

Geographic Variation in Epidural Steroid Injection Use in Medicare Patients

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Background: The rates of epidural steroid injections have increased dramatically over time, with conflicting evidence regarding the efficacy of epidural steroid injections for the treatment of various low-back pain disorders. Given the uncertainty about their role, we sought to evaluate the geographic variation in the use of epidural steroid injections for low back pain within the United States. We also sought to determine whether greater rates of epidural steroid injections are associated with lower rates of lumbar surgery.

Methods: We used the 2001 Medicare Physician Part-B claims to examine the geographic variation in the use of epidural steroid injections. Current Procedural Technology codes were used to identify the number of procedures performed as well as the percentage of injections that were fluoroscopically guided. Procedure rates were analyzed with use of several geographic indicators, including state, United States Census Bureau regions (Northeast, South, Midwest, and West), and health referral regions as defined by the *Dartmouth Atlas of Health Care*.

Results: In 2001, there was a 7.7-fold difference between the state with the lowest rate (Hawaii at 5.2 per 1000) and the state with the highest rate (Alabama at 39.9 per 1000). The variation among health referral regions, which are smaller in size, was even greater, with an 18.4-fold difference from 5.6 per 1000 in Honolulu, Hawaii, to 103.6 per 1000 in Palm Springs, California. Higher statewide rates of epidural steroid injections were associated with significantly higher rates of lumbar surgery ($p = 0.001$). In areas with high injection rates, a significantly higher percentage of patients who sought care for low back pain received injections ($p < 0.001$). In addition, in areas with high injection rates, a significantly higher percentage of patients who presented with low back pain received both injections and lumbar surgery within the same year ($p < 0.001$).

Conclusions: There is substantial geographic variation in the rates of epidural steroid injections within the United States. Southern states tend to have the highest procedure rates, whereas northeastern states have the lowest. Injection rates are positively correlated with lumbar surgery rates; therefore, epidural steroid injections do not appear to be substituting for lumbar surgeries or reducing overall rates of lumbar surgery.

Geographic variation in the use of many medical services is well established, particularly among procedures with uncertainty in their clinical effectiveness¹⁻⁴. The use of the diverse treatments for low back pain is highly variable. For example, lumbar surgery rates have been reported to vary substantially nationally and internationally⁵. Epidural steroid injection for low back pain is another treatment with uncertain effectiveness and without well-established guidelines

for its use⁶. The success rate of epidural steroid injection has been reported to range from 18% to 90%, depending on methodology, outcome measures, and technique⁷⁻¹⁴. Randomized trials have had conflicting conclusions^{15,16}. Nonetheless, this procedure has developed widespread acceptance and rapid increases in use⁶.

Given the variable success of surgery for lumbar spine disorders, less invasive and more cost-effective treatments are

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commonly sought to treat low back pain and sciatica¹⁷. Epidural steroid injections are often used as a less invasive alternative to lumbar surgery in patients with radiculopathy and other low-back pain disorders¹⁸. Epidural steroid injections can provide temporary pain relief to a subset of patients, and they are used for a variety of reasons. They may be used in an effort to avoid surgery by providing pain relief during the natural recovery from injury or to extend the period of time before a patient undergoes surgery. Understanding patterns of the use of epidural steroid injections across geographic regions can provide insight into variations in clinical decision-making. In this study, we sought to examine the patterns of the use of epidural steroid injections across geographic regions and to explore the relationship between the use of epidural steroid injections and lumbar surgery in actual clinical practice. We hypothesized that there would be substantial variation in the use of epidural steroid injections among both large (that is, region and statewide) and small (that is, health referral regions) geographic regions. We also hypothesized that regions with high epidural steroid injection rates would have lower lumbar surgery rates and that epidural steroid injection use in a geographic region would be positively correlated with the physician supply.

