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Medicaid Status is Associated with Higher Complication Rates after Spine Surgery

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Abstract

STUDY DESIGN—Multivariate analysis of prospectively collected registry data

OBJECTIVE—To determine the affect of payor status on complication rates after spine surgery.

SUMMARY OF BACKGROUND DATA—Understanding the risk of perioperative complications is an essential aspect in improving patient outcomes. Previous studies have looked at complication rates after spine surgery and factors related to increased perioperative complications. In other areas of medicine, there has been a growing body of evidence gathered to evaluate the role of payor status on outcomes and complications. Several studies have found increased complication rates and inferior outcomes in the uninsured and Medicaid insured.

METHODS—The XX Registry (XX-XX) is a collection of prospectively collected data on all patients who underwent spine surgery at our two institutions. Extensive demographic data, including payor status, and medical information were prospectively recorded as described previously by Mirza *et al*. Medical complications were defined in detail *a priori* and were prospectively recorded for at least 2 years after surgery. Using univariate and multivariate analysis, we determined risk of postoperative medical complications dependent on payor status.

RESULTS—1591 patients underwent spine surgery in 2003 and 2004 that met our criteria and were included in our analysis. With the multivariate analysis and by controlling for age, patients whose insurer was Medicaid had a 1.68 odds ratio (95% CI: 1.23, 2.29, p=0.001) of having any adverse event when compared to the privately insured.

CONCLUSION—After univariate and multivariate analyses, Medicaid insurance status was found to be a risk factor for postoperative complications. This corresponds to an ever-growing body of medical literature that has shown similar trends and raises the concern of underinsurance.

Keywords

spine surgery; perioperative complications; complication rates; payor status; underinsurance; Medicaid; public insurance

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INTRODUCTION

Understanding the risk of perioperative complications is an essential aspect in improving patient outcomes. Enhanced knowledge of the risks associated with increased complications in spine surgery has been an area of increased interest. Numerous studies employing various study design methods have examined complications after spine surgery.^{1–14} More recent work has focused on the importance of data collected in a prospective manner to most accurately determine rate of perioperative complications and risk factors most associated with perioperative complications.^{3,4,10} Validating the Spine Adverse Events Severity system first described by Rampersaud et al.¹⁵, Street et al. used prospectively collected data on 942 patients and have shown that major spine surgery is associated with “...a very high rate of previously unrecognized postoperative complications.”¹⁰ Other studies have previously reported a multivariate analysis on prospectively collected data to show medical comorbidities and other factors most associated with perioperative complications.^{3,4}

The Spine End Results Registry (2003–2004) is a registry of prospectively collected data of all patients undergoing spinal surgery at the University of XXXX Medical Center and XXXX Medical Center. Detailed information regarding patient demographics, insurance status, medical comorbidity, surgical invasiveness, and adverse occurrences were followed for up to two years and obtained prospectively using earlier published methods.^{16,17} Although insurance data were prospectively collected, this factor was not initially considered in determining risk and was not used in the multivariate analysis of previous studies in determining risk of perioperative complications.^{3,4}

Payor status and its role in patient complications and outcomes are gaining increasing attention in the medical literature. Extensive evidence reports inferior outcomes and increased complications in uninsured patients compared to the privately insured.^{18–43} Similarly, mounting evidence suggests that patients with public insurance, particularly Medicaid may have increased complications and inferior outcomes when compared to commercially insured patients.^{19,21,22,24,26–34,40–42,44–53} Ranging from increased perioperative complications²⁸ to increased mortality for common medical conditions,⁴² studies spanning multiple medical fields have corroborated these findings in the Medicaid population.

With the growing body of literature analyzing the role of payor status in patient outcomes, we examined payor status and risk of perioperative complications following spine surgery for patients in our Spine End Results Registry (2003–2004). We hypothesized that Medicaid payer status was significantly associated with higher likelihood of medical complications than non-Medicaid payer status.

