Self-referrals versus physician referrals: What new patient visit yields an actual surgical case?

Eric Z. Herring, BA,¹ Matthew R. Peck, MS,¹ Caroline E. Vonck, BS,¹ Gabriel A. Smith, MD,² Thomas E. Mroz, MD,² and Michael P. Steinmetz, MD^{2,3}

¹Case Western Reserve University School of Medicine; ²Center for Spine Health, Cleveland Clinic; and ³Department of Neurosurgery, Cleveland Clinic Lerner College of Medicine, Cleveland Clinic, Cleveland, Ohio

OBJECTIVE Spine surgeons in the United States continue to be overwhelmed by an aging population, and patients are waiting weeks to months for appointments. With a finite number of clinic visits per surgeon, analysis of referral sources needs to be explored. In this study, the authors evaluated patient referrals and their yield for surgical volume at a tertiary care center.

METHODS This is a retrospective study of new patient visits by the spine surgery group at the Cleveland Clinic Center for Spine Health from 2011 to 2016. Data on all new or consultation visits for 5 identified spinal surgeons at the Center for Spine Health were collected. Patients with an identifiable referral source and who were at least 18 years of age at initial visit were included in this study. Univariate analysis was used to identify demographic differences among referral groups, and then multivariate analysis was used to evaluate those referral groups as significant predictors of surgical yield.

RESULTS After adjusting for demographic differences across all referrals, multivariate analysis identified physician referrals as more likely (OR 1.48, 95% CI 1.04–2.10, $p = 0.0293$) to yield a surgical case than self-referrals. General practitioner referrals (OR 0.5616, 95% CI 0.3809–0.8278, $p = 0.0036$) were identified as less likely to yield surgical cases than referrals from interventionalists (OR 1.5296, $p = 0.058$) or neurologists (OR 1.7498, 95% CI 1.0057–3.0446, $p = 0.0477$). Additionally, 2 demographic factors, including distance from home and age, were identified as predictors of surgery. Local patients (OR 1.21, 95% CI 1.13–1.29, $p = 0.018$) and those 65 years of age or older (OR 0.80, 95% CI 0.72–0.87, $p = 0.0023$) were both more likely to need surgery after establishing care with a spine surgeon.

CONCLUSIONS In conclusion, referrals from general practitioners and self-referrals are important areas where focused triaging may be necessary. Further research into midlevel providers and nonsurgical spine provider's role in these referrals for spine pathology is needed. Patients from outside of the state or younger than 65 years could benefit from pre-visit screening as well to optimize a surgeon's clinic time use and streamline patient care.

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KEYWORDS referral; source; surgical; outcome; efficiency

SPINE surgery in the United States continues to grow at a steady rate, and surgical volume over the last decade has exceeded the supply of spine surgeons.^{16,17} For this reason, it is imperative for spine surgeons to maximize efficiency within their practice and critically evaluate the outpatient clinic. Over half of all outpatient visits in the United States are to specialists, and evaluating the appropriate indication for a visit request (i.e., surgical yield, in the case of visits to surgeons) is critical.¹ Currently, there

are many health care providers who treat patients with spine pathologies. In addition to orthopedic surgeons and neurosurgeons, these providers may include pain management, physical medicine, and rehabilitation physicians and neurologists, among others. All providers play a critical role in the continuum of spine care. Surgeons optimally should only be seeing patients with an appropriate indication for surgery and after failure of appropriate conservative therapy. For spine surgeons to provide nonoperative

ABBREVIATIONS BMI = body mass index; EQ-5D = EuroQol 5-dimension instrument; PDQ = Pain Disability Questionnaire; PHQ-9 = 9-question depression scale from the Patient Health Questionnaire.

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primary care of the spine is inefficient and may delay access to surgical care for other patients.

Patients do not have the medical expertise to understand whether they need to see a surgeon or an alternative spine care provider. They often feel or express that surgery is the only way to “fix” their problem and seek out a surgical referral even if all nonoperative modalities have not been tried. Moreover, patients who are told that they do not need surgery often seek multiple surgical opinions. Referring providers often are unsure how to treat spine patients whose condition does not improve with nonoperative therapies. These patients may be referred for a surgical opinion even if no surgical pathology is present on imaging.

