Original Article

Global Spine Journal
2018, Vol. 8(3) 266-272

DOI: 10.1177/2192568217717971
journals.sagepub.com/home/gsj

Predictors for Non-Home Patient Discharge Following Elective Adult Spinal Deformity Surgery

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Abstract

Study Design: Retrospective cohort study.

Objectives: Adult spinal deformity (ASD) surgery encompasses a wide variety of spinal disorders and is associated with a morbidity rate between 20% and 80%. The utilization of spinal surgery has increased and this trend is expected to continue. To effectively deal with an increasing patient volume, identifying variables associated with patient discharge destination can expedite placement and reduce length of stay.

Methods: The 2013-2014 American College of Surgeons National Surgical Quality Improvement Program database was queried using Current Procedural Terminology and International Classification of Diseases, Ninth Revision diagnosis codes relevant to ASD. Patients were divided based on discharge destination. Bivariate and multivariate logistic regression analyses were employed to identify predictors for patient discharge destination and hospital length of stay.

Results: A total of 4552 patients met inclusion criteria, of which 1102 (24.2%) had non-home discharge. Multivariate regression revealed total relative value unit (odds ratio [OR] = 1.01, 95% confidence interval [CI] = 1.00-1.01); female sex (OR = 1.54, 95% CI = 1.32-1.81); American Indian, Alaska Native, Asian, Native Hawaiian, or Pacific Islander versus black race (OR = 0.52, 95% CI = 0.35-0.78, *P* = .002); age ≥65 years (OR = 3.72, 95% CI = 3.19-4.35); obesity (OR = 1.18, 95% CI = 1.01-1.38, *P* = .034); partially/totally functionally dependent (OR = 2.11, 95% CI = 1.49-2.99); osteotomy (OR = 1.42, 95% CI = 1.12-1.80, *P* = .004) pelvis fixation (OR = 2.38, 95% CI = 1.82-3.11); operation time ≥4 hours (OR = 1.74, 95% CI = 1.47-2.05); recent weight loss (OR = 7.66, 95% CI = 1.52-38.65; *P* = .014); and American Society of Anesthesiologists class ≥3 (OR = 1.80, 95% CI = 1.53-2.11) as predictors of non-home discharge. *P* values were <.001 unless otherwise noted. Additionally, multivariate regression found non-home discharge to be a significant variable in prolonged length of stay.

Conclusions: The authors suggest these results can be used to inform patients preoperatively of expected discharge destination, anticipate patient discharge needs postoperatively, and reduce health care costs and morbidity associated with prolonged LOS.

Keywords

discharge destination, ASD, adult spinal deformity, rehabilitation, home, spinal fusion, deformity, length of stay, ACS-NSQIP, patient placement planning

Introduction

With prevalence rates as high as 60% in the elderly population,[1] adult spinal deformity (ASD) has become a common pathology that has the potential to greatly affect a patient's quality of life. Surgical treatment, which is indicated for patients with worsening neurological symptoms and sagittal malalignment, involves spinal decompression and restoration of global sagittal balance.[2,3] However, postoperative

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complication and revision rates remain high.[2,4] In fact, the United States Bone and Joint Initiative estimates nearly $50 billion in hospital discharge costs associated with ASD.[5] Advances in surgical and anesthetic techniques have made the option of ASD surgery available to a greater portion of the elderly population, a growing demographic in the United States.[6-8] This is evident by an increase in the annual number of discharges for spinal fusion procedures, which increased by 137% between 1998 and 2008.[9] In order to adapt to growing surgical volume, health care providers and administrators may find themselves obligated to minimize costs by streamlining discharges and reducing length of stay (LOS) in order to minimize third-party payer pressure. Patient discharge destination is closely related to hospital LOS. Although previous studies in ASD have identified patient comorbidities and intraoperative complications as risk factors for increased LOS,[10-12] bed availability at rehabilitation centers, insurance approval, and social support resources remain potential contributory factors for greater LOS. By identifying predictive factors for non-home patient discharge early, it may be possible to help mitigate associated discharge and LOS costs. Prior literature for predicting factors for non-home discharge exists, albeit sparsely, for other spinal surgeries,[13,14] but to the authors' knowledge, none have investigated this issue following ASD surgery. As such, this study seeks to identify preoperative and operative variables that are predictive of non-home discharge destination in ASD patients.