Materials and Methods

We used the 2001 standard 5% national sample of the U.S. Centers for Medicare and Medicaid Services (CMS) Physician Part-B outpatient billing claims. This dataset is a sample of patients enrolled in the fee-for-service Medicare program based on the selection of records with specific numbers in positions 8 and 9 of the health insurance claim number and is generated by CMS. This CMS 5% sample dataset is therefore unbiased and unpredictable in terms of any patient characteristics, but it does allow for tracking patients over time and across datasets. CMS makes this 5% sample available to researchers, as the 100% dataset is so large that it is not feasible to use for research purposes. Only patients who were sixty-five years old or older were included in this analysis, for consistency with prior studies on degenerative low-back pain treatments in the Medicare population^{5,19}. We also included only persons with continuous enrollment during the study year in order to have a stable population to study. Injection rates were calculated with use of the total number of injections performed on eligible enrollees with continuous enrollment during the study year in the numerator and the total number of eligible enrollees with continuous enrollment during the study period in the denominator. Injection rates as reported represent the number of injections performed per 1000 Medicare enrollees. As persons in this sample may have received more than one injection during the study year, we also reported the number of persons receiving injections per 1000 Medicare enrollees. This analysis was completed in order to determine if the areas with a high rate of injections had a high rate because injections were performed on a higher number of people or if the rate was high because more injections were performed per person.

The 2001 Current Procedural Terminology (CPT) procedure codes for lumbar epidural steroid injections (62311 and 64483) were used to select cases for inclusion in this study²⁰. Cases of patients who had lumbar surgery were identified with use of a previously described algorithm²¹. Patients with low back pain were defined as patients with any claim in the Medicare dataset with an International Classification of Diseases, Ninth Revision (ICD-9)²² diagnosis code for a low-back pain disorder based on a previously described algorithm⁶ and therefore represent those patients with low back pain who sought medical care for low back pain. Postal (ZIP) codes were used to determine the geographic location where the procedure was performed. Procedure rate variations were analyzed by state, U.S. Census Bureau definitions of regions (Northeast, South, Midwest, and West), and the *Dartmouth Atlas of Health Care's* previously defined health referral regions²³. There are 306 health referral regions throughout the United States created to represent smaller health markets. Each represents a region that provides tertiary care services and typically represents a city and the surrounding areas. Physician supply was determined by counting individual provider codes on the injection claims. The number of different providers identified in each region was totaled to calculate the number of "injection providers" per 1000 Medicare beneficiaries within geographic regions. Providers and provider specialties were identified with use of the provider code and the specialty code on each claim. Human subjects approval was obtained through the University of Washington prior to the start of this study. Most of the data analyses were descriptive. Rates of injections were correlated with surgical rates, physician supply, and other variables with use of Pearson correlations. When variables were not distributed normally and variances were large, nonparametric correlation tests were used (Spearman rank coefficient). A p value of <0.05 was considered significant.

Results

Epidural Steroid Injection Rates

In 2001, there was a 7.7-fold difference between the state with the lowest rate (Hawaii at 5.2 per 1000) and the state with the highest rate (Alabama at 39.9 per 1000) (Fig. 1-A). Eight states had injection rates of >25% above the national average of 26.5 per 1000. The statewide variations are graphically demonstrated in the map of the contiguous United States, with each quartile of rates depicted by a different color (Fig. 1-B). Both Hawaii, with the lowest injection rate, and Alaska, with the thirteenth lowest, are in the lowest quartile (dark blue) but are not represented in this map of the contiguous United States.

Among census regions, the Northeast had the lowest injection rates and the South had the highest rates overall, and these rates were different from each other ($p = 0.003$). The injection rates in the South, Midwest, and West were not significantly different from one another.