Patients without surgical pathology are often frustrated when told surgical options do not exist, especially if they have waited months to be seen. Referring doctors may be angered if patients are sent back without a solution as well. In an attempt to mitigate these concerns, spine surgeons have utilized a greater number of physician extenders to see and triage patients. In fact, a recent study also showed that patients were satisfied with an assessment by nonphysicians screening for surgical pathology.²¹

For optimal efficiency, a spine surgical practice must understand its referral sources and triage those requiring continued nonoperative management to optimize scheduling and increase surgical yield. Prior registry studies have examined surgical referral patterns by diagnosis coding but are limited in scope, as the referring provider was not a focus in any of these studies.^{14,18,19,25} We undertook this single-center retrospective review in order to identify the true surgical yield of an outpatient clinic appointment based upon referral status as well as to identify variables that affect surgical decision-making within each referral subgroup. We hypothesized that self-referral patients would more often receive nonsurgical consultations and that these referrals would thus yield less surgical volume per visit than referrals from other health care providers.

Methods

Overview and Study Design

This is a retrospective study of new patient visits to the spine surgery group at the Cleveland Clinic Center for Spine Health from 2011 to 2016. All new or consultation visits for 5 identified spinal surgeons, involving patients seen specifically at the Cleveland Clinic Main Campus Center for Spine Health, were collected. Referrals were made through central scheduling for the first available provider or directly to physicians whom patients were sent to see. Patients with an identifiable referral source and who were at least 18 years of age at the initial visit were included in this study. Patients were excluded if no referring provider or documentation of self-referral could be identified on chart review. Patients were also excluded if they were referred to one of the 5 surgeons but seen at a location outside the Center for Spine Health. Referring providers were then identified by specialty, and data were collected in 5 broad categories, including self-referral, interventionalists (including pain management and physical medicine rehabilitation specialists), general practitioners, neurologists, and other surgeons. Other sources of refer-

als were excluded due to small sample size. Primary outcome was a surgical procedure performed within 1 year of the new patient visit. Surgical operation performed, patient diagnosis, patient demographics (sex, race, date of birth, weight, height, medical comorbidities, medications, history of spinal trauma or surgical intervention, smoking history, alcohol history, and substance use), and the provider of interest were collected. Using the institution's functional outcome database, we also collected scores on the PHQ-9 (9-question depression scale from the Patient Health Questionnaire), PDQ (Pain Disability Questionnaire), and EQ-5D (EuroQol 5-dimension instrument) for all referrals as well.^{8,14}

All statistical analysis was done using the JMP Pro software package (version 13, SAS Institute Inc.). Univariate analysis and chi-square testing were used for comparison of demographic data and referral source for each subgroup. Multiple logistic regression analysis was performed to evaluate the association of groups, demographics, and comorbidities with surgical outcomes, with adjustment for significant covariates. In addition, multiple logistic regression analysis was used to identify any association of demographics and comorbidities with self-referral.

Results

From 2011 to 2016, a total of 2448 new visits to the main campus at the Cleveland Clinic Center for Spine Health were identified for 5 surgeons. From the 2448 new visits, 961 charts were excluded for unidentifiable referral source, for being incorrectly marked as a new patient visit, or for incomplete demographic data. Thus, 1487 patients were included in this study, with 821 (55.21%) being self-referred and 666 (44.79%) referred by physicians (Fig. 1). In total, 44.92% (668) of these patient visits led to spine surgery within 1 year of consultation (Table 1). Patients referred by physicians underwent surgery in 54.95% of cases versus only 36.78% for self-referrals. General practitioners, interventionalists, neurologists, and other surgeons

TABLE 1. Incidences of surgery and frequencies of referral sources

Referral Source	Surgery	No Surgery	Total
Physician referral vs self-referral			
Physician	54.95% (366)	45.05% (300)	44.79% (666)
Self	36.78% (302)	63.22% (519)	55.21% (821)
Total	44.92% (668)	55.08% (819)	
Physician subgroup			
General practitioner	47.59% (158)	52.41% (174)	49.84% (332)
Interventionalist	63.78% (81)	36.22% (46)	19.06% (127)
Neurologist	69.01% (49)	30.99% (22)	10.66% (71)
Other surgeons	54.22% (45)	45.78% (38)	12.46% (83)
Other	62.26% (33)	37.74% (20)	7.96% (53)
Total	54.95% (366)	45.04% (300)	

Surgery was defined as spine surgery performed at our center within 1 year of initial consultation. Numbers in parentheses represent the number of individuals.

made up 92% of all physician referrals and were included for subgroup analysis (Table 1). General practitioners accounted for 49.84% (332) of all physician referrals, but the referrals led to surgery in only 47.59% (158) of cases, whereas interventionalists and neurologists accounted for 19.06% (127) and 10.66% (71) of referrals, with yields for surgical cases at 63.78% (81) and 69.01% (49), respectively.