METHODS

Data Source

The Spine End Results Registry (2003–2004) is a registry of prospectively collected data of all patients undergoing spinal surgery at the XXXX Medical Center and XXXX Medical Center. Detailed information regarding patient demographics, insurance status, medical comorbidity, surgical invasiveness, and adverse occurrences were followed for up to two years and obtained prospectively using earlier published methods.¹⁶ This registry included patients undergoing any type of spinal surgery between January 1st 2003 and December 31st 2004 at two academic hospitals: a university based medical center, and a county hospital serving as the only Level I trauma center in a large multi-state area. All patients were prospectively followed for the occurrence of medical complication for at least two years after their surgery. The XXXX institutional review board approved the study and an

informed consent was obtained from participants. Although insurance data were prospectively collected, this factor was not initially considered in determining risk and was not used in the multivariate analysis of our previous studies in determining risk of perioperative complications.^{3,4} Insurance data were provided by the XXXX Medical Center's (XXMC) quality improvement database, which prospectively records and reports payor information in accordance with the Centers for Medicare and Medicaid Services (CMS) reporting criteria.

Exclusion Criteria

We excluded patients younger than 18 years of age, those with missing surgical invasiveness data and those with a surgical invasiveness index that was equal to zero, as this included patients who did not actually have surgery (Figure 1).

Any Adverse Event and Risk Factor Definitions

Medical complications examined in our study were combined into one outcome of "any adverse event". A patient experienced "any adverse event", a binary variable, if they had one or more coded adverse event in any one of six different organ system categories (cardiac, pulmonary, gastrointestinal (GI), neurological, hematological and urological) (see Supplemental Digital Content) (Table 3).

We assessed the odds ratio of several risk factors using univariate (Table 1) and multivariate analysis (Table 2). The exposure of interest was payor of surgical procedure and associated hospital stay. Risk factors assessed for confounding or effect modification included: age, gender, smoking status, alcohol use, drug use, diabetes, body mass index (BMI), medical comorbidity (myocardial infarction, history of non-MI cardiac disease (valve disease, prolapse, abnormal EKG), congestive heart failure, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), asthma, hypertension, rheumatoid arthritis, renal conditions, pre-existing neoplasm, history of syncope or seizure, anemia, bleeding disorder), previous spinal surgery, primary diagnosis (degenerative, trauma, neoplasm, infection, and other), level of surgery (cervical, thoracic, lumbosacral), surgical approach (anterior, posterior, combined), and surgical invasiveness. Surgical invasiveness (SI) was defined using methods described in previously published works of the same cohort.

Analysis

Categorical data are presented as the number of cases and percentages. For categorical values, Pearson's Chi-square or Fisher's exact tests (where cell counts were low) were used to assess the univariate effect of various risk factors, including the exposure of interest, payor status, on the outcome. Odds Ratio (OR) and 95% confidence intervals (95% CI) were calculated for each of the categorical variables using univariate and multivariate backwards, stepwise logistic regression analysis to examine the association between payor status and medical complication, adjusting for confounding factors of comorbidity and the effect-modifying interaction between age and the exposure of interest, payor status. In the model we included risk factors that were deemed of clinical importance by the study investigators to contribute to medical complication, were a known confounder, or had a univariate association of $p < 0.10$. Because surgical approach and the number of vertebral levels operated on are a component of the invasiveness index they were not included in the multivariate model.

Statistical analysis was performed using SAS Enterprise Guide 4.3 software (SAS Inc., Cary, NC) and STATA 12.1 (StataCorp, College Station, TX) with hypothesis testing using a 2-tailed test of significance and an alpha level of $p < 0.05$.

RESULTS

There were 1745 patients who underwent spine surgery from Jan 1st 2003 to Dec 31st 2004. Of these, 154 were excluded for reasons outlined in Figure 1, leaving 1591 patients who were analyzed in this study.

The United States Government was the majority payor (N=778/1594, 48.8%) in our study, with almost half of patients received either Medicare (N=367/1594, 23.1%), Medicaid (N=367/1594, 23.1%) or some other federally funded program, including the Veterans' Administration (N=44/1594, 2.8%). This was followed by private insurers (N=609/1594, 38.3%), and self-pay (N=44/1594, 2.8%).

