The Impact of Provider Volume on the Outcomes After Surgery for Lumbar Spinal Stenosis

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BACKGROUND: Investigation into the provider volume-outcomes association for patients undergoing spine surgery has been limited.

OBJECTIVE: To examine the impact of surgeon and hospital volume on the outcomes after decompression with or without fusion for lumbar spinal stenosis.

METHODS: Data from the Nationwide Inpatient Sample (2005-2008) were retrospectively extracted. Multivariate logistic regression analyses were performed to calculate the adjusted odds of in-hospital mortality and the development of a postoperative complication with increasing surgeon or hospital volume. Provider volume was evaluated continuously and categorically, divided by percentiles into quintiles. Very-low-volume surgeons performed < 15 procedures over 4 years. All analyses were adjusted for differences in patient age, sex, comorbidities, and primary payer, as well as hospital bed size, teaching status, and location (urban vs rural).

RESULTS: A total of 48 971 admissions were examined. In-hospital mortality did not differ significantly with increasing provider volume. When examined continuously, greater surgeon volume was associated with a significantly lower adjusted odds of developing a complication (odds ratio, 0.72; 95% confidence interval, 0.65-0.78; $P <$ .001). Patients who underwent surgery by very-low-volume surgeons (odds ratio, 1.38; 95% confidence interval, 1.19-1.60; $P = .001$), but not those treated by low-, medium-, or high-volume surgeons, had a significantly higher complication rate compared with those who underwent surgery by very high-volume surgeons. After adjustment for surgeon volume, hospital volume was not significantly associated with in-hospital mortality or complications.

CONCLUSION: In this nationwide study, patients treated by very-low-volume surgeons had a significantly higher complication rate compared with those treated by very high-volume surgeons.

KEY WORDS: Hospital volume, Lumbar decompression, Lumbar fusion, Lumbar spinal stenosis, Nationwide Inpatient Sample, Provider volume, Surgeon volume

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Since the publication of the landmark article in 1979 by Luft et al[1] first describing the volume-outcomes association, several studies have found that increased provider volume—both surgeon and hospital volume—is associated with superior outcomes.[2-53] The correlation of better outcomes with greater volume has been described for a number of high-risk surgeries, including craniotomy,[4-6,9] transphenoidal surgery for pituitary lesions,[8] ventriculoperitoneal shunt operations,[7] carotid endarterectomy,[46-48,54] coronary artery bypass grafting,[3] and abdominal or genitourinary surgeries.[2,10-12,14] Although the mechanisms responsible for the volume-outcomes association are unclear, it is not surprising that increased procedural performance may lead to better outcomes. However, some studies suggest that the volume-outcome association may not be applicable to more common operations for which the mortality and complication rates are comparatively low.[14] Moreover, other variables, including patient factors and adherence

ABBREVIATIONS: CI, confidence interval; **ICD-9-CM,** International Classification of Diseases, 9th revision, clinical modification; **NIS,** Nationwide Inpatient Sample; **OR,** odds ratio to quality measures, may be stronger predictors of outcomes than volume.[17,18,20,24,25,34-36,43,45]

Spinal stenosis describes a spinal canal that has a diminished caliber with resultant compression of neural structures,[54-61] and patients who are symptomatic despite conservative therapy may benefit from surgery.[62-67] Despite the prevalence of lumbar spinal stenosis, investigation into the volume-outcomes association for spine surgery has been limited.[16] We report the first nationwide study examining the independent effects of both surgeon and hospital volume with in-hospital mortality, complications, length of hospital stay, total charges, and discharge disposition in patients with lumbar spinal stenosis who undergo lumbar decompression with or without fusion.

