

# Detailed Analysis of Episode-of-Care Inpatient Costs in Adult Spinal Deformity Surgery

Ahmed Sulieman, Andrew Kim, Richard A Hostin, Breton G Line, Virginie Lafage, Renaud Lafage, Neel Anand, Thomas James Buell, Bassel Diebo, Robert Kenneth Eastlack, Jeffrey Gum, Munish C Gupta, D. Kojo Hamilton, Michael Patrick Kelly, Eric O Klineberg, Jeffrey P Mullin, Praveen Mummaneni, Gregory Michael Mundis, Pierce Dalton Nunley, David Okonkwo, Peter Gust Passias, Themistocles Stavros Protopsaltis, Alexandra Soroceanu, Jay D. Turner, Juan Santiago Uribe, Mitsuru Yagi, Justin S Smith, Christopher Ames, Lawrence G Lenke, Frank J Schwab, Christopher I Shaffrey, Robert Shay Bess, Sang Hun Lee, Khaled M Kebaish, International Spine Study Group

**INTRODUCTION:** Adult spinal deformity (ASD) surgery is associated with high costs that vary significantly between surgeons and institutions. While previous studies have examined the costs and cost-effectiveness associated with distinct groups of ASD, to our knowledge, this is the first study to analyze itemized episode-of-care (EOC) direct costs in ASD surgery.

**METHODS:** A prospective multicenter ASD surgery database was utilized. Patients who underwent ASD surgery from 2018 to 2023 were analyzed. Cost modeling was performed on the most common ASD surgeries (T3- and T10-pelvis posterior spinal fusion). Direct cost data for each index surgery was collected from hospital administrative records for each EOC inpatient encounter. Itemized charges were mapped into one of four categories of total cost: implants, biologics, inpatient services, and room and floor. Multivariable regression and analysis of variance were performed to assess for factors contributing to total direct costs while controlling for age, sex, procedure, American Society of Anesthesiologists (ASA) grade, and Length of Stay (LOS).

**RESULTS:** Among 137 patients, 67.2% (92/137) were female with a mean age of 63.81 years and 12.80 levels fused. Median total direct costs for T3-pelvis (T3P) and T10-pelvis (T10P) were \$77,360.91 and \$55,966.59 respectively. Instrumentation accounted for the largest portion of EOC costs in both T3P and T10P surgeries (38.34% and 36.78%), followed by room and floor (28.88% and 33.50%), and biologics (24.27% and 20.42%). After factoring for null charges, median total implant cost per level fused among all ASD surgeries was \$1,846.92, with pedicle screws, interbody cages, rods, and hooks accounting for 79.78%, 18.85%, 2.56%, and 3.10% of total implant cost per segment fused, respectively. Adjusted multivariable regression revealed a significant relationship between total direct cost and number of levels fused and LOS ( $p < 0.001$ ), with each additional level increasing EOC costs by \$2,230.27 and each additional day spent inpatient increasing costs by \$2,186.78. Age, sex, and preop ASA grade had no significant impact on total costs ( $p > 0.05$ ).

**DISCUSSION AND CONCLUSION:** Greater number of levels fused and longer inpatient LOS are associated with increasing total EOC costs following ASD surgery. Characterizing and understanding potential cost-drivers of ASD surgery can allow surgeons to identify strategies to minimize expenditures while optimizing cost-effectiveness.

	T3 to Pelvis			T10 to Pelvis		
	Median	IQR	% of Total Cost	Median	IQR	% of Total Cost
Pedicle Screws	23,597.54	20,339.04 - 26,781.92	30.71	17,676.70	14,241.01 - 20,916.94	31.58
Interbody Cages	851.20	0.00 - 1,688.17	1.10	1,252.96	0.00 - 5,932.76	2.26
Rods	819.09	376.71 - 1,197.76	1.06	511.56	397.52 - 842.35	0.91
Hooks	892.17	586.72 - 1,258.79	1.16	0.00	0.00 - 0.00	0.00
<b>Total Implant</b>	<b>25,657.54</b>	<b>20,481.24 - 31,757.59</b>	<b>33.54</b>	<b>20,544.94</b>	<b>18,009.76 - 23,664.00</b>	<b>36.78</b>
Biologics	14,792.62	12,578.40 - 15,664.04	19.15	7,673.74	5,766.52 - 10,131.02	13.91
Pharmaceuticals	1,747.19	1,311.24 - 2,401.18	2.26	1,470.12	1,208.41 - 1,743.53	2.64
Lab	2,716.28	1,888.84 - 3,451.18	3.51	1,743.42	977.50 - 2,581.48	3.15
Therapy	461.71	386.31 - 740.04	0.59	626.50	372.21 - 548.55	1.12
Radiology	164.83	242.41 - 421.24	0.21	388.19	244.41 - 551.32	0.69
Blood Products	0.00	0.00 - 65.17	0.00	0.00	0.00 - 53.83	0.00
<b>Total Inpatient Services</b>	<b>5,789.97</b>	<b>4,598.64 - 7,183.77</b>	<b>7.48</b>	<b>4,437.45</b>	<b>3,165.70 - 5,725.02</b>	<b>7.91</b>
Operating Rooms	10,889.77	8,782.76 - 12,489.41	14.21	8,965.02	7,623.65 - 10,755.91	16.07
Inpatient Floor	7,251.99	5,909.17 - 10,134.01	9.38	6,467.47	4,966.54 - 8,255.91	11.81
ICU	3,261.55	6.00 - 6,066.32	4.23	2,486.41	0.00 - 4,911.38	4.50
<b>Total Room and Floor</b>	<b>22,545.08</b>	<b>18,698.17 - 28,762.88</b>	<b>29.48</b>	<b>18,347.97</b>	<b>13,141.09 - 20,977.61</b>	<b>33.50</b>
<b>Total Costs</b>	<b>77,360.91</b>	<b>70,318.35 - 84,273.69</b>	-	<b>55,966.59</b>	<b>49,334.68 - 63,508.61</b>	-

Table 1. Itemized direct costs by procedure type

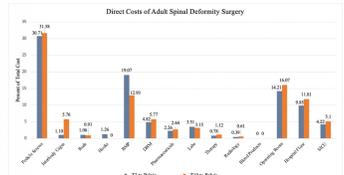


Figure 1. Percent breakdown of itemized direct costs of the most common adult spinal deformity surgeries