of-pocket and opportunity costs). Comparisons were made across each study regarding primary patient-reported outcomes and their transformed quality measures, location, cost perspective, cost source, and value formulas (Incremental Cost-Effectiveness or Cost-Utility Ratio (ICER/ICUR), Marginal Cost-Effectiveness Ratio (MCER), Average Cost-Effectiveness Ratio (ACER), Net Monetary Benefit (NMB), or Net Benefit Regression (NBR)).

RESULTS: Out of 795 studies, 12 knee studies, 8 hip studies, and 3 knee and hip studies met inclusion criteria. 9 different countries were represented with three studies being from the US (Table 1). Patient-reported outcomes were measured through the EQ-5D survey and its iterations (n=15), Oxford Hip Score (n=3), WOMAC (n=2), SF-6D (n=2), and Quality of Life Index (n-1). All studies transformed their outcome measure into a Quality-adjusted life year (QALY) other than two studies that did not transform their measure at all and one study which transformed its measure into a quality of well year (QWL). Most studies included multiple sources of costs to calculate total cost, of which public payer was the most common source (Table 2). Notably, 14 of the studies did not include any societal costs in their cost calculation. 3 studies had unclear or unidentified sources of costs. Likewise, multiple perspectives were used by studies when collecting cost data (Table 2). 6 formulas to calculate value as a simultaneous measure of cost and quality were noted in the included studies, including ICER/ICUR (n=18), NMB (n=3), ACER (n=3), MCER (n=2), and NBR (n=1).

DISCUSSION AND CONCLUSION: The intricacies in cost calculation, outcome reporting, and value evaluations seen in the preliminary findings highlight the multitude of different pathways by which value can be calculated. When sourcing costs in a mixed-payer environment such as in the US, it is essential to incorporate a healthcare perspective to capture all costs associated with an episode of care. As value-based care continues to grow in the US, it will be beneficial to analyze and adapt how other mixed-payer nations have approached value calculation. Compared to other orthopaedic subspecialties such as hand and wrist care, which have no economic evaluation studies in the US based on similar criteria, the field of joint replacement is seemingly more advanced in value comparison methodology and serves as an ideal launch pad for further development of value-based medicine in orthopaedics. In the end, the overall variability in methodology combined with a scarcity of U.S. healthcare studies highlights the need for standardization when calculating and comparing value in U.S. knee care. Creating a uniform method to analyze cost/quality will allow providers to allocate resources effectively, improve sustainability, and optimize decision-making in orthopaedic healthcare.

Table 1. Characteristics of value-based studies comparing value in hip and knee replacement		
Characteristic	N	%
Year Published	n=23	
2003-2007	1	4.35
2008-2012	5	21.74
2013-2017	8	34.78
2018-2023 as of 9/11/23	9	39.13
Geography	n=23	
United States	3	13.04
Canada	1	4.35
Denmark	3	13.04
China	2	8.7
Iceland	1	4.35
UK	9	39.13
Norway	1	4.35
Germany	2	8.7
Netherlands	1	4.35
Pathology	n=23	
Hip Osteoarthritis	8	34.78
Knee Osteoarthritis	12	52.17
Hip and Knee Osteoarthritis	3	13.04
Type of Treatment	n=23	
Healthcare Delivery	3	13.04
Rehabilitation	2	8.7
Surgical	11	47.83
Non-Surgical	5	21.74
Surgical vs Non-Surgical	2	8.7

Characteristic	N	%
Cost Perspective	n=23	
Healthcare	9	39.13
Societal	10	43.48
Payer	12	52.17
Patient	0	0
Type of Healthcare System	n=23	
Single Public Payer	11	47.83
Public and Private Payers	12	52.17
Source of Cost	n=23	
Public Payer Cost Data	14	60.87
Patient Diary/Questionnaire	6	26.09
Estimation by Finance Department	6	26.09
Local Primary Care Register	2	8.7
Private Payer Unit Cost Data	2	8.7
Manufacturer Price	4	17.39
Standardized Costing Method	1	4.35
RCC	1	4.35
Other Published Study	1	4.35
Unclear/Unidentified Cost	3	13.04
Type of Cost	n=23	
Healthcare Costs		
Direct Fixed	23	100.0
Direct Variable	14	60.87
Indirect	3	13.04
Out-of-Pocket	0	0
Societal Costs	n=23	
Non-Medical Indirect	8	34.78
Non-Medical Direct	8	34.78
Discount Rate	n=23	
Yes	9	39.13
No	14	60.87