Materials and Methods

Data Source

This was a retrospective study of prospectively collected data in the 2013-2014 ACS-NSQIP (American College of Surgeons National Surgical Quality Improvement Program) database. ACS-NSQIP is a large national database with risk-adjusted 30-day postoperative morbidity and mortality outcomes. Over 500 hospitals that vary in size, socioeconomic location, and academic affiliation contributed data to the database.[15] ACS-NSQIP data is collected prospectively by dedicated clinical abstractors at each institution on more than 150 demographic, preoperative, intraoperative, and 30-day postoperative variables. The success of quality improvement initiatives based on ACS-NSQIP data have been validated in the Veterans Administration system and private sector.[16,17]

Inclusion Criteria

The NSQIP database from 2013 to 2014 was used in this study. Adult patients (≥18 years) undergoing spinal fusion for deformity were identified based on Current Procedural Terminology (CPT) codes 22800, 22802, 22804, 22808, 22810, 22812, 22818, and 22819. CPT codes 22843, 22844, 22846, and 22847 were also included to capture long, multilevel fusion constructs. Patients with CPT codes 22842 and 22845 were included if they had an International Classification of Diseases, Ninth Revision, diagnosis for spinal deformity (including 737.1, 737.2, 737.3, 737.4, 737.8, 737.9). CPT code descriptions are included in Table 1. Cases with missing preoperative data, emergency cases, patients with a wound class of 2, 3, or 4, an open wound on their body, current sepsis, current pneumonia, prior surgeries within 30 days, cases requiring cardiopulmonary resuscitation prior to surgery, any patients undergoing a nonelective procedure, or cases with diagnoses of cervical spine, trauma, or injury to spine, or neoplasm of spine were excluded in order to reduce the risk of confounding variables.

Table 1. Included Current Procedural Terminology (CPT) Codes With Description.

CPT	Description
22800 or 22842	Poster fusion and instrumentation: Up to 6 levels
22802 or 22843	Posterior fusion and instrumentation: 7-12 levels
22804 or 22844	Posterior fusion and instrumentation: 13 or more levels
22808 or 22845	Anterior fusion or instrumentation: 2-3 levels
22810 or 22846	Anterior fusion or instrumentation: 4-7 levels
22812 or 22847	Anterior fusion or instrumentation: 8 or more levels
22818 or 22819	Kyphectomy1-2 or ≥3 segments

Variable Definition

Patient demographic variables included sex, age (≥65 years), and race (white, black, Hispanic, and other). Other race included American Indian, Alaska Native, Asian, Native Hawaiian, Pacific Islander, or Unknown/Not Reported. Preoperative variables included obesity (≥30 kg/m^2), diabetes (non–insulin-dependent diabetes mellitus or insulin-dependent diabetes mellitus), current smoking (within 1 year of surgery), dyspnea (≤30 days prior to surgery), functional status prior to surgery (independent or partially/totally dependent ≤30 days prior to surgery), pulmonary comorbidity (ventilator dependent ≤48 hours prior to surgery or history of chronic obstructive pulmonary disease ≤30 days prior to surgery), cardiac comorbidity (use of hypertensive medication or history of chronic heart failure ≤30 days prior to surgery), renal comorbidity (acute renal failure ≤24 hours prior to surgery or dialysis treatment ≤2 weeks prior to surgery), steroid use for chronic condition (≤30 days prior to surgery), ≥10% loss of body weight (in the last 6 months), bleeding disorder (chronic, active condition), preoperative transfusion of ≥1 unit of whole/packed red blood cells (RBCs) (≤72 hours prior to surgery), and American Society of Anesthesiologists (ASA) physical status classification (≥3).

