RISK FACTORS FOR NONROUTINE DISCHARGE IN PATIENTS UNDERGOING SPINAL FUSION FOR INTERVERTEBRAL DISC DISORDERS

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ABSTRACT

Background: Although outcomes following spinal fusion for intervertebral disc disorders have been studied, factors influencing discharge disposition and health care resource utilization have not been determined. This study sought to clarify perioperative risk factors for non-routine discharge and prolonged hospital stay in patients undergoing fusion for intervertebral disc disorders.

Methods: The National Hospital Discharge Survey was queried to identify all patients discharged from U.S. hospitals following spinal fusion for intervertebral disc disorders between 1990 and 2007. A cohort representative of 1,943,707 patients was identified and separated into those who were discharged home and those who were discharged to rehabilitation facilities. Multivariable logistic regression analysis was used to identify independent predictors of non-routine discharge to another inpatient facility and prolonged hospital stay.

Results: The strongest risk factors for non-routine discharge were age>65 years, congestive heart failure, atrial fibrillation, any general in-hospital complication, diabetes mellitus, osteoporosis, hypertension and any surgery-related complication. Patients younger than 50 years and males had the lowest rate of non-routine discharge. The strongest risk factors for prolonged hospital stay were any surgery-related complication, congestive heart failure, any general in-hospital complication, atrial fibrillation, age > 65 years, osteoporosis and diabetes mellitus. Patients 36-50 years of age had the lowest risk of increased length of hospital stay.

Conclusions: Knowledge of these risk factors may aid in better resource allocation and improved strategies for managing patients with spondylosis in order to decrease healthcare costs.

Key words: spinal fusion; intervertebral disc disorder; discharge; length of stay; hospital stay; comorbidities; post-hospitalization care; epidemiology

Level of evidence: 3

INTRODUCTION

Intervertebral disc disorders are a common cause of pain that affects mobility and quality of life and are increasing in prevalence[1-3]. Spinal fusion is often utilized for treatment of intervertebral disc disorders and studies have demonstrated improved outcomes in bodily pain and physical function compared to conservative therapy among persistently symptomatic patients who have failed nonoperative management[4,5]. Factors influencing clinical outcomes and operative success among patients undergoing spinal fusion have been studied at length[6-8]. However, risk factors for nonroutine discharge to other inpatient facilities and variables associated with prolonged hospital stays have not been identified. Early hospital discharge to home has been shown to be an important contributor to better postoperative outcomes, improved quality of life and less health care resource utilization among orthopaedic patients[9-11]. Knowledge of risk factors associated with nonroutine discharge and prolonged hospital stays may help identify patients at greater risk of prolonged post-hospitalization care, which may aid in proper resource allocation and reduce healthcare costs.

This study sought to identify risk factors associated with nonroutine discharge to inpatient facilities in patients undergoing spinal fusion for intervertebral disc disorders. We also sought to analyze variables associated with prolonged hospital stay and increased post-hospitalization utilization.

METHODS

National Hospital Discharge Survey

The National Hospital Discharge Survey (NHDS), developed by the National Center for Healthcare Statistics division of the Centers for Disease Control and Prevention (CDC)[12], was used to estimate incidence and

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Acknowledgements: None reported

to evaluate risk factors for nonroutine discharge and prolonged length of hospital stay for patients undergoing spinal fusion for intervertebral disc disorders. The NHDS is a publically available survey providing demographic and medical data for inpatients discharged from non-federal, short stay hospitals in the United States[13]. The NHDS is the principal database for the U.S. government to monitor hospital use and is considered the most comprehensive of all inpatient surgical databases[13]. The survey uses International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes[14] to classify medical diagnoses and procedures. The NHDS uses a stratified, multistage probability design to collect demographic information (age, gender, race), expected source of payment (insurance status), medical information of up to seven discharge diagnoses and up to four procedures, length of care, hospital size, U.S. region, and inpatient outcomes including discharge destination[15]. To ensure an unbiased national sampling of inpatient records, the NHDS uses a three-stage probability design including: inflation by reciprocals of the probabilities of sample selection, adjustment for no response and population weighting ratio adjustments[13]. This study did not require approval by the institutional review board because the NHDS is a publically available database with no patient identifying information.

