JNS SPINE

CLINICAL ARTICLE

Predictors of nonroutine discharge among patients undergoing surgery for grade I spondylolisthesis: insights from the Quality Outcomes Database

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OBJECTIVE Discharge to an inpatient rehabilitation facility or another acute-care facility not only constitutes a postoperative challenge for patients and their care team but also contributes significantly to healthcare costs. In this era of changing dynamics of healthcare payment models in which cost overruns are being increasingly shifted to surgeons and hospitals, it is important to better understand outcomes such as discharge disposition. In the current article, the authors sought to develop a predictive model for factors associated with nonroutine discharge after surgery for grade I spondylolisthesis.

METHODS The authors queried the Quality Outcomes Database for patients with grade I lumbar degenerative spondylolisthesis who underwent a surgical intervention between July 2014 and June 2016. Only those patients enrolled in a multisite study investigating the impact of fusion on clinical and patient-reported outcomes among patients with grade I spondylolisthesis were evaluated. Nonroutine discharge was defined as those who were discharged to a postacute or nonacute-care setting in the same hospital or transferred to another acute-care facility.

RESULTS Of the 608 patients eligible for inclusion, 9.4% (n = 57) had a nonroutine discharge (8.7%, n = 53 discharged to inpatient postacute or nonacute care in the same hospital and 0.7%, n = 4 transferred to another acute-care facility). Compared to patients who were discharged to home, patients who had a nonroutine discharge were more likely to have diabetes (26.3%, n = 15 vs 15.7%, n = 86, p = 0.039); impaired ambulation (26.3%, n = 15 vs 10.2%, n = 56, p < 0.001); higher Oswestry Disability Index at baseline (51 [IQR 42–62.12] vs 46 [IQR 34.4–58], p = 0.014); lower EuroQol-5D scores (0.437 [IQR 0.308–0.708] vs 0.597 [IQR 0.358–0.708], p = 0.010); higher American Society of Anesthesiologists score (3 or 4: 63.2%, n = 36 vs 36.7%, n = 201, p = 0.002); and longer length of stay (4 days [IQR 3–5] vs 2 days [IQR 1–3], p < 0.001); and were more likely to suffer a complication (14%, n = 8 vs 5.6%, n = 31, p = 0.014). On multivariable logistic regression, factors found to be independently associated with higher odds of nonroutine discharge included older age (interquartile OR 9.14, 95% CI 3.79–22.1, p < 0.001), higher body mass index (interquartile OR 2.04, 95% CI

ABBREVIATIONS ASA = American Society of Anesthesiologists; AUC = area under the curve; BMI = body mass index; EQ-5D = EuroQol-5D; IQR = interquartile range; NRS = numeric rating scale; ODI = Oswestry Disability Index; PRO = patient-reported outcome; QOD = Quality Outcomes Database; SNF = skilled nursing facility.

SUBMITTED May 31, 2019. **ACCEPTED** September 13, 2019.
INCLUDE WHEN CITING Published online December 6, 2019; DOI: 10.3171/2019.9.SPINE19644.

1.31–3.25, p < 0.001), presence of depression (OR 4.28, 95% CI 1.96–9.35, p < 0.001), fusion surgery compared with decompression alone (OR 1.3, 95% CI 1.1–1.6, p < 0.001), and any complication (OR 3.9, 95% CI 1.4–10.9, p < 0.001).

CONCLUSIONS In this multisite study of a defined cohort of patients undergoing surgery for grade I spondylolisthesis, factors associated with higher odds of nonroutine discharge included older age, higher body mass index, presence of depression, and occurrence of any complication.

https://thejns.org/doi/abs/10.3171/2019.9.SPINE19644

KEYWORDS spondylolisthesis; nonroutine discharge; discharge disposition; lumbar spine; spine surgery; Quality Outcomes Database; QOD

Recent years have seen a dramatic increase in the use of lumbar spinal procedures. According to one estimate there has been an increase of 62.3% in the volume of elective lumbar fusion for degenerative diagnoses, from 122,679 procedures performed in 2004 to 199,140 in 2015,[25] with a similar increase in both direct surgical cost and costs related to postsurgical care.[3,4,10] This rapid increase may be attributed to a couple of reasons. One could be the increase in life expectancy in the US, which translates in this case into more people with degenerative spine disease.[23,31] Another reason could be the increased consideration that is now given to factors such as preoperative global spinal alignment, which, if impaired, may also require fusion. These increases have resulted in demands for optimizing surgical outcomes as well as postoperative care. There is a strong need to formulate evidence-based recommendations for postsurgical care in the hospital as well as postdischarge.[1,9] In particular, experts recommend mitigating low-value practices such as prolonged length of stay due to unanticipated need for nonhome discharge. Studies have also shown that delays in discharge—for instance, due to an insurance precertification requirement by a skilled nursing facility (SNF)—after being medically cleared may be a significant driver of increased cost.[34] In other cases patients may be required to spend a few days in the hospital before being discharged to an SNF.[33] Hence, it is imperative to identify factors that may increase the risk of a nonroutine discharge for a patient so that preemptive measures can be used to prevent delays in transfer to an SNF or another inpatient facility.