PATIENTS AND METHODS

Data Source

Data were retrospectively extracted from the Nationwide Inpatient Sample (NIS; Agency for Healthcare Research and Quality, Healthcare Cost, and Utilization Project) from 2005 to 2008. The largest all-payer national inpatient database, the NIS is a 20% stratified sample of all nonfederal hospitals in which the stratification is based on hospital characteristics: region, location, teaching status, ownership, and size. The NIS has been used extensively to evaluate patients undergoing spine surgery.[68-73]

Inclusion Criteria

Patients with lumbar spinal stenosis who underwent spine surgery were included. The *International Classification of Diseases*, 9th revision, clinical modification (ICD-9-CM) diagnosis code 724.02 was used to identify patients with lumbar spinal stenosis. The ICD-9-CM procedure codes were used to extract patients who had undergone decompression (03.09) or fusion (81.06, 81.07, and 81.08) of the lumbar spine. To minimize misclassification, only those who had spine surgery as 1 of the first 3 coded procedures were included. The initial data set had 87 304 patients. Admission type is coded as (1) elective or (2) nonelective: those admitted nonelectively were excluded (n = 3939) because some emergent spine surgeries may be performed by surgeons who rarely perform other spinal operations.

Patient and Hospital Characteristics

Independent variables, including patient age, sex, comorbidities, expected primary payer, and the proportion of patients who underwent fusion, as well as hospital teaching status, bed size, and location (urban vs rural), were extracted. Comorbidities were assessed by evaluating the independent effect of the comorbidities defined by Elixhauser et al[74]; however, paralysis and other neurological deficits were not included because of their association with spinal disease. Expected primary payer is coded in the NIS as (1) Medicare, (2) Medicaid, (3) private insurance, (4) self-pay, (5) no charge, and (6) other. Those with an unknown expected primary payer were excluded (n = 85). Some outcomes may vary depending on whether patients underwent a fusion or decompression alone; thus, analyses were adjusted for the proportion of patients who underwent a fusion (81.06, 81.07, and 81.08). Hospital teaching status, bed size, and location are directly encoded in the NIS.

Because 100% of discharges from sampled hospitals are included in the NIS, the database can be used to quantify provider volume. Surgeon volume and hospital volume were determined from the identification number for the primary attending physician and hospital, respectively. Surgeon volume and hospital volume were first assessed as a continuous variable. As a result of the positive skew of both surgeon volume and hospital volume, they were logarithmically transformed before analysis. For consistency with prior publications,[10] both surgeon volume and hospital volume were also evaluated as categorical variables and divided into quintiles based on the percentile of the number of procedures performed during the entire 4-year period, which were defined as very low, low, medium, high, and very high volume. Fifteen states in the NIS do not report an identification number for the primary attending physician; because imputation of volume is unlikely to be accurate, data from these states were not included (n = 33 681).

Outcomes

The outcomes evaluated were in-hospital mortality, development of at least 1 complication, length of hospital stay, total hospital charges, and discharge disposition. Postoperative complications were extracted by use of ICD-9-CM codes for postoperative neurological complications (997.00-997.09); pulmonary complications (518.5, 518.81, 518.84, 997.3); venous thromboembolic events (415.11-415.19, 453.40-453.42, 453.8, 453.9); cardiac complications (997.1, 410); urinary and renal complications (584.5, 584.9, 997.5); gastrointestinal complications (008.45, 560.1, 997.4); infectious complications, including a wound infection (998.32, 998.51, 998.59, 998.6, 998.81, 998.83), urinary tract infection (595.0, 595.9, 599.0), meningitis (320), or pneumonia (481, 482, 486); and incidental durotomies (349.3).

Total hospital charges, which exclude professional fees, are reported by the NIS. Discharge disposition is classified into (1) routine, (2) transfer to a short-term hospital, (3) other transfer, (4) home health care, (5) against medical advice, (6) died, and (7) unknown. A nonroutine discharge was defined as any disposition other than the first category.