Intraoperative variables included operation year (2013-2014), fusion length (long fusion is ≥4 levels during an anterior approach and ≥7 levels during a posterior approach), surgical approach (anterior, posterior, or combined), pelvic fixation, osteotomy, intervertebral device, operative time (≥4 hours), and total relative value units (TRVUs). TRVU was used as a loose surrogate for surgical complexity as certain deformity cases such as those involving pedicle subtraction osteotomies or vertebral column resections are at greater risk for morbidity. Thirty-day postoperative outcome variables include mortality, any postoperative complication, LOS (≥5 days), wound complication (superficial or deep surgical site infection, organ space infection, or wound dehiscence), pulmonary complication (pneumonia, unplanned reintubation, or duration of ventilator-assisted respiration ≥48 hours), venous thromboembolism (pulmonary embolism or deep vein thrombosis), renal complication (progressive renal insufficiency or acute renal failure), urinary tract infection, cardiac complication (cardiac arrest requiring cardiopulmonary resuscitation or myocardial infarction), intra-/postoperative transfusion, sepsis, reoperation (related to initial procedure), and unplanned readmission (related to initial procedure). ACS-NSQIP provides further information on variable characteristics.[18]

Discharge destination is coded in the ACS-NSQIP database as follows: (1) skilled care, not home (eg, transitional care unit, subacute hospital, ventilator bed, skilled nursing home); (2) unskilled facility, not home (eg, nursing home or assisted facility—if not patient's home preoperatively); (3) facility which was home (eg, return to chronic care, unskilled facility, or assisted living, which was the patient's home preoperatively); (4) home; (5) separate acute care (eg, transfer to another acute care facility); and (6) rehab.[18] Patients were split up as 2 cohorts: those that were discharged home and those patients that were not discharged home. Destinations other than home included skilled and non-skilled care facility (which were not patient's home preoperatively), nursing homes, assisted living, and rehabilitation centers.

Statistical Analysis

Bivariate analyses were performed on patient demographic, preoperative, intraoperative, and postoperative characteristics using Pearson's χ^2 test. Fischer's exact test was used where appropriate. Multivariable logistic regression models were employed, adjusting for patient demographic, preoperative, and intraoperative variables, to identify risk factors for non-home patient discharge. Another multivariable logistic regression model was utilized to identify predictors for prolonged LOS. Both regression models utilized a stepwise entry and removal criteria, set to a significance level of .05. The *c*-statistic, which is the area under the receiver operating characteristic curve, was also retrieved from the multivariate logistic regression analysis and determined the accuracy of this model. SAS Studio Version 3.4 (SAS Institute Inc, Cary, NC) was used for all statistical analysis.

Results

Study Population

A total of 4552 patients met the inclusion criteria for the study, of which 3450 (75.8%) were discharged to home and 1102 (24.2%) were discharged to a destination other than home (Table 2). Of patients discharged to a destination other than home, 522 (47.4%) were discharged to a rehabilitation facility, 548 (49.7%) were discharged to a skilled care facility, and 32 (2.9%) were discharged to an "other" facility. Other includes an unskilled facility that was not home or separate acute care.

Patients discharged to destinations other than home were more likely to be female (66.0% vs 56.7%), of elderly age ≥65 years (64.3% vs 32.1%), obese (46.0% vs 42.2%, *P* = .025), diabetic (17.6% vs 14.2%, *P* = .005), be partially or fully functionally dependent (7.2% vs 2.5%), to use steroids (6.3% vs 4.3%, *P* = .010), have had recent weight loss (0.8% vs 0.1%), to have bleeding disorders (2.5% vs 1.2%, *P* = .002), to be ASA class ≥3 (69.6% vs 47.8%), and have cardiac (64.4% vs 52.0%) or pulmonary (7.3% vs 4.6%, *P* = .001) comorbidities. Operatively, these patients were also more likely to have an osteotomy (23.3% vs 10.1%), fusion to the pelvis (18.1% vs 4.3%), and operating times ≥4 hours (62.3% vs 40.5%). All *P* values were <.001 unless otherwise noted.