Univariate analysis confirmed our initial hypothesis, revealing that physician referrals were twice as likely to yield a surgical case as self-referrals (OR 2.10, 95% CI 1.70–2.58, $p < 0.001$). When comparing referrals by physician specialty, referrals from neurologists (OR 2.02, 95% CI 1.19–3.44, $p = 0.008$) and interventionalists (OR 1.64, 95% CI 1.09–2.45, $p = 0.016$) led to surgical procedures most frequently. Meanwhile, patients referred by general practitioners were less likely to undergo surgery (OR 0.55, 95% CI 0.40–0.76, $p < 0.001$). In addition, distance from home, income, and age were evaluated as predictors of surgery. Local patients were more likely to undergo surgery (OR 1.21, 95% CI 1.13–1.29, $p = 0.018$). There was a trend toward higher rates of surgery among patients from low-income ZIP codes (OR 1.15, $p = 0.11$), but it was not statistically significant. Patients older than 65 years were more likely to undergo surgery than younger patients (OR 0.80, CI 0.72–0.87, $p = 0.0023$).

Frequencies of patient demographic characteristics and health status questionnaire scores for physician referrals, self-referrals, and physician-referral subcategories are listed in Table 2. Physician-referred patients were more

likely to come from Ohio, be older, have a higher body mass index (BMI), and have more comorbidities, while self-referred patients were more likely to be married, have a higher income, and consume alcohol (Table 3). All other demographic and patient health status questionnaire differences between the 2 groups were not statistically significant. Patients referred by general practitioners were more likely to be white and have lower scores on patient health status questionnaires, while patients referred by interventionalists were more likely to have higher scores on patient health status questionnaires, to be non-white, and to be from outside of Ohio. Patients referred by neurologists were more likely to have comorbidities. All other demographic and patient health status questionnaire differences between the 3 groups were not statistically significant (Table 3).

To further evaluate the connections between referral source and surgical yield, multivariate analysis was done to control for bias introduced by significant demographic and health status questionnaire differences (Table 4). Multivariate analysis confirmed our findings, as physician referrals was more likely to lead to surgery (OR 1.48, 95% CI 1.04–2.10, $p = 0.0293$), compared to self-referrals (OR 0.6761, 95% CI 0.4754–0.9614, $p = 0.0293$). Neurologist referrals were also more likely to lead to surgery (OR 1.7498, 95% CI 1.0057–3.0446, $p = 0.0477$) and general practitioner referrals were less likely to lead to surgery (OR 0.5616, 95% CI 0.3809–0.8278, $p = 0.0036$). Interventionalist referrals only showed a trend toward signifi-