Statistical Analysis

Descriptive statistics were conducted for demographic and hospital variables. Multivariate logistic regression models were constructed for categorical variables, and multivariate linear regression was performed to analyze length of hospital stay and total hospital charges. As a result of the positive skew of length of hospital stay and total hospital charges, logarithmic transformation was performed; after logarithmic transformation, the Shapiro-Wilk test was used to evaluate whether normality was met (data not shown). All regression analyses were adjusted for patient and hospital characteristics. Moreover, to determine the independent effect of surgeon and hospital volume, analyses of surgeon volume were performed after adjustment for hospital volume (measured categorically), and analyses of hospital volume were performed after adjustment for surgeon volume. Statistical analyses were performed with STATA 11 (Stata Corp, College Station, Texas). All regression analyses were performed accounting for the survey design of the NIS (using SVY commands), which includes hospital clustering and the weight of each discharge. A value of $P < .05$ was accepted as significant.

RESULTS

Demographics of the Study Population

A total of 48 971 admissions were included, and patients were divided into quintiles based on the total number of procedures performed by a surgeon, so that each quintile had approximately 20% of the total study population (Table 1). Likewise, patients were divided into quintiles based on hospital volume. The median number of operations for lumbar spinal stenosis performed by a surgeon over the 4-year period was 36 (interquartile range, 17-69) and at a hospital was 164 (interquartile range, 81-292). The cutoff values for the number of surgeries in the quintiles for a surgeon were very low (< 15), low (15-28), medium (29-47), high (48-81), and very high (> 81) volume. Likewise, the cutoff values for the number of operations in the quintiles for a hospital were as follows: very low (< 68), low (68-129), medium (129-208), high (209-394), and very high (> 394) volume.

Surgeon Volume

Increasing surgeon volume was not associated with a significantly different adjusted odds of in-hospital death (odds ratio [OR], 0.62; 95% confidence interval [CI], 0.34-1.13; P = .12). Additionally, when evaluated as a categorical variable, surgeon volume was not significantly associated with in-hospital mortality (Table 2). Increasing surgeon volume was associated with a significantly lower adjusted odds of the development of at least 1 complication (OR, 0.72; 95% CI, 0.65-0.78; $P < .001$) but not of a significantly different odds of a nonroutine discharge (OR, 0.87; 95% CI, 0.76-1.01; P = .07). The unadjusted proportion of patients who developed at least 1 complication was highest among patients treated by a very-low-volume surgeon (11.6%) and lowest among patients treated by a very-high-volume surgeon (8.6%; Figure). The adjusted odds of the development of at least 1 postoperative complication were significantly lower for patients treated by a low-, medium-, high-, or very-high-volume surgeon compared with those treated by a very-low-volume surgeon (Table 2). Compared with those treated by a very-high-volume surgeon, only patients treated by very-low-volume surgeons (OR, 1.38; 95% CI, 1.19-1.60; P = .001), but not those treated by low-volume (OR, 1.17; 95%

TABLE 1. Demographics of the Patients With Lumbar Spinal Stenosis Who Underwent Lumbar Spine Surgery Divided Into Quintiles by Surgeon Volume

