

Surgeon-Directed Cost Variation in Isolated Rotator Cuff Repair

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Background: As value becomes a larger component of health care decision making, cost data can be evaluated for regional and physician variation. Value is determined by outcome divided by cost, and reducing cost increases value for patients. "Third-party spend" items are individual selections by surgeons used to perform procedures. Cost data for third-party spend items provide surgeons and hospitals with important information regarding care value, potential cost-saving opportunities, and the total cost of ownership of specific clinical decisions.

Purpose: To perform a cost review of isolated rotator cuff repair within a regional 7-hospital system and to document procedure cost variation among operating surgeons.

Study Design: Economic and decision analysis; Level of evidence, 4.

Methods: Current Procedural Terminology (CPT) codes were used to retrospectively identify subjects who received an isolated rotator cuff repair within a 7-hospital system. Cost data were collected for clinically sensitive third-party spend items and divided into 4 cost groups: (1) suture anchors, (2) suture-passing devices and needles, (3) sutures used for cuff repair, and (4) disposable tools or instruments.

Results: A total of 62 isolated rotator cuff repairs were performed by 17 surgeons over a 13-month period. The total cost per case for clinically sensitive third-party spend items (in 2015 US dollars) ranged from \$293 to \$3752 (mean, \$1826). Four surgeons had a mean procedure cost that was higher than the data set mean procedure cost. The cost of an individual suture anchor ranged from \$75 to \$1775 (mean, \$403). One disposable suture passer was used, which cost \$140. The cost of passing needles ranged from \$140 to \$995 (mean, \$468). The cost per repair suture (used to repair cuff tears) varied from \$18 to \$298 (mean, \$61). The mean suture (used to close wounds) cost per case was \$81 (range, \$0-\$454). A total of 316 tools or disposable instruments were used, costing \$1 to \$1573 per case (mean, \$624).

Conclusion: This study demonstrates significant cost variation with respect to cost per case and cost of individual items used during isolated rotator cuff repair. Suture anchors represent the most expensive and variable surgeon-directed cost. The wide cost variation seen in all cost categories illustrates both the effect of surgeon choice in procedure cost and the opportunity for significant cost savings in cases of isolated rotator cuff repair. Engaging surgeons in discussion on cost can positively influence the value of care provided to patients if costs can be reduced without affecting the quality of patient outcomes.

Keywords: rotator cuff repair; economic and decision analysis; value improvement

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The cost of health care and the efficient use of health care resources in the United States is a topic of increasing concern. Value in health care has been defined as being proportional to outcome/cost.¹⁶ Lower cost at the same outcome provides increased value to patients. Thus, it is important for physicians and hospitals to evaluate the cost of patient care and to measure clinical outcomes to determine overall efficacy of treatment options. As clinical outcomes are often difficult to quantify, cost utility analyses provide a meaningful way to evaluate treatment options.^{3,12,13,17}

While overall cost-effectiveness of a specific intervention is an important quality benchmark, there can be significant cost variation among institutions and physicians for the same or similar treatments. As a result, evaluation of cost

and financial utilization of physician practices is a necessary component of a thorough quality and value assessment.⁷ Evaluation of “third-party spend” items is a critical element of any cost evaluation process. Third-party spend items are individual item selections by surgeons to perform procedures, such as implants, disposable devices, and so on. In contrast to other costs such as procedure time, which may depend heavily on an individual institution’s practices and policies, third-party spend costs can be readily influenced by surgeon choice.

Many orthopaedic procedures are performed in high volume and are major hospital cost drivers, making financial analyses of these interventions particularly significant.⁶ Over 250,000 rotator cuff repairs are performed annually in the United States, and there are a wide variety of hardware and surgical techniques available.^{5,14,19} For each case, variation in equipment, disposable instruments, and suture anchors can lead to large discrepancies in cost.^{4,20} Some of the variation in cost may be due to patient factors such as tear size and morphology, requiring more complex and costly implants/disposables to obtain good outcomes. Variation based on individual patient needs is justifiable when additional resources improve outcomes. But more expensive items may not always add value or improve outcomes in a meaningful manner. Analyzing cost data and distributing this information to physicians is necessary to engage providers in cost evaluation and make cost a relevant factor in surgical decision making.¹

The purpose of this study was to determine cost variation among surgeons performing isolated rotator cuff repair performed in a regional 7-hospital system.

