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Orthopaedic Surgeons Frequently Underestimate the Cost of Orthopaedic Implants

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Abstract

Background A poor understanding of cost among healthcare providers may contribute to high healthcare expenditures. Currently, it is unclear whether and how much surgeons know about the costs of implantable medical devices (IMDs).

Questions/purposes We (1) determined the level of comfort with orthopaedic IMD costs among orthopaedic residents and attending surgeons, (2) quantified how accurately surgeons understand the costs of orthopaedic IMDs, and (3) identified which constructs yield the most accurate cost estimations among residents and attending surgeons.

Methods A questionnaire was presented to 60 residents and 37 attending orthopaedic surgeons from two large academic medical centers. Respondents estimated the cost of 13 commonly used orthopaedic devices. Fifty-one surgeons participated (36 residents, 15 attending surgeons), for an overall response rate of 53%. Cost estimates were compared against the actual material costs, and we recorded the percentage error for each estimate.

Results More than ½ of the respondents rated their knowledge of IMD cost as poor. The mean percentage error in estimation for all respondents was 69% (range, 29%–289%). Overall, 67% of responses were underestimations and 33% were overestimations. Residents demonstrated a mean percentage error of 73% (range, 29%–289%) while attending surgeons had a mean percentage error of 59% (range, 49%–79%). Residents and attending surgeons demonstrated differences in accuracy within groups and between groups based on the IMD being estimated.

Conclusions We found the knowledge of orthopaedic IMD costs among the orthopaedic residents and attending surgeons surveyed was poor. Further investigation of how physicians conceptualize material costs will be important to healthcare cost control.

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Each author certifies that his or her institution approved or waived approval for the reporting of this investigation and that all investigations were conducted in conformity with ethical principles of research.
This work was performed at University Hospitals Case Medical Center (Cleveland, OH, USA) and The University of Michigan Medical Center (Ann Arbor, MI, USA).

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Introduction

The rapid and unsustainable increase in American healthcare spending is an important public policy issue that has attracted a great deal of attention in the press and in the orthopaedic literature [1, 3, 4, 7, 9]. Costs for implantable medical devices (IMDs) were estimated to have reached

USD 80 billion in 2007, and orthopaedic implant costs alone were expected to grow at a rate of 9.8% annually, reaching USD 23 billion by 2012 [5]. A recent study of 31 hospitals by the US Government Accountability Office (GAO) found expenditures for procedures involving the use of IMDs increased from USD 16.1 billion to USD 19.8 billion over a 5-year period from 2004 to 2009, and orthopaedic devices accounted for the largest portion of this increase [13]. TKAs and THAs already constitute the largest hospital expenditure category for Medicare [11]. Robinson et al. [11] found the cost of total hip and knee implants represented a large percentage of the overall cost of these procedures, ranging from 13% to 87% in a study of 61 hospitals in 2008.

The manufacturers of orthopaedic IMDs are in a highly competitive industry, and pricing contracts between hospitals and manufacturers are usually confidential. Orthopaedic surgeons' lack of knowledge of implant pricing may have real implications for healthcare cost control. As outlined in a recent editorial [9], when neither the patient nor the surgeon directly pays for the costs of orthopaedic implants, both parties often believe "newer is better," which can lead to out-of-control costs. The average price of hip and knee implants has increased by more than 100% in the past decade [10], making it difficult to control costs. Educating surgeons about the cost of orthopaedic IMDs has not traditionally been considered the responsibility of training programs. However, accurate knowledge of the costs and the benefits of treatments utilizing these IMDs will become increasingly important to orthopaedic surgeons in the future, as new devices are introduced and the healthcare landscape changes dramatically. It is intuitive that surgeons can only participate in cost containment if they know the cost of the materials used. The degree of knowledge of IMD costs among orthopaedic residents in training and their attending surgeons is unclear.

We therefore (1) determined the level of comfort with orthopaedic IMD costs among residents and attending surgeons, (2) quantified how accurately surgeons understand the costs of orthopaedic IMDs, and (3) identified which constructs yielded the most accurate cost estimations among residents and attending surgeons.