The variation among health referral regions, which are smaller in size, was even greater, with an 18.4-fold difference from 5.6 per 1000 in Honolulu, Hawaii, to 103.6 per 1000 in

2001 Epidural Steroid Injection Rates

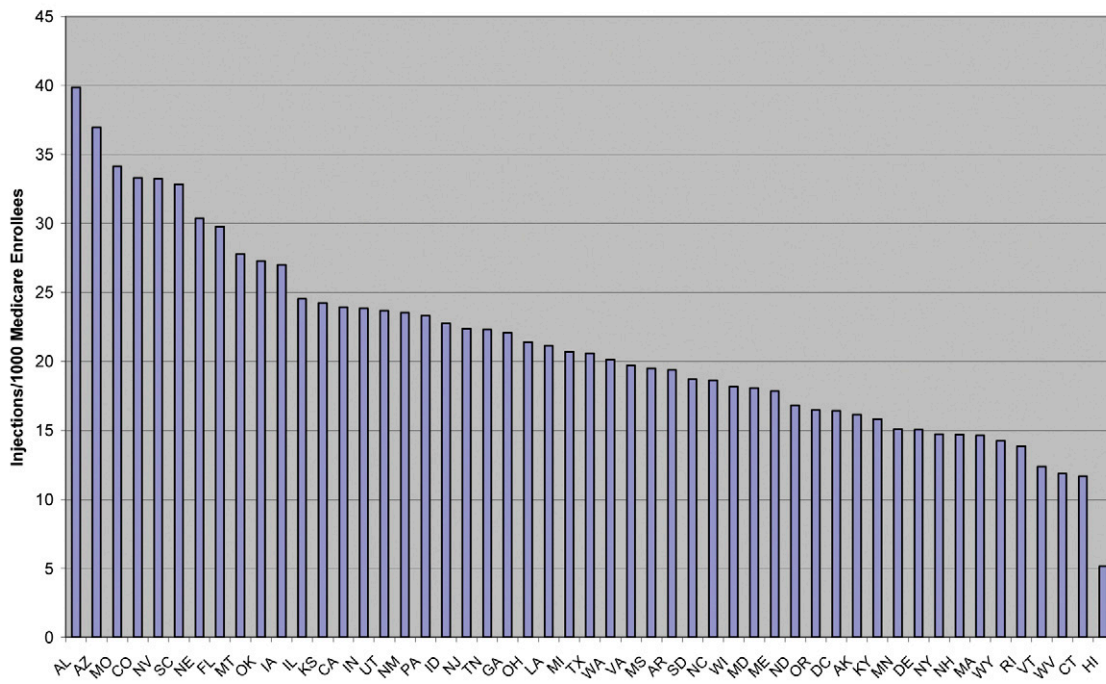


Fig. 1-A
 Variations in the use of epidural steroid injections in the United States in 2001.