Patient selection

All patients admitted to hospitals in the U.S. who underwent spinal fusion for intervertebral disc disorders between 1990 and 2007 were identified using ICD-9-CM codes. Discharges with a diagnosis code (ICD-9-CM) of displacement of cervical (722.0), thoracic/lumbar (722.1) or unspecified (722.2) intervertebral disc without myelopathy, degeneration of cervical (722.4), thoracic/lumbar (722.5), or unspecified (722.6) intervertebral disc, intervertebral disc disorder with myelopathy (722.7) or unspecified intervertebral disc disorder (722.9) were identified using previously described techniques[16]. The database was subsequently queried to identify patients treated using spinal fusion (ICD-9 procedure code 81.0x). Patients were split into two groups: (1) patients discharged to home (routine discharge) after spinal fusion and (2) patients transferred to an inpatient facility (nonroutine discharge). Demographic variables were then collected including: age, sex, primary diagnosis, prevalence of comorbidities, length of stay, discharge destination, geographic region, hospital size, and insurance status. The complication screening package[17] was used to determine the incidence of complications. The variable adverse event was created based on the variables: postoperative wound complication (998.3), postoperative bleeding (998.1), acute postoperative infection (998.5), acute postoperative anemia (285.1), acute renal failure (584), acute myocardial infarction (410), pulmonary embolism (415.1), induced mental disorder (293), pneumonia (480-486), pulmonary insufficiency (518.5), deep venous thrombosis (453.4), intubation (96.xx) and transfusion of blood (99.x).

Statistical analysis

Because of the large sample size, a normal distribution of the data was assumed. In bivariate analysis, the routine discharge and nonroutine discharge groups were compared using Pearson's chi-square test for categorical data and independent-samples t test for continuous data. To determine independent predictors of nonroutine discharge to inpatient facilities, all variables present in at least 2% of the population[18] were included in a multivariable binary logistic regression model. For in-hospital adverse events, a 1% cutoff was used due to their lower rates of occurrence, as previously described[19]. A multivariable regression model allows for the control of potential confounders, isolating the effect of individual variables on inpatient outcomes. The dichotomous variables were 1) nonroutine discharge to inpatient facility and 2) prolonged hospital stay. We defined prolonged hospital stay when the average length of stay was greater than the 75th percentile, as previously described[20,21]. Covariates accounted for in the regression model included: gender, age, region of the country, and preexisting comorbidities (anemia, obesity, diabetes mellitus, hypertension, congestive heart failure, coronary artery disease, atrial fibrillation, prior myocardial infarction, and osteoporosis). To assess for the association between individual variables and inpatient outcomes, odds ratios and confidence intervals were calculated. A P value of <0.001 was used to define statistical significance, correcting for multiple comparisons, as previously described[19]. United States census data were used to obtain national population estimates for each year of the study 1990-2007[22]. Rates were presented as the number of fusions for per 100,000 standard population. All data were analyzed using the software-statistical package for social sciences [SPSS] version 20 (Chicago, IL, USA).

Source of funding

No external funding source was used for the conduct of this study.

RESULTS

Incidence and Demographics:

A cohort representative of 1,943,707 patients who underwent spinal fusion for intervertebral disc disorders was identified between 1990 and 2007, with the routine discharge group comprising 1,780,071 patients (91.6%) and the nonroutine discharge group comprising 65,966 patients (3.4%) (Table 1). The remaining 5.0% of patients

Table 1: Characteristics for patients who underwent fusion for intervertebral disc disorders in the United States from 1990 to 2007

Parameter	Total 1990-2007, (%)	Discharge to Home (%)	Discharge to Inpatient Facility (%)	P
N=	1,943,707	1780071	65966	
% Total	100.0%	91.6%	3.4%	
Gender				
Male	50.8	51.8	33.1	<0.001
Female	49.2	48.2	66.9	
Age				
≤35	14.7	15.3	3.6	<0.001
36-50	48.6	50.6	21.0	
51-65	26.7	26.7	27.4	
>65	10.0	7.4	48.0	
Region				
Northeast	14.7	14.6	17.5	<0.001
Midwest	22.5	22.2	21.2	
South	43.0	43.8	28.5	
West	19.8	19.3	32.8	
Bedsize				
6–99	4.0	4.1	5.1	<0.001
100-199	23.2	23.4	25.9	
200-299	27.6	27	32.5	
300-499	29.7	29.9	23.4	
500 or more	15.6	15.6	13.1	
Insurance				
Medicare	13.7	11.2	51.6	<0.001
Medicaid	4.7	4.7	6.3	
Workmens comp	15.5	16.1	6.7	
Private	56.4	58.4	30	
Self pay	1.9	2.1	0.1	
Other	7.6	5.8	4.4	
Not stated	1.9	1.8	0.8	
Primary Diagnosis				
722.0x cervical disc displacement	41.1	43.4	7.4	<0.001
722.10 lumbar disc displacement	20.0	19.2	29.8	
722.52 lumbar disc degeneration	18.9	17.8	33.7	
722.71 cervical disc disorder with myelopathy	7.6	7.4	10.7	
722.4x cervical disc degeneration	5.3	5.6	2.8	
Comorbities	27.6	25.7	58.5	<0.001
Adverse Events	8.1	6.9	20.6	<0.001
Discharge Dispostion				
Routine/home (1)	91.6	100	-	<0.001
Left AMA (2)	0	-	-	
Short term fac (3)	1.2	-	35.4	
Long term fac (4)	2.2	-	64.6	
Alive, not stated (5)	3.6	-	-	
Dead (6)	0.1	-	-	
Not reported (9)	1.3	-	-	
Age (years), mean (SD)	47.83(12.26)	46.90(11.48)	61.62(14.22)	<0.001
Days of Care, mean (SD)	3.41(1.25)	3.15(3.50)	7.10(7.73)	<0.001

