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Operative costs, reasons for operative waste, and vendor credit replacement in spinal surgery

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Abstract

Background: In 2012, Epstein *et al.* documented that educating spinal surgeons reduced the cost of operative waste (explanted devices: placed but removed prior to closure) occurring during anterior cervical diskectomy/fusion from 20% to 5.8%.[5] This prompted the development of a two-pronged spine surgeon-education program (2012-2014) aimed at decreasing operative costs for waste, and reducing the nine reasons for operative waste.

Methods: The spine surgeon-education program involved posting the data for operative costs of waste and the nine reasons for operative waste over the neurosurgery/orthopedic scrub sinks every quarter. These data were compared for 2012 (latter 10 months), 2013 (12 months), and 2014 (first 9 months) (e.g. data were normalized). Savings from a 2013 Vendor Credit Replacement program were also calculated.

Results: From 2012 to 2013 and 2014, spinal operative costs for waste were, respectively reduced by 64.7% and 61% for orthopedics, and 49.4% and 45.2% for neurosurgery. Although reduced by the program, the major reason for operative waste for all 3 years remained surgeon-related factors (e.g. 159.6, to 67, and 96, respectively). Alternatively, the eight other reasons for operative waste were reduced from 68.4 (2012) to 12 (2013) and finally to zero by 2014. Additionally, the Vendor Replacement program for 2013 netted $78,564.

Conclusions: The spine surgeon-education program reduced the costs/reasons for operative waste for 2012 to lower levels by 2013 and 2014. Although the major cost/reasons for operative waste were attributed to surgeon-related factors, these declined while the other eight reasons for operative waste were reduced to zero by 2014.

Key Words: Cost operative waste, education program, nine reasons, spine surgeon, surgeon-related factors, vendor replacement program

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INTRODUCTION

Based on prior studies, we determined that the high incidence of operative waste in spinal surgery substantially adds to its total costs (costs to the hospital without overhead, not charges that include overhead). Epstein *et al.* documented that the total costs for instrumentation implanted by 15 spinal surgeons performing 102 anterior

cervical diskectomy and fusion (ACDF) in 2008 at one institution was $355,863; the total cost of wasted devices (explanted devices; implanted but removed prior to closure) unnecessarily added $32,850 (9.2%) to that cost.[4] Epstein *et al*. later documented that educating spinal surgeons (requiring only 2 lectures) could reduce operative waste from occurring in 45.5% (January–April 2010) to 16% (May–December 2010) of single-level ACDF cases, while also reducing the overall cost of wasted/explanted devices from 20% to 5.8%.[6] In order to reduce the costs of operative waste and explore nine reasons for operative waste occurring during all spinal procedures at a single institution, we initiated a two-pronged surgeon-education program in 2012 and followed its impact over the subsequent 2 years (2013, 2014).

MATERIALS AND METHODS

The spine surgeon-education program included recording the cost of wasted materials (without overhead, not charges that include overhead) and the nine reasons for operative waste occurring in 2012 (latter 10 months), 2013 (12 months), and 2014 (first 9 months) [Tables 1-3]. For ease of comparison, data were normalized to 12-month periods [Tables 1 and 2]. The highest costs of wasted materials were recorded for 2 of the 5 orthopedic spinal surgeons and 5 of the 15 spinal neurosurgeons on staff at a single institution. Additionally, the nine major reasons for operative waste were monitored; one major reason included spine-surgeon-related factors (e.g. the surgeon changed his/her mind, the surgeon chose another manufacturer's device, the surgeon determined the anatomy warranted another size), along with eight others [Table 3]. Data were posted quarterly over the neurosurgery/orthopedic scrub sinks. Furthermore, in 2013, Roberts R.N., the Vice President of Operative Services, instituted the Vendor Credit Replacement program to recover reimbursements for devices that never touched the patient but could not be re-utilized for a variety of reasons [Table 4].

RESULTS

Costs of waste in spinal orthopedics and spinal neurosurgery

For 2012-2014 (Normalized Data) [Tables 1 and 2]

The costs of operative waste for all spinal orthopedic and spinal neurosurgery procedures performed in 2012 (latter 10 months) were reduced in 2013 (12 months) and 2014 (first 9 months) to 64.7% and 61% for orthopedics, and to 49.4% and 45.2% for neurosurgery, respectively (data were normalized) [Table 1]. The highest costs of waste were also individually recorded (anonymously) for two of the spinal orthopedists and five of the spinal neurosurgeons [Table 2].

Reasons for waste in spinal orthopedic and spinal neurosurgery 2012-2014

Of the nine reasons for operative waste recorded for 2012-2014, surgeon-related factors decreased but were still the most responsible for waste; 159.6 (2012) to 67 (2013), and 96 (2014) [Table 3]. Of interest, the remaining eight reasons for waste decreased from 68.4 in 2012 to 12 in 2013, and 0 by 2014.