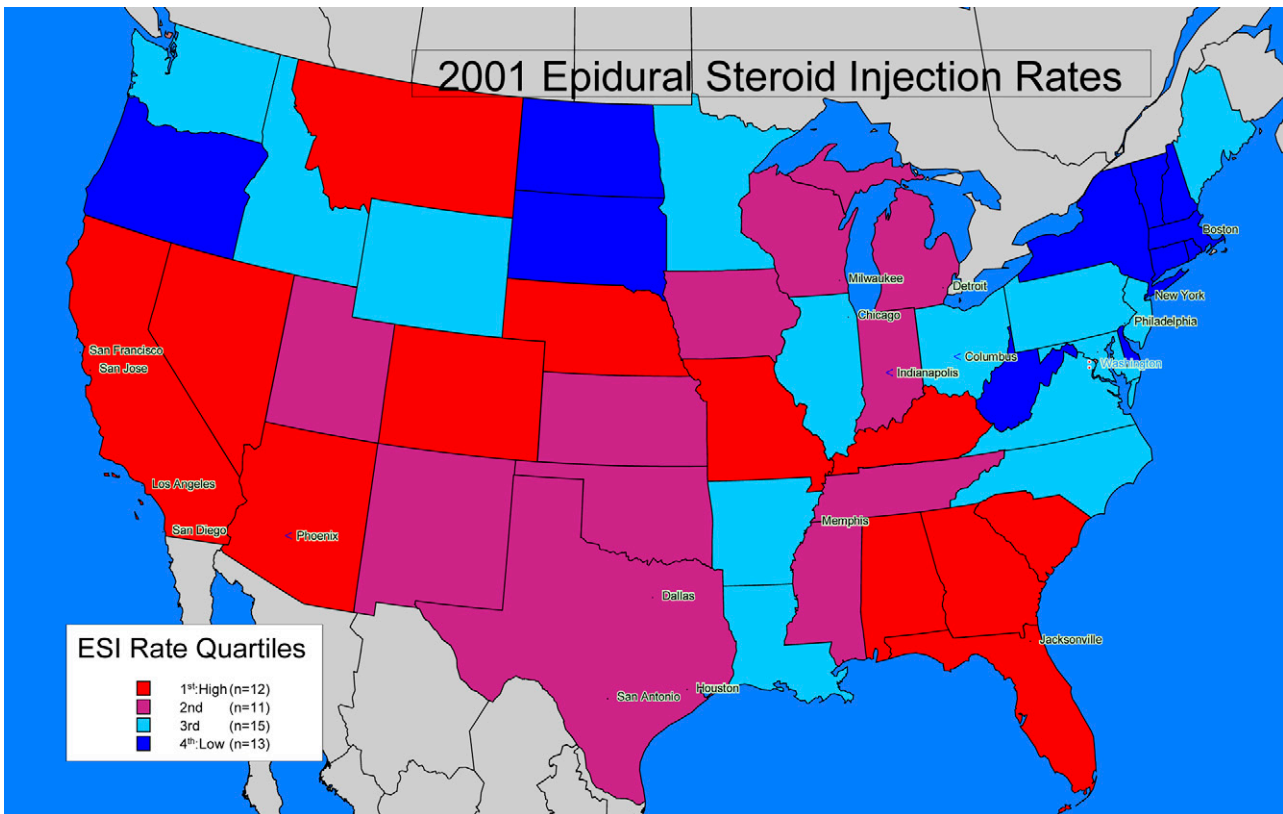


Fig. 1-B
 Map showing the statewide variations in the use of epidural steroid injections (ESI) in 2001.

TABLE I Percentages of Medicare Enrollees Receiving Epidural Steroid Injections, Lumbar Surgery, or Both, in 2001

Health Referral Region†	Epidural Steroid Injections per 1000 Enrollees	Percentage of Patients with Back Pain Receiving Various Treatments in 2001*		
		Epidural Steroid Injections	Lumbar Surgery	Epidural Steroid Injection and Surgery
Top 20 health referral regions				
Palm Springs, CA	103.6	16.5	2.9	1.4
Pueblo, CO	79.2	11.8	0.0	0.0
Mobile, AL	68.8	14.9	2.6	0.6
Charleston, SC	61.8	10.9	1.6	0.5
Abilene, TX	59.1	9.8	0.8	0.2
Fort Lauderdale, FL	57.5	9.3	1.7	0.5
Dubuque, IA	55.4	12.4	2.8	1.5
Kansas City, MO	55.2	7.0	1.2	0.3
Houma, LA	52.2	7.5	0.5	0.3
Fort Myers, FL	52.0	9.2	3.0	0.5
San Angelo, TX	51.3	10.6	3.1	1.1
Pensacola, FL	50.4	8.9	3.8	0.5
Columbia, MO	49.9	8.9	1.3	0.4
Waterloo, IA	49.0	6.2	3.1	1.0
Hattiesburg, MS	48.3	8.3	1.1	0.5
Greeley, CO	47.4	7.6	2.2	0.4
Tuscaloosa, AL	47.0	10.8	0.4	0.0
Hinsdale, IL	46.6	10.0	2.4	0.9
Hickory, NC	45.4	6.5	2.1	0.3
Newport News, VA	44.5	10.7	4.1	1.1
Lowest 20 health referral regions				
Dearborn, MI	11.76	1.9	1.7	0.07
Paducah, KY	11.75	1.8	0.7	0.08
Lebanon, NH	11.61	3.4	0.8	0.21
Temple, TX	11.51	3.7	1.2	0.00
Rochester, MN	11.38	2.7	2.2	0.09
Pontiac, MI	11.35	2.3	1.8	0.32
Kettering, OH	11.17	1.8	0.8	0.12
Duluth, MN	10.97	2.0	2.4	0.21
Waco, TX	10.5	2.1	2.8	0.00
Rochester, NY	9.95	1.7	0.6	0.10
Bronx, NY	9.06	1.0	0.2	0.00
Longview, TX	8.97	1.2	0.8	0.18
Salem, OR	8.53	3.2	5.1	0.33
St. Joseph, MI	8.46	1.9	0.5	0.00
Huntington, WV	8.37	1.7	0.8	0.10
Lexington, KY	7.26	1.0	1.0	0.12
Charleston, WV	7.04	1.6	0.5	0.09
Sayre, PA	6.96	0.8	0.8	0.00
Honolulu, HI	5.64	2.2	0.6	0.00