Unadjusted Analysis

There were statistically significant differences in 30-day unadjusted morbidities and mortality between these the 2 patient cohorts (Table 3). Patients discharged to a destination other than home had greater incidence of mortality (1.5% vs 0.1%), any complication (51.6% vs 21.0%), LOS ≥5 days (53.0% vs 16.6%), wound complications (3.8% vs 1.7%), pulmonary complications (5.4% vs 1.4%), venous thromboembolisms (3.5% vs 1.0%), renal complications (1.3% vs 0.1%), urinary tract infections (3.7% vs 1.3%), cardiac complications (1.5% vs 0.3%), intra-/postoperative RBC transfusion (45.2% vs 17.5%), postoperative sepsis (3.2% vs 0.9%), unplanned readmission (8.5% vs 5.0%), and reoperation (6.3% vs 2.9%). All *P* values were <.001 unless otherwise noted.

Multivariate Analysis

Multivariate logistic regression analysis (Table 4) revealed TRVU (odds ratio [OR] = 1.01, 95% confidence interval [CI] = 1.00-1.01), female sex (OR = 1.54, 95% CI = 1.32-1.81), other versus black race (OR = 0.52, 95% CI = 0.35-0.78, *P* = .002), age ≥65 years (OR = 3.72, 95% CI = 3.19-4.35), obesity (OR = 1.18, 95% CI = 1.01-1.38, *P* = .034), partially or totally dependent functional status (OR = 2.11, 95% CI = 1.49-2.99), osteotomy (OR = 1.42, 95% CI = 1.12-1.80, *P* = .004), fusion to pelvis (OR = 2.38, 95% CI = 1.82-3.11), operation time ≥4 hours (OR = 1.74, 95% CI = 1.47-2.05), recent weight loss (OR = 7.66, 95% CI = 1.52-38.65, *P* = .014), and ASA class ≥3 (OR = 1.80, 95% CI = 1.53-2.11) as predictors of non-home discharge. *P* values were <.001 unless otherwise noted. The *c*-statistic for this model was 0.77.

A second multivariate logistic regression model was fit to determine predictors for LOS ≥5 days (Table 5). The model identified diabetes (OR = 1.38, 95% CI = 1.10-1.72, *P* = .005), partially or totally dependent versus independent functional status (OR = 1.94, 95% CI = 1.34-2.82), long

Table 2. Bivariate Analysis of Patient Demographic, Preoperative, and Intraoperative Characteristics Following Elective ASD Surgery (N = 4552).

Category	Discharge Other Than Home (n)		Discharge Home (n)		*P* Value
	n	%	n	%	
Sex					
Female	727	66.0%	1957	56.7%	<.001
Male	375	34.0%	1493	43.3%	
Age ≥65 years	709	64.3%	1108	32.1%	<.001
Race					
White	904	82.0%	2792	80.9%	.576
Other	67	6.1%	245	7.1%	
Hispanic	40	3.6%	141	4.1%	
Black	91	8.3%	272	7.9%	
Obese	507	46.0%	1455	42.2%	.025
Functional status					
Partially or totally dependent	79	7.2%	88	2.6%	<.001
Independent	1023	92.8%	3362	97.4%	
Pulmonary comorbidity	80	7.3%	160	4.6%	.001
Cardiac comorbidity	710	64.4%	1793	52.0%	<.001
Renal comorbidity	7	0.6%	11	0.3%	.145
Diabetes	194	17.6%	489	14.2%	.006
Smoke	164	14.9%	813	23.6%	<.001
Steroid use	69	6.3%	150	4.3%	.010
Recent weight loss	9	0.8%	2	0.1%	<.001
Bleeding disorder	28	2.5%	42	1.2%	.002
Preoperative RBC transfusion	6	0.5%	7	0.2%	.064
ASA class ≥3	770	69.9%	1648	47.8%	<.001
Operation time ≥4 hours	686	62.3%	1400	40.6%	<.001
Operation year					
2013	540	49.0%	1573	45.6%	.048
2014	562	51.0%	1877	54.4%	
Osteotomy	257	23.3%	348	10.1%	<.001
Intervertebral device	416	37.7%	1556	45.1%	<.001
Fusion to Pelvis	199	18.1%	147	4.3%	<.001
Fusion length					
Long[a]	675	61.3%	2001	58.0%	.056
Short	427	38.7%	1449	42.0%	
Surgical approach					
Posterior	882	80.0%	1740	50.4%	<.001
Anterior	192	17.4%	1622	47.0%	
Combined	28	2.5%	88	2.6%	