METHODS

This project was reviewed by the institutional review board and designated as a performance improvement project (not a research project); therefore, it did not require human subjects research approval or formal review.¹³ Subjects who received a rotator cuff repair within a 7-hospital system over a 13-month period (January 2014 to January 2015) were retrospectively identified using the Current Procedural Terminology (CPT) surgical codes (rotator cuff repair code: 29827) and International Classification of Diseases, 9th Revision (ICD-9) diagnosis codes (rotator cuff repair code: 83.63). Cost data were collected for all supply-chain items considered under the influence of the operating surgeon. Contracts with outside vendors are negotiated for the entire hospital system, and thus the cost of third-party spend items are standardized across all locations of care. The hospital system includes both inpatient and outpatient surgery centers. Analysis of factors such as operating room time per case was not included due to variation in anesthesia techniques (some peripheral nerve blocks are placed in the preoperative area, while some are placed in the operating room, which adds to operating room case time). Complication rates and clinical outcomes were not included, as these data sets were not present in a consistent format within the system and among surgeons. Patient factors (tear size and morphology, repair technique used) and surgeon factors (age, training

background, etc) were excluded from our analysis as well. Encounters that involved secondary procedures such as a biceps tenodesis, subacromial decompression, or distal clavicle excision were excluded to avoid introducing costs not associated with an isolated rotator cuff repair.

The items deemed under the choice of the operating surgeon were divided into 4 cost groups: (1) suture anchors (including single-, double-, triple-loaded, etc), (2) suture-passing devices and suture-passing needles, (3) sutures used for cuff repair, and (4) disposable tools or instruments. Sutures for cuff repair were distinguished from sutures used for skin closure. Disposable tools and instruments included bandages, cannulas, drains, drills, electro-surgical and cauterizing devices, endoscopic shavers, probes, punches, intraoperative patient positioning devices, skin closure sutures, and adhesives. All items included in the cost analysis could not be reused or reesterilized.

The cost detail from each case was combined to analyze isolated rotator cuff repair mean surgical costs under the influence of the operating surgeon.

RESULTS

A total of 521 rotator cuff repairs were performed during the 13-month period analyzed in this study. Of these, 62 cases were isolated rotator cuff repairs performed by 17 surgeons (range, 1-14 cases per surgeon).

Total Cost Per Procedure

The total surgeon-directed cost per case (in 2015 US dollars) ranged from \$293 to \$3752, with a mean cost of \$1826. The difference between the highest and lowest cost procedure was \$3459. The median total cost per procedure was \$1500. Four surgeons had a mean procedure cost that was higher than the data set mean procedure cost (Figure 1). For surgeons who performed four or more isolated rotator cuff repairs ($n = 5$), the lowest cost procedure was \$317 and the highest cost procedure was \$3747. There was no relationship between surgeon case volume and cost per case (Table 1).

Suture Anchor Cost

The number of suture anchors used per case ranged from 1 to 5, with a mean of 1.7 suture anchors per case. The cost of an individual suture anchor ranged from \$75 to \$1775 (mean, \$403). This represents a difference of \$1700 between the most and least expensive suture anchors. The maximum amount spent on suture anchors for a single case was \$2986 (2 suture anchors), representing 80% of the surgeon-directed costs of the procedure. This was the most expensive case in the data set.

Suture-Passing Needles and Suture Passer Cost

One disposable suture passer and 44 passing needles were used. Reusable suture passers were not included in the cost analysis since the cost of reusable items can be shared among