*Data show the percentage of enrollees with low back pain receiving one or more epidural steroid injections in 2001, the total percentage of enrollees with low back pain receiving one or more lumbar operations in 2001, as well as the percentage of enrollees with low back pain who received one or more epidural steroid injections followed by a subsequent lumbar surgery within a year of the first injection. †The highest and lowest health referral regions are given in terms of overall epidural steroid injection rates.

Palm Springs, California (Table I). Of note, one health referral region recorded no injections and four health referral regions had fewer than ten recorded procedures during the study period, and these health referral region data are not presented individually to maintain confidentiality. Seventy-one of the

306 health referral regions had injection rates of >25% above the national average of 26.5 per 1000.

The analysis was also performed with use of the number of persons receiving injections per 1000 Medicare enrollees rather than the number of actual injections performed per 1000

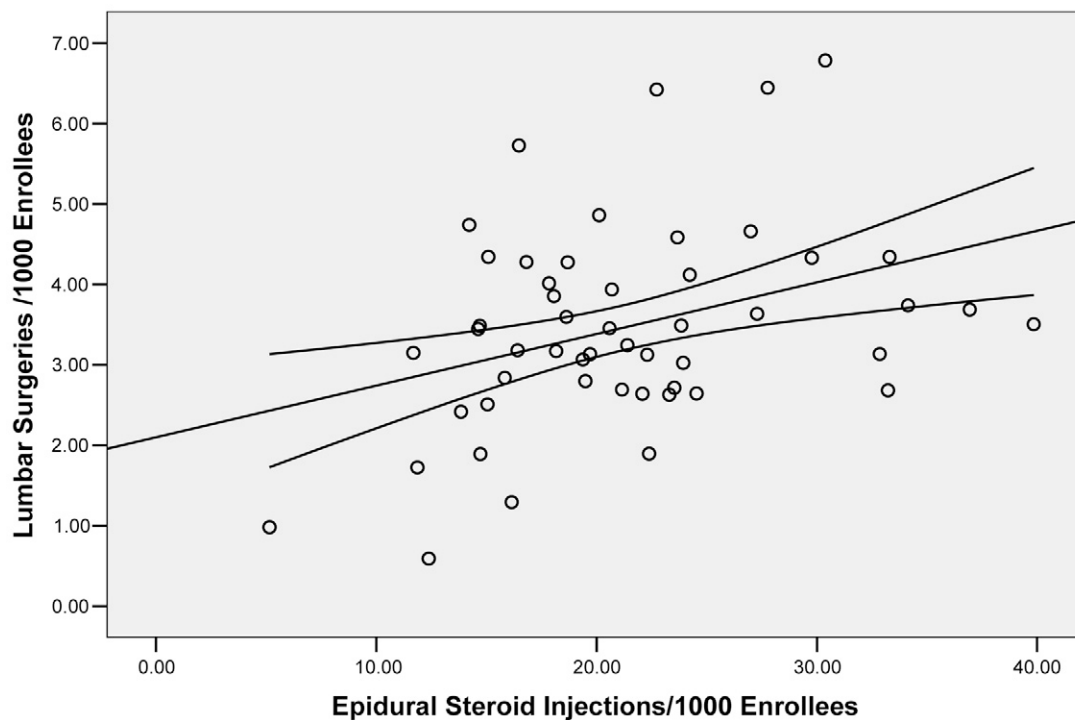


Fig. 2

This graph depicts the relationship between state-level epidural steroid injection (ESI) rates and lumbar surgery rates. The lumbar surgery rates include only the persons who underwent surgery within one year of receiving an epidural steroid injection. This graphically depicts the moderate correlation ($r = 0.59$, $p < 0.001$) between epidural steroid injection rates and subsequent surgery rates. The circles indicate states, the middle line indicates the fit line for state data, and the two outer lines indicate the 95% confidence interval.