Characteristic	Total Study (n = 48 971), %	Very Low Volume (n = 10 246), %	Low Volume (n = 9404), %	Medium Volume (n = 10 000), %	High Volume (n = 9671), %	Very High Volume (n = 9650), %
Age, y						
<60	31.5	31.6	30.6	29.6	30.5	35.1
60-69	29.0	28.2	28.9	29.5	29.5	28.8
>69	39.6	40.2	40.5	41.0	39.9	36.1
Sex						
Male	46.5	46.4	47.1	45.8	46.1	46.9
Female	53.5	53.6	53.0	54.2	53.9	53.1
Comorbid disease, n						
0	22.2	21.8	21.8	22.3	21.8	23.5
1	31.1	30.9	30.4	31.5	31.0	32.0
2	25.9	25.7	26.7	26.0	26.4	24.6
≥3	20.8	21.7	21.2	20.2	20.8	19.9
Expected primary payer						
Medicare	54.0	54.2	54.3	55.9	55.6	50.1
Medicaid	2.1	3.2	2.2	2.3	1.7	1.3
Private insurance	37.2	35.3	37.3	35.5	37.2	41.0
Self-pay	0.6	1.2	0.5	0.5	0.3	0.3
No charge	0.1	0.1	0.1	0.1	0.0	0.0
Other	6.0	6.0	5.7	5.7	5.3	7.3
Hospital volume						
Very low	20.2	40.6	29.5	22.8	5.6	1.6
Low	19.8	22.4	26.9	23.2	18.8	7.8
Medium	20.1	17.3	20.8	18.6	25.6	18.3
High	19.9	11.8	14.9	23.5	31.4	18.0
Very high	20.0	7.9	7.9	11.9	18.6	54.3
Hospital bed size						
Small	16.3	13.2	17.1	13.6	10.4	27.5
Medium	20.7	26.7	22.6	16.5	17.4	20.1
Large	63.0	60.1	60.3	69.9	72.2	52.5
Teaching hospital	53.5	50.6	54.2	49.1	55.6	58.3
Urban hospital	94.8	94.1	96.6	96.5	94.2	92.7
Lumbar fusion	47.6	43.7	45.9	47.8	47.7	53.0

TABLE 2. The Association of Surgeon Volume (Divided Categorically Into Quintiles) With the Outcomes After Surgery for Lumbar Spinal Stenosis[a]

Surgeon Volume	In-Hospital Mortality	Postoperative Complications	Nonroutine Discharge
Very low (n = 10 246)			
Crude rate, %	0.2	11.6	32.0
Adjusted odds ratio (95% CI)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Low (n = 9404)			
Crude rate, %	0.1	10.0	32.5
Adjusted odds ratio (95% CI)	1.09 (0.55-2.18)	0.85 (0.75-0.96)[b]	1.03 (0.92-1.16)
P	.81	<.009	.60
Medium (n = 10 000)			
Crude rate, %	0.1	9.1	30.4
Adjusted odds ratio (95% CI)	0.69 (0.28-1.69)	0.77 (0.68-0.87)[b]	0.89 (0.77-1.03)
P	.42	<.001[b]	.11
High (n = 9671)			
Crude rate, %	0.1	8.8	28.1
Adjusted odds ratio (95% CI)	0.49 (0.19-1.25)	0.73 (0.64-0.83)[b]	0.83 (0.69-0.99)[b]
P	.14	<.001[b]	.04
Very high (n = 9650)			
Crude rate, %	0.1	8.6	28.3
Adjusted odds ratio (95% CI)	1.23 (0.45-3.36)	0.73 (0.62-0.84)[b]	0.93 (0.71-1.23)
P	.68	<.001[b]	.62
Area under the curve	0.86	0.70	0.75

[a]CI, confidence interval. All analyses are adjusted for differences in patient age, sex, comorbid disease, expected primary payer, hospital teaching status, hospital bed size, hospital location (urban vs rural), hospital volume of surgery for lumbar spinal stenosis, and proportion of patients who underwent fusion.
[b]Statistically significant difference.

CI, 0.99-1.38; P = .07), medium-volume (OR, 1.06; 95% CI, 0.89-1.18; P = .53), or high-volume (OR, 1.01; 95% CI, 0.86-1.18; P = .93) surgeons, had a significantly higher complication rate.

Increasing surgeon volume was associated with a significantly shorter length of hospital stay (−4.39%; 95% CI, −6.05 to −2.73; $P < .001$) and significantly lower total charges (−5.34%; 95% CI, −8.03 to −2.64; $P < .001$). Compared with those treated by a very-low-volume surgeon, those who underwent surgery by medium-, high-, and very-high-volume surgeons, but not those treated by low-volume surgeons, had a significantly shorter length of stay and significantly lower charges (Table 3). Compared with those who underwent surgery by a very-high-volume surgeon, only patients treated by a very-low-volume surgeon had a significantly longer length of hospital stay and significantly higher total hospital charges (data not shown).