Previous studies have investigated factors associated with nonroutine discharge after a lumbar surgery by using a surgical quality database or their institutional records, and have found certain demographic characteristics, comorbidities, and clinical factors to be associated with increased odds of adverse discharge.[18,20] However, these studies may be limited in generalizability due to a lack of granular operative details related to lumbar surgery, or due to the small sample size.

The objective of the current study was to use a neurosurgical registry to identify predictors of a nonroutine discharge for a homogeneous subset of patients undergoing 1- to 2-level decompression or 1-level fusion surgery for grade I spondylolisthesis.

Methods

Patient Cohort

The Quality Outcomes Database (QOD) was queried for patients undergoing surgery for Meyerding grade I degenerative lumbar spondylolisthesis between July 1, 2014, and June 30, 2016. The QOD spine registry is the largest prospective multiinstitutional registry in North America. The registry was established in 2012; the overarching objective behind its inception was to assess risk-adjusted expected morbidity and 30-day and 12-month patient-reported outcomes (PROs) and clinical outcomes, which would facilitate a data-driven mechanism of providing insights into improving quality of care for routinely performed spine surgeries in the US.[6,12,29] As of February 2019, almost 80,000 patients across 220 participating sites nationwide had been enrolled in the Lumbar Spine Surgery QOD module (https://www.neuropoint.org/registries/qod/). Among these, 12 of the highest-enrolling sites came together for a focused project to assess the impact of fusion on PROs in patients undergoing surgery for grade I lumbar spondylolisthesis.[2,5,7,8,28] This group of sites consisted of those that had 1) a full-time study coordinator available and 2) a centralized auditing mechanism to ensure data accuracy. To determine the diagnosis of grade I spondylolisthesis, surgeons at each of the participating sites evaluated preoperative standing or dynamic radiographs.[2,5,7,8,28] Intraoperative variables including laminectomy performed, fusion performed and number of levels of fusion or laminectomy, and minimally invasive versus open procedures were also abstracted for all eligible patients.[2,5,7,8,28] For the current study, we only included patients who underwent elective 1- or 2-level decompression or 1-level decompression and fusion surgery for grade I spondylolisthesis according to the Meyerding classification,[27] and in whom data for discharge disposition were available.

Outcome of Interest

The primary outcome of interest for the current study was discharge disposition. The QOD documents discharge disposition as 1) home routine, 2) home with home healthcare, 3) postacute or nonacute-care setting, 4) transferred to another acute-care facility, 5) against medical advice, or 6) died in hospital. For the purposes of this study we classified "home routine" and "home with home healthcare" as "discharge to home," whereas all others were classified as "nonroutine discharge."

Covariates

The following covariates were included in the analysis:[2,5–8,28,29] 1) demographic characteristics including age,

TABLE 1. Details regarding patients discharged to home and those with nonroutine discharge

Discharge Disposition	No. (%)	Binary Variable Group
Home routine	519 (85.4%)	Discharge to home, n = 551 (90.6%)
Home with home healthcare	32 (5.3%)	
Postacute or nonacute-care setting	53 (8.7%)	Nonroutine discharge, n = 57 (9.4%)
Transferred to another acute-care facility	4 (0.7%)	
Against medical advice	0 (0.0%)	
Died in hospital	0 (0.0%)	

sex, body mass index (BMI), ethnicity, insurance, education level, employment, and workers' compensation; 2) comorbidities including smoking, diabetes, anxiety, osteoporosis, depression, and American Society of Anesthesiologists (ASA) classification; 3) clinical characteristics including symptom duration, dominant symptom, ambulation, and presence of motor deficit; and 4) baseline PROs including Oswestry Disability Index (ODI),[15] EuroQol-5D (EQ-5D) score,[14] and numeric rating scale (NRS) scores for back and leg pain.[22] Surgical variables including intraoperative blood loss, operating time, interbody graft, and use of minimally invasive techniques were also documented. A minimally invasive procedure was classified as such if there was documentation of the use of percutaneous or tubular screw fixation or tubular laminectomy, with or without intervertebral body graft placement. We also compared the rate of complications between patients with nonroutine discharge and those who were discharged to home. These complications included deep venous thrombosis, new neurological deficit, myocardial infarction, urinary tract infection, surgical site infection, hematoma, cerebrovascular accident, durotomy, and pneumonia.