Abbreviations: ASD, adult spinal deformity; RBC, red blood cell; ASA, American Society of Anesthesiologists.
[a]Long fusion is ≥4 levels during anterior approach and ≥7 levels during posterior approach.

versus short fusion length (OR = 1.67, 95% CI = 1.41-1.99), combined versus anterior surgical approach (OR = 2.53, 95% CI = 1.58-4.06), posterior versus anterior surgical approach (OR = 2.07, 95% CI = 1.68-2.54), osteotomy (OR = 1.86, 95% CI = 1.49-2.32), fusion to pelvis (OR = 2.00, 95% CI = 1.51-2.64), operation time ≥4 hours (OR = 2.89, 95% CI = 2.43-3.45), cardiac comorbidity (OR = 0.84, 95% CI = 0.71-1.00, *P* = .049), renal comorbidity (OR = 7.02, 95% CI = 2.17-22.69, *P* = .001), preoperative RBC transfusion (OR = 5.48, 95% CI = 1.39-21.65, *P* = .015), ASA class ≥3 (OR = 1.39, 95% CI = 1.17-1.65), and non-home discharge (OR = 3.74, 95% CI = 3.15-4.43). *P* values were <.001 unless otherwise noted. The *c*-statistic for this model was 0.82.

Discussion

This retrospective analysis of the 2013-2014 ACS-NSQIP database identified several risk factors for patient discharge to a facility other than home following elective ASD surgery. Identified factors for non-home discharge were increasing TRVU, female sex, American Indian, Alaska Native, Asian, Native Hawaiian, or Pacific Islander versus black race, ≥65 years of age, obesity, partially or totally functionally dependent, osteotomy, pelvis fixation, operation time ≥4 hours, recent weight loss, and ASA class ≥3. ACS-NSQIP is a well-established database in the surgical literature and contains preoperative, intraoperative, and 30-day postoperative patient data from over 500 medical centers across the United States.[17-20] The success

Table 3. Bivariate Analysis of 30-Day Postoperative Outcomes Following Elective ASD Surgery (N = 4552).

	Discharge Other Than Home		Discharge Home		
Category	n	%	n	%	*P* Value
Mortality	17	1.5%	2	0.1%	<.001
Any complication	569	51.6%	725	21.0%	<.001
Length of stay ≥5 days	584	53.0%	572	16.6%	<.001
Wound complication	42	3.8%	59	1.7%	<.001
Pulmonary complication	59	5.4%	49	1.4%	<.001
Venous thromboembolism	40	3.6%	36	1.0%	<.001
Renal complication	14	1.3%	5	0.1%	<.001
Urinary tract infection	41	3.7%	44	1.3%	<.001
Cardiac complication	17	1.5%	12	0.3%	<.001
Intra-/postoperative RBC transfusion	498	45.2%	603	17.5%	<.001
Sepsis	35	3.2%	30	0.9%	<.001
Unplanned readmission (related to initial procedure)	94	8.5%	173	5.0%	<.001
Reoperation (related to initial procedure)	69	6.3%	101	2.9%	<.001

Abbreviations: ASD, adult spinal deformity; RBC, red blood cell.

Table 4. Predictors for Non-Home Discharge Following Elective ASD (N = 4555; *c*-statistic = 0.7714).