Hospital Volume

After adjustment for increasing surgeon volume, the adjusted odds of in-hospital death (OR, 0.63; 95% CI, 0.36-1.12; P = .12), the development of at least 1 postoperative complication (OR, 1.07; 95% CI, 0.92-1.26; P = .39), and the likelihood of a nonroutine hospital discharge (OR, 0.85; 95% CI, 0.65-1.11; P = .24) were not significantly associated with hospital volume. Increasing hospital volume was also not associated with a significantly different length of hospital stay (0.66%; 95% CI, −2.33 to 3.66; P = .67) or total charges (3.97%; 95% CI, −1.03 to 8.96; P = .12).

Subgroup Analysis: Fusion

Because the outcomes of patients undergoing fusion of the lumbar spine may differ from the outcomes of those treated with decompression alone, subgroup analyses were performed for those treated with and without fusion. A total of 23 296 patients underwent lumbar fusion. Greater surgeon volume was not significantly associated with in-hospital mortality (OR, 0.57; 95% CI, 0.26-1.26; P = .17). For those undergoing fusion, increasing surgeon volume was associated with a significantly lower adjusted odds of developing a complication (OR, 0.77; 95% CI, 0.68-0.88; $P < .001$), a significantly shorter length of hospital stay (by −2.31%; 95% CI, −4.24 to −0.37; P = .02), and significantly lower total hospital charges (by −5.29%; 95% CI, −8.21 to −2.39; $P < .001$). However, surgeon volume was not associated with a significantly different odds of a nonroutine discharge (OR, 0.94; 95% CI, 0.79-1.12, P = .49).

Subgroup Analysis: Decompression Alone

A total of 25 675 patients underwent surgical decompression without fusion, and increasing surgeon volume was not significantly associated with in-hospital mortality (OR, 0.60; 95% CI, 0.23-1.53; P = .28). However, increasing surgeon volume was associated with a significantly lower adjusted odds of developing a postoperative complication (OR, 0.66; 95% CI, 0.59-0.75; $P < .001$), a shorter length of hospital stay (by −5.96%; 95% CI, −7.98 to −3.94; $P < .001$), a lower total