enrollees (that is, accounting for the fact that a person could and often did receive multiple injections during the study year). We found a high degree of correlation between the “person” rates (that is, the number of persons receiving injections per 1000 enrollees) and the “injection” rates (that is, the total number of injections performed per 1000 enrollees) ($r = 0.91$, $p < 0.001$). Thus, in areas with high injection rates, more persons received injections (with population size differences controlled for by calculating rates). Along with this, we found a correlation between injection rates (and “person” rates) and the average number of injections being performed per patient ($r = 0.392$, $p < 0.001$). Therefore, it appears that areas with high injection rates have high rates because more injections are performed per patient and more patients are receiving injections.

Lumbar Surgery Rates

Statewide lumbar surgery rates also varied widely, with an 11.5-fold difference between the state with the highest rate (Nebraska, with 6.9 per 1000 Medicare enrollees) and the state with the lowest rate (Vermont, with 0.6 per 1000 Medicare enrollees). Among health referral regions, lumbar surgery rates (0.6 to 11.6 per 1000 enrollees) also varied to a similar degree as that of injection rates. Statewide rates of epidural steroid injections were positively correlated with lumbar surgery rates (Pearson correlation coefficient, $r = 0.299$; $p = 0.001$). There

was a weaker positive correlation between surgery rates and epidural steroid injection rates at the health referral region level (Pearson correlation coefficient, $r = 0.21$; $p < 0.001$). To account for the fact that persons can and do receive more than one injection or operation, we also calculated the number of persons receiving surgery per 1000 enrollees and the number of persons receiving injections per 1000 enrollees. Using the rates at the person level, we found no difference in correlations compared with those between the rates calculated at the procedure level.

We also found a moderate correlation between injection rates and the percentage of persons who had one injection or more as well as surgery in the year 2001 (Pearson correlation coefficient, $r = 0.41$; $p < 0.001$) (Table I), as well as a correlation between injection rates and rates of lumbar surgeries within one year following an epidural steroid injection ($r = 0.58$, $p < 0.001$) (Fig. 2). Therefore, in areas with a high injection rate, persons were more likely to undergo both epidural steroid injections as well as a subsequent lumbar surgery.

Fluoroscopy Use

Only 7% of the injections performed in Vermont were fluoroscopically guided compared with 87% of the injections in Wyoming. Nationally, 42% of the injections were performed with use of fluoroscopy. The use of fluoroscopy varied even