TABLE 2. Analysis of demographic characteristics between patients discharged to home and those with nonroutine discharge

Characteristic	Nonroutine Discharge, n = 57	Home Routine, n = 551	Total, N = 608	p Value
Age in yrs				**<0.001**
Median	71	62.585	63	
Q1, Q3	63, 75.750	54.037, 69.285	55, 70.790	
Female	35 (61.4%)	315 (57.2%)	350 (57.6%)	0.538
Ethnicity				0.728
Hispanic	2 (3.5%)	27 (4.9%)	29 (4.8%)	
Non-Hispanic	54 (94.7%)	506 (91.8%)	560 (92.1%)	
Prefer not to answer	1 (1.8%)	18 (3.3%)	19 (3.1%)	
BMI				0.002
Median	31.140	29.200	29.495	
Q1, Q3	28.998, 36.580	25.522, 33.733	25.726, 33.976	
Education				0.793
Less than high school	2 (3.6%)	15 (2.7%)	17 (2.8%)	
High school diploma or GED	21 (37.5%)	217 (39.7%)	238 (39.5%)	
2-yr college	12 (21.4%)	97 (17.7%)	109 (18.1%)	
4-yr college	11 (19.6%)	110 (20.1%)	121 (20.1%)	
Postcollege	8 (14.3%)	100 (18.3%)	108 (17.9%)	
Prefer not to answer	2 (3.6%)	8 (1.5%)	10 (1.7%)	
Workers' compensation	0 (0.0%)	27 (4.9%)	27 (4.4%)	0.195
Employment				**<0.001**
Employed and working	9 (16.4%)	235 (44.1%)	244 (41.5%)	
Employed but not working	1 (1.8%)	30 (5.6%)	31 (5.3%)	
Unemployed	45 (81.8%)	268 (50.3%)	313 (53.2%)	
Attending school	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Hx of major surgery	5 (8.8%)	65 (11.8%)	70 (11.5%)	0.496

GED = general equivalency degree; Hx = history.
Boldface type indicates statistical significance. Some totals vary because of missing data.

TABLE 3. Analysis of comorbidities and clinical characteristics between patients discharged to home and those with nonroutine discharge

Characteristic	Nonroutine Discharge, n = 57	Home Routine, n = 551	Total, N = 608	p Value
Diabetes	15 (26.3%)	86 (15.7%)	101 (16.6%)	**0.039**
Osteoporosis	4 (7.0%)	34 (6.2%)	38 (6.2%)	0.801
Dominant symptom				0.424
Back dominant	17 (29.8%)	213 (38.7%)	230 (37.8%)	
Leg dominant	14 (24.6%)	117 (21.2%)	131 (21.5%)	
Back same as leg	26 (45.6%)	221 (40.1%)	247 (40.6%)	
Motor deficit	13 (22.8%)	126 (22.9%)	139 (22.9%)	0.986
Ambulation				**<0.001**
Independent	42 (73.7%)	495 (89.8%)	537 (88.3%)	
With an assistive device	12 (21.1%)	53 (9.6%)	65 (10.7%)	
Wheelchair bound	3 (5.3%)	3 (0.5%)	6 (1.0%)	
Symptom duration				0.867
≤3 mos	2 (3.5%)	13 (2.4%)	15 (2.5%)	
>3 mos	53 (93.0%)	518 (94.0%)	571 (93.9%)	
Unknown	2 (3.5%)	20 (3.6%)	22 (3.6%)	
NRS back pain baseline				0.163
Median	8	7	7	
Q1, Q3	6.5, 9	5, 9	5, 9	
NRS leg pain baseline				0.278
Median	7	7	7	
Q1, Q3	6, 9	5, 9	5, 9	
ODI baseline				**0.014**
Median	51	46	46.667	
Q1, Q3	42.000, 62.125	34.389, 58	36, 60	
EQ-5D baseline				**0.010**
Median	0.437	0.597	0.597	
Q1, Q3	0.308, 0.708	0.358, 0.708	0.333, 0.708	

Boldface type indicates statistical significance.

Statistical Analysis

We summarized continuous variables using medians with interquartile ranges (IQRs) and categorical variables using frequencies with proportions. In order to identify predictors of nonroutine discharge, we fitted a multivariable logistic regression model after adjusting for age, BMI, sex, insurance status, education status, employment status at the time of surgery, dominant symptom, length of stay, coronary artery disease, diabetes, anxiety, depression, osteoporosis, baseline ODI score, EQ-5D score, NRS back and leg scores, ambulation status, symptom duration, ASA score, and presence of any complication. Complications included intraoperative complications such as durotomy and also those within 30 days, including deep venous thrombosis/pulmonary embolism, myocardial infarction, urinary tract infection, surgical site infection, hematoma, cerebrovascular accident, new neurological deficit, and pneumonia. Moreover, we also analyzed the absolute importance of each covariate in the model in predicting patient satisfaction by using an importance metric defined as Wald chi-square test penalized by the predictor degrees of freedom.[17] According to this method, the higher the metric, the more importance a variable has in predicting the outcome. Finally, acknowledging the heterogeneity of practices in place in different institutions for patients undergoing decompression alone and those undergoing fusion, we performed subgroup multivariable regression analyses for these two subsets separately. The analysis was performed using R 3.3.1 (R Foundation for Statistical Computing; https://www.R-project.org) and the "rms" package, whereas optimal cutoff points for continuous variables found to be predictive of nonroutine discharge were calculated using the package "OptimalCutpoints." The p values were 2-tailed and were considered significant at < 0.05.