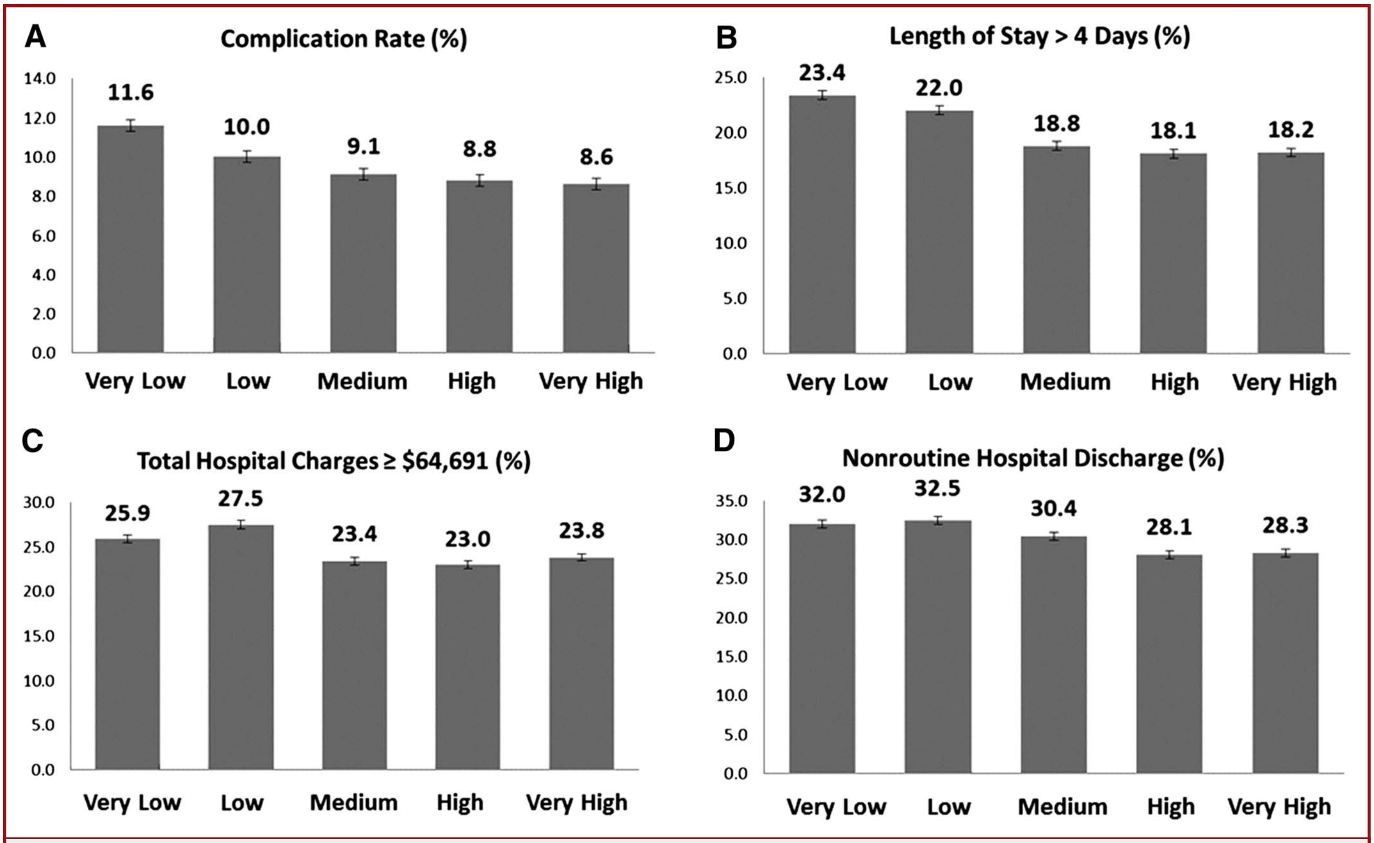

FIGURE. *The variation in the proportion of patients who developed at least 1 postoperative complication (**A**) and who had a nonroutine hospital discharge (**D**) is displayed graphically by quintile of surgeon volume. Additionally, differences in the proportion of patients who had a length of hospital stay > 4 days (**B**) or total charges greater than $64 691 (**C**), both of which are greater than the upper quartile of the interquartile range of the entire population, are shown by quintile of surgeon volume.*

charge (by −5.32%; 95% CI, −8.49 to −2.15; P = .001), and a lower adjusted odds of a nonroutine discharge (OR, 0.81; 95% CI, 0.69-0.94; P = .006).

DISCUSSION

In this nationwide study, 48 971 patients from across the United States were examined to evaluate the impact of provider volume on the outcomes after surgery for lumbar spinal stenosis. After adjustment for hospital volume, increasing surgeon volume was independently associated with significantly decreased rates of postoperative complications, a significantly shorter length of stay, and significantly lower charges. On the other hand, after adjustment for surgeon volume, increasing hospital volume was not associated with differential outcomes.

Although high-volume providers of relatively high-risk operations are frequently associated with large academic medical centers, in this study of a relatively common surgery, there were many notable features of high-volume surgeons. The majority of high- and very-high-volume surgeons performed their operations at teaching hospitals, but a large proportion—44.4% of high-volume and 41.7% of very-high-volume surgeons—were not associated with an academic medical center. Moreover, a higher percentage of very-high-volume surgeons were affiliated with rural and small hospitals compared with the other quintiles. Therefore, the resources of an academic medical center or a large, urban hospital may not be necessary for a high-volume spine surgeon.