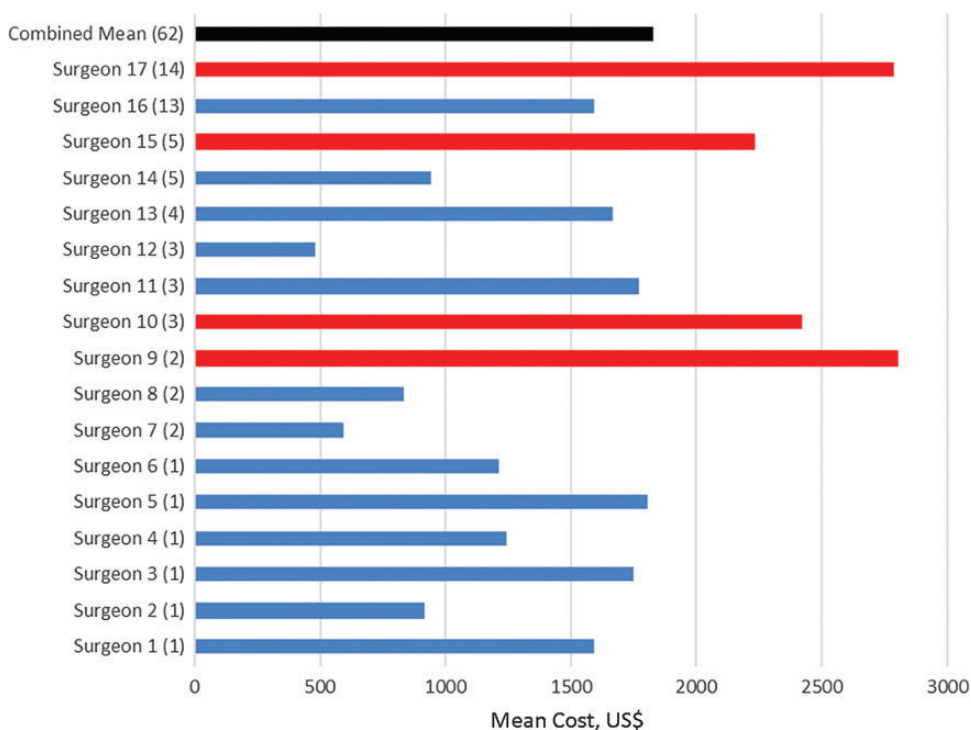


Figure 1. Mean cost per surgery. The combined mean cost (US\$1826) is shown in black. Surgeons whose mean cost per case was greater than the mean cost per case of the entire sample are highlighted in red, and surgeons whose mean cost was less than the combined mean are highlighted in blue. The values in parentheses represent the number of repairs performed by each surgeon during the 13-month period.

TABLE 1
Surgeon Volume and Cost per Case

No. of Cases	Surgeon	Cost, 2015 US\$					
		Minimum	Deviation From Median ^a	Maximum	Deviation From Median ^a	Mean ^b	Physician Mean/ Total Mean Deviation ^c
14	Surgeon 17	1178	-372	3747	2247	2786	960
13	Surgeon 16	317	-1233	3170	1670	1592	-234
5	Surgeon 15	749	-801	1805	305	2230	404
5	Surgeon 14	809	-741	1145	-355	943	-883
4	Surgeon 13	1055	-495	2845	1345	1667	-159
3	Surgeon 12	2299	749	2636	1136	2420	594
3	Surgeon 11	1130	-420	2520	1020	1769	-57
3	Surgeon 10	293	-1257	687	-814	481	-1345
2	Surgeon 9	1849	299	3752	2252	2801	975
2	Surgeon 8	558	-992	1106	-394	832	-994
2	Surgeon 7	564	-986	617	-883	591	-1235
1	Surgeon 6	1213	-337	1213	-287	1213	-613
1	Surgeon 5	1805	255	1805	305	1805	-21
1	Surgeon 4	1243	-307	1243	-257	1243	-583
1	Surgeon 3	1750	200	1750	250	1750	-76
1	Surgeon 2	911	-639	911	-589	911	-915
1	Surgeon 1	1591	41	1591	91	1591	-235

^aDifference between physician minimum and maximum cost and the data set median cost. A negative value indicates that the physician value was less expensive than the total median.

^bFor physicians who performed ≥ 2 cases, the mean cost per case was calculated. For physicians who performed 1 case, the absolute procedure cost was included.

^cDifference between physician mean cost and the total data set mean cost. A negative value indicates that the physician's mean cost was lower than the total mean.

TABLE 2
Disposable Tools and Instruments

Component	n	Cost, 2015 US\$		
		Minimum	Mean	Maximum
Bandage	2	4	23	42
Cannula	60	15	140	290
Drain	1	240	240	240
Drill	3	150	175	225
Electrosurgical accessory	34	3	83	137
Endoscopic shaver	66	48	258	339
Probe	3	137	137	137
Punch	1	75	75	75
Operating room patient-positioning device	17	70	71	78
Skin closure	123	1	61	427

cases. The single disposable suture passer was \$140. The mean cost of a suture-passing needle was \$468 (range, \$140-\$995).

Repair Suture Cost

A total of 82 individual sutures were used for cuff repair. The cost per repair suture varied from \$18 to \$298 (mean, \$61). The mean suture cost per case was \$81 (range \$0-\$454).

Disposable Tools and Instrument Cost

A total of 310 disposable tools and instruments were used in the 62 cases. The cost per case ranged from \$1 to \$1573 (mean, \$624). The breakdown of number and cost of disposable tools can be seen in Table 2.

DISCUSSION

The cost of an isolated rotator cuff repair performed by 1 of 17 surgeons within a single hospital system ranged from \$293 to \$3751, with the most expensive repair totaling approximately 12 times the least expensive repair. Although the overall cost of cuff repairs varied substantially, the variation in cost between materials that serve specific purposes is perhaps the most interesting and clinically relevant finding of this study. The most expensive suture anchor cost approximately 23 times more than the least expensive suture anchor. Only 1 case used a disposable needle passer, but this item added \$140 to the total procedural cost. The cost of a needle varied from \$140 to \$995, with a 7-fold difference between the most and least expensive needle. Additional disposable tools and instruments added between \$1 and \$1573 to each case evaluated in this study.

