Small Area Variation in Endoscopic Sinus Surgery Rates Among the Medicare Population

Giri Venkatraman, MD, MBA; Donald S. Likosky, PhD; Daniel Morrison, MD; Weiping Zhou, MS; Samuel R. G. Finlayson, MD, MPH; David C. Goodman, MD, MS

Objectives: To determine endoscopic sinus surgery (ESS) rates among 306 hospital referral regions (HRRs) and to assess whether variability in ESS rates correlates with population density of beneficiaries, per capita number of otolaryngologists within an HRR, or proportion of patients diagnosed as having chronic rhinosinusitis.

Design: Retrospective cohort analysis.

Setting: Academic research.

Patients: A 20% sample of Medicare beneficiaries aged 65 to 99 years diagnosed as having chronic rhinosinusitis and undergoing ESS in 2006.

Main Outcome Measures: Variation in per capita rates of chronic rhinosinusitis diagnosis and ESS in 2006.

Results: Among 306 HRRs nationally, ESS was performed in sufficient volume to be reported in 148 HRRs. Per capita ESS rates (sinus surgical procedures per 1000 beneficiaries) varied 5-fold, from 0.02 to 0.10, with significant variations within states. Nationally, no geographic or regional patterns were noted, and high-use HRRs were often geographically proximal to low-use HRRs. Higher rates of chronic rhinosinusitis diagnosis and more beneficiaries in particular HRRs did not predict increased ESS within the HRRs.

Conclusions: Local ESS rates in the Medicare population vary considerably across the United States. Variability in high-use vs low-use regions seems to be random and independent of climate or the number of beneficiaries diagnosed as having chronic rhinosinusitis. Given that the appropriate rate of sinus surgery is unknown, this study points to the need for identifying and adopting more rigorous clinical criteria for ESS.


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cicular or neurosurgical procedures. Analysis was restricted to HRRs where ESS was performed in sufficient volumes to be captured. We examined whether rates of chronic rhinosinusitis diagnosis were predictive of ESS rates in individual HRRs using Medicare claims. In addition, we determined whether ESS rates were associated with measures of supply, including the number of practicing otolaryngologists and the number of beneficiaries residing in individual HRRs.

METHODS

We used a 20% sample of non–health maintenance organization Medicare beneficiaries aged 65 to 99 years from January 1, 2006, to December 31, 2006, to identify patients diagnosed as having chronic rhinosinusitis and patients undergoing endoscopic or open sinus surgery. Identified from the physician and supplier file were clinician claims with Current Procedural Terminology (CPT) and International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes (Table 1), date of procedure, and race/ethnicity of the beneficiary. The denominator file provided information on the beneficiary's age, sex, race/ethnicity, and information about eligibility by year for the Medicare Part B program.

We determined the incidence of CPT codes for the various endoscopic sinus surgical procedures at the HRR level. To capture patients diagnosed as having chronic rhinosinusitis, we identified beneficiaries with an ICD-9 code for chronic rhinosinusitis during the year. We excluded patients with ICD-9 codes for nasal tumors (benign or malignant) to ensure that the surgical procedures were performed to manage chronic rhinosinusitis and not endonasal tumors. Per capita rates of chronic rhinosinusitis diagnosis were calculated using the number of beneficiaries diagnosed as having chronic rhinosinusitis as the numerator and the total number of beneficiaries as the denominator. Per capita ESS rates were analyzed using procedure and patient counts as the numerator and the total number of beneficiaries as the denominator. Provider information was obtained using American Medical Association files.

Rates of endoscopic sinus surgery and rates of chronic rhinosinusitis diagnosis in each HRR were sorted from highest to lowest and divided into quintiles. The range of each quintile and upper and lower confidence intervals were calculated using commercially available software (STATA; StataCorp LP, College Station, Texas); t test comparison of the mean rates among quintiles was also performed. Scatterplots were generated of ESS rates within each HRR vs the number of beneficiaries within the HRR, per capita number of otolaryngology providers, and per capita rate of chronic rhinosinusitis diagnosis. Correlation coefficients and P values were obtained using STATA and a commercially available spreadsheet (Excel; Microsoft, Redmond, Washington).