In this study, both surgeon volume and hospital volume were examined, and surgeon volume was found to be more strongly associated with postoperative outcomes. Increasing surgeon volume was significantly associated with superior outcomes for all of the end points evaluated except postoperative mortality; on the other hand, greater hospital volume was not associated with superior outcomes. This finding suggests that for patients undergoing surgery for lumbar spinal stenosis, the individual surgeon's experience, skill, and clinical knowledge may be key determinants of outcomes, whereas hospital resources may be of secondary importance.

Although prior studies examining the volume-outcomes association have found that greater hospital volume is correlated with superior surgical outcomes,[4-7,9] there are some important differences between lumbar decompression with or without fusion and

TABLE 3. The Association of Surgeon Volume, Divided Categorically Into Quintiles, With Measures of the Efficiency of Care[a]

Surgeon Volume	Length of Hospital Stay, d	Total Hospital Charges, $
Very low (n = 10 246)		
Median (IQR)	3 (2-4)	32 713 (17 715-65 415)
Adjusted percent difference (95% CI)	1.0 (Reference)	1.0 (Reference)
Low (n = 9404)		
Median (IQR)	3 (2-4)	33 968 (18 171-68 785)
Adjusted % difference (95% CI)	−1.35 (−2.84 to 0.15)	−0.09 (−2.14 to 1.96)
P	.18	.93
Medium (n = 10 000)		
Median (IQR)	3 (2-4)	31 714 (17 170-62 079)
Adjusted % difference (95% CI)	−3.73 (−5.37 to −2.09)[b]	−4.40 (−6.92 to −1.87)[b]
P	<.001[b]	.001[b]
High (n = 9671)		
Median (IQR)	3 (2-4)	31 619 (16 363-61 621)
Adjusted % difference (95% CI)	−5.42 (−7.42 to −3.43)[b]	−6.00 (−8.82 to −2.77)[b]
P	<.001[b]	.001[b]
Very high (n = 9650)		
Median (IQR)	3 (2-4)	36 818 (19 076-65 969)
Adjusted % difference (95% CI)	−3.30 (−6.27 to −0.32)[b]	−4.30 (−8.30 to −0.26)[b]
P	.03[b]	.04[b]
R^2	0.28	0.50

[a]IQR, interquartile range. All analyses are adjusted for differences in patient age, sex, comorbid disease, expected primary payer, hospital teaching status, hospital bed size, hospital location (urban vs rural), hospital volume of surgery for lumbar spinal stenosis, and proportion of patients who underwent fusion.
[b]Statistically significant difference.

the more complex operations examined in those studies. The outcomes of patients undergoing high-risk surgeries may be dependent on hospital resources such as staffing levels of the intensive care unit, diagnostic (particularly imaging) studies, and specialist consultation. On the other hand, patients who have undergone a lumbar spine surgery typically do not require postoperative monitoring in the intensive care unit, and most complications do not require further procedural intervention, transfer to the intensive care unit, or specialty consultation.

The potential implications of this study merit closer evaluation. Many authors have inferred from the data on the volume-outcomes association that procedures should be centralized into regional "centers of excellence." Although greater surgeon volume was found in this study to be associated with superior outcomes after surgery for lumbar spinal stenosis, there were some notable patterns to this association. When surgeon volume was evaluated as a categorical variable, only patients treated by very-low-volume surgeons had a significantly higher complication rate compared with patients treated by very-high-volume surgeons. This suggests that there may be a certain threshold of annual volume of surgery for spinal stenosis that is required to maintain surgical skill and clinical acumen. Moreover, there was no significant difference in complications between patients who underwent surgery by a low-, medium-, or high-volume surgeon compared with patients of very-high-volume surgeons. Given that there was no significant difference in complications for the majority of patients evaluated in this study, the centralization of spine surgery into centers of excellence may not be necessary. In fact, simply reducing the number of operations performed by surgeons who very rarely do spine surgery may be sufficient to improve outcomes.

