

Procedures Employing Interbody Devices and Multi-Level Fusion Require Target Price Adjustment to Build a Sustainable Lumbar Fusion Bundled Payment Model

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INTRODUCTION: Bundled payment models require risk adjustment to ensure appropriate targets are set. While this may be standardized for many services, spine fusions demonstrate significant variability in approach, invasiveness, and use of implants that may require further risk adjustment. Our objective was to evaluate variability in costs of spinal fusion episodes in a private insurer bundle payment program and identify whether current procedural terminology (CPT) code modifications are necessary for sustainable implementation.

METHODS: A review was conducted of all lumbar fusions in a single institution's payer database from October 2018 – December 2020. Surgical characteristics (approach [posterior lumbar decompression and fusion (PLDF), transforaminal lumbar interbody fusion (TLIF), and circumferential fusion], levels fused, and primary vs. revision) were collected from manual chart review. Episode of care cost data were collected as net surplus or deficit with respect to target prices. Outcomes included 120-day episode of care net surplus/deficit, 90-day readmissions, discharge disposition, and length of hospital stay. A multivariate linear regression model was constructed to measure the independent effects of primary vs. revision, levels fused, and approach on the net cost savings.

RESULTS: Most procedures were PLDFs (N = 312, 57.6%), single-level (N = 416, 76.8%), and primary fusions (N = 477, 88.0%). Overall, 197 (36.3%) resulted in a deficit, and were more likely to be three levels (7.11% vs. 2.03%, p=0.005), revisions (18.8% vs. 8.12%, p<0.001), and TLIF (47.7% vs. 35.1%, p<0.001) or circumferential fusions (p<0.001). One-level PLDFs resulted in the greatest cost savings per episode (\$6,883). Across both PLDFs and TLIFs, three-level procedures resulted in significant deficit of -\$23,040 and -\$18,887, respectively. For circumferential fusions, one-level fusions resulted in deficit of -\$17,169 per case which rose to -\$64,485 and -\$49,222 for two- and three-level fusions. All two- and three-level circumferential spinal fusions resulted in a deficit. On multivariable regression, TLIF and circumferential fusions were independently associated with a deficit of -\$7,378 (p=0.004) and -\$42,185 (p<0.001), respectively. Three-level fusions were independently associated with an additional -\$26,003 deficit compared to single-level fusions (p<0.001).

DISCUSSION AND CONCLUSION: Interbody fusions, especially circumferential fusions, and multi-level procedures are not adequately risk adjusted by current bundled payment models. Health systems may not be able to financially support these alternative payment models with improved procedure-specific risk adjustment.

Table 1. Demographics of Patients By Presence of Surplus or Deficit

	Deficit (N = 197)	Surplus (N=345)	P-value
Sex (female)	106 (53.8%)	179 (51.9%)	0.732
Age (years)	63 (30.071)	64.0 (37.872)	0.441
Body mass index	30.3 (26.916)	29.2 (24.614)	0.106
Smoking status:			0.729
Never smoker	152 (77.0%)	222 (64.4%)	
Former smoker	35 (17.8%)	71 (20.6%)	
Current smoker	10 (5.2%)	51 (14.8%)	
Aspirin	19 (9.6%)	31 (9.0%)	0.520
Aspirin	34 (17.3%)	36 (10.4%)	0.032*
Anxiety	28 (14.7%)	84 (24.3%)	0.011*
Asthma	31 (15.7%)	24 (6.9%)	0.002*
Bloodstain	14 (7.1%)	11 (3.1%)	0.600
Cancer	20 (10.2%)	32 (9.3%)	0.872
CHF	8 (4.0%)	7 (2.0%)	0.265
Chronic Steroid Use	13 (6.6%)	8 (2.3%)	0.024
Degenerative Joint Disease	70 (35.3%)	123 (36.2%)	0.944
Dementia	3 (1.5%)	3 (0.8%)	1.000
Depression	37 (18.8%)	55 (15.9%)	0.467
Diabetes	41 (20.8%)	44 (12.8%)	0.008*
Heart Failure	6 (3.0%)	5 (1.4%)	0.219
Hypertension	104 (52.8%)	171 (49.8%)	0.526
Hypothyroidism	80 (40.6%)	140 (40.9%)	0.468
Liver Disease	5 (2.5%)	3 (0.8%)	0.147
Osteoporosis	39 (19.8%)	42 (12.2%)	0.023*
Peripheral Vascular Disease	3 (1.5%)	8 (2.3%)	0.754
Rheumatoid Arthritis	30 (15.2%)	35 (10.1%)	0.106
Scurvy	4 (2.0%)	10 (2.9%)	0.760
Stroke	4 (2.0%)	6 (1.7%)	1.000
TIA/Mini-Stroke	10 (5.0%)	10 (2.9%)	0.291
Thyroid Disease	25 (12.7%)	63 (18.3%)	0.116
Levels fused			0.003*
One	140 (71.1%)	276 (80.0%)	
Two	41 (20.8%)	62 (18.0%)	
Three	14 (7.1%)	7 (2.0%)	
Revision surgery:			<0.001*
Approach	37 (18.8%)	28 (8.1%)	
PLDF	92 (46.7%)	220 (63.8%)	
TLIF	94 (47.7%)	121 (35.1%)	
Circumferential	11 (5.5%)	2 (0.6%)	

