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Tobacco Use Is Associated With Increased 90-Day Readmission Among Patients Undergoing Surgery for Degenerative Spine Disease

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Abstract

Study Design: Retrospective database study.

Objective: Tobacco use is associated with complications after surgical procedures, including poor wound healing, surgical site infections, and cardiovascular events. We used the Nationwide Readmissions Database (NRD) to determine if tobacco use is associated with increased 30- and 90-day readmission among patients undergoing surgery for degenerative spine disorders.

Methods: Patients who underwent elective spine surgery were identified in the NRD from 2010 to 2014. The study population included patients with degenerative spine disorders treated with discectomy, fusion, or decompression. Descriptive and multivariate logistic regression analyses were performed to identify patient and hospital factors associated with 30- and 90-day readmission, with significance set at P value $<.001$.

Results: Within 30 days, 4.8% of patients were readmitted at a median time of 9 days. The most common reasons for 30-day readmission were postoperative infection (12.5%), septicemia (3.5%), and postoperative pain (3.0%). Within 90 days, 7.3% were readmitted at a median time of 18 days. The most common reasons for 90-day readmission were postoperative infection (9.6%), septicemia (3.5%), and pneumonia (2.3%). After adjustment for patient and hospital characteristics, tobacco use was independently associated with readmission at 90 days (odds ratio 1.05, 95% confidence interval 1.03-1.07, $P < .0001$) but not 30 days (odds ratio 1.02, 95% confidence interval 1.00-1.05, $P = .045$).

Conclusions: Tobacco use is associated with readmission within 90 days after cervical and thoracolumbar spine surgery for degenerative disease. Tobacco use is a known risk factor for adverse health events and therefore should be considered when selecting patients for spine surgery.

Keywords

complications, discectomy, fusion, hospital, laminectomy, readmission, smoking, spine surgery, tobacco

Introduction

Cigarette smoking is a leading problem in public health that impacts an estimated 34.3 million adults in the United States.[1,2] Increasing evidence has shown that tobacco use results in worse outcomes after surgery, and studies have sought to characterize the effect of tobacco use on perioperative morbidity and mortality.[3,4] Such complications have been demonstrated in both institutional and database studies in a number of surgical disciplines, including general,[5] plastic,[5,6] head and neck,[7] orthopedic,[8,9] and cardiac.[10] Within cranial neurosurgery, tobacco use has been associated with increased intraoperative

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blood loss and wound complications.[11,12] Furthermore, in the spine literature, tobacco use has been associated with increased rates of pseudoarthrosis, infection, and wound complications.[13-16]

Readmission is an important measure of patient outcome and hospital performance, and hospitals maybe be penalized for higher-than-average readmission rates through the Hospital Readmission Reduction Program (HRRP).[17] Accordingly, increasing attention has been paid to understand factors associated with readmission and to develop strategies to reduce readmission. Studies examining readmission after spine surgery have previously identified comorbid conditions, older age, and postoperative complications[18-23] as factors associated with readmission.

This study used the Nationwide Readmissions Database (NRD) from 2010 to 2014 to measure 30- and 90-day readmission rates and identify factors related to readmission after degenerative spine surgery. We examined whether tobacco use was independently associated with readmission after adjusting for patient and hospital factors.

Methods

Database

This is a retrospective study utilizing the NRD, a nationally representative database that is maintained through the Healthcare Cost and Utilization Project. The NRD includes data on approximately 50% of all hospitalizations and readmissions in the United States. Each patient in the NRD has a unique identifier link that is used to determine patient hospitalizations and discharges within a calendar year. The NRD was queried from 2010 to 2014. The study period was selected to include the last 5 years of International Classification of Diseases, Diagnosis, and Procedure codes (ICD-9-CM, ICD-9-PCS), prior to the transition to ICD-10 in 2015. Institutional review board approval was not required for this review.

Study Population

Patients aged 18 and older who underwent elective decompression, discectomy, or fusion for cervical or thoracolumbar degenerative spine diseases were included in the study. Patients were identified using ICD-9 diagnosis and procedure codes (Table 1), in accordance with other studies.[24] Patients with traumatic injuries or nondegenerative spine diseases were excluded. Patients who died during index hospitalization were excluded. Patients with missing data for survival or length of stay were also excluded. To allow for sufficient follow-up time, patients discharged in January to November were included in the 30-day readmission cohort; patients discharged in January to September were included in 90-day readmission cohort. As such, fewer patients are represented in the latter group. For patients with multiple readmissions in the study period, only the first nonelective readmission was studied.