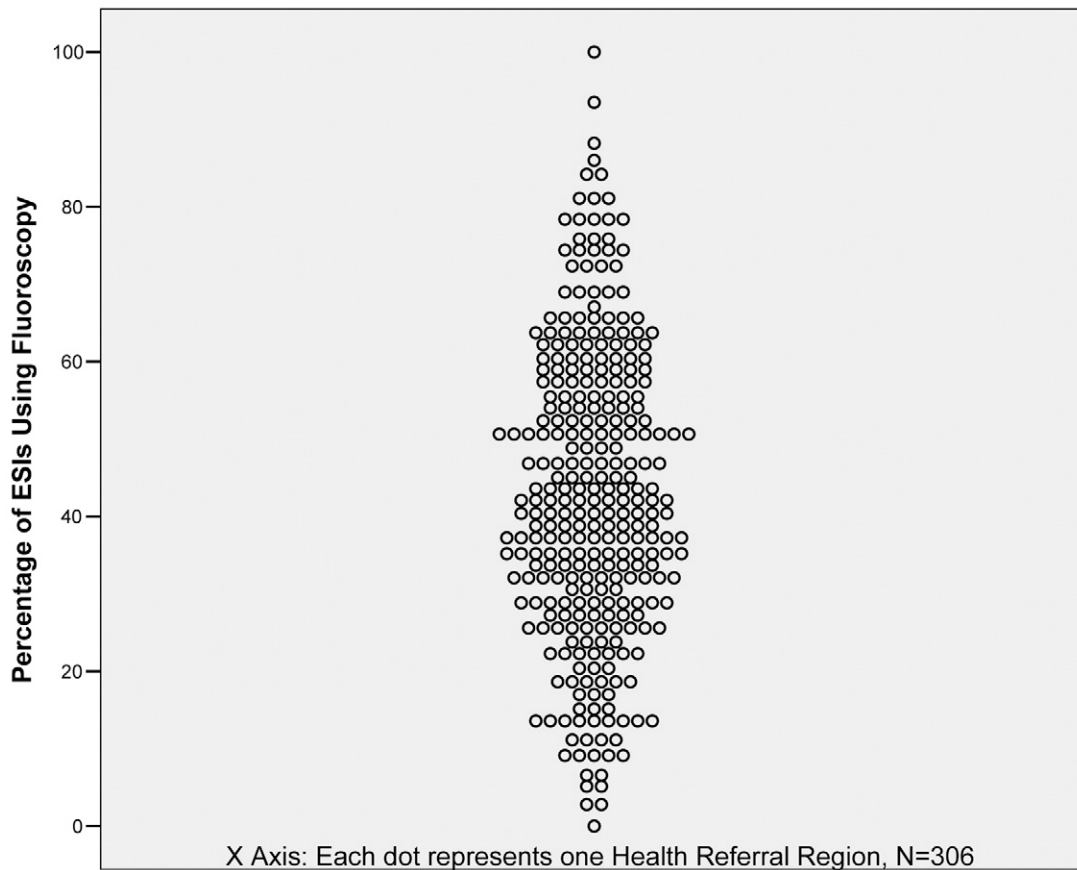


Fig. 3

Variation in fluoroscopy use by health referral region. ESI = epidural steroid injections.

more widely among health referral regions, ranging from 0% to 100% (Fig. 3). Fluoroscopy use was not correlated with injection rates at either the statewide level (Spearman rank coefficient, $\rho = 0.056$; $p = 0.70$) or the regional level (Spearman rank coefficient, $\rho = -0.01$; $p = 0.86$).

Physician Supply

Physician supply was determined by counting the number of distinct providers who performed the injections (“injection providers”) in each health referral region during the year 2001. The density of injection providers was determined by calculating the number of injection providers per 1000 Medicare enrollees at the state and health referral region level. Health referral regions with high rates of steroid injections were associated with higher densities of physicians performing the procedures ($r = 0.79$, $p < 0.001$). The physician supply was further examined in two distinct health referral regions, one with a very high injection rate and another with a very low injection rate. In the health referral region with a high injection rate, there were twenty-five physicians performing injections per 1000 enrollees. However, only a small percentage of physicians (3.4%, or two physicians) accounted for 43% of all injections performed, and one of those two physicians accounted for 30% of all injections performed in this area. In contrast, in

a health referral region with a low injection rate, there were fewer injection providers (3.8 per 1000 enrollees) and two physicians accounted for 39% of all injections performed in the area.

We also examined the number of injections provided per patient by individual providers to try to better understand the variation in practice patterns. There was an enormous range in the number of injections performed per patient by individual providers during the study year (range, one to forty injections per patient per year; median, 1.3 injections; mean [and standard deviation], 1.6 ± 0.9 injections). Only a very small percentage of physicians performed a large number of injections per patient per year, with only 0.06%, or twenty-four physicians, who performed ten or more injections per patient per year. Over 75% of physicians performed two or fewer injections per Medicare patient per year.