Additionally, procedural centralization should be performed with caution because some studies have found that the creation of centers of excellence is associated with greater disparities based on race and insurance status in the access to high-quality health care.[75] Furthermore, other studies have shown that although increasing volume is associated with superior outcomes, there can be wide variability of the quality between both high-volume and low-volume surgeons. Thus, although volume may be an important variable, it may be an imperfect proxy for quality.[11]

There are many advantages of using the NIS to investigate the impact of provider volume on surgical outcomes, and many prior studies have used this database to examine the provider-volume association for other conditions.[2-14] The NIS contains data from > 1000 hospitals across the United States, which diminishes the bias of academic medical centers or databases of more limited geographic regions (such as statewide databases). The NIS is the only national database that includes patients without insurance coverage.

However, this study has many limitations. Although the NIS includes all of the discharges from included hospitals, some surgeons may operate at > 1 hospital. Given that the NIS includes only 20% of all nonfederal hospitals in the United States, if a surgeon performs surgery at > 1 hospital, the other hospital(s) may not be included in the NIS, which limits the accuracy of the quantification of surgeon volume. However, this likely only underestimates differences based on volume by including patients who may have actually been treated by high-volume providers in the very-low-volume and low-volume groups. Nonetheless, this severely restricts the ability to deduce the absolute numbers of procedures that should be performed to maintain surgical skill. The NIS also does not include data on surgeon specialty, fellowship training, or years of experience.

Additionally, limited clinical data are available in the NIS. Thus, the analyses could not be adjusted for preoperative pain or neurological deficits, the number of levels of spinal stenosis, or imaging findings (such as concomitant scoliosis). The relationships of volume with readmission rates and with long-term outcomes, including pain relief and neurological function, could not be assessed. The volume-outcomes association may be related to the unique healthcare delivery system in the United States and may not be applicable internationally. As with all administrative databases, there also may be miscoded data in the NIS.

Future investigation into the impact of surgeon volume on the outcomes after surgery for lumbar spinal stenosis is needed, particularly studies that evaluate differences in validated clinical outcome measures such as the Visual Analog Scale and the Oswestry Disability Index. Moreover, data collected in a prospective fashion may decrease the bias of a retrospective study. Nonetheless, this nationwide study suggests that increasing surgeon volume of lumbar decompression with or without fusion may be associated with superior outcomes.

Disclosures

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COMMENTS

The authors should be congratulated for addressing the topic of provider volume and complication rates for lumbar spinal surgery. Previous studies have identified an effect of increasing provider volume and better outcome after higher-risk procedures such as craniotomy and coronary artery bypass grafting. This article shows that very-low-volume providers (< 15 lumbar spinal procedures over 4 years) had greater complications than providers who performed ≥ 15 procedures in the 4-year study period. The authors point out that the data for lumbar spinal decompression surgery vs lumbar spinal fusion were similar. These data demonstrate that even for relatively routine surgical procedures, very low surgical volume is associated with greater complications.

Studies like these that rely upon the Nationwide Inpatient Sample (NIS) are powerful because of the volume of patient data than can be studied. In this study, 48 971 admissions were examined. The limitations of these administrative databases are particularly important to emphasize when making conclusions about spinal surgery. These databases do not include disease-specific outcome measures or health-related quality-of-life outcome measures (eg, Short Form-36, EuroQol 5D). Furthermore, these databases include hospital charges only as a surrogate for healthcare costs. Hospital charges represent a highly inflated number that does not accurately reflect the true costs of healthcare.

Nevertheless, the authors should be congratulated for an excellent study that demonstrates the effect of provider volume on complications after lumbar spinal surgery for spinal stenosis, which represents one of the more common reasons for surgery performed in the United States.

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The authors have performed a very thoughtful analysis of surgical volume and major outcomes after lumbar decompressions with and without fusion. The data indicate that outcomes are better for surgeons with higher surgical volumes. Be aware that the outcomes analyzed are very crude measures. They do not provide much detail about the quality of care rendered. They do not include readmission rates, which might confound their conclusions. What is interesting is that surgeon, not hospital volume, was the prime determinant of outcome.

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