TABLE 2. Demographic data frequencies for referral groups

Variable	Physician (666)	Self (821)	General Practitioner (332)	Interventionalist (127)	Neurologist (71)	Other Surgeon (83)
From Ohio	79.88% (520)	71.77% (572)	80.86% (262)	70.87% (90)	85.71% (60)	80.52% (62)
White	90.18% (588)	89.86% (727)	92.59% (300)	83.46% (106)	85.71% (60)	96.15% (75)
Female	49.85% (332)	46.41% (381)	51.51% (161)	47.24% (67)	40.85% (42)	55.42% (37)
Married	61.50% (401)	68.73% (556)	64.51% (209)	57.48% (73)	62.86% (44)	56.41% (44)
Income >\$54K	35.15% (226)	46.36% (363)	30.43% (98)	28.80% (36)	33.33% (23)	39.47% (30)
Smoking	14.89% (91)	14.96% (111)	14.38% (43)	17.36% (21)	13.85% (9)	11.84% (9)
Alcohol	48.98% (287)	57.31% (404)	44.01% (125)	51.26% (61)	53.97% (34)	57.53% (42)
Drugs	3.61% (17)	3.74% (19)	2.30% (5)	4.95% (5)	3.45% (2)	3.64% (2)
Age >60 yrs	69.97% (466)	42.87% (352)	73.19% (243)	70.08% (89)	71.83% (51)	57.83% (48)
BMI >30 kg/m ²	43.79% (134)	36.39% (151)	43.87% (68)	42.42% (28)	47.83% (11)	40.54% (15)
Cancer	11.88% (79)	7.68% (63)	12.05% (40)	11.81% (15)	10.00% (7)	14.46% (12)
CRF	1.50% (10)	0.85% (7)	1.21% (4)	0% (0)	5.71% (4)	1.21% (1)
Diabetes	9.92% (66)	8.41% (69)	5.12% (17)	13.39% (17)	25.71% (18)	7.23% (6)
Depression	6.77% (45)	5.24% (43)	5.42% (18)	8.66% (11)	10.00% (7)	7.23% (6)
CAD	5.71% (38)	3.42% (28)	5.42% (18)	6.30% (8)	8.57% (6)	4.82% (4)
Hypertension	23.01% (153)	13.42% (110)	18.37% (61)	29.13% (37)	35.71% (25)	19.28% (16)
Stroke	2.26% (15)	1.83% (15)	1.21% (4)	3.15% (4)	5.71% (4)	2.41% (2)
Antidepressant use	19.10% (127)	15.73% (129)	17.78% (59)	22.84% (29)	22.86% (16)	18.07% (15)
EQ-5D <52	40.37% (262)	36.61% (298)	37.54% (122)	45.60% (57)	44.78% (30)	36.59% (30)
PHQ-9 ≤10	79.58% (491)	79.63% (610)	82.68% (253)	72.27% (86)	81.67% (49)	78.75% (63)
PDQ <79	45.75% (285)	49.74% (385)	48.55% (151)	36.29% (45)	45.45% (30)	50.63% (40)

CAD = coronary artery disease; CRF = chronic renal failure.

Not all patients provided answers for all demographic categories. Percentages are based on the total number of patients who provided answers for that demographic category. Numbers in parentheses represent the number of individuals.

FIG. 1. Summary of patients included and excluded from initial record collection to final analyses.

cance with respect to subsequent surgery (OR 1.5296, $p = 0.0582$), most likely due to sample size (Table 4).

The diagnosis given after referral to a spine surgeon was also examined to further evaluate differences in referral providers. Back pain was the most common diagnosis for self-referred patients (21%), while lumbar stenosis was the most common diagnosis for patients referred by physicians (24%) (Table 5). On univariate analysis, self-referred patients were more likely to be diagnosed with back pain and lumbar radiculopathy and less likely to be diagnosed with lumbar stenosis or cervical myelopathy (Table 6). Within physician subgroups, patients referred by general practitioners were less likely to be diagnosed with cervical myelopathy than those referred by neurologists. Patients referred by other surgeons were more likely to be diagnosed with fractures.

In addition to surgical status, the operation performed was compared among referral groups. The most common operation for both self-referred and physician-referred patients was a single-level lumbar laminectomy with fusion (Table 7). This also held true for physician-referral subgroups, with the exception of referrals from interventionalists, for which single-level lumbar laminectomy without

TABLE 3. Significantly different demographic data for referral groups

Referral Source & Patient Characteristic	p Value	OR
Physician		
From Ohio	0.0004	1.5614
Married	0.0039	0.7270
Income >\$54K	<0.0001	0.6271
Alcohol	0.0028	0.7152
Age >60 yrs	<0.0001	3.1045
BMI >30	0.0444	1.3621
Cancer	0.0062	1.6199
CAD	0.0325	1.7143
Hypertension	<0.0001	1.9288
Self		
From Ohio	0.0004	0.6405
Married	0.0039	1.3755
Income >\$54K	<0.0001	1.5946
Alcohol	0.0028	1.3982
Age >60 yrs	<0.0001	0.3221
BMI >30 kg/m ²	0.0444	0.7342
Cancer	0.0062	0.6173
CAD	0.0325	0.5833
Hypertension	<0.0001	0.5185
General practitioner		
White	0.0026	2.3343
Diabetes	<0.0001	0.2498
Hypertension	0.0006	0.4901
Stroke	0.0329	0.2881
PHQ < median	0.0475	1.4471
Neurologist		
CRF	0.0020	6.8939
Diabetes	<0.0001	4.3269
Stroke	0.0377	3.4167
Hypertension	0.0081	2.0465
Interventionalist		
From Ohio	0.0089	0.5439
White	0.0117	0.4768
PDQ <79	0.0229	0.6168
PHQ-9 ≤10	0.0017	0.5138