Results

A total of 608 patients with lumbar grade I spondylolisthesis undergoing either 1- or 2-level decompression (23%, n = 140) or 1-level decompression and fusion (77%, n = 468) met the inclusion criteria. Among these, 90.6% (n = 551) were discharged to home (home routine: 85.4%, n = 519; home with home healthcare: 5.3%, n = 32), whereas 9.4% (n = 57) had a nonroutine discharge (postacute or

TABLE 4. Analysis of operative characteristics and perioperative outcomes between patients discharged to home and those with nonroutine discharge

Characteristic	Nonroutine Discharge, n = 57	Home Routine, n = 551	Total, N = 608	p Value
ASA				**0.002**
Normal healthy patient	0 (0.0%)	23 (4.4%)	23 (3.9%)	
Mild systemic disease	20 (35.7%)	303 (57.5%)	323 (55.4%)	
Severe systemic disease	35 (62.5%)	196 (37.2%)	231 (39.6%)	
Severe systemic disease that is a constant threat to life	1 (1.8%)	5 (0.9%)	6 (1.0%)	
Surgical approach				0.739
Posterior only	54 (94.7%)	505 (91.8%)	559 (92.1%)	
Anterior only	1 (1.8%)	16 (2.9%)	17 (2.8%)	
Lateral only	1 (1.8%)	6 (1.1%)	7 (1.2%)	
2-stage	1 (1.8%)	23 (4.2%)	24 (4.0%)	
Group				0.710
Decompression alone	12 (21.1%)	128 (23.2%)	140 (23.0%)	
Decompression and fusion	45 (78.9%)	423 (76.8%)	468 (77.0%)	
Estimated blood loss in ml				**0.020**
Median	200	100	125	
Q1, Q3	100, 362	50, 250	50, 250	
Length of surgery in mins				0.940
Median	174	168	169	
Q1, Q3	131.750, 211.250	114, 222	115, 222	
Length of stay in days				**<0.001**
Median	4	2	3	
Q1, Q3	3, 5	1, 3	2, 4	
Any complication	8 (14.0%)	31 (5.6%)	39 (6.4%)	**0.014**

Boldface type indicates statistical significance.

nonacute-care setting: 8.7% [n = 53]; transferred to another acute-care facility: 0.7% [n = 4]) (Table 1).

Demographic Characteristics

Patients who had a nonroutine discharge were found to be older (71 [IQR 63–75.75] vs 62.6 [IQR 54–69.3], $p < 0.001$), had a slightly higher BMI (31.1 [IQR 29–36.6] vs 29.2 [IQR 25.5–33.7], $p = 0.002$), and were more likely to be unemployed at the time of surgery (81.8% [n = 45] vs 50.3% [n = 268], $p < 0.001$). We did not observe any difference in education status, ethnicity, and workers' compensation status. These results have been summarized in Table 2.

Baseline Clinical Characteristics, Comorbidities, and PROs

When compared to patients who were discharged to home, patients who had a nonroutine discharge were more likely to have diabetes (26.3% [n = 15] vs 15.7% [n = 86], $p = 0.039$) and were more likely to present with impaired ambulation (26.3% [n = 15] vs 10.1% [n = 56], $p < 0.001$). For PROs, patients who had a nonroutine discharge were more likely to have disability and poor quality of life, as is evident by the higher ODI at baseline (51 [IQR 42–62.12] vs 46 [IQR 34.4–58], $p = 0.014$) and lower EQ-5D scores (0.437 [IQR 0.308–0.708] vs 0.597 [IQR 0.358–0.708], $p = 0.010$), respectively. We did not observe any difference between the two groups in terms of presence of osteoporosis, dominant symptom at presentation, symptom duration, presence of motor deficit, and back and leg pain scores. These results are presented in Table 3.

Operative Characteristics and Perioperative Outcomes

Patients who experienced a nonroutine discharge had higher ASA scores (3 or 4: 64.3% [n = 36] vs 38.1% [n = 201], $p = 0.002$) and a longer length of stay (4 days [IQR 3–5] vs 2 days [IQR 1–3], $p < 0.001$). Patients who had a nonroutine discharge were also more likely to suffer a complication (14% [n = 8] vs 5.6% [n = 31], $p = 0.014$). We did not observe significant differences between the two groups in terms of surgical approach, fusion surgery, and operating time. These results have been summarized in Table 4.