Table 1. ICD-9 Diagnosis and Procedure Codes.

ICD-9 diagnosis codes
721.0: Cervical spondylosis without myelopathy
721.1: Cervical spondylosis with myelopathy
721.3: Lumbosacral spondylosis without myelopathy
721.41: Spondylosis with myelopathy, thoracic region
721.42: Spondylosis with myelopathy, lumbar region
722.0: Displacement of cervical intervertebral disc without myelopathy
722.10: Displacement of lumbar intervertebral disc without myelopathy
722.11: Displacement of thoracic intervertebral disc without myelopathy
722.4: Degeneration of cervical intervertebral disc
722.51: Degeneration of thoracic or thoracolumbar intervertebral disc
722.52: Degeneration of lumbar or lumbosacral intervertebral disc
722.71: Intervertebral disc disorder with myelopathy, cervical region
722.72: Intervertebral disc disorder with myelopathy, thoracic region
722.73: Intervertebral disc disorder with myelopathy, lumbar region
722.81: Postlaminectomy syndrome, cervical region
723.0: Spinal stenosis in cervical region
723.1: Cervicalgia
723.4: Brachial neuritis or radiculitis NOS
723.7: Ossification of posterior longitudinal ligament in cervical region
724.2: Lumbago
738.2: Acquired deformity of neck
738.4: Acquired spondylolisthesis
ICD-9 procedure codes
80.50: Excision or destruction of intervertebral disc, unspecified
80.51: Excision of intervertebral disc
81.00: Spinal fusion, not otherwise specified
81.01: Atlas-axis spinal fusion
81.02: Other cervical fusion of the anterior column, anterior technique
81.03: Other cervical fusion of the posterior column, posterior technique
81.04: Dorsal and dorsolumbar fusion of the anterior column, anterior technique
81.05: Dorsal and dorsolumbar fusion of the posterior column, posterior technique
81.06: Lumbar and lumbosacral fusion of the anterior column, anterior technique
81.07: Lumbar and lumbosacral fusion of the posterior column, posterior technique
81.08: Lumbar and lumbosacral fusion of the anterior column, posterior technique
81.31: Refusion of atlas-axis spine
81.32: Refusion of other cervical spine, anterior column, anterior technique
81.33: Refusion of other cervical spine, posterior column, posterior technique
81.34: Refusion of dorsal and dorsolumbar spine, anterior column, anterior technique
81.35: Refusion of dorsal and dorsolumbar spine, posterior column, posterior technique
81.36: Refusion of lumbar and lumbosacral spine, anterior column, anterior technique
81.37: Refusion of lumbar and lumbosacral spine, posterior column, posterior technique
81.38: Refusion of lumbar and lumbosacral spine, anterior column, posterior technique
81.62: Fusion or refusion of 2-3 vertebrae
81.63: Fusion or refusion of 4-8 vertebrae
03.09: Other exploration and decompression of spinal canal

Abbreviation: ICD-9, International Classification of Diseases, 9th Revision.

Patient and Hospital Variables

Patient and hospital variables available in the database were chosen to include in the model based on relevant risk factors previously associated with readmission after spine surgery.

Patient demographic factors included gender (male, female), patient age (18-44, 45-59, 60-74, or ≥75 years old), primary insurance type (Medicare, Medicaid, private insurance, self-pay, no-charge, other), median household income (0-25, 26-50, 51-75, 76-100 percentile), length of stay (0-1, 2, 3-4, ≥5 days), and discharge disposition (routine, short-term hospital, transfer, home health care, against medical advice).

In addition, patient comorbidities previously associated with readmission or poor surgical outcomes were identified using the NRD or ICD-9 codes and included presence of Elixhauser comorbidity (yes, no), presence of a medical or neurological complication during initial hospitalization (intracerebral hemorrhage [431 998.11-12], seizures [345.xx], neurological complications after procedure [997.01 997.09]), tobacco use (305.1, V15.82), obesity (278.0, V85.3-V85.4), steroid use (V58.65), systemic inflammatory response syndrome (995.9x, 785.52), chronic lung disease, ventilator dependence (V46.1x), history of chemotherapy (V58.11, V87.41), diabetes (250.xx), and hypercoagulable state (289.81). Hospital variables included procedure volume (>/<90th percentile), hospital bed size (small, medium, large), hospital location (urban, rural), and teaching status (teaching, nonteaching).