In 2006 among 306 HRRs in the United States, 148 HRRs had ESS performed in sufficient volume (>11 Medicare beneficiaries undergoing ESS) to be included in our analysis. The HRRs with 10 Medicare beneficiaries or fewer undergoing ESS are not reported because of patient privacy concerns. Per capita ESS rates (sinus surgery procedures per 1000 beneficiaries) in 148 HRRs ranged from 0.02 to 0.10, a 5-fold variation. Per capita rates of patients diagnosed as having chronic rhinosinusitis showed an approximate 3-fold variation, from 14.04 to 45.44 per 1000 beneficiaries within each HRR. The rural southeastern part of the United States had the greatest proportion of HRRs with beneficiaries diagnosed as having chronic rhinosinusitis, suggesting increased allergy burden as a reason. However, these HHRs did not have correspondingly high ESS rates (Table 2).

Endoscopic sinus surgery rates within HRRs were divided into quintiles. Rates of ESS rates varied considerably within and between quintiles (national range, 0.02-0.10; interquartile range, 0.03-0.05). t Test comparing the mean ESS rates between the first and fifth quintiles dem-

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### Table 1. Study Inclusion Diagnostic Codes for Chronic Rhinosinusitis and Procedure Codes for Endoscopic Sinus Surgery

<table>
<thead>
<tr>
<th>ICD-9 Diagnostic Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>471</td>
<td>Polyv nasal cavity</td>
</tr>
<tr>
<td>471.1</td>
<td>Polyvoid sinus degeneration</td>
</tr>
<tr>
<td>471.8</td>
<td>Other polyv of sinus</td>
</tr>
<tr>
<td>472</td>
<td>Chronic rhinitis</td>
</tr>
<tr>
<td>473</td>
<td>Chronic maxillary sinusitis</td>
</tr>
<tr>
<td>473.1</td>
<td>Chronic frontal sinusitis</td>
</tr>
<tr>
<td>473.2</td>
<td>Chronic ethmoid sinusitis</td>
</tr>
<tr>
<td>473.3</td>
<td>Chronic sphenoid sinusitis</td>
</tr>
<tr>
<td>473.8</td>
<td>Pansinusitis</td>
</tr>
<tr>
<td>473.9</td>
<td>Unspecified chronic sinusitis</td>
</tr>
</tbody>
</table>

### Table 2. Hospital Referral Regions (HRRs) With the Most Medicare Beneficiaries Diagnosed as Having Chronic Rhinosinusitis and Corresponding Endoscopic Sinus Surgery Rates of the HRRs

<table>
<thead>
<tr>
<th>HRR</th>
<th>Chronic Rhinosinusitis Rate per 1000 Beneficiaries</th>
<th>Endoscopic Sinus Surgery Rate per 1000 Beneficiaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulfport, Mississippi</td>
<td>45.44</td>
<td>0.0608</td>
</tr>
<tr>
<td>Huntsville, Alabama</td>
<td>43.87</td>
<td>0.0390</td>
</tr>
<tr>
<td>Lafayette, Louisiana</td>
<td>43.57</td>
<td>0.0255</td>
</tr>
<tr>
<td>Bradenton, Florida</td>
<td>42.70</td>
<td>0.0401</td>
</tr>
<tr>
<td>Mobile, Alabama</td>
<td>39.98</td>
<td>0.0365</td>
</tr>
<tr>
<td>Dothan, Alabama</td>
<td>39.57</td>
<td>0.0544</td>
</tr>
<tr>
<td>Lake Charles, Louisiana</td>
<td>38.51</td>
<td>0.0473</td>
</tr>
<tr>
<td>Pensacola, Florida</td>
<td>38.05</td>
<td>0.0364</td>
</tr>
<tr>
<td>Birmingham, Alabama</td>
<td>37.40</td>
<td>0.0346</td>
</tr>
</tbody>
</table>

onstrated a significant difference ($P < .001$) (Figure 1). Further analysis of the quintiles showed that the highest-use quintile had the lowest rate of patients diagnosed as having chronic rhinosinusitis. This difference in diagnosis rates between the first and fifth quintiles was statistically significant ($P = .002$). The range of per capita ESS rates in select states is shown in Figure 2. Every state had low-use and high-use regions.

To postulate possible reasons for this regional discrepancy, we correlated ESS rates with the proportion of patients diagnosed as having chronic rhinosinusitis (Figure 3), population density of Medicare beneficiaries within an HRR (Figure 4), and per capita number of otolaryngology providers within each HRR (Figure 5). No appreciable correlation was noted between ESS rates and per capita rates of beneficiaries diagnosed as having chronic rhinosinusitis nationally ($R^2 = 0.06, P < .01$). Similarly, no appreciable correlation was noted between ESS rates and per capita number of otolaryngology providers per 100,000 residents in an HRR ($R^2 = 0.00, P < .01$). To determine the association of rates strictly with population, we correlated ESS rates with the number of beneficiaries within the HRR. Again, no appreciable correlation was noted ($R^2 = 0.08, P < .01$).