Multivariable Analysis and Predictor Importance

On multivariable logistic regression, after adjusting for an array of patient-specific variables, older age (interquartile OR 9.14, 95% CI 3.79–22.1, $p < 0.001$), higher BMI (interquartile OR 2.04, 95% CI 1.31–3.25, $p < 0.001$), presence of depression (OR 4.28, 95% CI 1.96–9.35, $p < 0.001$),

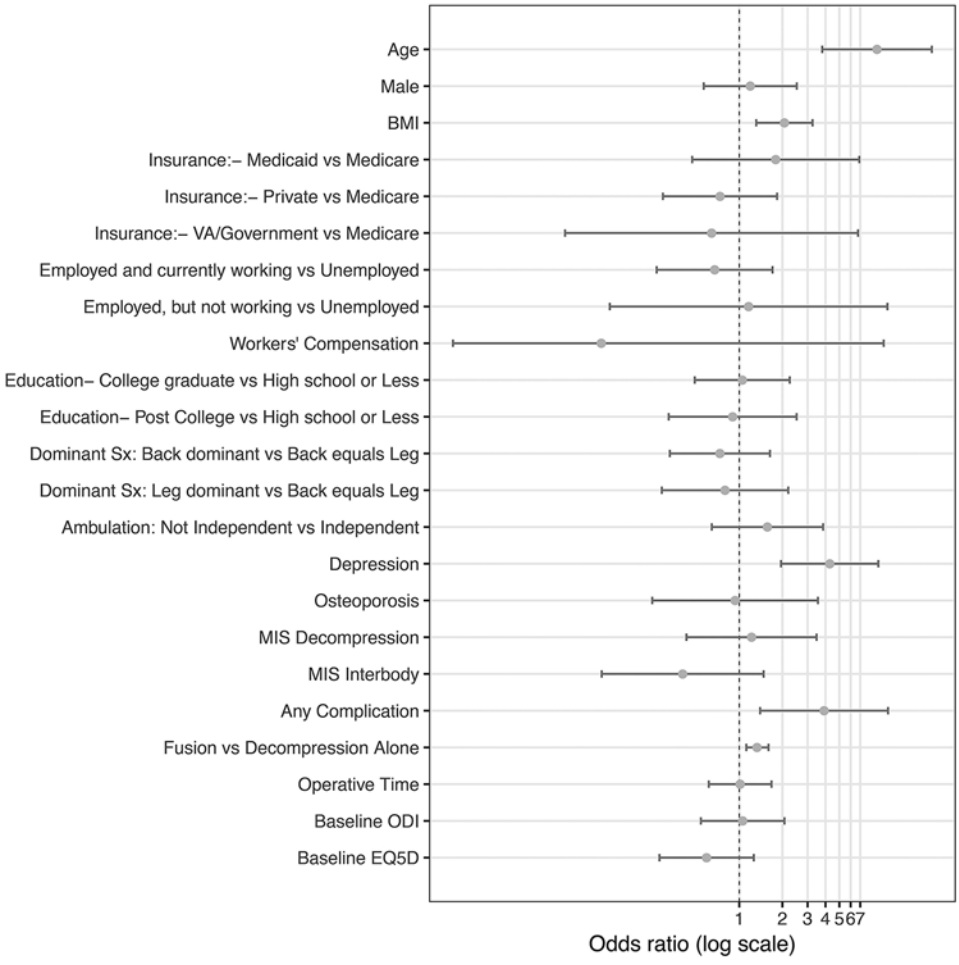

FIG. 1. Multivariable logistic regression model for factors associated with nonroutine discharge for all patients. MIS = minimally invasive surgery; Sx = symptom; VA = Veterans Affairs.

fusion surgery compared to decompression alone (OR 1.3, 95% CI 1.1–1.6), and any complication (OR 3.9, 95% CI 1.4–10.9, $p < 0.001$) were all found to be independently associated with higher odds of a nonroutine discharge (Fig. 1). Predictor importance revealed the most important predictors of nonroutine discharge to be 1) age (Wald χ^2 = 24.3, accounting for 35.7% of total Wald χ^2, $p < 0.001$); 2) depression (Wald χ^2 = 13.3, accounting for 19.5% of total Wald χ^2, $p = 0.0003$); 3) BMI (Wald χ^2 = 9.9, accounting for 14.5% of total Wald χ^2, $p = 0.0017$); and 4) any complication (Wald χ^2 = 6.7, accounting for 10% of total Wald χ^2, $p = 0.0094$). These results are summarized in Fig. 2. We also obtained optimal cutoff values for age and BMI, predicting a nonroutine discharge, for patients undergoing decompression alone and decompression and fusion separately. For patients undergoing decompression alone, we found the optimal age cutoff to be 74.2 years (area under the curve [AUC] 0.721, 95% CI 0.587–0.856) and the BMI cutoff to be 28.9 (AUC 0.683, 95% CI 0.53–0.848). For patients undergoing fusion, we found the age cutoff to be 73 years (AUC 0.701, 95% CI 0.622–0.781) and the BMI cutoff to be 28.9 (AUC 0.689, 95% CI 0.53–0.848).

We also performed a subgroup multivariable regression analysis for patients undergoing decompression alone and for those undergoing fusion separately. For patients undergoing decompression alone, we did not find any variable to be significantly associated with nonroutine discharge (Fig. 3). For patients undergoing fusion, we found older age (OR 7.9, 95% CI 2.9–19.3, $p < 0.001$), higher BMI (OR 2.16, 95% CI 1.3–3.6, $p < 0.001$), presence of depression (OR 4.9, 95% CI 2.05–12.03, $p < 0.001$), and any complication (OR 4.7, 95% CI 1.5–14.84, $p < 0.001$) to be significantly associated with nonroutine discharge (Fig. 4).