Statistical Analysis

Descriptive statistics were used to characterize patient and hospital factors. These factors were then included in a multivariate logistic regression analysis to determine which of these were associated with 30- and 90-day readmissions. Generalized Estimation Equation was used to account for hospital clustering. We used odds ratios (ORs) and 95% confidence intervals (CIs) to report these results, with statistical significance defined as $P < .001$. Statistical analyses were performed using SAS 9.4 (SAS Inc).

Results

Study Population

A total of 703 051 patients were identified in the 90-day model who underwent surgery for degenerative disease of the cervical or thoracolumbar spine (Table 2). Surgery for degenerative disease of the thoracolumbar spine comprised the majority of operations (61.5%). Overall, 29.0% of patients were tobacco users.

The overall readmission rate was 4.8% within 30 days and 7.3% within 90 days. The most common reasons for readmission were postoperative infection (12.5% and 9.6% of primary readmission diagnoses, respectively), septicemia (3.5% and 3.5%, respectively), and pneumonia (2.4% and 2.3%, respectively; Table 3).

Tobacco Use Is Associated With 90-Day Readmission

After adjustment for patient- and hospital-level factors, tobacco use was independently associated with increased likelihood of readmission within 90 days (OR 1.05, 95% CI 1.03-1.07,

Table 2. Demographics for Readmission Within 90 Days.

Characteristic	Tobacco use (n = 203 323)	Total (n = 703 051)	P
Anatomic location, n (%)			
Cervical	83 753 (41.2)	270 361 (38.5)	<.0001
Thoracolumbar	119 570 (58.8)	432 690 (61.5)	
Age, n (%)			
18-44	43 319 (21.3)	138 397 (19.7)	<.0001
45-59	82 142 (40.0)	253 887 (36.1)	
60-74	62 663 (30.8)	235 885 (33.6)	
≥75	15 199 (7.5)	74 882 (10.7)	
Gender, n (%)			
Male	109 573 (53.9)	344 007 (48.9)	<.0001
Female	93 750 (46.1)	359 044 (51.1)	
Primary insurance, n (%)			
Medicare	73 640 (36.2)	263 447 (37.5)	<.0001
Medicaid	18 610 (9.2)	42 425 (6.0)	
Private insurance	78 662 (38.7)	297 726 (42.3)	
Self-pay	3932 (1.9)	9715 (1.4)	
No charge	667 (0.3)	1537 (0.2)	
Other	27 266 (13.4)	85 831 (12.2)	
Missing	546 (0.3)	2370 (0.3)	
Median household income[a], n (%)			
0-25 percentile	51 890 (25.5)	159 106 (22.6)	<.0001
26-50 percentile	53 361 (26.2)	169 459 (24.1)	
51-75 percentile	51 471 (25.3)	181 858 (25.9)	
76-100 percentile	42 920 (21.1)	179 555 (25.5)	
Missing	3681 (1.8)	13 073 (1.9)	
Elixhauser comorbidity, n (%)			
Yes	144 640 (71.1)	476 031 (67.7)	<.0001
No	58 683 (28.9)	227 020 (32.3)	
Diabetes, n (%)			
Yes	35 393 (17.4)	126 410 (18.0)	<.0001
No	167 930 (82.6)	576 641 (82.0)	
Chronic lung disease, n (%)			
Yes	45 666 (22.5)	106 219 (15.1)	<.0001
No	157 657 (77.5)	596 832 (84.9)	
Obesity, n (%)			
Yes	722 (0.4)	2762 (0.4)	.0012
No	202 601 (99.6)	700 289 (99.6)	
Hypercoagulable state, n (%)			
Yes	412 (0.2)	1461 (0.2)	.54
No	202 911 (99.8)	701 590 (99.8)	
Steroid use, n (%)			
Yes	2124 (1.0)	6038 (0.9)	<.0001
No	201 199 (99.0)	697 013 (99.1)	
History of chemotherapy, n (%)			
Yes	491 (0.2)	1313 (0.2)	<.0001
No	202 832 (99.8)	701 738 (99.8)	
Venous thromboembolism, n (%)			
Yes	5174 (2.5)	17 170 (2.4)	.0004
No	198 149 (97.5)	685 881 (97.6)	
Hospital bed size, n (%)			
Small	21 231 (10.4)	79 498 (11.3)	<.0001
Medium	49 235 (24.2)	169 530 (24.1)	
Large	132 857 (65.3)	454 023 (64.6)	
Hospital teaching status, n (%)			
Teaching	116 155 (57.1)	386 203 (54.9)	<.0001
Nonteaching	87 168 (42.9)	316 848 (45.1)	

