

A Value Driven Cost Analysis of Transforaminal Lumbar Interbody Fusions in Spine Surgery: Where Can Value Be Optimized?

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INTRODUCTION: With Medicare seeking to transition to bundled payments for lumbar fusion, value-based health care is of increasing importance. In spine surgery, lumbar fusions are responsible for some of the highest charges billed to payers. This study analyzed the cost (reimbursements herein “cost”, as opposed to charges) for transforaminal lumbar interbody fusions (TLIF) over a 10-year period at a single academic institution in order to evaluate salient factors in cost trends and determine the variance and drivers of cost, identifying them as targets for cost reduction.

METHODS: 376 patients who underwent single-level TLIF at a single academic institution between 2014 and 2024 were identified and reviewed for Value Driven Outcomes (VDO) and demographic data. Stratified by year, variables measured included total cost, as well as breakdown by implant, facility, pharmacy, lab, imaging, and other costs. Uncontrolled descriptive statistics, including means and medians, were summarized. To account for unobserved heterogeneity across providers and time, we conducted multivariable analysis using a leaner model with fixed effects on total cost, controlling for patient demographic and procedure characteristics. Because VDO data cannot be reported as absolute dollar amounts, all statistics were normalized as percentages of the mean total cost per TLIF encounter.

RESULTS: Differences in age, sex, BMI, smoking status, and payer type were not associated with higher costs. Implants made up the largest portion of cost at 51%. Upon multivariable analysis using a fixed effects model, expandable cages were associated with a significant increase in total cost when compared with static cages (expandable fixed effect coefficient = 25%, $p = 0.023$). Other cost categories, such as imaging, pharmacy, facility, and lab were notably smaller contributors on average compared with implant type. There were no significant differences in rates of post-operative radiculopathy or durotomy between static and expandable cages. Of note, there were some outlier years with respect to cost, but this was likely due to the smaller number of cases at that time (COVID-19). There was so significant variance in costs over the 10-year period.

DISCUSSION AND CONCLUSION: The primary driver of total cost for single-level TLIF was implant type, with expandable cages costing significantly more than static. Given this, choice of implant may be a viable target for price reduction and optimizing value. Before such measures can be applied, however, further studies are warranted to determine the impact of cage type on other outcomes, such as subsidence, arthrodesis rates, and patient reported outcomes.

Table 1. Results from fixed effect model on total cost

	Coefficient	p-value	Confidence Interval
Procedure year			
2014 (N=28)			
2015 (N=21)	-4% (1%)	0.193	(-12%, 20%)
2016 (N=46)	6% (1%)	0.133	(-10%, 23%)
2017 (N=40)	3% (1%)	0.158	(-6%, 12%)
2018 (N=43)	-4% (2%)	0.315	(-30%, 22%)
2019 (N=37)	25% (9%)	0.221	(-92%, 142%)
2020 (N=32)	39% (8%)	0.129	(-63%, 142%)
2021 (N=35)	12% (1%)	0.052	(0%, 24%)
2022 (N=59)	-10% (3%)	0.128	(-56%, 25%)
2023 (N=25)	-18% (1%)*	0.027	(-28%, -8%)
2024 (N=10)	-21% (7%)	0.209	(-110%, 69%)
Age	0% (0%)	0.674	(-2%, 2%)
BMI	0% (0%)	0.845	(-2%, 2%)
Gender			
Male			
Female	2% (0%)	0.105	(-2%, 6%)
Race/ethnicity			
Whites			
Black/Natives/Hispanic/Asian	-10% (1%)	0.051	(-20%, 0%)
Unknown/Missing	4% (4%)	0.489	(-42%, 50%)
Smoking status			
Never			
Former	1% (1%)	0.683	(-15%, 16%)
Current	2% (1%)	0.328	(-10%, 13%)
Implant type			
Static			
Expandable	25% (1%)*	0.023	(13%, 36%)
Payer type			
Commercial			
Medicaid	2% (3%)	0.654	(-36%, 40%)
Medicare	2% (3%)	0.647	(-38%, 42%)
Others/unknown	9% (3%)	0.182	(-26%, 45%)

* Indicates statistical significance at the 95% confidence interval ($p < 0.05$)

Table 2. Results from fixed effect model on implant cost

	Coefficient	p-value	Confidence Interval
Procedure year			
2014			
2015	0% (2%)	0.870	(-25%, 26%)
2016	-4% (5%)	0.558	(-66%, 58%)
2017	-7% (1%)	0.076	(-16%, 3%)
2018	-7% (3%)	0.222	(-40%, 26%)
2019	40% (17%)	0.250	(-172%, 252%)
2020	76% (16%)	0.130	(-124%, 276%)
2021	30% (1%)*	0.028	(13%, 47%)
2022	-21% (4%)	0.131	(-77%, 35%)
2023	-29% (1%)*	0.023	(-43%, -16%)
2024	-27% (2%)	0.055	(-50%, 2%)
Age	0% (0%)	0.678	(-2%, 2%)
BMI	0% (0%)	0.192	(-2%, 1%)
Gender			
Male			
Female	0% (1%)	0.836	(-8%, 8%)
Race/ethnicity			
Whites			
Black/Natives/Hispanic/Asian	-15% (1%)*	0.027	(-32%, -7%)
Unknown/Missing	4% (3%)	0.387	(-34%, 43%)
Smoking status			
Never			
Former	0% (1%)	0.934	(-13%, 13%)
Current	1% (1%)	0.659	(-18%, 20%)
Implant type			
Static			
Expandable	42% (2%)*	0.031	(16%, 69%)
Payer type			
Commercial			
Medicaid	0% (3%)	0.940	(-42%, 42%)
Medicare	-2% (2%)	0.537	(-30%, 26%)
Others/unknown	-4% (6%)	0.618	(-74%, 67%)

* Indicates statistical significance at the 95% confidence interval ($p < 0.05$)