Table 2: Characteristics in 1990, 1995, 1999, 2003 and 2007 among patients who underwent fusion for intervertebral disc disorders. SD, Standard deviation

	1990	1995	1999	2003	2007	Comparison between 2007 and 1990 (p)
N	65510	70669	116904	144368	150448	
Incidence per 100,000 capita	23.21	25.04	41.43	51.16	53.31	
Gender (%)						
Male	61	61.3	56.2	48.6	49.1	<0.001
Female	39	38.7	43.8	51.4	50.9	
Comorbidities (%)	9.9	24.0	19.8	29.4	45.2	<0.001
Adverse events (%)	2.7	5.9	6.7	10.1	7.3	<0.001
Transfusion (%)	0.6	1.4	3.0	3.3	2.0	<0.001
Discharge (%)						
Routine	93.9	91	92.2	92.1	91.7	<0.001
Non-routine	3.3	3.7	3	3.3	5.5	
Mean Age (yrs) (SD)	43.14(11.8)	45.70(11.55)	46.83(11.69)	48.46(12.1)	50.91(12.78)	<0.001
Mean DOC (days) (SD)	5.92(4.07)	3.41(3.22)	3.26(8.3)	3.23(4.99)	3.16(3.02)	<0.001

Table 3: Prevalence of comorbidities in patients who underwent fusion for intervertebral disc disorders between 1990 and 2007. (N=1,943,707)

Parameter (ICD-9)	Total (%)	Routine Discharge (%) (N=1,780,071)	Nonroutine Discharge (%) (N=65,966)	p
Diabetes mellitus (250)	7.08%	6.29%	21.42%	<0.001
Obesity(278.00, 278.01)	3.07%	2.99%	4.44%	<0.001
Hypertensive disease (401-405)	21.16%	20.05%	43.98%	<0.001
Old myocardial infarction (412)	1.10%	1.04%	1.33%	<0.001
Coronary artery disease (414.01)	1.90%	1.74%	3.96%	<0.001
Atrial fibrillation (427.31)	0.90%	0.62%	3.41%	<0.001
Congestive heart failure (428)	0.60%	0.43%	2.61%	<0.001
Osteoporosis (733.0)	0.84%	0.74%	2.52%	<0.001

were excluded from the subgroup analysis because their discharge status was either alive with no discharge status stated (3.6%), dead (0.1%) or not reported (1.3%) (Table 1).

Patients in the nonroutine discharge group were mostly female (66.9% vs 48.2%, P < 0.001), were significantly older (62± 14 years vs 47 ± 11 years, P < .001; 48% >65 years vs 7.4% >65 years, P < .001), living in the West (33% vs 19%, P < .001), and mainly admitted to medium-sized hospitals with 200-299 beds (32.5 vs 277%; P < .001) compared to patients in the routine discharge group. Length of hospital stay was 7.1 ± 7.7 days in the non-routine discharge group and 3.2 ± 3.5 days in the home discharge group. The most common primary diagnosis in the nonroutine discharge group was lumbar disc degeneration (33.7% vs 17.8%; P < 0.001) followed by lumbar disc displacement (29.8% vs 19.2%; P < 0.001) compared with the routine discharge group. Among patients in the nonroutine discharge group, Medicare was the most common form of payment (51.6% vs 11.2%; P < 0.001) compared with the routine discharge group (Table 1).