(continued)

Table 2. (continued)

Characteristic	Tobacco use (n = 203 323)	Total (n = 703 051)	P
Hospital volume, n (%)			
>90th percentile	79 351 (39.0)	265 715 (37.8)	<.0001
≤90th percentile[b]	123 972 (61.0)	437 336 (62.2)	
SIRS criteria, n (%)			
Yes	775 (0.4)	2930 (0.4)	.003
No	202 548 (99.6)	700 121 (99.6)	
Medical complication, n (%)			
Yes	3096 (1.5)	11 466 (1.6)	<.0001
No	200 227 (98.5)	691 585 (98.4)	
Neurological complication, n (%)			
Yes	5508 (2.7)	16 691 (2.4)	<.0001
No	197 815 (97.3)	686 360 (97.6)	
Disposition, n (%)			
Routine	154 762 (76.1)	527 273 (75.0)	<.0001
Short-term hospital	697 (0.3)	2810 (0.4)	
Transfer	16 576 (8.2)	65 308 (9.3)	
Home health care	30 945 (15.2)	106 929 (15.2)	
Against medical advice	334 (0.2)	676 (0.1)	
Missing	DS[c]	55 (0.0)	
Index length of stay, n (%)			
0-1 days	70 896 (34.9)	244 466 (34.8)	<.0001
2 days	40 746 (20.0)	139 056 (19.8)	
3-4 days	53 817 (26.5)	188 437 (26.8)	
≥5 days	37 864 (18.6)	131 092 (18.6)	

[a]For patient's ZIP code, based on current year.
[b]A total of 652 procedures/year.
[c]Data suppressed for patient confidentiality.

Table 3. Primary Diagnoses for 30- and 90-Day Readmission.

ICD-9 diagnosis	30 Days, n (%); N = 40 841	90 Days, n (%); N = 51 473
998.59 Postoperative infection	5090 (12.5)	4959 (9.6)
038.9 Septicemia	1431 (3.5)	1821 (3.5)
338.18 Acute postoperative pain	1230 (3.0)	1200 (2.3)
998.12 Hematoma complicating a procedure	1220 (3.0)	1090 (2.1)
486 Pneumonia	970 (2.4)	1065 (2.1)
415.19 Pulmonary embolism and infarction	942 (2.3)	1051 (2.0)
998.13 Seroma complicating a procedure	931 (2.3)	980 (1.9)
599.0 Urinary tract infection	736 (1.8)	958 (1.9)
584.9 Acute renal failure	704 (1.7)	893 (1.7)
722.10 Lumbar disc displacement	677 (1.7)	846 (1.6)

Abbreviation: ICD-9, International Classification of Diseases, 9th Revision.

$P < .0001$). Tobacco use did not meet our preset threshold for significance at 30 days (OR 1.02, 95% CI 1.00-1.05, $P = .045$; Table 4).

Other comorbidities associated with readmission included older age, male gender, chronic lung disease, diabetes, obesity, venous thromboembolism, hypercoagulability, steroid use, and history of chemotherapy. Insurance other than Medicaid was associated with decreased readmission. Hospitalization factors included SIRS criteria, medical complications, neurological complications, increased index length of stay, and disposition other than routine were associated with increased readmission, while smaller hospital bed size was associated with decreased readmission.

Discussion

This study leveraged the NRD from 2010 to 2014 to investigate tobacco use and other factors associated with 30-day and 90-day readmissions following cervical and thoracolumbar degenerative spine surgery. In this cohort, 4.8% and 7.3% of patients were readmitted within 30 and 90 days, respectively. After adjusting for common causes of readmission, tobacco use was independently associated with readmission within 90 days but not 30 days based on our preset threshold for significance. Postoperative complications including infection contributed to readmissions.

Readmission rates in this study were similar to those reported in other studies for patients undergoing spine surgery. A previous NRD study from January to September 2013 reported a 30-day readmission rate of 5.4% and a 90-day readmission rate of 10% for patients following elective posterior cervical spine surgery for degenerative conditions.[25] Additional studies have estimated 30-day readmission rates between 3.2% and 12.9% and 90-day readmission rates between 5.6% and 12.7%.[13,19-22,26-29] This study is the first to isolate the effect of tobacco use on readmission among spine patients.