Results of vendor credit replacement for all of orthopedics and spinal neurosurgery in 2013 [Table 4]

The Vendor Credit Replacement netted $58,000 for all of orthopedics (including joint replacement and spinal surgery), and $20,564 for spinal neurosurgery in 2013; the total was $78,564 [Table 4].

DISCUSSION

United States trends in lumbar fusion surgery for degenerative conditions

In 2005, Deyo *et al*. used the Healthcare Cost and Utilization Project Nationwide Inpatient Sample (1988-2001) to evaluate trends in spinal surgery.[1] They found that from 1996 to 2001, lumbar fusions increased by 113%, vs. 13-15% for hip replacement and knee

Table 1: Cost of waste in spinal orthopedics and spinal neurosurgery for 2012 (10 months), 2013 (12 months), and 2014 (9 months) with percent (%) reduction in costs

Service	2012	2013	2014
Orthopedics	$92,688	$39,284	$32,505
Months	(10 months)	(12 months)	(9 months)
Normalized*	$111,224	$39,284	$43,340
% Reduction		64.7	61
Neurosurgery	$104,629	$63,531	$50,640
Months	(10 months)	(12 months)	(9 months)
Normalized*	$125,553	$63,531	$68,853
% Reduction		49.4	45.2

*Normalized: Data projected over 12 month period

Table 2: Cost of maximal waste for 2 of 5 spinal orthopedic surgeons and 5 of 15 spinal neurosurgeons

Spine service	Total costs	Dr 1	Dr 2	Dr 3	Dr 4	Dr 5
2012 orthopedics (10 months)	$92,688	67,092	25,596			
2013 orthopedics (12 months)	$39,284	27,136	12,148			
2014 orthopedics (9 months)	$32,505	28,509	3,996			
2012 neurosurgery (10 months)	$104,629	37,066	32,758	14,064	11,930	8,811
2013 neurosurgery (12 months)	$63,531	14,578	14,381	14,377	10,585	9,610
2014 neurosurgery (9 months)	$50, 640	27,918	8,555	8,243	2,990	2,934

Table 3: 9 reasons for waste by spinal surgeons (2 orthopedists, 5 neurosurgeons)

Reason for waste	Orthopedics+neurosurgery		
	March-december 2012 (10 months)	January-december 2013 (12 months)	January-september 2014 (9 months)
Surgeon factors for waste	133 (normalized 159.6)	67	72 (normalized 96)
Intentionally opened/not implanted	7 (normalized 8.4)	7	0
Wrong size opened	22 (normalized 26.4)	2	0
Compromised integrity/sterility	8 (normalized 9.6)	0	0
Opened did not use	1 (normalized 1.2)	0	0
Opened by mistake	2 (normalized 2.4)	0	0
Product failure/broken	9 (normalized 10.8)	0	0
Physician insistence	6 (normalized 7.2)	0	0
Over tapped* (screw loosened)	2 (normalized (2.4)	3	0
Total	Normalized Surgeon 159.6 Other 68.4	Normalized Surgeon 67 Other 12	Normalized Surgeon 96 Other 0

Table 4: 2013 vendor credit replacements

Criteria	Did not touch patient Could not be used/ implanted
Wrong size opened	
Opened by mistake	
Product failure	
Sterility compromised	
Surgeon changed mind/used different size	
Surgical specialty	**Amount of vendor credit**
Orthopedics (ALL)	$58,000
Neurosurgery	$20,564

ALL: All significant savings

arthroplasty. The greatest increases were observed in patients aged over 60 years, and involved new surgical implants; of interest, they failed to demonstrate a true "value added" (e.g. greater efficacy/safety).

Surgeon choices, and the choice of surgeons affect total hospital charges for single-level anterior cervical surgery (2008)

In 2008, Epstein *et al*. examined the variations in total hospital charges (charges defined as including overhead vs. costs without overhead), and determined how surgeons impacted these charges. They retrospectively analyzed the total hospital charges for 15 spinal surgeons performing 102 single-level ACDF (1-ACDF) during a single year (2008) at one institution ([DRG] category 473: cervical spine fusion; Principle Procedure Code [81.02]).[3] Total hospital charges were divided into in-patient hospital charges (e.g. room charge, length of stay [LOS], diagnostic studies), and surgical charges (operative charges, instrumentation charges, and supply charges). Total hospital charges per patient ranged from $26,653 to $129,220 (a factor of 4.8). In-patient hospital charges ranged from $15,113 to $76,687 (a factor of 5.0), a number largely reflecting the differences in LOS (1-11 days). Critically, the large variation in surgical charges was largely due to the surgeon's choice of instrumentation (range from $4062 to $40,409; a factor of 10). Of interest, these higher charges did not correlate with any "value added" as also noted in the Deyo *et al*. study.[1]

The incidence and costs of devices explanted during single-level anterior diskectomy/fusions: Data from the 2009 Study

In 2009, Epstein *et al*. observed that little is known about the costs (without overhead differentiated from charges that include overhead) of devices paid for by the hospitals, and explanted during 87 ACDF procedures performed at one hospital.[4] The costs for permanently implanted instrumentation was $355,863 (e.g. screws [$103,572: 84 patients]; plates [$120,694: 85 patients]; allograft spacers [$92,776: 64 patients]; cages [$38,821: 9 patients]; and autografts [no charge; 14 patients]). The added costs for explanted (wasted) instrumentation was $32,850 (9.2%) (e.g. 37 screws [$11,014: 17 patients]; 7 plates [$12,743: 5 patients]; and 8 allograft spacers [$9093: 7 patients]).