In 2006, per capita ESS rates varied significantly across US HRRs. When rates in individual HRRs were grouped into quintiles, statistically significant differences were noted between the highest and lowest quintiles. Our analysis indicated that per capita rates of patients diagnosed as having chronic rhinosinusitis were lower in regions with the highest ESS rates. Endoscopic sinus surgery rates within HRRs did not correlate significantly with population density of beneficiaries within each HRR, per capita number of otolaryngologists, or proportion of beneficiaries diagnosed as having chronic rhinosinusitis. Our findings indicate that ESS rates in many areas of the country seem to be dictated by local practice patterns and patient and physician expectations and not by disease burden or clinical guidelines.

Several reasons may account for our present findings. The treatment of chronic rhinosinusitis is variable because of a lack of clear effectiveness data for medical
variations that lead to less surgical morbidity and inconsistent medical management of the disease. Variability in sinus surgery rates cannot be rationalized on the basis of environmental factors, as noted by ESS rates in geographically proximal HRRs such as San Francisco (ESS rate, 0.059) and Sacramento (ESS rate, 0.045), California, or York, Pennsylvania (ESS rate, 0.074), and Baltimore, Maryland (ESS rate, 0.040). Indeed, high-use and low-use HRRs were noted within every region of the country (eg, in the Southeast and in the Midwest), further indicating that local climate did not influence sinus surgery rates.

Our findings are not unique to the treatment of chronic rhinosinusitis. Deyo et al observed similar patterns in lumbar spine surgery. As in chronic rhinosinusitis, surgical treatment of lumbar spine is preference sensitive, whereby surgeon bias and patient input may dictate treatment choices given a lack of clear effectiveness data. In both instances, the use of expensive technology for diagnosing disease has outpaced understanding of the epidemiological factors and natural history of the diseases. Laparoscopic antireflux surgery and laparoscopic gallbladder surgery are further examples of similar increases in the use and decreases of clinical thresholds for surgical intervention when minimally invasive (and less morbid) alternatives are introduced. Another possible contributing factor to variability of ESS rates could be the mean age of practicing physicians within an HRR. Because ESS is a fairly new technological advance, recent graduates from residency training and fellowship programs would be more likely to offer these services to patients and more comfortable in performing the surgery. We are planning further analyses to answer this question.

There are a few possible limitations to our analysis. As mentioned previously, Medicare beneficiaries may not be the ideal population in which to study use patterns because chronic rhinosinusitis is more prevalent among young adults. Despite this, significant variability has been observed, and we assume that similar patterns would be seen in younger cohorts. Although the cost of care was not directly addressed in our study, we would hypothesize that significant savings could be achieved if high-use HRRs adopted more conservative rates even within the Medicare population. Also, because patients were not followed up longitudinally, beneficiaries undergoing surgery in early 2006 could have been diagnosed as having chronic rhinosinusitis in late 2005. However, we believe that this would be balanced by patients diagnosed in late 2006 and undergoing surgery in 2007. Furthermore, patients undergoing revision procedures could not be differentiated because CPT codes for revision and primary surgical procedures are the same. Regardless, we think that the significant variability and random patterns of use cannot be explained by this alone.

Endoscopic sinus surgery has improved chronically low quality of life among significant numbers of patients, with less morbidity than open approaches. Our findings showing national increases in ESS rates, as well as significant variability at the regional level among Medicare beneficiaries, point to the need for clearer clinical guidelines for practicing otolaryngologists and rhinologists who manage the complex disease of chronic rhinosinusitis. Such patterns of variability—neighboring regions with significant differences in surgical rates, haphazard geographic distribution, and scientific uncertainty regarding clinical effectiveness—are hallmarks of preference-sensitive care. Addressing this variability in surgical care will not be easy but would be helped by widespread dissemination of patient decision aids, individual education along with multi-institutional randomized controlled trials, and establishment of chronic rhinosinusitis registries to minimize the scientific and clinical uncertainty and provide data on the natural history of the disease.

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Author Contributions: Drs Venkatraman, Finlayson, and Goodman had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Venkatraman, Likosky, Finlayson, and Goodman. Acquisition of data: Goodman. Analysis and interpretation of data: Venkatraman, Likosky, Zhou, and Finlayson. Drafting of the manuscript: Venkatraman and Likosky. Critical revision of the manuscript for important intellectual content: Likosky, Morrison, Zhou, and Finlayson. Study supervision: Morrison and Finlayson.

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REFERENCES