Use of advanced imaging technology and endoscopy for chronic rhinosinusitis varies by physician specialty

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ABSTRACT

Background: Patients with chronic rhinosinusitis are cared for by multiple specialties. Endoscopy and imaging are important diagnostic tools. However, because physicians vary in their access to imaging and endoscopy, testing may vary across specialties. The purpose of this study is to characterize differences in use of imaging and endoscopy between physician specialties.

Methods: Using data from the National Ambulatory Medical Care Survey, we identified adult visits with primary, secondary, and tertiary diagnoses of chronic rhinosinusitis from 2005 through 2008. We measured rates of advanced radiographic imaging (CT, MRI, and PET) and office procedures. Logistic regression models were used to assess the bivariate and independent effects of patient, physician, and practice-level factors on use of advanced imaging and office procedures.

Results: There were nearly 51 million visits for diagnoses coded as chronic rhinosinusitis, representing an average of 12.7 million visits annually. Primary care providers saw the majority of these patients. Otolaryngologists used advanced radiographic imaging at a rate higher than primary care physicians per outpatient visit (16.0% versus 1.93%; $p < 0.001$). Office procedures, performed almost exclusively (99.2%) by otolaryngologists, were performed at 24.5% of otolaryngology visits. Private insurance was significantly associated with a lower use of advanced radiographic imaging (odds ratio, 0.54; 95% CI, 0.31–0.94) among otolaryngology visits, but no patient or provider-level variables were associated with office procedure use.

Conclusion: Radiographic imaging and office procedures are used at a higher rate per outpatient visit by otolaryngologists than by primary care providers. Additional studies are needed to identify and characterize factors that contribute to these different rates of use.

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Rhinosinusitis is one of the most commonly diagnosed conditions in the United States, affecting one in seven adults and diagnosed in 31 million patients annually.^{1–3} Diagnoses of rhinosinusitis are one of the most common reasons for a patient to see a physician and one of the most common indications for antibiotic therapy.⁴ Ambulatory care visits for rhinosinusitis result in \$6 billion in spending^{2,5} and an estimated 600,000 surgical procedures annually.⁶

Unfortunately, chronic rhinosinusitis is difficult to accurately diagnose clinically. It shares the same signs and symptoms as other common clinical conditions, including allergies, the common cold, and migraine headache. Given the high prevalence of chronic rhinosinusitis and other conditions with similar clinical presentations, effective clinical practice guidelines are essential. The evidence base underlying existing rhinosinusitis clinical practice guidelines for chronic rhinosinusitis is limited and the guidelines are necessarily limited in scope. These limitations allow ample discretion to the individual physician in the care of chronic rhinosinusitis. The guidelines emphasize the importance of nasal exam, endoscopy, or sinus CT scan for chronic rhinosinusitis diagnosis.^{1,4,7–9} However, primary care physicians, who are often on the front lines of rhinosinusitis treatment, typically are not well trained in these skills.¹⁰

In light of the different practice styles, training, and expertise of physicians who care for patients with chronic rhinosinusitis, use of advanced radiographic imaging and endoscopy are likely to vary widely. Accordingly, we set out to describe contemporary practice patterns for chronic rhinosinusitis diagnosis regarding use of ad-

vanced imaging and endoscopy, using patient data from a nationally representative sample of outpatient visits.

METHODS

Data Source and Subjects

Using data from the National Ambulatory Medical Care Survey (NAMCS), we identified adult (≥ 18 years) visits to otolaryngologists or primary care physicians with primary, secondary, and tertiary diagnoses of chronic rhinosinusitis from 2005 through 2008. NAMCS uses a three-stage probability sample of nonfederal, office-based physicians that is conducted annually by the United States National Center for Health Statistics.¹¹ Visit-level information collected includes demographic characteristics, up to three diagnoses (one primary and two secondary diagnoses, coded by the International Classification of Diseases Ninth Revision, Clinical Modification [ICD9-CM]), comorbidities, procedures performed, and radiographic studies ordered. Application of patient visit weights, provided by the National Center for Health Statistics, is essential to obtain unbiased estimates and standard errors.¹² Doing so allows extrapolation of the study results from this sample population to the universe of ambulatory care visits in the United States annually. Physician specialty codes allow for the identification of otolaryngologists as well as primary care physicians (general or family medicine, internal medicine, and pediatrics). Chronic rhinosinusitis was defined as ICD-9-CM diagnosis codes 473xx or 471xx.