Reducing the cost and frequency of explanations associated with single-level anterior diskectomy and fusion at a single institution through education (2010)

In 2010, Epstein *et al*. prospectively evaluated the costs (without overhead to the hospital, differentiated from charges that include overhead) and frequency of explanted instrumentation (devices implanted but removed prior to closure) for all single-level ACDF performed by 15 spine surgeons at a single institution before and after surgeon education.[5] For the first 4 months of 2010, prior to education, 33 single-level ACDF were performed. At the end of April, two meetings were held to educate spine surgeons regarding the costs/frequency of explantation. Following this meeting, for the last 8 months of 2010, 50 single-level ACDF were performed. Explantation rates following surgeon education were markedly reduced (from 45.5%

of cases [January-April 2010] to 16% of cases [May-December 2010]), and were accompanied by a large decrease in the costs of wasted devices (20-5.8%).

Costs and frequency of "off-label" use of Bone Morphogenetic Protein/INFUSE (Medtronic, Memphis, TN, USA) for spinal fusions at one institution in 2010

In 2010, Epstein and Schwall evaluated the costs (without overhead to the hospital, differentiated from charges that include overhead) and frequency of "on-label" vs. "off-label" use of Bone Morphogenetic Protein (BMP)/INFUSE (Medtronic, Memphis, TN, USA) utilized in the performance of all types of spinal fusions at one institution in 2010.[2] In one year, they found that 96% (170 of 177) of spinal fusions were performed using "off-label" BMP/INFUSE costing $4,547,822, while only 4% of cases (7 of 177) utilized BMP/INFUSE "on-label" (Anterior Lumbar Interbody Fusion [ALIF]) costing $296,419.

Intraoperative waste in spine surgery: Incidence, cost, and effectiveness of an educational program (2011)

In 2011, Soroceanu *et al.* examined whether an educational program would reduce the cost (without overhead to the hospital, differentiated from charges that include overhead) of intraoperative waste occurring in spine surgery at one academic medical center, and paid particular attention to the costs of spinal implants.[7] Over 25 months (an initial 15-month observational period followed by a 10-month post-awareness program), they prospectively evaluated the frequency of waste occurring during all spine procedures. All surgeons and operating room personnel were educated regarding waste, and surgeons were apprised of their individual frequency of waste (without anonymity). Their most common reason for waste, as in our study, was due to the surgeon (e.g. surgeon changed his mind [44%]). Unique to their study, however, was contamination (26.9%) as the next highest reason for waste; notably, the frequency of contamination was much lower in our series (e.g. 0 by both 2013 and 2014). Their definitions of waste, like ours, included: (i) prepared/opened not used during the case, (ii) could not be used or implanted in another patient, (iii) the surgeon changed his mind, (iv) equipment failure/technical difficulties, (v) opened by mistake, (vi) contamination, and (vii) case cancellations.[7] In the Soroceanu *et al.* study, before surgeon-education, surgical waste constituted 4.3% of the total operative spine budget (e.g. surgical implants comprised 42% of the waste); this was later reduced to 1.2%.

Lean principles to optimize instrument utilization for spine surgery in an academic medical center

Lunardini *et al.* introduced "process improvement systems" to better assess routines/efficiency/uniformity for implanting spinal instrumentation, while reducing costs (without overhead to the hospital, differentiated from charges that include overhead) in an urban level 1 academic medical center.[6] Of 38 spinal procedures performed by both spinal orthopedists and spinal neurosurgeons, only 89 (58%) of the instruments were used at least once. Therefore, 63 (41%) of the instruments not being used were removed from the set; this reduced not only the weight of the instrumentation "boats" by 17.5 lbs, but also saved $41,000/year.

Summary

The spine surgeon-education program introduced in the latter part of 2012 (10 months) and continued through 2013 (12 months) and 2014 (first 9 months), substantially reduced the cost of operative waste in spinal orthopedics (64.7% [2013] and 61% [2014]) and spinal neurosurgery (49.4% [2013] and 45.2% [2014]). The major reason for operative waste, attributed to surgeon-related factors, decreased over this time period, while all eight other reasons for operative waste were reduced to 0 by 2014.

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