The incidence of patients undergoing spinal fusion for intervertebral disc disorders increased from 23.2 per 100,000 capita in 1990 to 53.3 per 100,000 capita in 2007. From 1990 to 2007 there was in increase in comorbidities (9.9% vs 45.2%; P < 0.001), adverse events (2.7% vs 7.3%; P < 0.001) and blood transfusions (0.6% vs 2.0%; P < 0.001). Nonroutine discharge to inpatient facilities increased from 3.3% in 1990 to 5.5% in 2007 while mean days of in-hospital care decreased from 5.9 ± 4.1 in 1990 to 3.2 ± 3.0 in 2007 for the entire patient cohort (Table 2).

Comorbidities and Adverse Events:

Patients in the nonroutine discharge group had higher rates of all comorbidities including diabetes mellitus (21% vs 6%; P <0.001), obesity (4% vs 3%; P < 0.001), hypertension (44% vs 20%; P < 0.001), old myocardial infarction (1.33% vs 1.04%; P <0.001), coronary artery disease (4% vs 2%; P < 0.001), atrial fibrillation (3% vs 1%; P < 0.001), congestive heart failure (2.6% vs 0.4%; P < 0.001), and osteoporosis (2.5% vs 0.7%; P < 0.001) compared with patients in the routine discharge group

Table 4: Prevalence of adverse events among patients who underwent fusion for intervertebral disc disorders between 1990 and 2007. (N=1,943,707)

Parameter (ICD-9)	Total, (%)	Routine Discharge (%) (N=1780071)	Nonroutine Discharge (%) (N=65966)	p
Post Surgery Complications:				
Postoperative wound complication (998.3)	0.03%	0.01%	0.13%	<0.001
Postoperative bleeding (998.1)	0.73%	0.61%	1.85%	<0.001
Acute postoperative infection (998.5)	0.20%	0.16%	0.69%	<0.001
Acute postoperative anemia (285.1)	5.01%	4.41%	10.06%	<0.001
General Complications:				
Acute renal failure (584)	0.16%	0.04%	1.40%	<0.001
Acute myocardial infarction (410)	0.90%	0.04%	0.58%	<0.001
Pulmonary embolism (415.1)	0.05%	0.02%	0.60%	<0.001
Induced mental disorder (293)	0.10%	0.07%	0.51%	<0.001
Pneumonia (480-486)	0.36%	0.23%	2.39%	<0.001
Pulmonary insufficiency (518.5)	0.41%	0.31%	1.40%	<0.001
Deep venous thrombosis (453.4)	0.04%	0.04%	0.00%	<0.001
Intubation (96.x)	0.25%	0.19%	1.07%	<0.001
Transfusion of blood (99.0)	2.69%	2.25%	6.17%	<0.001

Table 5: Logistic regression for predictors of non-routine discharge among patients who underwent fusion for intervertebral disc disorders (N=1,943,707) CI, confidence interval; OR, odds ratio.

Variable	OR (95% CI)	P
Age >65 years	11.517 (11.331-11.706)	<0.001
Congestive heart failure	6.187 (5.869-6.523)	<0.001
Atrial fibrillation	5.685 (5.429-5.953)	<0.001
Any general complication	4.522 (4.410-4.637)	<0.001
Diabetes mellitus	4.06 (3.981-4.140)	<0.001
Osteoporosis	3.478 (3.303-3.662)	<0.001
Hypertension	3.132 (3.083-3.182)	<0.001
Any surgery complication	2.544 (2.482-2.607)	<0.001
Coronary artery disease	2.333 (2.240-2.430)	<0.001
Obesity	1.508 (1.452-1.567)	<0.001
Old myocardial infarction	1.283 (1.199-1.374)	<0.001
Age 51-65 years	1.036 (1.018-1.054)	<0.001
Region	0.956 (0.803-1.139)	0.614
Sex (M)	0.532 (0.523-0.542)	<0.001
Age 36-50 years	0.259 (0.254-0.264)	<0.001
Age ≤35 years	0.209 (0.201-0.218)	<0.001

Omnibus X 18,397, P < 0.001

Nagelkerke R2, P=0.177

(Table 3). When compared to patients discharged home, those discharged to inpatient facilities had a significantly increased incidence of adverse events including acute postoperative anemia (10% compared to 4%, P < .001), wound complications (0.13% compared to 0.01%, P < .001), acute renal failure (1.4% compared to 0.04%, P < .001), pneumonia (2.4% compared to 0.2%, P < .001), pulmonary insufficiency (1.4% compared to 0.3%, P < .001), and blood transfusion (6.2% compared to 2.3%, P < .001) (P < .001) (Table 4).

