



Original research

Strategies for reducing implant costs in the revision total knee arthroplasty episode of care

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ABSTRACT

Background: Implant price has been identified as a significant contributing factor to high costs associated with revision total knee arthroplasty (rTKA). The goal of this study is to analyze the cost of implants used in rTKAs and to compare this pricing with 2 alternative pricing models.

Methods: Using our institutional database, we identified 52 patients from January 1, 2014 to December 31, 2014. Average cost of components for each case was calculated and compared to the total hospital cost for that admission. Costs for an all-component revision were then compared to a proposed “direct to hospital” (DTH) standardized pricing model and a fixed price revision option. Potential savings were calculated from these figures.

Results: On average, 28% of the total hospital cost was spent on implants for rTKA. The average cost for revision of all components was \$13,640 and ranged from \$3000 to \$28,000. On average, this represented 32.7% of the total hospital cost. Direct to hospital implant pricing could potentially save approximately \$7000 per rTKA, and the fixed pricing model could provide a further \$1000 reduction per rTKA—potentially saving \$8000 per case on implants alone.

Conclusions: Alternative implant pricing models could help lower the total cost of rTKA, which would allow hospitals to achieve significant cost containment.

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Introduction

In the United States, the number of total knee arthroplasty (TKA) procedures has more than doubled over the past decade [1]. These dramatic increases in TKA utilization are expected to result in a proportionate increase in patients requiring revision surgery (rTKA) [2,3]. It is estimated that the number of rTKA will increase by 601%

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by 2030 [4]. Previous studies have already demonstrated that rTKA consumes considerably more resources than primary TKA, which is projected to place significant economic burden on the healthcare system [5,6]. In turn, hospitals that provide high volumes of revision procedures must learn to do so in a financially sustainable manner [7,8].

Alternative payment programs have been successfully implemented for primary TKA through resource utilization management and evidence-based care management programs [9,10]. Adjustments to reimbursement for rTKA are necessary to ensure that hospitals can accommodate the increasing number of patients requiring revision procedures. Despite a decrease in hospital length of stay for rTKA, associated costs and resource consumption still remain high [10]. The revision implant cost has been identified as a major contributing factor to the direct cost of rTKA [11,12]. Therefore, estimated costs of rTKA as a function of implant type have been highlighted as a potential area of cost saving [8–10]. Controlling implant cost can reduce the clinical and financial burden of rTKA, while allowing surgeons to better stratify resources.

This study investigated the implant cost as a component of the rTKA episode of care. The purposes of this study are (1) to assess if the principles of value-based care could be applied to rTKA; (2) to identify if implant cost can be used to reduce the overall hospital cost for the episode of care; and (3) to analyze the costs of revision implants in comparison to 2 proposed alternate pricing models. The study hypothesized that with alternative pricing models, the direct costs of rTKA can be significantly reduced.

Material and methods

Using our institutional database, we retrospectively reviewed all patients undergoing rTKA from January 2014 to December 2014. Inclusion criteria were restricted to patients undergoing rTKA Medicare fee-for-service. In the case of multiple knee revisions in the same patient, only initial revision surgery was included and subsequent re-revisions were excluded. These patients were excluded from the study to allow for a direct comparison between the price of the implants across 1-, 2-, and 3-component cases used clinically and the negotiated price of implants in both models. We have excluded revision cases that had significantly more expensive implants or additional cost components that are not used routinely, since such cases would not be included in a negotiated price model. Those excluded cases included cones, sleeves, hinged components, and tumor prostheses.

We then used our institutional all-payer data-reporting system to obtain the total hospital bill, which included the actual amount that the hospital paid for each component in the revision procedure. From these figures, the average cost of the implant component for each case was calculated and compared to the total cost of the hospital admission for those same rTKA operations. There was no standardization of implants and each surgeon chose their preferred implant and vendor. Cases were divided into groups depending on which components were actually revised. We then analyzed these individual component costs to determine the percentage of the overall hospital cost attributable to implants.

The implant costs were then compared to a proposed “direct to hospital” (DTH) standardized pricing model from a US-based manufacturer and a fixed price revision option from another US vendor. These figures were used to calculate potential savings. The proposed DTH pricing would require partnering directly with the manufacturer, therefore saving money on distribution and representative costs. The implants are manufactured within the United States and are made with premium materials.

The fixed price model requires negotiating prices with companies for specific implants. This would restrict the surgeon to only 4 sizes of femoral components, including stems, built-in femoral augments, and tibial augments. The instrumentation is simplified and requires only 2 trays, reducing sterilization and operating room costs. Nursing education on the fixed price revision instrumentation requires minimal training. The instrumentation has been simplified to allow for easier implantation and minimal need for sales representatives in the operating room.

Statistical analysis

All statistical analyses were performed using Microsoft Excel. Using the cost data, the ratio of implant cost to total hospital cost for each case was calculated. Costs for an all-component revision were then compared to a proposed DTH standardized pricing model and a fixed price revision option.

Table 1
Implant price models for revision total knee arthroplasty.

Pricing model	Cost (\$)	Potential savings (\$)
National average (ONR)	16,109	(–) 2469
Current cost	13,640	–
Direct-to-hospital	6500	(+) 7140
Fixed	5550	(+) 8140

ONR, Orthopaedic Research Network

Results

Fifty-two patients were evaluated for inclusion and exclusion criteria for this study. The procedures performed in our study group included 23 patients requiring revision of both the femoral and tibial components (full revision); these patients were included in the study. The excluded patients were the following: 7 patients requiring a hinge or distal femoral replacement; 2 patients who underwent tibial component revision only (with polyethylene exchange); 2 cases requiring a patella and polyethylene exchange; 5 requiring patella-only revisions; and 13 requiring only a polyethylene insert exchange. Average age was 62.7 years (range 29–87), and 13 patients were women and 10 men.