fusion was the most common operation (Table 7). On univariate analysis (Table 6), self-referred patients were less likely to undergo multilevel lumbar laminectomy and fusion, single-level cervical laminectomy and fusion, and lumbar kyphoplasty or vertebroplasty. Within physician subgroups, general practitioner referrals were less likely to lead to multilevel cervical laminectomy and fusion but more likely to lead to thoracic kyphoplasty or vertebroplasty. Interventionalist referrals were more likely to lead to single-level lumbar laminectomy without fusion but less likely to lead to single-level cervical laminectomy and fusion. Patients referred by other surgeons were more likely to undergo single-level thoracic laminectomy.

TABLE 4. Predictors of undergoing surgery after accounting for demographic differences

Referral Source	p Value	OR	95% CI
Self	0.0293	0.6761	0.4754–0.9614
Physician	0.0293	1.4789	1.0401–2.103
General practitioner	0.0036	0.5616	0.3809–0.8278
Interventionalist	0.0582	1.5296	0.9809–2.3853
Neurologist	0.0477	1.7498	1.0057–3.0446

Discussion

Importance of Referral Source and Demographic Data

In many spine surgery practices, patients can refer themselves for a consultation, and while many patients are referred from other physicians and health care providers, self-referrals represent a substantial referral source. In our spine practice, self-referrals make up nearly 50% of the patients seen. Referral source is associated with both having surgery and surgical outcomes in other medical fields.^{12,13,22} Resnick et al. studied the patient experience of 22,811 self-referred or physician-referred Medicare beneficiaries seen by urologists and found that self-referred patients underwent CT imaging more often but were surgically treated less often than patients referred by a physician.²² Similarly, our data suggest that self-referred patients are less likely to need surgical treatment as compared to those referred

by health care providers. Moreover, we found that patients referred by specialists (i.e., neurologists and spine interventionalists) were more likely to need surgery compared to general practitioners. Logistic regression analysis, adjusted for demographic and health status differences, supported these findings.

Demographic data also play a role in patient care; age, sex, income, comorbidities, and race are all associated with differences in referral and treatment patterns in other specialties.^{4,5,7,9,15,20,24} Similarly, our study showed that local patients, patients over the age of 65 years, and patients suffering from hypertension were more likely to undergo spine surgery according to logistic regression.

Ambulatory Practice Efficiency

Back or neck pain is one of the most common reasons to seek medical attention.² Most often, acute exacerbations do not require advanced imaging or referral to a specialist, but the condition can become chronic. In our experience self-referred patients often seek multiple opinions and look to surgery as a “fix.” Many health systems and insurance plans allow patients to seek out the opinion of a specialist without a referral. Patient interactions are often negative, as the patients typically face a long wait time for a visit, and as our data suggest, surgery is usually not necessary. The spine surgeon is then required to spend considerable time discussing the good news that surgery is not needed, and even with this action, the patient may leave dissatisfied.

TABLE 5. Diagnosis frequencies stratified by referral group

Diagnosis	Self (821)	Physician (613)	General Practitioner (332)	Interventionalist (127)	Neurologist (71)	Other Surgeon (83)
Back pain	21.07% (173)	14.68% (90)	16.87% (56)	14.96% (19)	5.63% (4)	13.25% (11)
Lumbar						
Radiculopathy	11.08% (91)	7.67% (47)	8.13% (27)	6.30% (8)	8.45% (6)	7.23% (6)
Stenosis	15.83% (130)	23.98% (147)	23.49% (78)	24.41% (31)	29.58% (21)	20.48% (17)
Disc disease	10.96% (90)	11.91% (73)	11.75% (39)	14.17% (18)	8.45% (6)	12.05% (10)
Spondylolisthesis	5.48% (45)	6.69% (41)	7.83% (26)	7.09% (9)	1.41% (1)	6.02% (5)
Fracture	1.58% (13)	1.79% (11)	2.41% (8)	1.58% (2)	0.00% (0)	1.20% (1)
Cervical						
Radiculopathy	6.46% (53)	4.57% (28)	5.12% (17)	4.72% (6)	5.63% (4)	1.20% (1)
Myelopathy	6.58% (54)	9.46% (58)	7.23% (24)	7.09% (9)	22.54% (16)	10.84% (9)
Stenosis	12.18% (100)	11.09% (68)	9.94% (33)	11.02% (14)	12.68% (9)	14.46% (12)
Fracture	0.37% (3)	0.82% (5)	0.60% (2)	0.00% (0)	0.00% (0)	3.62% (3)
Thoracic						
Myelopathy	0.85% (7)	0.82% (5)	0.60% (2)	0.79% (1)	0.00% (0)	2.41% (2)
Fracture	0.61% (5)	0.49% (3)	0.90% (3)	0.00% (0)	0.00% (0)	0.00% (0)
Stenosis	0.12% (1)	0.33% (2)	0.60% (2)	0.00% (0)	0.00% (0)	0.00% (0)
Miscellaneous*	4.63% (38)	4.40% (27)	3.92% (13)	4.72% (6)	4.23% (3)	6.02% (5)
FBS or post-laminectomy	2.19% (18)	1.31% (8)	0.60% (2)	3.15% (4)	1.41% (1)	1.20% (1)