Discussion

As providers and hospitals transition toward a "value-based" healthcare system, it is important to implement policies that will help alleviate the financial burden by eliminating low-value practices. Nonroutine discharge is one such measure that has been identified as a significant driver of inpatient cost. Hence, we sought to investigate factors associated with nonroutine discharge for patients undergoing surgery for grade I spondylolisthesis.

We found that 9.4% (n = 57) of patients required a nonroutine discharge; these results are in agreement with previously published results from large multiinstitutional database studies,[20,26] as well as those from institutional stud-

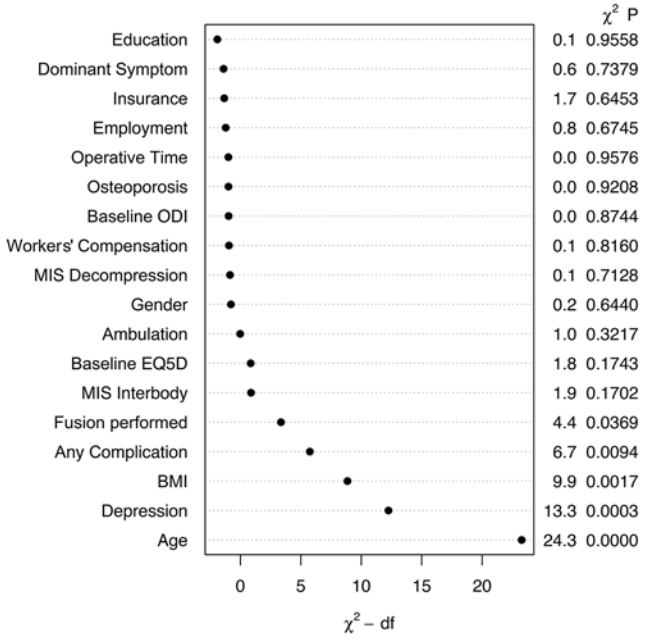

FIG. 2. Predictor importance figure for multivariable model. df = degrees of freedom.

ies.[19] We found that older patients were more likely to be discharged to an SNF or another acute-care facility, a finding that has previously been reported in other studies as well.[11,16,18,20,26,30] Older patients are more likely to have comorbid conditions, have declining physical function, are at a higher risk of operative complications, and are more likely to require longer recovery time after surgery.[11,36] Hence they may require postoperative care in a setting such as an SNF where they may be monitored closely for postoperative complications or deterioration. We also found patients with higher BMI to be at risk of a nonroutine discharge after surgery for grade I spondylolisthesis. This is also consistent with previously published results investigating discharge disposition after a lumbar surgery.[20] Karhade et al. investigated 26,364 patients undergoing elective lumbar surgery for degenerative disorders by using the National Surgical Quality Improvement Program (NSQIP) database and found that patients with higher BMI were more likely to be discharged to an SNF. We also found that patients with depression were more likely to have a nonroutine discharge. These results are consistent with those presented by Orhurhu et al., who investigated 115,976 patients with failed back surgery syndrome who had concurrent depres-