Other studies have previously reported univariate analysis of risk factors for medical complications in greater detail³, we did not present the complete results of the univariate analysis in this manuscript as those risk factors are not the focus of our study question (Table 1). However, we did incorporate the results of the univariate analysis into our multivariate analysis and do present the significantly associated risk factors along with the payor data (Table 2).

The risk for any adverse event was highest among those patients receiving the most invasive surgical treatment (surgical invasiveness > 25). The odds of any adverse event following the most invasiveness spinal surgeries (SI>25) was more than 10-fold higher than those who received the least invasive (SI ≤ 5) spine surgeries (OR=11.0, 95% CI: 6.11, 19.7, p<0.0001). In the univariate analysis, patients whose payor was Medicare had a 2.87 odds (95% CI: 2.14, 3.85, p<0.0001) of any adverse event occurring compared to those with private insurance. However, when controlling for age as a risk factor in the multivariate, Medicare was not statistically, significantly associated with any adverse event. However after controlling for confounders and effect modifiers in the multivariate analysis, those patients whose insurer was Medicaid had a 1.68 odds (95% CI: 1.23, 2.29, p=0.001) of having any adverse event when compared to the privately insured (Tables 1 & 2).

DISCUSSION

Significant evidence in the medical literature has shown clearly inferior outcomes and increased complications in uninsured patients compared to the privately insured.¹⁸⁻⁴³ While this association to the uninsured population may be intuitive, there is increasing evidence of similarly inferior outcomes and increased complications in patients with public insurance, particularly Medicaid, when compared to privately insured patients.^{19,21,22,24,26-34,40-42,44-53} In addition, multiple studies have even found Medicaid status to be a significant factor for increased in-hospital mortality when compared to privately insured patients.^{19,24,27,28,34,42,46} Disparities in the care of children on public insurance also exist, ranging from cleft palate repair, otitis media treatment, and complications associated with spinal fusions for scoliosis.^{45,48,52} Alosch et al. have also published in the spine literature to show an increased risk of perioperative mortality in patients covered by Medicaid undergoing anterior cervical spine surgery.³²

With our results corroborating multiple previous studies regarding Medicaid status and inferior patient outcomes, the essential follow up question is "Why?" Much attention, and justifiably so, is given to the plight of the uninsured. However, what is often neglected is the concept of underinsurance. Underinsurance is considered to be present when the health insurance benefits are in some way inadequate. Bashur et al. defined it in general terms as "coverage that fails to provide adequate protection against health care expenditures."⁵⁸ More specifically, three main indicators of underinsurance have been specified as: "lack of needed benefits or services, limited access to providers, or out-of-pocket costs that are considered to

be unreasonable.”^{44,59} Two decades ago, Bodenheimer discussed the importance of addressing the problem of underinsurance and stated that “...it reduces access to health care, especially for lower-income people, creates an inequitable method of financing care, and... can contribute to substandard clinical outcomes.”⁶⁰ Kogan et al. showed that similar to uninsured children, underinsured children have suboptimal access to health care and quality of health care.⁴⁴ In response to these findings, Perrin wrote that “the Affordable Care Act may leave chronically ill children...and newly insured Medicaid populations underinsured.”⁵⁹ A recent study by Link et al. found that underinsured patients were less healthy and had lower health related quality of life than uninsured patients and that their study results may be generalizable to the U.S. population.⁶¹ From their findings, they concluded that underinsurance at the very least is as big of a challenge to public health and health policy as non-insured status. With their study mentioned previously, Lidor et al. concluded that the “lack of adequate health insurance is a...powerful predictor of disease severity...and mortality.”³⁰

In addition to inadequate access, a component of underinsurance is when the coverage does not adequately protect the patient against healthcare expenditures. Thus, patients with Medicaid insurance may be faced with higher medical payments than they can afford and as a result avoid recommended treatment. Furthermore, lacking resources may prevent the patients from following physician recommendations. If socioeconomic disparities are an underlying cause for the differences in patient outcomes of Medicaid versus private insurance, then it is possible that level of education and understanding of medical conditions and treatment could be a factor. This helps explain the finding by Dasenbrock et al. who found Medicaid patients presented with a higher acuity of disease than private insurance patients.¹⁹ Therefore, rather than being a risk factor on its own, insurance status more likely serves as a proxy for other variables.