FBS = failed back surgery.

Numbers in parentheses represent the number of individuals.

* Heterogeneous group comprising Pancoast tumor, hip pain/arthritis, generalized weakness, tongue cancer, carpal tunnel, osteoid osteoma, multiple myeloma, biceps tendinitis, osteomyelitis, osteoporosis, hamstring injury/groin pain, elbow pain, knee pain, nerve sheath tumor, idiopathic small fiber sensory neuropathy, hemangioblastoma, abdominal pain, limb pain unrelated to spinal pathology, Tarlov cyst, subdural hematoma, rotator cuff pathology or shoulder pain, neurofibromatosis, nerve sheath tumor, cachexia, nephropathy, headache, chronic pain syndrome, thyroid cancer, facial numbness, diffuse idiopathic skeletal hyperostosis, and brain compression.

TABLE 6. Significantly different diagnosis and operative data on univariate analysis

Referral Source & Diagnosis or Operation	p Value	OR
Diagnosis		
Self-referral		
Back pain	0.0018	1.5514
Lumbar radiculopathy	0.0283	2.1706
Lumbar stenosis	0.0001	0.5964
Cervical myelopathy	0.0452	0.6737
General practitioner referral		
Cervical myelopathy	0.0404	0.5661
Neurologist referral		
Back pain	0.0112	0.3166
Cervical myelopathy	0.0004	3.4632
Other surgeon referral		
Cervical fracture	0.0149	9.9000
Operation performed		
Self-referral		
Lumbar laminectomy & fusion >1 level	0.0094	0.4179
Cervical laminectomy & fusion, 1 level	0.0207	0.3547
Lumbar kyphoplasty or vertebroplasty	0.0108	0.0988
General practitioner referral		
Cervical laminectomy & fusion >1 level	0.0225	0.2115
Thoracic kyphoplasty or vertebroplasty	0.0060	12.5765
Interventionalist referral		
Lumbar laminectomy, 1 level	0.0175	2.0999
Cervical laminectomy & fusion, 1 level	0.0013	0.0778
Other surgeon referral		
Thoracic laminectomy, 1 level	0.0303	6.7857

In our rapidly changing health care system, ambulatory practice efficiency is paramount. A system that permits spine surgeons to see patients prescreened to those who may require surgical intervention is desirable. As seen in our study, self-referred patients underwent surgery much less often than patients referred by a physician. Interventionalists, general practitioners, and neurologists refer patients to surgeons after considering a number of factors, including the history and physical examination findings, imaging, and a fund of knowledge regarding conservative therapeutic options that a self-referred patient may not have.⁷ Self-referring patients' lack of knowledge often results in inappropriately seeking surgical opinions because surgical options may be perceived as quick fixes rather than what they are, the final treatment option for intractable conditions in most instances. Lastly, modern electronic medical records have resulted in patients having open access to their electronic medical record. Disc bulges, asymptomatic disc herniations, or other degenerative pathologies such as lumbar stenosis with no clinical correlate that are found on imaging are often sources of anxiety to patients, and patients will seek surgical opinions for them.