Outcomes

CT scan was the imaging modality of primary interest. However, temporal variations in data reporting precluded our ability to analyze CT separate from MRI and PET during the entire study period. For this reason we measured rates of advanced radiographic imaging (CT, MRI, and PET). We measured rates of office procedures, which were identified by specific ICD9-CM codes: rhinoscopy (21.2x), aspiration and lavage of sinuses (22.0x), other diagnostic procedures on nasal or sinus (22.1x), pharyngoscopy (29.11), and laryngoscopy and other tracheoscopy (31.42).

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Figure 1. Chronic rhinosinusitis visits to otolaryngologists and primary care physicians (2005–2008).

Statistical Analysis

We examined changes in provider type for chronic rhinosinusitis visits over time. We also explored differences in patient level (age, gender, race/ethnicity, insurance status, and comorbid respiratory illness), provider level (type of professional degree and employment status), and practice level (solo or group practice and geographic region) factors by provider type.

Among patients seeing otolaryngologists, logistic regression models were used to assess the bivariate and independent effects of patient, physician, and practice-level factors on two separate outcome variables: advanced radiographic imaging and use of office procedures. Multivariable models used a backward stepwise model-building technique to arrive at a parsimonious model, in which all variables were included in the complete model with backward stepwise elimination of the least significant variable, using $p < 0.05$ as the cut point.

We applied the NAMCS sampling weights, clusters, and stratification to correct our estimates of the standard errors for the complex survey design in all analyses described previously. The Rao-Scott chi-square was used to test for all bivariate associations, and the SURVEYLOGISTIC procedure was used for the multivariable logistic regression models. The University of Michigan Institutional Review Board deemed this study of existing, publically available data exempt from oversight. All analyses were performed at the 5% significance level using SAS v9.2 (SAS Institute, Inc., Cary, NC).

RESULTS

During the 4-year study period (2005–2008) there were nearly 51 million ambulatory care adult visits for chronic rhinosinusitis diagnoses, representing an average of 12.7 million visits annually. Overall, primary care providers saw the majority of these patients (Fig. 1). There were no significant differences between groups in patient age, gender, race, or geographic region (Table 1). Asthma was more commonly reported as a comorbid illness among otolaryngology visits (13.5% versus 5.56%; $p < 0.001$). Conversely, chronic obstructive pulmonary disease was more common among patient visits to primary care physicians (0.78% versus 12.1%; $p < 0.001$). Private insurance was more common among visits to otolaryngologists than visits to primary care physicians (74.7% versus 65.2%; $p = 0.006$).

On a per visit basis, advanced radiographic imaging (CT/MRI/PET) was more commonly used by otolaryngologists (16.0% versus 1.93%; $p < 0.001$). In contrast, basic radiography was ordered at similar rates (4.0% versus 3.4%; $p = 0.68$). Office procedures were performed almost exclusively (99.2%) by otolaryngologists. Overall, office procedures were performed at 24.5% of otolaryngology visits but only 0.03% of primary care physician visits ($p < 0.001$).