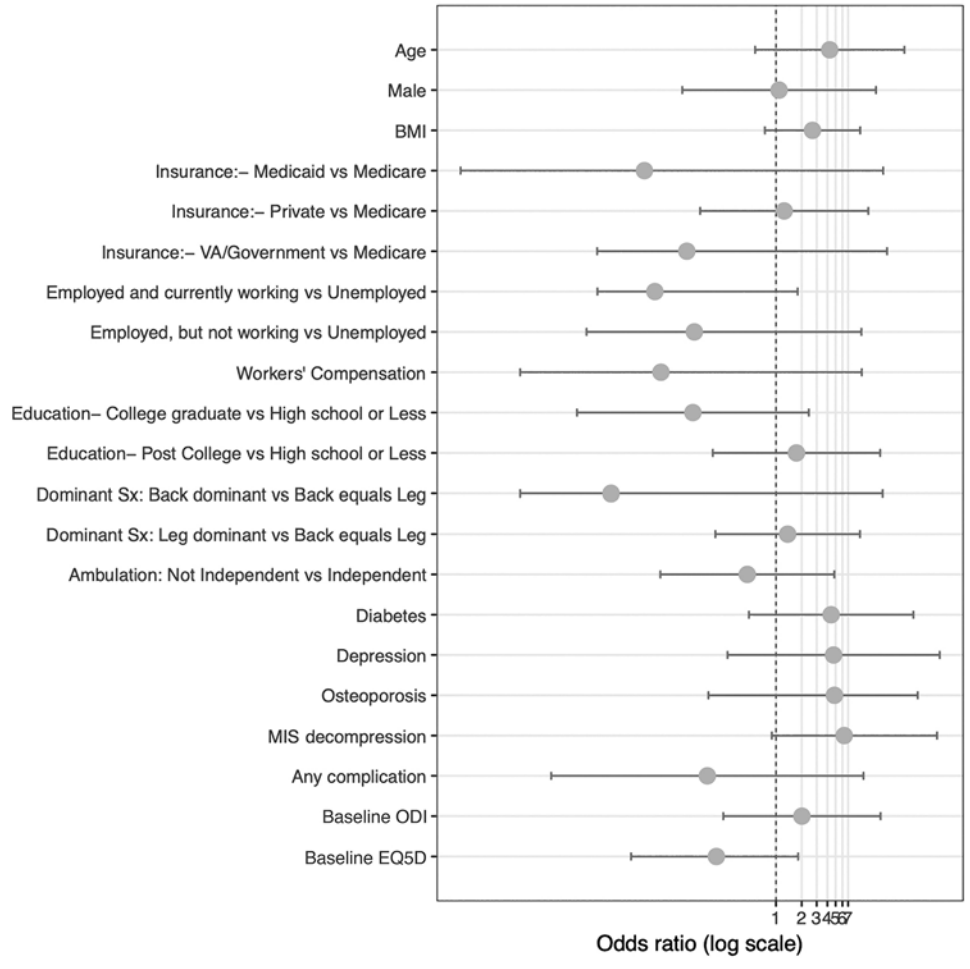

FIG. 3. Multivariable logistic regression model for factors associated with nonroutine discharge among patients undergoing decompression alone.

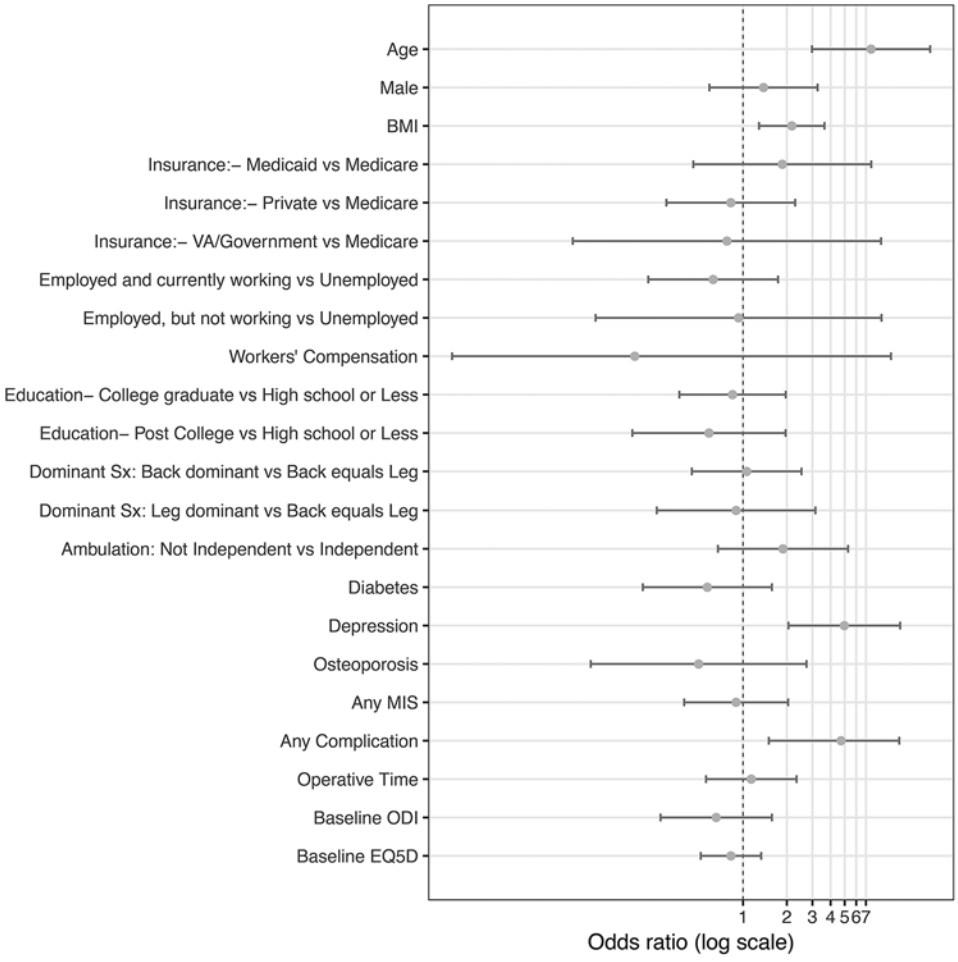

FIG. 4. Multivariable logistic regression model for factors associated with nonroutine discharge among patients undergoing decompression and fusion.