In an attempt to make the included overall cost of cases more comparable, cases involving secondary operative procedures beyond rotator cuff repair (acromioplasty, etc) were excluded. Isolated rotator cuff repairs represent only 12% of all rotator cuff repairs for our system during the 13-month period. Thus, the effect of cost reduction on the entire spectrum of rotator cuff cases (isolated rotator cuff repair and rotator cuff repair combined with other procedures) would be much greater if increased value and lower cost could be extended to each of the cases.

Although this study set is limited by a small number of cases and surgeons, the data show a high degree of variation in cost of an isolated rotator cuff repair and the materials used therein. The study is also limited in that the cost analysis neither took into account patient-specific factors such as age, cuff tear size, or tear morphology, nor did it compare clinical outcomes. These variables are undoubtedly important for a comprehensive evaluation of cost and value of procedures. This analysis focused on cost factors that are applicable to all cases and can be influenced by surgeon decisions in the operating room. We did not include the cost of operating time in this analysis. In some centers, the anesthesia extremity block is placed in the operating room, and in others, the block is placed in the preoperative area. Due to this variation in anesthesia practice, we did not include time in the operating room as a factor of cost. This may be an important variable for future studies on cost and value, as procedure time may be related to surgeon volume and outcomes for other orthopaedic surgeries have been previously demonstrated to be related to surgeon volume.^{2,8-11} The analysis did not include complications, outcomes, or readmission rates, as this information is not consistently collected throughout the 7 hospitals of the health system.

It is important to note that some degree of cost variation is expected and even necessary. A previous study by Archibald-Seiffer et al¹ noted similar differences in the cost of isolated primary anterior cruciate ligament (ACL) reconstruction, with wide variation in the price of different tibial and femoral fixation and total cost per case. The study found 12-fold differences between the most and least expensive ACL reconstructions.¹ Some cases may require additional cost inputs to create better outcomes for patients, including more expensive implants. In the case of rotator cuff repair, additional or more expensive devices may be necessary for more complex and/or larger rotator cuff cases or may decrease operating time. But the remarkable cost variation for similar implants, needles, sutures, and so on may be an area of investigation that can identify cost-saving opportunities. Engaging surgeons in these discussions will be important to ensure the best choices for patient care are considered appropriately.

Other analyses have found a relationship between surgeon volume or hospital center volume and cost per case.^{1,4,6} Jain et al⁶ found that high surgeon volume was associated with a lower cost for surgical repair of proximal

humeral fractures. Previous work on primary ACL reconstruction has shown that high-volume surgeons tend to perform this procedure at lower cost than low-volume surgeons.¹ This study did not find any association between surgeon volume and cost; however, time in the operating room—which may be associated with surgeon volume—was not included in our analysis.

Reduction in both cost and resource variation is essential to quality and value improvement, especially when value gains can be identified that maintain and/or improve outcome and reduce cost inputs.^{7,15} Future health care contracts may require fixed reimbursements for some higher volume procedures, which may include all costs (facility fees, professional fees of surgeons and anesthesiologists, durable medical equipment, physical therapy, etc). A better understanding of surgeon-directed costs may increase value for patients and also assist with contract negotiation with private and government payers.

Many surgeons may be unaware of the drastic differences in cost between similar items. Certainly, differences in quality, reliability, and ease of use exist between products; however, in the case of products such as suture anchors (mean cost, \$403; range, \$75-\$1775) and needles (mean cost, \$468; range, \$140-\$995), it seems unlikely that the added benefit of the most expensive products is proportional to their added cost in most situations. Therefore, if the dual aim of cost reduction and value improvement is to be achieved, it is crucial that cost information be made available to surgeons and orthopaedic departments. Choice of third-party spend items may also be influenced by an individual surgeon's situation. Surgeons who share in the profits or losses of a surgery center might have more incentive to evaluate cost-saving opportunities, while others may have conflicts of interest such as research funding or royalties from a particular company, which influence their decision making. Even in cases in which surgeons may not participate in the financial performance of the surgery center or have other conflicts, insurance companies track costs by individual surgeons. In some regions, insurance companies will direct patients to centers and surgeons that have lower costs of care. Regardless, surgeons are the best equipped to decide which products will be both cost-effective and improve the care of patients, thus they are essential to the discussion about costs and quality. The least expensive device may or may not always be the best choice, but surgeons must be aware of cost data to make the best decision about value.

CONCLUSION

Surgeon decision making in the operating room is complex, and third-party spend is just one of many important factors.¹⁸ While some variation in cost and product choice may be rational, patient centered, and improve outcomes, surgeon awareness of this variation is crucial for recognizing and realizing opportunities to decrease cost without affecting the quality of care provided to patients. This study found wide variation in rotator cuff repair cost categories, which illustrates both the effect of surgeon decision making in procedure cost and the opportunity to reduce the total

cost and improve value to patients who are undergoing rotator cuff repair. Physician expertise and leadership will be critical to providing the best value to patients in any cost management initiative.

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