To counter the need for a spine surgeon to see a large volume of nonoperative patients, new practice patterns

have emerged. Triage systems have been developed to evaluate a patient's pathology; additionally, many practices have employed physician extenders to efficiently manage a larger patient population and triage patients. Many surgical referral centers also require advanced imaging before consultations, a practice that may limit appointments being made without appropriate imaging, but also at the cost of possibly increasing unnecessary imaging. There has been fear expressed by some providers that patients or referring doctors may resent a visit with an advanced practice provider, but in fact patient attitudes support nonphysician recommendations as a sufficient opinion in many instances.²¹ Some providers are concerned that triaging patients directly to other nonoperative specialties may delay care for patients with conditions like cervical myelopathy. Research into these specific conditions and their referral patterns is needed. Furthermore, an outpatient model to screen patients better needs to be explored to prevent long scheduling wait times and potentially negative impact on patient satisfaction.

Researchers have found referrals from general practitioners resulting in a surgical procedure to be low for lower-back pain and attribute this to inappropriate referral patterns based upon imaging findings and lack of concomitant symptoms.^{2,6,11,13} Moreover, patients with true surgical problems are suffering due to long wait times before surgeon consultations.¹⁰ Our data predicts the likelihood of a patient's need for surgery based on referral provider alone. Thus, patients referred by an interventionalist or neurologist should be triaged and given a direct appointment with a spine surgeon, while patients who are self-referred or referred by a general practitioner should be seen first by an alternative provider such as a medical spine physician or advanced practice provider. Ultimately, more research is needed to see if this model would improve functional outcomes and patient satisfaction and be cost-effective for a hospital health system.

Another important point is that although referrals from general practitioners lead to surgery less often, this referral source is the largest. If this approach is to be adopted, general practitioners should be involved in restructuring referral triaging. One disadvantage to this triaging solution is that patients may feel that surgeons are more qualified to advise them about nonsurgical options. Although this may be true, nonsurgeon providers can ensure that appropriate conservative management is performed first and have more time available for patient education. These solutions have been outlined extensively in previous studies from health care systems and have the potential to decrease patient wait times and improve patient satisfaction.^{3,23,26}

Strengths and Limitations

While this study was the first to examine referral patterns broadly for spine surgeons and examine associations of referral patterns and demographics with the need for surgery, it is important that our results be understood in light of several limitations. This is a single-institutional study from the main campus clinic in a large hospital health system, and external validity is not generalizable to all health care systems. Although we were able to observe significant statistical differences between some of

TABLE 7. Operation frequencies for referral groups

Operation	Self (302)	Physician (333)	General Practitioner (158)	Interventionalist (81)	Neurologist (49)	Other Surgeon (45)
Lumbar						
Laminectomy & fusion, 1 level	25.83% (78)	24.62% (82)	27.21% (43)	25.93% (21)	18.37% (9)	20.00% (9)
Laminectomy & fusion >1 level	3.97% (12)	9.01% (30)	10.13% (16)	6.17% (5)	10.20% (5)	8.89% (4)
Laminectomy, 1 level	22.19% (67)	18.02% (60)	17.09% (27)	27.16% (22)	14.29% (7)	8.89% (4)
Laminectomy >1 level	3.64% (11)	6.31% (21)	4.43% (7)	6.17% (5)	12.45% (6)	6.67% (3)
Fusion, 1 level	0.93% (3)	0.60% (2)	1.27% (2)	0.00% (0)	0.00% (0)	0.00% (0)
Corpectomy, 1 level	0.33% (1)	0.00% (0)	0.00% (0)	0.00% (0)	0.00% (0)	0.00% (0)
Corpectomy >1 level	0.00% (0)	0.30% (1)	0.63% (1)	0.00% (0)	0.00% (0)	0.00% (0)
Laminoplasty or laminotomy	8.28% (25)	5.71% (19)	6.33% (10)	7.41% (6)	2.04% (1)	4.44% (2)
Kyphoplasty or vertebroplasty	0.00% (0)	1.50% (5)	1.90% (3)	1.23% (1)	0.00% (0)	2.22% (1)
Discectomy or discotomy	0.99% (3)	0.30% (1)	0.63% (1)	0.00% (0)	0.00% (0)	0.00% (0)
Cervical						
ACDF, 1 level	9.60% (29)	11.71% (39)	9.49% (15)	11.11% (9)	14.29% (7)	17.78% (8)
ACDF >1 level	4.30% (13)	2.70% (9)	1.90% (3)	3.70% (3)	6.12% (3)	0.00% (0)
Laminectomy & fusion, 1 level	1.99% (6)	5.41% (18)	7.59% (12)	0.00% (0)	4.08% (2)	8.89% (4)
Laminectomy & fusion >1 level	3.31% (10)	3.60% (12)	1.26% (2)	6.17% (5)	8.16% (4)	2.22% (1)
Laminectomy, 1 level	3.97% (12)	3.00% (10)	1.90% (3)	1.23% (1)	6.122% (3)	6.67% (3)
Laminectomy >1 level	0.66% (2)	0.90% (3)	0.63% (1)	1.23% (1)	2.04% (1)	0.00% (0)
Corpectomy, 1 level	1.99% (6)	0.60% (2)	0.00% (0)	1.23% (1)	0.00% (0)	2.22% (1)
Fusion, 1 level	0.99% (3)	0.90% (3)	0.63% (1)	0.00% (0)	2.04% (1)	2.22% (1)
Laminoplasty or laminotomy	2.98% (9)	0.90% (3)	0.00% (0)	1.23% (1)	0.00% (0)	0.00% (0)
Kyphoplasty or vertebroplasty	0.00% (0)	0.30% (1)	1.27% (2)	0.00% (0)	0.00% (0)	2.22% (1)
Thoracic						
Laminectomy & fusion, 1 level	0.66% (2)	0.00% (0)	0.00% (0)	0.00% (0)	0.00% (0)	0.00% (0)
Laminectomy & fusion >1 level	0.33% (1)	0.00% (0)	0.00% (0)	0.00% (0)	0.00% (0)	0.00% (0)
Laminectomy, 1 level	1.99% (6)	1.80% (6)	1.90% (3)	0.00% (0)	0.00% (0)	6.67% (3)
Laminectomy >1 level	0.00% (0)	0.30% (1)	0.63% (1)	0.00% (0)	0.00% (0)	0.00% (0)
Kyphoplasty or vertebroplasty	0.99% (3)	1.50% (5)	3.16% (5)	0.00% (0)	0.00% (0)	0.00% (0)