Nonroutine Discharge:

Multivariable logistic regression analysis showed the strongest independent predictors of nonroutine discharge following spinal fusion for intervertebral disc disorders were age > 65 years (OR 11.52 range: 11.33-11.71, P < 0.001), congestive heart failure (OR 6.19 range: 5.87-6.52, P < 0.001), atrial fibrillation (OR 5.69 range: 5.43-5.95, P < 0.001), any general in-hospital complication (OR 4.52 range: 4.41-4.64, P < 0.001), diabetes mellitus (OR 4.1 range: 3.98-4.14, P < 0.001), osteoporosis (OR 3.48 range: 3.30-3.66, P < 0.001), hypertension (OR 3.13 range: 3.08-3.18, P < 0.001), and any surgery related complication (OR 2.54 range: 2.48-2.61, P < 0.001). Factors associated with decreased odds of nonroutine discharge include age ≤ 35 years (OR 0.21 range: 0.20-0.22, P < 0.001), age 36-50 years (OR 0.26 range: 0.25-0.26, P < 0.001), and male sex (OR 0.53 range: 0.52-0.54, P < 0.001) (model fit: omnibus test of model coefficients: X2 = 18,397, P < 0.001, Nagelkerke R2 = 0.177; Table 5).

Prolonged Length of Hospital Stay:

Multivariable logistic regression analysis showed the strongest independent risk factors for prolonged hospital stay following spinal fusion for intervertebral disc disorders were any surgery related complication (OR 7.85 range: 7.74-7.95, P < 0.001), congestive heart failure (OR 6.90 range: 6.63-7.17, P < 0.001), any general in-hospital complication (OR 5.94 range: 5.85-6.03, P < 0.001), atrial fibrillation (OR 3.21 range: 3.12-3.31, P < 0.001), age > 65

Table 6: Logistic regression for predictors of prolonged hospital stay among patients who underwent fusion for intervertebral disc disorders (N=1,943,707) CI, confidence interval; OR, odds ratio.

Variable	OR (95% CI)	P
Any Surgery complication	7.845 (7.743-7.948)	<0.001
Congestive heart failure	6.895 (6.633-7.168)	<0.001
Any General complication	5.938 (5.847-6.031)	<0.001
Atrial fibrillation	3.21 (3.116-3.307)	<0.001
Age >65 years	2.639 (2.614-2.665)	<0.001
Osteoporosis	2.32 (2.248-2.394)	<0.001
Diabetes mellitus	1.644 (1.625-1.664)	<0.001
Old Myocardial infarction	1.45 (1.408-1.494)	<0.001
Coronary artery disease	1.393 (1.362-1.425)	<0.001
Hypertension	1.244 (1.234-1.254)	<0.001
Age 51-65 years	1.174 (1.165-1.182)	<0.001
Age ≤35 years	1.113 (1.103-1.123)	<0.001
Sex (M)	1.041 (1.033-1.048)	<0.001
Region	1.009 (0.949-1.974)	0.77
Obesity	0.971 (0.953-0.990)	0.003
Age 36-50 years	0.546 (0.532-0.560)	<0.001

Omnibus X 18397, P < 0.001

Nagelkerke R2, P=0.0325

years (OR 2.64 range: 2.61-2.67, P < 0.001), osteoporosis (OR 2.32 range: 2.25-2.39, P < 0.001), and diabetes mellitus (OR 1.64 range: 1.63-1.66, P < 0.001). The strongest independent predictor of normal or decreased length of hospital stay was age 36-50 years (OR 0.55 range: 0.53-0.56, P < 0.001) (model fit: omnibus test of model coefficients: X2 = 18,397, P < 0.001, Nagelkerke R2 = 0.033; Table 6).

DISCUSSION

This study identified perioperative risk factors associated with nonroutine discharge and prolonged hospital stay among patients undergoing spinal fusion for intervertebral disc disorders. Between 1990 and 2007, we identified an increasing incidence (23.2 per 100,000 capita in 1990 to 53.3 per 100,000 capita in 2007) of spinal fusion for intervertebral disc disorders as well as an increasing rate of nonroutine discharge to inpatient facilities (3.3% in 1990 to 5.5% in 2007). Concurrently, this study demonstrated a decreased mean length of hospital stay (5.9 days in 1990 to 3.2 days in 2007). It is possible the decreased length of stay and higher proportion of nonroutine discharges over time is related to earlier transfer to inpatient rehabilitation facilities. The trends found in this study demonstrate a growing use of postoperative care facilities, such as inpatient rehabilitation facilities, which is similar to previous reports[23-25].