sion, and found that up to 40% of these patients were discharged to an SNF.[32] Additionally, Tanenbaum et al. investigated 8914 patients undergoing atlantoaxial fusion and found depression to be a predictor of adverse discharge.[35] We also found that fusion surgery was associated with higher odds of a nonroutine discharge compared to decompression alone. Our results agree with those presented by Drazin et al., who investigated patients undergoing surgery for spinal stenosis, disk herniation without myelopathy, or protrusion due to degeneration of spine or disc disorders, and found patients undergoing fusion to be more likely to be discharged to another facility.[13]

Our study is one of the largest on a homogeneous subset of patients with low-grade spondylolisthesis undergoing 1- to 2-level decompression and 1-level fusion in which predictors of nonroutine discharge were investigated. However, our study has some limitations. We could not assess the association of psychosocial factors such as living at home with spouse or children, social support, or median income with nonroutine discharge. These factors have previously been implicated as predictors of discharge to an SNF.[21,24] Moreover, although previous studies have corroborated the association between depression and adverse outcomes, we included patients with active depression or any history of depression. Therefore, it is unclear if a patient who is currently on medication for active depression is at higher risk of adverse outcomes compared to those with any history of depression.

Conclusions

We found that patients undergoing decompression or decompression and fusion for low-grade spondylolisthesis who were discharged to an SNF or another acute-care facility were older, had a higher BMI, were more likely to be unemployed, had depression, had impaired ambulation at presentation, had a poor quality of life, were more likely to have a higher ASA grade, had more blood loss, had longer operating times, had a longer length of stay, and were more likely to have an operative complication. Additionally, factors including older age, presence of psychological comorbidities such as depression, higher BMI, and presence of a complication were found to be associated with nonroutine discharge. As we move toward value-based healthcare and bundled-care payment models, it is important to identify patients at risk of being discharged to another facility so that their outcomes can be optimized appropriately.

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Disclosures

Dr. Bisson is a consultant for nView and MiRus, and also has direct stock ownership on those companies. She receives clinical or research support for the study described (includes equipment or material) from the Neurosurgery Research and Education Foundation (NREF). Dr. Chan receives non–study-related research support from Orthofix, Inc. Dr. Foley is a consultant for Medtronic; has direct stock ownership in Digital Surgery Systems, Discgenics, DuraStat, LaunchPad Medical, Medtronic, NuVasive, nView Medical, Practical Navigation/Fusion Robotics, SpineWave, TDi, and Triad Life Sciences; is a patent holder with Medtronic and NuVasive; and is a member of the board of directors of Digital Surgery Systems, Discgenics, DuraStat, LaunchPad Medical, nView Medical, Practical Navigation/Fusion Robotics, TDi, and Triad Life Sciences. Dr. Fu is a consultant for SI Bone, Globus, and Johnson & Johnson. Dr. Glassman is an employee of Norton Healthcare; is a consultant for K2M and Medtronic; is a patent holder with Medtronic, from which he receives royalties; and receives clinical or research support for the study described (includes equipment or material) from NuVasive. Dr. Haid has direct stock ownership in Globus Medical, NuVasive, Paradigm Spine, Spine Universe (Vertical Health), and SpineWave. He also receives royalties for IP; Globus Lateral and TLIF Interbody Implants; Medtronic Atlantis, Venture Anterior Plates; Medtronic Prestige ST and LP; NuVasive ALIF; Post Pedicle Screw Reline; and multiple textbooks. He sits on the board of directors for the AANS, Lumbar Spine Research Society, and NREF as well. Dr. Mummaneni is a consultant for DePuy Synthes, Globus, and Stryker; has direct stock ownership in Spinicity-ISD; receives clinical or research support for the study described (includes equipment or material) from NREF; receives support of a non–study-related clinical or research effort that he oversees from ISSG and AOSpine; receives honoraria from Spineart; and receives royalties from Thieme Publishing, Springer Publishing, and DePuy Synthes. Dr. Park is a consultant for Globus and NuVasive; receives royalties from Globus; and receives support of a non–study-related clinical or research effort that he oversees from Pfizer and Vertex. Dr. Potts is a patent holder with Medtronic. Dr. C. Shaffrey has direct stock ownership with NuVasive; is a patent holder with NuVasive, Medtronic, Zimmer Biomet, and SI Bone; and is a consultant for NuVasive, Medtronic, and SI Bone. Dr. Slotkin is a consultant for Medtronic and Stryker. Dr. Wang is a consultant for DePuy-Synthes Spine, K2M, Stryker, and Spineology; has direct stock ownership in ISD and Medical Devices Partners; and is a patent holder with DePuy-Synthes Spine.

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Conception and design: Mummaneni. Acquisition of data: Alvi. Analysis and interpretation of data: Alvi. Drafting the article: Mummaneni, Alvi, Chan, Guan, Biase, Strauss, Glassman, Foley, Slotkin, Potts, M Shaffrey, C Shaffrey, Haid, Fu, Wang, Park, Asher, Bisson. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Bydon. Statistical analysis: Alvi. Administrative/technical/material support: Bydon, Mummaneni. Study supervision: Bydon, Guan.

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