On average, for all rTKA, 28% of the total cost of admission was spent on implants. This amount ranged from as low as 4% (polyethylene exchange only) to as high as 46% (tumor prostheses/hinges). The average cost for revision of 2-component rTKA was \$11,142 and ranged from \$2120 to \$28,080. This represented, on average, 34% of the total hospital cost. Our hospital's current average price for 3-component rTKA, \$13,640, is already lower than the national average price of \$16,109 [13] (Tables 1 and 2). Using the DTH model, standardized pricing could reduce the implant cost for 3-component rTKA to approximately \$6500. This would represent on average a \$7140 saving per case and would reduce the percentage of the total cost to 20% of the total admission cost. In 2014, this would have amounted to an annual saving of \$107,000 for the hospital.

The fixed price revision option afforded greater savings, with the cost of a femoral and tibial component revision being fixed at \$5500. On average, this would provide further saving of \$1000 per case, which reduces the percentage of implant cost to 17% of the total admission cost. In 2014, this would have represented an annual savings of over \$129,000 for the hospital.

Discussion

The purpose of this study is to analyze the implant cost as a component of the rTKA episode of care. There were 3 major findings in our study. First, we analyzed the cost of the revision implants in relation to the overall hospital cost and found it to be a significant portion, up to 34% at our institution for 2-component revisions. Second, by using the proposed DTH implant model, we could reduce the percentage of the total cost to 20% of the total admission cost. Third, using a fixed price implant model, we could further reduce the percentage of implant cost to 17% of the total

Table 2
Cost comparison based on number of revision components.

Revision type	Average implant cost (\$)	Total hospital cost (\$)	% of total hospital bill
One-component	7498	29,992	25
Two-component	11,142	32,771	34
Three-component	13,640	41,712	33

admission cost. Each of these models project significant cost savings without compromising delivery of patient care.

Our findings suggest that in an appropriate patient population, controlling implant costs could serve as a cost-saving strategy in the rTKA episode of care. However, to identify these patients, we need long-term studies to establish outcomes and clinical effectiveness indications with these implant models. At our institution, there have been no early failures to date with the use of these implants. We also understand that not all revisions will have the same total cost of hospital care; however, the goal of our analysis is to demonstrate the potential cost-saving opportunities to improve the value in an average knee revision episode of care involving revision of all components. Therefore, there will be instances where backup constructs will be necessary to provide appropriate care for patients. We understand that reducing costs should not interfere with achieving high-quality patient outcomes. However, in uncomplicated revision cases, such as those not due to a fracture or tumor resection, controlling implant costs can serve as a useful tool for maintaining access to high-quality care for these often expensive problems. We respect the challenge of performing complex replacement procedures and understand that premium implants known for the many available construct options may be more suitable in some instances. For instance, it is plausible that in a younger patient needing complex revision surgery, a surgeon may opt to use a more high-cost implant with more extensive technology.

Our study is not a study of longitudinal clinical results, but rather a financial projection for how escalating surgical costs can be contained. It has been shown that premium implants have not demonstrated better survival than standard implants, and on average cost approximately \$1000 more than standard implants [11]. We are simply providing one alternative within the episode of care that can address the harsh economic realities associated with rTKA implant costs, primarily for patients who may not require all the bells and whistles. Obtaining a consensus regarding revision implants among orthopaedic surgeons will be difficult, but introducing such models could serve as a useful cost-saving measure in some cases. It is difficult enough to get surgeons to perform revision surgery, only compounded by possibly limiting their implant armamentarium would be a challenge. Furthermore, our study concentrates on implant cost only and does not attempt to suggest other cost cutting measures (length of stay, bone grafts, post-acute care, etc.). We do not suggest a complete overhaul of institution-specific protocols, but rather a process by which hospitals can establish new initiatives that allow surgeons to better control rTKA costs.

Under the recent Bundled Payment for Care Initiative, our hospital has successfully implemented an alternative payment model for both primary total hip arthroplasty and TKA; a significant portion of this success is competitive pricing of primary implants.

The success of implementing a fixed cost implant system or a DTH model is predicated on surgeon-hospital alignment. Each surgeon must commit to using the cost-contained implants unless extenuating circumstances dictate otherwise. For many surgeons, this would mean employing new surgical instrumentation and implants that are unfamiliar to them. The benefits associated with cost savings far outweigh the burden of surgeons learning a new implant for revision procedures. However, for this model to be truly successful, it is important to include other measures that contribute to cost minimization. Pre-operative optimization of patient comorbidities, adequate hemoglobin management, and

inpatient perioperative consultations can all help decrease readmissions and supplement cost savings achieved by implant pricing alone [12].

Our study highlights that in order to ensure the financial sustainability of rTKA, providers must identify acceptable solutions, including cost factors such as implant pricing, which can influence the long-term economic viability of a hospital.

Limitations

A number of limitations were present in this study—most of which are inherent to database research. First, our analysis is dependent on administrative coding for cost analysis. Nonetheless, it is unlikely that minor distinctions in coding methodology would greatly affect our cost figures. Second, we did not account for specific indications for the revision arthroplasty, and it is possible that associated costs of the procedure could vary based on this factor. Finally, as previously mentioned, not every rTKA will have the same total cost of hospital admission, and an average cost may not fully portray the entire range of pricing differences as we do not have direct data on how these models may or may not affect the total cost of hospital care other than implant pricing.

Conclusions

Implants used in rTKA contribute a significant proportion of the total hospital cost of admission for these episodes of care. Our analysis suggests that, in the appropriate patient population, a DTH pricing model or a fixed price implant model may provide significant cost containment.

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