Materials and Methods

We administered a 17-item, anonymous questionnaire (Appendix 1) to 60 orthopaedic residents and 37 attending surgeons at two high-volume academic medical centers. The questionnaire was sent via email at one institution and was administered at grand rounds at the second institution. Approval was granted from the institutional review board at one institution before beginning this study. Consent to participate was implied by a participant's completion of the questionnaire. Neither the residents nor attending surgeons had prior knowledge that the questionnaire would be administered.

The questionnaire was completed by a total of 51 surgeons, of whom 36 were residents and 15 were attending surgeons. The overall response rate was 53% (60% among residents, and 41% among attending surgeons). Twenty-nine responses (20 residents, nine attending surgeons) were obtained from one institution, and 22 responses were obtained from the other institution (16 residents, six attending surgeons). Responses were obtained from residents at all training levels and from surgeons with experience ranging from less than 5 years to more than 25 years in practice.

Respondents were asked to list their years in training or, in the case of attending surgeons, the number of years in practice and to rate their perceived knowledge of implant costs before completing the questionnaire. Respondents were then asked to estimate the hospital costs of 13 different orthopaedic IMDs commonly used in practice. Descriptions of these IMDs were specific and included, for instance, the exact number of screws used in an internal fixation construct or an exact quantity of bone cement.

After the questionnaires had been collected, respondents were divided into groups based on whether they identified themselves as residents or attending surgeons. These groups were then further subdivided based on the years of training or, in the case of attending surgeons, years in practice. The accuracy of cost estimation was accomplished by comparing our questionnaire responses with actual hospital cost calculations provided by one institution, due to the need for confidentiality between the two institutions. We verified with IMD personnel that costs were not different by more than 5% between the institutions. Retail costs of orthopaedic IMDs are more easily obtained but do not represent the true costs paid by hospitals. The absolute difference between each respondent's estimated cost and the actual hospital cost was determined, and this value was then divided by the true hospital cost to calculate the percentage error contained in each response. To maintain the confidentiality of the hospital's contract with the manufacturers, only the percentage errors were used for the final analysis.

The percentage error in each estimation was calculated by subtracting the hospital cost of the implant from the respondent's estimated cost and then dividing that result by the hospital cost of the implant (percentage error = [hospital cost − estimated cost]/hospital cost). The mean percentage error and SD of the mean were calculated for the residents as a group and for the attending surgeons as a group. The absolute value of each percentage error was then used to calculate the mean percentage error for the group.

Results

Two respondents rated their knowledge of orthopaedic implant cost as good, 12 as fair, 32 as poor, and five as none.

The overall mean percentage error in cost estimation for the study population was 69% ± 42% (range, 29%–289%). Taking all responses into account, 67% were underestimations, and the proportion of underestimations was nearly identical between residents and attending surgeons. The mean underestimation was 52% (n = 455), and the mean overestimation was 104% (n = 208). The mean percentage error was larger (p = 0.10) for residents (73% ± 50%; range, 29%–289%) than for attending surgeons (59% ± 9%; range, 49%–79%) (Table 1).

Residents were most accurate when estimating the cost of a distal radius locking plate and a clavicle locking plate; however, the mean errors for these constructs were 50% and 57%, respectively, meaning, at their best, the residents' responses were wrong by approximately ½ of the cost of the implant. Residents were least accurate in estimating the cost of a dynamic compression plate for the distal radius (111% error) and an anterior cervical fusion construct (103% error). Attending surgeons were most accurate when estimating the cost of a cemented total knee construct (36% error) and a sliding hip screw construct (39% error), and they were least accurate when estimating the cost of a dynamic compression plate for the distal radius (122% error) and an anterior cervical fusion construct (96% error) (Table 2).

Discussion

Orthopaedic surgeons' knowledge of surgical materials costs is important to the success of cost control measures, which are becoming more important in modern health care. Due to variations in price and competition within the industry, it is sometimes difficult for surgeons to determine the costs of the materials they use. We therefore (1) determined the level of comfort with orthopaedic IMD costs among orthopaedic residents and attending surgeons, (2) quantified how accurately surgeons understand the costs of orthopaedic IMDs, and (3) identified which constructs yield the most accurate cost estimations among residents and attending surgeons.