Surprisingly, prior retrospective studies in specific subsets of patients have failed to find an association between tobacco use and readmission. For example, a single-institution analysis of 839 patients undergoing elective complex spinal fusion did not find an association between tobacco use and readmission.[26] Similarly, there was no association between tobacco use and readmission in 2207 patients undergoing surgery for spinal tumors.[19] Last, a study of 2761 patients readmitted within 90 days following spine surgery for degenerative disease found no association in multivariable analysis.[28] These studies differ from the current study in that the sizes of the cohorts were smaller, which may explain the difference.

Postoperative complications such as infection, septicemia, and pain were the most common reasons for readmission in this study. Tobacco use is a known risk factor for these adverse health events. Tobacco use has been shown to increase surgical site infections following spine surgery.[15,30-33] The same trend has been noted in additional surgical specialties.[6-8,10] When investigating all surgeries, tobacco use has been associated with increased rates of sepsis and 30-day mortality.[32] Given these reports, it is surprising that there was not a clear relationship between tobacco use and 30-day readmission in this study. Nonetheless, studies have suggested that factors intrinsic to tobacco use may contribute to delayed wound healing and increased risk of infection. For example, nicotine induces

Table 4. Summary of Associations with 30- and 90-Day Readmission.

	30-Day readmission		90-Day readmission	
Characteristic	OR (95% CI)	*P*	OR (95% CI)	*P*
Tobacco use	1.02 (1.00-1.05)	.045	1.05 (1.03-1.07)	<.0001
Age				
18-44	Ref		Ref	
45-59	1.05 (1.02-1.09)	.004	1.05 (1.02-1.08)	.0024
60-74	1.11 (1.07-1.15)	<.0001	1.05 (1.01-1.09)	.0097
≥75	1.25 (1.19-1.31)	<.0001	1.22 (1.17-1.27)	<.0001
Female gender	0.90 (0.88-0.91)	<.0001	0.90 (0.89-0.92)	<.0001
Primary insurance				
Medicare	0.83 (0.80-0.87)	<.0001	0.83 (0.79-0.86)	<.0001
Medicaid	Ref		Ref	
Private insurance	0.60 (0.57-0.63)	<.0001	0.55 (0.53-0.58)	<.0001
Self-pay	0.81 (0.73-0.89)	<.0001	0.78 (0.72-0.85)	<.0001
No charge	0.92 (0.75-1.13)	.42	1.01 (0.84-1.21)	.95
Other	0.61 (0.58-0.64)	<.0001	0.55 (0.53-0.58)	<.0001
Elixhauser comorbidity	1.23 (1.20-1.27)	<.0001	1.25 (1.21-1.28)	<.0001
Chronic lung disease	1.21 (1.18-1.24)	<.0001	1.27 (1.24-1.30)	<.0001
Diabetes	1.25 (1.22-1.28)	<.0001	1.27 (1.25-1.30)	<.0001
Obesity	1.31 (1.13-1.52)	.0004	1.21 (1.06-1.38)	.0053
Venous thromboembolism	1.52 (1.44-1.59)	<.0001	1.51 (1.45-1.58)	<.0001
Hypercoagulable state	1.25 (1.06-1.48)	.0095	1.32 (1.12-1.55)	.0009
Steroid use	1.37 (1.26-1.50)	<.0001	1.47 (1.35-1.59)	<.0001
History of chemotherapy	1.47 (1.24-1.74)	<.0001	1.64 (1.41-1.91)	<.0001
SIRS criteria	1.41 (1.28-1.55)	<.0001	1.55 (1.41-1.70)	<.0001
Medical complication	1.39 (1.32-1.47)	<.0001	1.47 (1.40-1.54)	<.0001
Neurological complication	1.40 (1.34-1.47)	<.0001	1.44 (1.38-1.51)	<.0001
Index length of stay				
0-1 days	Ref		Ref	
2 days	1.34 (1.29-1.39)	<.0001	1.30 (1.26-1.34)	<.0001
3-4 days	1.53 (1.48-1.58)	<.0001	1.44 (1.39-1.48)	<.0001
≥5 days	2.41 (2.32-2.50)	<.0001	2.32 (2.25-2.40)	<.0001
Disposition				
Routine	Ref		Ref	
Short-term hospital	2.33 (2.05-2.73)	<.0001	2.43 (1.15-2.74)	<.0001
Transfer	1.74 (1.69-1.80)	<.0001	1.90 (1.84-1.95)	<.0001
Home health care	1.23 (1.20-1.27)	<.0001	1.23 (1.19-1.27)	<.0001
Against medical advice	2.66 (2.17-3.27)	<.0001	2.36 (1.93-2.90)	<.0001
Hospital bed size				
Small	0.88 (0.82-0.94)	.0002	0.87 (0.81-0.93)	<.0001
Medium	0.97 (0.94-1.00)	.051	0.95 (0.92-0.98)	.0006
Large	Ref		Ref	