The results of our study further support the growing body of literature that Medicaid patients have higher rates of complications. One study previously reported risk factors for medical complications using this data registry, however in one previous report, we did not include payor status as a covariate.³ In this study we specifically examine the role of payor status in the context of previously defined risk factors. In the univariate analysis, both Medicare and Medicaid insurance status had increased rates of perioperative medical complications. However, with the multivariate analysis controlling for other significant risk factors, especially age, Medicaid but not Medicare, insurance status remained a significant risk factor for perioperative medical complications. Because our patient population is very heterogeneous with our academic institution seeing a broad spectrum of patients, we feel that our findings are generalizable to the overall spine surgery community. Therefore, just as medical and surgical co-morbidity factors should be taken into account when considering the safety of surgery and likelihood of complication, Medicaid status should be considered as well as our study clearly suggests an association.

The implication of this finding is significant, particularly as we progress into an era of quality metrics being linked to reimbursement. The occurrence of a complication is increasingly being regarded as an indicator of ‘poor quality’. Metrics such as surgical site infection or readmission within 30 days of discharge already are subject to ‘quality adjustment payments’ to medical centers. However, these metrics are not risk adjusted to account for patient risk factors. Inherently, patients will have different risks for complications based on their medical co-morbidities and other socioeconomic risk factors. It goes without saying that sicker patients are more likely to have complications from treatment when compared to a healthy patient undergoing the same treatment. Thus, medical centers that treat a disproportionate number of patients with co-morbidities and risk factors may find their ‘quality’ rating to be lower than other facilities that treat healthier patients.

Without sufficient risk adjustment to account for patient morbidity and known risk factors, these quality metrics not only inaccurately assign quality grades but also can financially penalize medical institutions that treat patients with these known risk factors. As hospital reimbursement becomes directly related to various non-risk-adjusted outcome measures, it is possible that higher risk patients may encounter additional challenges in access to health care. As our study and others before it have demonstrated an association of payor status and complications, it is entirely possible that this may have unintended consequences in limiting access of care for these patients. Further investigation is essential to fully understand the etiology of this finding and more importantly, to remedy this disparity in health care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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UWMC IRB-approved

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KEY POINTS

- This study identifies the role of payor status in the risk for perioperative medical complications following spine surgery.
- Medicaid insurance status is a risk factor for perioperative complications
- Underinsurance of patients is an often unacknowledged problem

Figure 1.
Participant Flow Diagram

Table 1

Univariate Analysis of Odds Ratio for Any Medical Complication (N=1591)

Payor	NO Adverse Event 1,145 (77%)	Any Adverse Event 446 (28%)	OR of Adverse Event	95% CI		p-value
				Lower	Upper	
Private	482 (79%)	127 (21%)	1.00	-	-	-
Medicaid	260 (71%)	107 (29%)	1.56	1.15	2.13	0.003
Medicare	209 (57%)	158 (43%)	2.87	2.14	3.85	<0.001
Labor & Industry	122 (76%)	38 (24%)	1.18	0.759	1.81	0.427
Other Federal/VA *	34 (77%)	10 (23%)	1.12	0.479	2.39	0.768
Self-Pay	38 (86%)	6 (14%)	0.599	0.203	1.47	0.251

* Veteran's Administration

Table 2

Multivariate Analysis of Odds Ratio for Any Medical Complication

Risk Factor	Odds Ratio	95% C.I.		p-value
		Lower	Upper	
Age (18 – 39)	1.00	-	-	-
40 – 64	2.09	1.47	2.96	< 0.0001
65	4.40	2.90	6.68	< 0.0001
Medicaid Payor	1.68	1.23	2.29	0.001
Congestive Heart Failure	3.65	2.00	6.65	< 0.0001
Bleeding Diagnosis or Blood Clots	1.91	1.23	2.98	0.004
Diagnosis (Degenerative)	1.00	-	-	-
Trauma	3.45	2.54	4.68	< 0.0001
Infection	2.40	1.26	4.56	0.008
Surgical Invasiveness Group (1 – 5)	1.00	-	-	-
6 – 10	1.60	1.15	2.23	0.005
11 – 15	2.95	2.06	4.24	< 0.0001
16 – 20	4.30	2.62	7.03	< 0.0001
21 – 25	7.09	3.62	13.89	< 0.0001
> 25	11.0	6.11	19.71	< 0.0001