This study had a number of limitations. First, all of the surgeons practiced or trained primarily at large, high-volume academic institutions, and thus, we could not examine for any differences in the community practice settings. Further investigation of the differences in price conceptualization between the academic and community practice settings may help to identify the reasons for any differences in understanding, if these exist. However, we believe our study provides a good starting point for any discussion of such a difference. Second, we based our true hospital costs on the figures presented to us by one of our institutions. This was done out of necessity, however, because confidentiality agreements prohibit the sharing of cost data between our institutions. We were, however, able to verify costs did not differ by more than 5% between our two medical centers, and this difference is small in relation to the levels of error demonstrated by our survey respondents. Third, the retail costs of these items were not used in our investigation because these do not accurately portray the true costs to our institutions nor to most institutions in the country. Most hospitals receive substantial discounts on IMDs, making hospital cost substantially lower than retail cost. Because most responses represented underestimation of cost, the use of retail

Table 1. Percentage errors for all participants

Participant	Number of respondents	Mean percentage error	SD
All surgeons	51	69	42
Attending surgeons	15	59	9
Residents	36	73	50
PGY-1	9	60	77
PGY-2	9	65	45
PGY-3	5	52	33
PGY-4	8	52	29
PGY-5	5	55	23

PGY = postgraduate year.

Table 2. Percentage error for each device measured for all respondents

Device	Mean percentage error	
	Attending surgeons (15 respondents)	Residents (36 respondents)
Distal radius locking plate	43	50
Radius dynamic compression plate	122	111
Clavicle locking plate	76	57
Sliding hip screw	39	58
Cephalomedullary nail	49	66
TKA with cemented tibia	36	58
TKA with all-polyethylene tibia	44	61
Anterior cervical fusion construct	96	103
Posterior cervical fusion construct	53	62
Bone morphogeneic protein	80	61
Demineralized bone matrix	51	89
Bone cement	57	60
Antibiotic-impregnated bone cement	75	78

costs would likely have resulted in even greater errors in estimation by our study participants. Finally, our questionnaire response rate was relatively low, and this is possibly important, as it may reflect the lack of interest in the cost of IMDs among physicians. Rather than a limitation, we believe this low response rate is an important finding, as it could be the case that those surgeons who participated in the study are the ones having the greatest interest in the pricing of implants, which only emphasizes the lack of accurate knowledge regarding IMD costs among surgeons.

Most respondents acknowledged their familiarity with orthopaedic IMD costs was poor. The costs of IMDs account for a high percentage of hospital costs and in some cases the payments hospitals make to manufacturers for IMDs used in surgical procedures are higher than the payments made to surgeons for performing those procedures [13]. The GAO has been investigating these costs, specifically as they are billed directly to patients, and in 2013 will begin incorporating them into the bundled payments provided to institutions through Medicare's prospective payment system. The GAO investigation noted substantial variation in the prices paid by hospitals for the same device, specifically 78% to 83% variation in hospital cost for the same THA and TKA implants, and cited relationships between physicians and manufacturers as being instrumental in this difference [2, 13]. A recent study of hospitals in California by Robinson et al. [11] reached this same conclusion, finding TKA implants varied from USD 1797 to USD 12,093 and THA implants varied between USD 2392 and USD 12,651 between medical centers. It should not be surprising that the surgeons who participated in our study did not have an accurate knowledge of IMD costs, as confidentiality agreements between hospitals and manufacturers make disclosure of price information difficult, and in fact, the GAO report includes a discussion of the difficulty their organization had in obtaining this information for the report [13].