Variable	Odds Ratio	Lower Confidence Limit	Upper Confidence Limit	*P* Value
Total RVU	1.01	1.00	1.01	<.001
Male vs female sex	1.54	1.32	1.81	<.001
Race				
Hispanic vs Black	0.73	0.46	1.17	.198
Other vs Black	0.52	0.35	0.78	.002
White vs Black	0.76	0.58	1.01	.055
Age ≥65 years	3.72	3.19	4.35	<.001
Obese	1.18	1.01	1.38	.034
Partially/totally dependent vs independent functional status	2.11	1.49	2.99	<.001
Osteotomy	1.42	1.12	1.80	.003
Fusion to pelvis	2.38	1.82	3.11	<.001
Operation time ≥4 hours	1.74	1.47	2.05	<.001
Recent weight loss	7.66	1.52	38.65	.014
ASA class ≥3	1.80	1.53	2.11	<.001

Abbreviations: ASD, adult spinal deformity; RVU, relative value unit; ASA, American Society of Anesthesiologists.

Table 5. Predictors for LOS ≥5 days in Patients Undergoing Elective ASD Surgery (N = 4552; *c*-statistic = 0.8249).

Variable	Odds Ratio	Lower Confidence Limit	Upper Confidence Limit	*P* Value
Diabetes	1.38	1.10	1.72	.005
Partially or totally dependent vs independent functional status	1.94	1.34	2.82	<.001
Long vs short fusion length	1.67	1.41	1.99	<.001
Combined vs anterior approach	2.53	1.58	4.06	<.001
Posterior vs anterior approach	2.07	1.68	2.54	<.001
Osteotomy	1.86	1.49	2.32	<.001
Fusion to pelvis	2.00	1.51	2.64	<.001
Operation time ≥4 hours	2.89	2.43	3.45	<.001
Cardiac comorbidity	0.84	0.71	1.00	.049
Renal comorbidity	7.02	2.17	22.69	.001
Preoperative RBC transfusion	5.48	1.39	21.65	.015
ASA class ≥3	1.39	1.17	1.65	<.001
Non-home discharge	3.74	3.15	4.43	<.001

Abbreviations: LOS, length of stay; ASD, adult spinal deformity; RBC, red blood cell; ASA, American Society of Anesthesiologists.

of quality improvement initiatives based on ACS-NSQIP data has been validated in the Veterans Administration system and private sector.[16,17] To our knowledge, this is the first large cohort analysis using a national database to identify predictors for patient discharge in the ASD surgery population.

Approximately 5 million adults in the United States are disabled to some degree from spine-related disorders.[7] The number of surgical candidates is expected to increase as advances in surgical and anesthetic techniques make the option of surgery available to a larger population of patients. Therefore, efficient planning of patient discharge may be a contributory factor to improving patient satisfaction and hospital flow.[21] Discharge to a destination other than home may also be a surrogate for higher degrees of patient illness,[22] which was observed from the presence of significantly greater postoperative morbidity in these patients. On the other hand, these postoperative complications may have risen in the care facilities that were not previously the patient's home where, for example, health care teams may not know the details of a patient's medical history.[23,24]

In an analysis of 15 092 patients undergoing lumbar spine fusion, Aldebeyan et al identified female gender, advanced age, body mass index ≥35, diabetes, congestive heart failure, hypertension, ASA class >1, multilevel surgery, operation time ≥259 minutes, postoperative morbidity, and nonelective surgery to be significant factors for requiring an inpatient admission to a facility other than home.[13] The results of the present analysis support the findings of Aldebeyan et al while also contributing new factors significantly associated with discharge destination in the ASD surgery population. In the present analysis, the identified predictors for discharge destination can be separated based on their interventional capacities, for example, as modifiable or nonmodifiable variables. Modifiable patient risk factors can be actively addressed by a patient and their surgeon before surgery in order to mitigate postoperative risk, whereas nonmodifiable risk factors set a patient's baseline predisposition and ideally can be identified by the health care team early. Potentially modifiable predictive variables for patient discharge include TRVU, body mass index, functional status, use of osteotomy, pelvic fixation, operation time, and recent weight loss. Nonmodifiable variables include sex, race, age, and possibly ASA class. Physicians should consider a patient's constellation of modifiable and nonmodifiable factors when initiating patient placement.