Table 2. Patient Surgical Outcomes

	Deficit (N = 197)	Surplus (N=345)	P-value
Length of Stay (days)	3.00 (2.004-9.0)	2.09 (1.092-3.0)	<0.001*
Discharge Disposition			
Home	130 (66.0%)	299 (86.7%)	
Home Health	30 (15.2%)	34 (9.8%)	
SNF	21 (10.7%)	12 (3.4%)	
AIR	7 (3.5%)	0 (0.0%)	
Readmissions	17 (8.6%)	11 (3.1%)	0.011*

Abbreviations: LOS = length of stay; SNF = skilled nursing facility; AIR = acute inpatient rehabilitation

Table 3. Cost Outcome Of Specific Surgical Procedures

Procedure	Patients with Deficit (%)	Average Surplus/Deficit* (\$)	Net Surplus/Deficit*
PLDF			
One-Level (N=230)	67 (28.0%)	-\$6,883 (27,159)	-\$1,645,127
Two-Level (N=59)	17 (28.8%)	-\$86 (30,942)	-\$2,682
Three-Level (N=14)	8 (57.1%)	-\$23,040 (75,427)	-\$322,566
TLIF			
One-Level (N=68)	68 (60.5%)	+\$165 (33,575)	+\$27,672
Two-Level (N=42)	22 (52.5%)	-\$9,219 (23,772)	-\$87,193
Three-Level (N=5)	4 (80%)	-\$18,887 (17,987)	-\$94,433
Circumferential			
One-Level (N=9)	4 (44.4%)	-\$17,169 (54,127)	-\$154,517
Two-Level (N=3)	3 (100%)	-\$64,485 (21,142)	-\$193,455
Three-Level (N=3)	3 (100%)	-\$49,222 (43,368)	-\$147,666

Abbreviations: PLDF = posterior lumbar decompression and fusion; TLIF = transforaminal lumbar interbody fusion; SD = standard deviation

*All average and net surplus or deficit values are presented as United States dollars rounded to the nearest dollar.

Table 4. Multivariate Linear Regression of Dollar Amount Surplus/Deficit Based on Procedural Characteristics

Variable	Estimate	Lower 95	Upper 95	P-Value
Category:				
PLDF	Reference			
TLIF	-7,278	-12,420	-2,136	0.004*
Circumferential	-42,185	-61,520	-24,110	<0.001*
Levels Fused:				
One	Reference			
Two	-6,558	-12,115	-712	0.052
Three	-26,003	-39,321	-12,686	<0.001*
Revision	-5,000	-12,098	2,099	0.192

Abbreviations: PLDF = posterior lumbar decompression and fusion; TLIF = transforaminal lumbar interbody fusion