The overall accuracy of cost estimation demonstrated by our study was poor. Taking all estimations into account, 22 residents and 10 attending surgeons demonstrated overall mean errors in their knowledge of orthopaedic IMD costs of between 50% and 100%, while five residents had overall mean errors of greater than 100%. Even though these two large academic medical centers received considerable discounts on orthopaedic IMDs, most responses were underestimations. It is unclear how surgeons should best be educated regarding these costs. Although institutions could list the prices of operating room materials directly on the packaging, neither of our institutions currently employs this practice, and it may be the case that current contractual confidentiality agreements would prevent this from occurring. Some hospitals, unable to disclose cost to their own physicians due to confidentiality agreements with manufacturers, choose to use colored stickers on IMDs to indicate high, medium, or low cost [13]. Direct collaboration between manufacturers and surgeons for the purpose of education, especially of residents during their training, would be beneficial but would be highly scrutinized due to the 2005 to 2007 Department of Justice investigation and eventual prosecution of orthopaedic device manufacturers for improper relationships with surgeons [6, 8]. The relationships between surgeons and industry continue to be cited as factors complicating the effective negotiation of prices between hospitals and device companies [11, 13].

The accuracy of cost estimation in our study differed based on the implant being studied. It appears knowledge of cost is influenced by familiarity with a material or device. For instance, the anterior cervical fusion construct, a highly specialized device used by a relatively small number of practicing surgeons, showed consistently poor accuracy in estimation across groups. The greatest accuracy was observed when attending surgeons estimated the costs of a cemented TKA and a sliding hip screw, which are two implants that many have used often in the course of their training and/or practice. The residents also demonstrated this pattern, which possibly exists because of recent publications [1, 12] regarding cost comparisons between some of these implants. Newer products were associated with a greater percentage error in our study, and because these products are also more expensive than older IMDs, these errors are magnified in terms of actual device expenditures. These findings regarding familiarity with a device and its cost demonstrate surgeons can learn and retain pricing information if it is presented to them, whether through direct discussions with other surgeons or reading the orthopaedic literature. At present, given the confidentiality agreements between hospitals and industry propensity toward nontransparency in pricing, these discussions and the academic work of other surgeons are the only practical means of obtaining cost information for most orthopaedic surgeons. Based on our results, this learning model is in need of major change.

In conclusion, we found orthopaedic surgeons have poor knowledge of orthopaedic IMD costs. For surgeons to actively participate in cost containment in a healthcare environment in which spending will be intensely scrutinized, they must have a thorough understanding of IMD pricing. As the current level of expenditures is not sustainable, new strategies for the education of surgeons regarding costs of IMDs and an evidence-based rationale for their use should be utilized.

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Appendix 1

Survey Assessing Surgeon Knowledge of Orthopaedic Implant Costs

Please answer all questions that apply to you.
Please do not confer with others or use outside information sources.
Please estimate costs to the nearest USD 5.

What is your program?
○ Case Western Reserve University
○ University of Michigan

What is your year of training (residents)?
○ PGY-1
○ PGY-2
○ PGY-3
○ PGY-4
○ PGY-5

How many years have you been in practice (attending surgeons)?
○ 1–5
○ 6–10
○ 11–15
○ 16–20
○ 21–25
○ 26 or greater

How would you rate your knowledge of orthopaedic implant costs?
○ None
○ Poor
○ Fair
○ Good
○ Excellent

Estimate the hospital cost: standard-length distal radius volar locking plate + 7 locking cortical screws: _____

Estimate the hospital cost: 8-hole distal radius dynamic compression T-plate + 7 nonlocking cortical screws: _____

Estimate the hospital cost: 8-hole nonanatomic superior clavicle locking plate + 6 locking cortical screws: _____

Estimate the hospital cost: 4-hole sliding hip screw + 4 cortical screws: _____

Estimate the hospital cost: long cephalomedullary nail with 1 distal titanium interlocking screw: _____

Estimate the hospital cost: TKA with cemented femur, cemented tibial tray, polyethylene insert, and polyethylene patella: _____

Estimate the hospital cost: TKA with cemented femur, all-polyethylene tibia, and polyethylene patellar button: _____

Estimate the hospital cost: titanium anterior cervical plate with 4 titanium vertebral body screws: _____

Estimate the hospital cost: posterior cervical fusion construct consisting of 2 rods, 4 set screws, and 4 pedicle screws: _____

Estimate the hospital cost: 5 cc bone morphogenetic protein (BMP): _____

Estimate the hospital cost: 5 cc demineralized bone matrix (DBM): _____

Estimate the hospital cost: one unit/bag of bone cement: _____

Estimate the hospital cost: one unit/bag of tobramycin-impregnated bone cement: _____

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