There may be a relationship between patient discharge destination and hospital LOS. LOS following any surgical procedure is of great importance to health care system expenditure and a patient's sense of well-being.[12,13] At baseline, it costs approximately US$1000 to keep a patient in the hospital per day.[12,13,25] Patients discharged to a destination other than home were more likely to experience a LOS ≥5 days (53.0% vs 16.6%). A multivariate logistic regression model revealed patients discharged to a destination other than home had a 3.74 greater odds of hospital LOS ≥5 days (Table 5). Unfortunately, the ACS-NSQIP database does not provide an explanation for a patient's extended hospital stay or clinical reasoning behind patient discharge destination, making the direction of causality between LOS and discharge destination unclear. The direction of causality likely changes on a case-by-case basis, yet our results suggest that patients may experience an extended hospital LOS due to delays associated with non-home discharge. Brasel et al found that delays in discharge, which led to extended hospital stays, were predominantly linked to lack of beds in rehabilitation centers.[13,26] They defined delayed discharge as a patient discharged ≥1 day following medical clearance and timely discharge as a patient discharged on the same day as medical clearance.[26] Additionally, their analysis showed that patients who experienced a delayed discharge incurred $15 000 more in hospital costs in comparison to patients who were discharged in a timely manner.[26] Another plausible explanation is that patients who had more extensive surgeries (eg, osteotomies, long fusions extending to the pelvis, etc) were more likely to stay in the hospital longer and needed extra recuperation time at a monitored facility other than home later on. Furthermore, patients who had more preoperative medical comorbidities (ASA class ≥3) would have required more supervision and assistance postoperatively and, therefore, would be more fitting to be discharged to a rehab or skilled nursing facility.

There are several limitations that must be addressed in this work. Because the ACS-NSQIP database classifies cases based on CPT codes, differences between procedural techniques cannot be accounted for in this study. Adjustment for more surgery-specific variables, such as type of osteotomy used and type of spinal deformity, were unable to be performed. TRVU was used as a loose surrogate for surgical complexity in an attempt to control for those cases where patients underwent technically demanding osteotomies such as pedicle subtraction or vertebral column resections. Although it offers a large patient size, ACS-NSQIP overrepresents academic medical centers and therefore is less able to fully represent all US hospitals. The ACS-NSQIP database does not include non-US hospitals, thus potentially limiting the applicability of the findings to non-US centers. However, the variables identified in the analysis are commonly used variables that can be assessed in any patient. Contributing hospital is kept anonymous, limiting the ability to adjust for institution size, patient volume, academic affiliation, and surgeon experience. Additionally, long-term complications are not captured in the NSQIP database, leading to a potential underestimation of risk. Finally, a major limitation of this study is due to its retrospective nature, which limits the ability to determine the direction of causality. For example, it is unclear whether a postoperative complication occurred in the hospital following surgery or at the patient's final destination. The authors are unable to include the occurrence of postoperative complications in the multivariate logistic regression models, which could potentially influence a patient's overall LOS and disposition, thus introducing a potential confounding bias.

Despite these limitations, this is the first national study of predictors for patient discharge to a facility other than home following elective ASD surgery. Identified predictors include increasing TRVU, female sex, American Indian, Alaska Native, Asian, Native Hawaiian, or Pacific Islander versus black race, ≥65 years of age, obesity, partially or totally functionally dependent, osteotomy, pelvis fixation, operation time ≥4 hours, recent weight loss, and ASA class ≥3. Additionally, the study evaluated predictive factors for prolonged hospital LOS and found discharge destination to be a significant variable. The authors suggest there is a potential for the results of this study be used by health care teams to inform patients preoperatively of expected discharge disposition, anticipate patient discharge needs postoperatively, and reduce health care costs and morbidity associated with prolonged LOS.

Authors' Note

This study was qualified as exempt by the Mount Sinai Hospital Institutional Review Board.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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