Among patients seeing otolaryngologists, bivariate results showed that only private insurance was significantly associated with a lower

Table 1 Characteristics of chronic rhinosinusitis visits by physician type, NAMCS, 2005–2008

	ENT	PCP	<i>p</i> Value
Total visits (weighted)	6,910,523	43,954,721	
(unweighted)	530	879	
Age in years			0.24
18–34	19.2%	25.4%	
35–44	19.5%	20.0%	
45–54	24.2%	21.4%	
55–64	17.5%	17.5%	
>65	19.5%	15.8%	
Female gender	61.0%	65.3%	0.17
White race	92.3%	90.4%	0.44
Region			0.82
Northeast	19.5%	18.2%	
Midwest	22.5%	23.8%	
South	40.7%	43.9%	
West	17.3%	14.1%	
Comorbid respiratory disease			
Asthma	13.5%	5.56%	<0.001
COPD	0.78%	12.1%	<0.001
Private insurance	74.7%	65.2%	0.006

COPD = chronic obstructive pulmonary disease; ENT = otolaryngology; NAMCS = National Ambulatory Medical Care Survey; PCP = primary care physician.

use of advanced radiographic imaging (odds ratio, 0.54; 95% CI, 0.31–0.94), but no patient- or provider-level variables were associated with office procedure use (all, $p > 0.05$; Table 2). Multivariable findings from the backward model-building technique arrived at the same conclusion.

DISCUSSION

In this study we find that patients with clinical conditions coded as chronic rhinosinusitis are most often treated by primary care physicians, a trend that has remained stable over time. However, use of diagnostic services is much more common among otolaryngologists. Although the overwhelming difference in use of endoscopy and other office procedures between specialties is expected and can be explained by variations in technical training and access to instrumentation, the substantial differences in use of imaging between specialties was unanticipated. In fact, we had expected higher use of advanced imaging by primary care physicians as an alternative to endoscopy. Furthermore, in comparison with prior research from the NAMCS dataset by Smith *et al.*,¹³ the imaging rates of both provider types were lower than expected. Smith *et al.* reported that diagnostic services are ordered in 88–95% of CRS patient visits. In contrast, we found an overall imaging rate of 8.15% (not shown). This large discrepancy between previously published data and our own likely reflects methodological differences. The NAMCS data set does not report CT use as a discrete variable in most years. Instead, CT use is reported in combinations with other tests. For the years we studied, CT is reported in combination with MRI and PET imaging and we thus report this as “advanced radiographic imaging.” CT use is also reported with a broader array of diagnostic services including screening examinations (*e.g.*, breast, pelvic, or rectal exam), imaging (*e.g.*, x ray, bone density, CT, echocardiography, MRI, *etc.*), blood tests, and scope procedures (endoscopy and colonoscopy). This latter variable for diagnostic services is much less specific and we believe this may have been the variable analyzed and reported by Smith *et al.* (we were unsuccessful in our attempts to contact the authors).¹³

We also find that chronic respiratory illness is common among chronic rhinosinusitis patient visits, with asthma more commonly

Table 2 Bivariate association of patient-, physician-, and practice-level factors with advanced radiographic imaging and use of office procedures

Factors	Advanced Radiographic Imaging		Office Procedures	
	Odds Ratio (95% CI)	p Value	Odds Ratio (95% CI)	p Value
Solo practice (vs group)	0.96 (0.39–2.36)	0.92	0.57 (0.23–1.42)	0.22
Owner (vs employee)	0.65 (0.24–1.77)	0.40	0.65 (0.28–1.50)	0.31
Private insurance (vs other)	0.54 (0.31–0.94)	0.03	1.29 (0.64–2.58)	0.48
Age (vs 65+), yr		0.36		0.21
18–34	0.63 (0.34–1.15)		0.56 (0.22–1.42)	
35–44	0.49 (0.22–1.09)		1.17 (0.55–2.46)	
45–54	0.61 (0.31–1.19)		0.98 (0.47–2.02)	
Female gender (vs male)	0.94 (0.57–1.55)	0.81	0.74 (0.50–1.09)	0.12
Region (vs West)		0.85		0.78
Midwest	1.14 (0.36–3.64)		1.19 (0.46–3.09)	
Northeast	1.72 (0.51–5.79)		1.64 (0.55–4.94)	
South	1.15 (0.50–2.68)		0.91 (0.28–3.00)	
Asthma (vs none)	0.70 (0.25–1.98)	0.50	0.79 (0.41–1.54)	0.49

reported as a comorbid illness among otolaryngology visits (13.5% versus 5.56%; $p < 0.001$). Conversely, chronic obstructive pulmonary disease was more common among patient visits to primary care physicians (0.78% versus 12.1%; $p < 0.001$). Private insurance was more common among visits to otolaryngologists than visits to primary care physicians (74.7% versus 65.2%; $p = 0.006$).