Abbreviations: OR, odds ratio; CI, confidence interval; SIRS, systemic inflammatory response syndrome.

vasoconstriction and tissue hypoxia, disrupting angiogenesis, and cigarette smoke impairs neutrophil and monocyte migration and chemotaxis.[26,34] A retrospective study leveraging the National Surgical Quality Improvement (NSQI) database from 2012 to 2014 found that surgical site infections were the most common cause for readmission after spine surgery.[20] Tobacco use thus likely contributes to readmissions by increasing the risk and incidence of infection.

Smokers also exhibit poorer outcomes, increased postoperative pain, and decreased satisfaction following spinal surgery.[35,36] Two years following surgery for lumbar spine stenosis, smokers had a higher Owestry Disability Index (a marker of inferior quality of life), increased leg and back pain, and decreased walking ability compared to nonsmokers.[35] This suggests that long-term outcomes in smokers are also affected.

Some studies with smaller sample sizes have failed to identify an association between tobacco use status and postoperative complications. A retrospective study of patients following spinal fusion found no difference in 30-day complication rates including pain, wound dehiscence, and wound drainage in smokers compared to nonsmokers.[26] A study utilizing the NSQI from 2006 to 2010 found no association between tobacco use and major complications after elective spine surgery, but patients who were current smokers with more than 60 pack-year histories were more likely to die within 30 days of surgery.[37] This suggests that the adverse effects of tobacco use

may to some extent be dose dependent. Unfortunately, the NRD does not stratify details of tobacco use such as pack-year history.

It has long been advocated that smoking cessation should be encouraged prior to spine surgery. Studies have suggested that up to 75% of tobacco users who undergo surgery have the desire to quit.[3,38] Patients who quit tobacco use after surgery for longer than 6 months following spinal fusion had decreased rates of nonunion and increased patient satisfaction and return to work rates compared to those who continued to smoke.[39,40] In one orthopedic study, preoperative smoking intervention 6 to 8 weeks before surgery, including cessation counseling and nicotine replacement therapy, was associated with decreased postoperative complication rates in patients undergoing hip or knee alloplasty.[41] Across surgical specialties, one meta-analysis found that preoperative tobacco use cessation was associated with a 41% risk reduction of postoperative complications.[42]

Limitations

This retrospective study utilized the NRD, which is subject to coding errors and information bias. The NRD may underestimate true readmission rates, as it only contains data on patients who were readmitted in the same state. In addition, this study is limited by the ICD-9 diagnosis and procedure codes available through the NRD. To overcome this limitation, we included numerous diagnoses and surgical procedures in this study to ensure a heterogeneous group of patients undergoing degenerative spine surgery were included in the analysis. As a result of this, conclusions cannot be drawn regarding the effects of tobacco use on specific spine surgeries and patient conditions. Relatedly, the lack of granularity on surgical details precludes the specific study of factors such as surgical time and incision size which are related to complication rates. Additionally, due to the transition in ICD coding between the 9th and 10th editions, our analysis does not include the most recent years (2015-2017) of NRD data.

As both current and former tobacco users were included in this study, the effect of tobacco use cessation cannot be quantified by this type of analysis. Given that pre- and postoperative smoking cessation have been shown to decrease rates of postoperative complications, it is possible that the effect of tobacco use on rates of readmission may be even higher in active smokers. Finally, this study did not separately assess the use of e-cigarettes. More study is warranted for this increasingly prevalent condition.

Conclusions

This study identified tobacco use as a modifiable risk factor for readmission after elective spine surgery for degenerative conditions. These data be used to aid in patient selection and perioperative planning.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr Mack—Consultant: Rebound Therapeutics, Viseon Imperative Care, Q'Apel, Medtronic, Stryker, Stream Biomedical, Spartan Micro; Investor: Cerebrotech, Endostream, Viseon, Rebound, Q'Apel, and Spartan Micro. Dr Liu—Viseon (consultancy). The authors declare no additional disclosures or conflicts of interest related to this work.

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