CI = confidence intervals

Table 3

Distribution of Demographics and Risk Factors across Payor Mix

	PAYOR					
	Private	Medicaid	Medicare	L&I	Fed&VA	SelfPay
N	611	367	369	161	42	44
Row %	38%	23%	23%	10%	3%	3%
Age						
18 – 25	192	134	9	52	16	30
	44%	31%	2%	12%	4%	7%
40 – 64	408	223	87	106	21	14
	48%	26%	10%	12%	2%	2%
>=65	11	10	273	3	5	0
	4%	3%	90%	1%	2%	.
Gender						
Male	315	226	190	119	32	34
	34%	25%	21%	13%	3%	4%
Female	296	141	179	42	10	10
	44%	21%	26%	6%	1%	1%
Adverse Events						
No	508	272	240	130	34	39
	42%	22%	20%	11%	3%	3%
Yes	103	95	129	31	8	5
	28%	26%	35%	8%	2%	1%
Anemia						
No	571	339	324	155	39	43
	39%	23%	22%	11%	3%	3%
Yes	40	28	45	6	3	1
	33%	23%	37%	5%	2%	0.1%
Cancer History						
No	538	337	291	154	34	44

	PAYOR					
	Private	Medicaid	Medicare	L&I	Fed&VA	SelfPay
	38%	24%	21%	11%	2%	3%
Yes	73	30	78	7	8	0
	37%	15%	40%	4%	4%	0%
Cardiac History						
No	575	342	292	156	39	43
	40%	24%	20%	11%	3%	3%
Yes	36	25	77	5	3	1
	24%	17%	52%	3%	2%	1%
COPD						
No	582	339	328	151	39	43
	39%	23%	22%	10%	3%	3%
Yes	29	28	41	10	3	1
	26%	25%	37%	9%	3%	1%
CVD						
No	590	350	323	159	40	44
	39%	23%	21%	11%	3%	3%
Yes	21	17	46	2	2	0
	24%	19%	52%	2%	2%	0%
Drug Use						
No	579	279	352	143	40	33
	41%	20%	25%	10%	3%	2%
Yes	32	88	17	18	2	11
	19%	52%	10%	11%	1%	7%
Hypertension						
No	473	268	176	121	30	42
	43%	24%	16%	11%	3%	4%
Yes	138	99	193	40	12	2
	29%	20%	40%	8%	2%	0%

	PAYOR					
	Private	Medicaid	Medicare	L&I	Fed&VA	SelfPay
Liver Disease						
No	596	321	335	154	38	41
	40%	22%	23%	10%	3%	3%
Yes	15	46	34	7	4	3
	14%	42%	31%	6%	4%	3%
Rheumatoid Arthritis						
No	595	349	345	159	40	44
	39%	23%	23%	10%	3%	3%
Yes	16	18	24	2	2	0
	26%	29%	39%	3%	3%	0%
Renal Disease						
No	577	338	327	152	40	44
	39%	23%	22%	10%	3%	3%
Yes	34	29	42	9	2	0
	29%	25%	36%	8%	2%	0%
Diagnosis						
Degenerative	379	210	240	127	24	11
	38%	21%	24%	13%	2%	1%
Trauma	138	101	73	28	6	27
	37%	27%	20%	8%	2%	7%
Neoplasm	67	17	24	1	7	2
	57%	14%	20%	1%	6%	2%
Infection	7	33	15	0	3	2
	12%	55%	25%	0%	5%	3%
Complication	10	3	16	5	1	2
	27%	8%	43%	14%	3%	5%
Other	10	3	1	0	1	0
	67%	20%	7%	0%	7%	0%

	PAYOR				
	Private	Medicaid	Medicare	L&I	Fed&VA
Surgical Invasiveness Score					
Mean	7.86	7.32	11.40	7.64	8.26
SD	7.24	5.90	9.45	6.04	6.62
					SelfPay
					6.27
					3.97