One possible explanation for disparate rates of imaging between otolaryngologists and primary care physicians is that these different provider types see different patient populations. Otolaryngologists likely see patients with more severe sinusitis and our finding of a higher rate of asthma among the otolaryngology group is consistent with this idea.¹⁴ A second factor contributing to higher imaging rates among the otolaryngology group is that some of the imaging studies may have been ordered for presurgical planning and not simply to make or confirm a diagnosis of chronic rhinosinusitis.

A third possible explanation for the lower rate of imaging in the primary care group is that there may be an element of diagnostic imprecision or uncertainty among those patients. A portion of patients diagnosed with chronic rhinosinusitis in the primary care setting might subsequently have their diagnoses revised to deviated nasal septum, allergic rhinitis, or migraine headache if a referral to otolaryngology is made.^{1,15} In the specialty care setting where diagnostic certainty is crucial, we suspect that CT scan of the sinuses may be used at higher rates by the otolaryngologists for its high sensitivity and efficacy in ruling out chronic disease.¹⁶ Finally, patients with more severe symptoms or disease manifestations are more likely to be cared for in otolaryngology practices. This referral bias may contribute to the higher per visit rates of imaging among otolaryngologists.

Nonetheless, the fact that most patients with chronic rhinosinusitis are seen by primary care providers has important implications for improving the quality of care. Research in chronic rhinosinusitis has focused on the disease as it is typically encountered in otolaryngology clinics and comparatively little research has focused on the large group of patients cared for by primary care providers.¹⁷ This study is an initial step to examine patterns of diagnosis and treatment of chronic rhinosinusitis among primary care physicians. Given the substantial health quality and financial cost burdens of rhinosinusitis, it is equally important that we understand the patients cared for by primary care providers. This is important because those patients may experience health disparity, either as a result of less intense care or as a result of misdiagnosis.

Our study is the first to objectify differences in imaging and clinical procedure rates between specialties but should be interpreted with a few limitations in mind. Interpreting data from ICD-9 codes is inher-

ently limited by the clinical information to support the diagnosis, and it is not possible to delineate confirmed disease from tentative disease diagnoses using the NAMCS data. In addition, granularity of coding is limited, as evidenced by the fact that there is no ICD-9 code for patients with “subacute rhinosinusitis.” If primary care providers systematically coded these patients as chronic rhinosinusitis, it might have resulted in an overestimate of the number of chronic rhinosinusitis patients seen. However, we do not know of any plausible reason why coding of this condition would systematically differ between physician groups. The NAMCS data reflect visit-level data, not patient-level data. As a result, it is possible that a single patient was sampled more than once in this data set. However, this is unlikely because the visits represent only a sample from each physician’s practice during a single 1-week period. Finally, these study results were obtained from a single data source, the National Center for Health Statistics and merit evaluation in a different data set.

CONCLUSION

In the evaluation of chronic rhinosinusitis, primary care physicians and otolaryngologists differ considerably in rates of advanced imaging and nasal endoscopy. In a condition managed by multiple specialties, consistency in diagnosis is needed to achieve optimal patient outcomes. Given the fact that primary care providers see a substantial number of patients with chronic rhinosinusitis, it is prudent to examine patterns of care across specialties. The current study suggests these different specialties may treat different groups of patients. Additional study is needed to identify and characterize factors that contribute to these different rates of imaging use and the potential implications on quality of care.

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