ACDF = anterior cervical discectomy and fusion.

Numbers in parentheses represent the number of individuals.

the physician categories, analyses of smaller subgroups were underpowered due to subgroup sample sizes. Ideally, a larger registry study of new patient visits could elucidate higher-powered differences with more refined confidence intervals than we were able to observe. We also did not examine whether patients were seeking second opinions or the recorded visit was the patient's first consultation with a spine surgeon. Also, patients categorized as not having surgery may have gone on to have surgery at other facilities. Both of these are points that would be valuable to examine in the future. Furthermore, our study was not designed with regard to the outcomes of surgical procedures, and further work needs to be done to elucidate whether differences in outcomes exist based on referral sources.

Conclusions

In conclusion, patients referred by physicians were more likely to undergo surgery than self-referred patients. Patients referred by interventionalists or neurologists were more likely to need surgery while those referred by gen-

eral practitioners were less likely. Patients over the age of 65 years and with hypertension were also more likely to undergo surgery. These findings suggest that the outpatient clinic may benefit from structuring around the referral pattern yield of surgical cases. Self-referred patients could be directed to midlevel providers or medical spine specialists prior to being seen by a surgeon, whereas subspecialty referrals may be more appropriate for direct consultation with a spine surgeon. A robust examination of outcomes of any spinal surgery based on referral source is the next step and should be investigated in the future. These results should help spine surgeons better evaluate their referral patterns in order to optimize patient selection and outcomes and maximize provider efficiency.

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Dr. Mroz reports a consultant relationship with Stryker and direct stock ownership in Pearl Diver. Dr. Steinmetz reports a consultant relationship with Intellirod Spine and Globus and receipt of honoraria from Biomet, Globus, and Stryker.

Author Contributions

Conception and design: Peck, Vonck, Smith, Mroz, Steinmetz. Acquisition of data: Herring, Peck, Vonck. Analysis and interpretation of data: Herring, Peck, Smith, Mroz, Steinmetz. Drafting the article: Herring, Peck, Smith, Steinmetz. Critically revising the article: Herring, Peck, Smith, Mroz, Steinmetz. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Herring. Statistical analysis: Herring, Smith. Administrative/technical/material support: Steinmetz. Study supervision: Herring, Smith, Steinmetz.

Supplemental Information

Previous Presentations

Portions of this work were presented in digital poster form at the 2017 annual meeting of the Congress of Neurological Surgeons, Boston, Massachusetts, October 7–11.

Correspondence

Eric Z. Herring: Case Western Reserve University School of Medicine, Cleveland, OH. ezh2@case.edu.