Comparison of Epidural Steroid Injection Rates and Low-Back Pain Rates

To determine whether high injection rates in certain geographic regions simply reflected the variable prevalence of low back pain, we standardized injection rates to eliminate the potential effects of these differences between health referral regions. We did this by calculating injections per 1000 patients

with low back pain in each health referral region. We found that health referral regions with a high injection rate tended to have high rates whether the entire Medicare population was considered or just the subset of patients who sought care for low back pain (Spearman rank coefficient, $\rho = 0.97$; $p < 0.001$). We also found that, in health referral regions with a high injection rate, a substantially higher percentage of patients who sought care for low back pain received at least one epidural steroid injection during the study year (Pearson correlation coefficient, $r = 0.84$; $p < 0.001$). For example, in Palm Springs, California, the injection rate was the highest in the nation at 103.6 per 1000 Medicare enrollees and nearly 17% of all patients who sought care for low back pain received one injection or more. In contrast, in one of the areas with the lowest injection rates (Honolulu, Hawaii), <3% of the patients who sought care for low back pain received one injection or more. In addition, in high injection-rate areas, a higher percentage of patients who presented with low back pain also underwent lumbar surgery (Pearson correlation coefficient, $r = 0.16$; $p = 0.006$) and a higher percentage had one injection or more as well as surgery in the year 2001 (Pearson correlation coefficient, $r = 0.41$; $p < 0.001$) (Table I).

Discussion

Previous studies have documented substantial geographic variation in several medical procedures, including lumbar surgery for low back pain³. We found that there was large geographic variation in the rates of epidural steroid injections within the United States. The extent of this variation is similar to the variation in the rates of lumbar surgery. We found that injection rates were highest in the southern states, whereas lumbar surgery rates were highest in the Midwest. Northeastern states had the lowest rates of both injections and lumbar surgeries. High injection rates were not simply a result of a higher prevalence of back pain in certain geographic regions. Areas with high injection rates tended to have higher rates whether the entire Medicare population was considered or just the patients who sought care for low back pain.

Contrary to our original hypothesis, there was a modest positive correlation between lumbar surgery and the use of epidural steroid injections among Medicare patients with low back pain, such that states and health referral regions with higher injection rates also had higher lumbar surgery rates. In addition, in the areas with high injection rates, a larger percentage of patients with low back pain received at least one epidural steroid injection as well as a subsequent lumbar surgery within the same year. Thus, it does not appear that the epidural steroid injections were substituting for lumbar surgeries or reducing overall rates of lumbar surgery.

The use of fluoroscopy throughout the country at the statewide level as well as at the regional level was also extremely variable, ranging from 0% to 100%. Fluoroscopy use did not correlate with injection rates at either the statewide level or the regional level.

As we hypothesized, areas with high injection rates were associated with higher densities of injection providers, or

physicians performing the injections. In both the health referral regions with high injection rates and those with low injection rates, a small percentage of physicians accounted for a substantial portion of the injections performed. This suggests that some of the regional variations may be due to physician supply as well as local practice conventions, training styles, or other factors.

There are several limitations to our study. This study examines Medicare patients over the age of sixty-five years with degenerative spinal disorders. The use of steroid injections in this group may be different from that in a younger group with different causes of low back pain. Since billings for patients in the Medicare health maintenance organization are not captured in our dataset, our findings also cannot be generalized to this group. Another limitation is that some of the variation may be related to coding errors, diagnostic ambiguity, or local conventions^{24,25}. However, as the billing claims are used for reimbursement and are subject to regular audits, providers are obligated to report procedures accurately and are subject to substantial penalties if procedure codes are not reported properly²⁵. Studies that have examined the accuracy of Medicare claims data for other diagnoses and procedures have generally found that the claims data have a good deal of accuracy in capturing procedures and diagnosis codes, with positive predictive values ranging from 62% to 95%²⁶⁻³⁰. However, on the basis of these previous studies of other diagnoses, such as renal disease, cancer, and arthritis, the claims data may be less accurate for determining disease prevalence^{31,32}. These studies have demonstrated that there are frequent omissions in the claims data in terms of diagnoses, but that the diagnoses captured in the Medicare claims data are relatively accurate. In the current study, we primarily focused on procedure rates and thus it is unlikely that potential diagnostic inaccuracies affected the analysis of geographic variations in the use of injections. ■

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