In this study, patients over the age of 65 had the highest odds of nonroutine discharge and also had higher odds of prolonged length of hospital stay, which is in line with previous studies[26,27]. Interestingly, this study found females were at greater risk of nonroutine discharge. This finding is similar to the results reported by Katz et al[28] in which women had worse functional outcomes than men following laminectomy for spinal stenosis, as well unilateral hip and knee arthroplasty. Their study found that women had significantly worse preoperative functional status than men, suggesting they may have been treated at more advanced disease stages and alluding to possible gender differences in preferences for symptom relief, attitudes toward surgery, or access to operative procedures[28]. This is supported by several studies that demonstrated women are less likely to undergo cardiac catheterization and revascularization, or renal transplantation then men with similar coronary or renal disease severity[29-34].

Another finding of this study was that patients in the nonroutine discharge group had higher rates of all comorbid medical conditions compared with those patients in the routine discharge group. Multivariate logistic regression showed that all comorbidities analyzed in this study, except obesity, were independent predictors of both nonroutine discharge and prolonged hospital stays. This is similar to work by Deyo et al[25], showing that major medical complications, mortality and healthcare utilization were higher in patients with comorbidities such as diabetes, obesity or coronary artery disease who underwent various surgeries for lumbar stenosis. Additionally, Slover et al[35] showed patients with comorbidities had worse scores on bodily pain, physical function and physical component assessments following lumbar spine surgery. Among patients undergoing ankle fusion, Menendez et al[23] showed that diabetes was linked to higher nonroutine discharge and prolonged hospitalization, though obesity was not linked to prolonged hospital stay in this study. One possible explanation for this is coding bias by the NHDS database towards more stable diseases, leading to underestimation of certain conditions. Indeed, of the total patient cohort, only 3.07% had a diagnosis of obesity, which is far below the national prevalence[36] and illustrates its underestimation in this study.

Surgery-related and general in-hospital complications were among the strongest predictors of prolonged hospital stay and nonroutine discharge. The most common surgery related complication was acute postoperative anemia, followed by postoperative bleeding and infection. Blood transfusion was the most common general in-hospital complication followed by pneumonia and pulmonary insufficiency. These complications are similar to those reported by Shamji et al[24] among patients undergoing cervical fusion for cervical spondylosis and are

associated with increased health care utilization among patients with spinal stenosis[37].

While large national databases have been recognized as suitable for epidemiological research[38], our study has several limitations. Like all large databases, the NHDS is subject to coding error or error in data entry[39]. Additionally, the database only allows for seven diagnosis codes and four procedure codes per entry. As a result, the prevalence of comorbid conditions and adverse events may be underreported[19]. Moreover, the severity of a comorbid disease cannot be appreciated when classified dichotomously[40].

Our study is also limited by the inability to distinguish between the types and extent of fusion procedures performed among our patient population. Although the use of instrumentation may lead to higher fusion rates[41,42], these procedures have an increased operative time, blood loss, infection rate, as well as risk of nerve root injury or vascular injury from malpositioning[43]. Patients older than 65 may have more extensive disease with greater rates of instability requiring longer instrumented fusion constructs compared to younger patients. The higher odds of non-routine discharge and prolonged length of hospital stay among patients greater than 65 may be attributable to the more extensive surgical fusion procedures needed to treat this population. Also, the indication for surgery was not recorded, so it is unknown whether these patients had axial pain, radiculopathy or other symptoms. Another limitation of this database is that it only provides inpatient data, so complications that arise after discharge as well as follow up data, are unknown. Furthermore, the database does not provide billing information so cost analysis is unable to be performed. Future work should be conducted to evaluate the cost of length of stay and discharge to another inpatient facility. Lastly, the results of this study are limited to spinal fusion in the United States from 1990 to 2007.

In conclusion, this study provides the largest analysis of perioperative risk factors associated with nonroutine discharge and prolonged hospital stays among patients undergoing spinal fusion for intervertebral disc disorders. Identifying risk factors associated with increased healthcare utilization has the potential to change treatment strategies, improve preoperative optimization and resource allocation for this patient population in an attempt to prevent prolonged hospitalization and postoperative acute care utilization, while decreasing health care costs.

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