



High Risk Neurosurgical Spine Patients are Associated with Increased In-hospital Costs

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Introduction

The American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) online Surgical Risk Calculator uses inherent patient characteristics to provide predictive risk scores for adverse postoperative events. The purpose of our study is the determine if neurosurgical spine patients with a high predicted risk scores are associated with increased in-hospital costs.

Methods

A single centered retrospective review of 191 spinal surgery patients treated from a period of September 2011 to December 2014 was performed. Individual patient characteristics were entered into the NSQIP calculator. Predicted risk scores were compared wth actual in-hospital costs contained from a billing database. We used the Pearson coefficient to assess correlation between post-op neuosurgical complication risk scores predicted by the ACS NSQIP Surigcal Risk Calculator and surgical encounter costs in 191 neuosurgical spine patients. We evaluated 11 types of complications and compared 3 different types of encounter cost. All nominal costs were adjusted to real costs baded on GDP deflation / inflation factors provided by the bureau of economic analysis. To determine if correlations between risk scores an encounter costs were not simply an artifact related to procedure-specific OR costs we used the Pearson partial correlation coefficient to assess correlation between complication risk scores and encounter costs while adjusting for procedure specific OR costs.

We used the pearson correlation coefficient (R) to assess correlation between 11 types of complication risk scores and 5 types of encounter costs from 192 spine UF health encounters involving spine procedures. Risk scores in categories such as serious complication, any complication, pneumonia, cardiac complication, surgical site infection, urinary tract infection, venous thromboembolism, renal failure, return to operating room, death, and discharge to nursing home or rehab were examined.

Results

Post-op spinal surgery complication risk scores:									
Variable	N	Nmiss	Mean	SD	Min	P25	Median	P75	Max
Serious complication	191	0	8.01	5.88	1.30	4.10	6.80	9.70	50.20
Any complication	191	0	10.75	6.82	1.30	6.10	9.20	13.40	53.00
Pneumonia	191	0	0.86	0.92	0.10	0.30	0.60	1.10	7.40
Cardiac complication	191	0	0.44	0.64	0.05	0.10	0.30	0.50	6.60
Surg site infection	191	0	2.12	1.19	0.20	1.30	1.80	2.60	6.40
UTI	191	0	1.74	1.48	0.20	0.70	1.30	2.20	8.80
VT	191	0	1.07	1.04	0.20	0.50	0.80	1.30	7.50
Renal failure	191	0	0.36	0.50	0.05	0.10	0.20	0.40	4.60
Return to OR	191	0	4.37	3.03	0.50	2.50	3.80	5.40	26.00
Death	191	0	0.81	1.80	0.05	0.10	0.30	0.60	14.20
Dischg nursing/rehab	191	0	16.02	17.92	1.00	4.20	9.50	20.80	91.00

Real costs associated with the spinal surgery encounter:									
Variable	N	Nmiss	Mean	SD	Min	P25	Median	P75	Max
Direct fixed cost	191	0	2204.31	2109.53	577.03	1210.68	1678.44	2409.49	22941.67
Direct variable cost	191	0	8565.84	8892.98	1870.43	4285.33	6312.09	9497.75	100193.90
Indirect fixed cost	191	0	7076.44	6698.78	1931.83	3921.73	5407.50	7691.59	70077.21
Indirect variable cost	191	0	1253.99	1209.95	144.07	533.55	1046.30	1627.21	13081.11
Total cost	191	0	19100.61	18486.20	4581.76	10147.98	15200.37	21268.50	206293.90
Total - OR cost	191	0	12195.32	17438.24	1073.02	4611.79	7795.72	12886.97	200757.30
OR cost	191	0	6905.29	4001.29	2050.08	4285.84	5936.58	7894.57	29466.17

Correlation between post-operative spinal surgery complication risk scores and various costs associated with the surgical encounter												
Complication	Direct Fixed Cost		Direct Variable Cost		Indirect Fixed Cost		Indirect Variable Cost		Total Cost		Total-OR Cost	
	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj
Serious complication	0.487	0.587	0.368	0.560	0.455	0.582	0.376	0.445	0.420	0.587	0.545	0.600
Any complication	0.467	0.570	0.350	0.547	0.441	0.573	0.364	0.436	0.402	0.574	0.526	0.584
Pneumonia	0.438	0.447	0.439	0.503	0.438	0.459	0.351	0.347	0.446	0.491	0.482	0.480
Cardiac complication	0.275	0.334	0.256	0.384	0.286	0.366	0.169	0.206	0.270	0.376	0.316	0.348
Surg site infection	0.293	0.333	0.198	0.274	0.268	0.321	0.224	0.249	0.238	0.307	0.293	0.311
UTI	0.321	0.389	0.193	0.309	0.294	0.379	0.204	0.248	0.246	0.353	0.352	0.388
VT	0.343	0.459	0.207	0.403	0.305	0.446	0.179	0.257	0.258	0.434	0.379	0.447
Renal failure	0.346	0.416	0.309	0.462	0.333	0.424	0.228	0.274	0.325	0.452	0.382	0.419
Return to OR	0.429	0.526	0.289	0.466	0.394	0.517	0.326	0.394	0.349	0.506	0.468	0.522
Death	0.377	0.448	0.330	0.482	0.372	0.466	0.292	0.339	0.356	0.483	0.440	0.478
Dischg nursing/rehab	0.406	0.424	0.352	0.411	0.390	0.418	0.333	0.337	0.381	0.429	0.446	0.450
Pearson correlation (Unadj) coefficients and Pearson partial correlation (Adj) coefficients adjusted for operating room costs.												
Blue highlighted P-values are not statistically significant at $\alpha=0.0005$. This α -level was used to maintain an acceptable Type I error rate across all tests of Pearson R=0 and Pearson partial R=0 in the above table.												

Conclusions

Previous work has demonstrated the ACS NSQIP Surgical Risk Calculator can accurately predict mortality but is poorly predictive of other potential adverse events and clinical outcomes. However, this study demonstrates that neurosurgical spine patients predicted to be high risk by the ACS NSQIP Surgical Risk Calculator have a statistically significant positive correlation with in-hospital cost. Controlling for operating room charges the pearson coefficient demonstrated moderate positive correlation between risk profiles and hospital costs.

Given the current healthcare climate emphasizing value-driven care future iterations of the ACS Universal Risk Calculator may be valuable tool in predicting in-hospital costs.