Determining the Drivers of Cost in Arthroscopic Rotator Cuff Repair: A Time-Driven Activity-Based Costing (TDABC) Analysis

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INTRODUCTION:

Delivering high value orthopaedic care requires optimizing value, defined as health outcomes achieved per dollar spent. On the cost side of the value equation, it has long been a challenge to accurately calculate total cost. Published literature is stippled with inaccurate proxies for cost, including negotiated reimbursement rates, fees paid, or listed prices. Time-driven activity-based costing (TDABC) offers a much more robust and accurate approach to calculating cost for medical services, including shoulder care. Further, TDABC allows stakeholders to assess the major cost drivers and implement strategies to make changes wherever possible to reduce cost without impacting outcomes. In the present study, we sought to determine the drivers of total cost in arthroscopic rotator cuff repair (ARCR) using TDABC.

METHODS:

Institutional Review Board (IRB) approval was obtained to retrospectively analyze consecutive patients undergoing ARCR at multiple sites associated with a single, large urban healthcare system between January 2019 and September 2021. Total cost was determined using TDABC methodology.[3] The episode of care was defined by three phases: preoperative, intraoperative, and postoperative care. To determine cost drivers of ARCR, patient factors including age, body mass index (BMI), and comorbidities (Charlson Comorbidity Index) were recorded. Rotator cuff tear characteristics including acuity, revision status, radiographic Hamada grade and acromiohumeral index (AHI), magnetic resonance imaging (MRI) analysis of tear retraction, average and maximum Goutallier grade, and number of tendons torn were recorded. Surgeon characteristics including volume and fellowship training were included. Implant characteristics including number of anchors used, anchor brand, and the use of biologic adjuncts were recorded. Descriptive statistical analysis and multivariable linear regression were performed.

RESULTS:

Patients from one general hospital and two ambulatory surgery centers were included. In total, 798 ARCRs were included, performed by 26 orthopaedic surgeons. By TDABC analysis, total ARCR cost varied 8.3-fold from least to most costly (SD 0.93). Intraoperative costs accounted for 92.2% of average total cost, followed by preoperative costs and postoperative costs (5.0% and 2.8%, respectively). Biologic adjuncts (Regression Coefficient: 1.9 [95% CI: 1.6-.21], $p<0.001$) and surgeon idiosyncrasy (Regression Coefficient of Highest Cost Surgeon: 1.1 [95% CI: 0.7 to 1.4], $p<0.001$) were the major cost drivers in ARCR. Patient age, number of rotator cuff tendons torn, average Goutallier grade, and chronicity of tear were not significantly associated with total cost. The amount of tendon retraction - either supraspinatus/infraspinatus (Regression Coefficient: 0.008 [95% CI: 0.004 to 0.01], $p=0.004$) or subscapularis (Regression Coefficient: 0.009 [95% CI: 0.003 to 0.01], $p=0.003$) - was significantly associated with higher cost but to a minimal extent.

DISCUSSION AND CONCLUSION:

Our study is the first of its kind to accurately highlight the major cost drivers in ARCR using TDABC. The cost of ARCR is generated intraoperatively. The major drivers of total cost in ARCR are the use of biologics and surgeon idiosyncrasy. This suggests that as we seek to optimize value for our patients, we - as orthopaedic surgeons – may control a great deal of the cost ourselves.

Table 1. Linear Regression Assessing Factors Associated With Normalized Total Cost (Via TDABC)

		Adjusted R-2	0.67
Characteristic	**Coefficient**	**95% CI**	**p-value**
Age	0.002	-0.008 to 0.1	0.64
Charlson Comorbidity Index (CCI)	0.02	-0.04 to 0.08	0.49
Anchor Brands			
1		Reference	
2	-0.09	-0.7 to 0.5	0.77
3	-0.5	-0.7 to -0.3	<0.001
4	-0.3	-0.5 to -0.08	0.007
Biologics			
Yes	1.9	1.6 to 2.1	<0.001
Surgeon			
1		Reference	
2	0.1	-0.1 to 0.3	0.27
3	0.4	-0.02 to 0.7	0.07
4	0.6	0.2 to 0.9	0.001
5	0.2	-0.03 to 0.5	0.08
6	0.8	0.5 to 1.2	<0.001
7	0.3	-0.01 to 0.5	0.06
8	0.09	-0.7 to 0.8	0.81
9	0.1	-0.3 to 0.5	0.55
10	0.2	-0.08 to 0.6	0.14
11	0.4	0.01 to 0.7	0.04
12	1.1	0.7 to 1.4	<0.001
13	0.3	-0.05 to 0.6	0.09
14	0.4	0.2 to 0.7	0.001
Hamada Classification			
2	0.02	-0.2 to 0.2	0.87
Number of Tendons Torn	0.1	-0.007 to 0.2	0.07
Goutallier Average	0.02	-0.08 to 0.1	0.66
Supraspinatus/Infraspinatus Tendon Retraction	0.008	0.003 to 0.01	0.004
Subscapularis Tendon Retraction	0.009	0.003 to 0.01	0.003
Type of Tear			
Acute		Reference	
Chronic	0.001	-0.2 to 0.2	0.99
Unknown	0.07	-0.5 to 0.6	0.81