AMERICAN ACADEMY OF OTOLARYNGOLOGY–HEAD AND NECK SURGERY FOUNDATION

Original Research

OTO Open
2020, 4(3) 1–8

DOI: 10.1177/2473974X20950727
http://oto-open.org
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Burden of Nasal Polyps in the United States

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Abstract

Objective. To investigate the clinical and health care burden of chronic rhinosinusitis (CRS) with nasal polyps (CRSwNP) in the United States.

Study Design. Retrospective, cross-sectional design with analyses of patient visits from 2 databases.

Setting. National Ambulatory Medical Care Survey (NAMCS, 2012-2016) and State Ambulatory Surgery and Services Databases (SASD, 2012-2015) in available states.

Methods. In each analysis, we identified patients (≥18 years old) with a diagnosis of CRSwNP (*ICD-9-CM*: 471.x; *ICD-10-CM*: J33.x) in the visit record during the study period. CRS patients without polyps (CRSsNP: *ICD-9-CM*: 473.x, *ICD-10-CM*: J32.x; without CRSwNP codes) were identified for comparison. In the SASD, we focused on visits involving relevant sinus procedures. Outcomes included comorbidities, diagnostic testing, and prescribed medication (NAMCS) and surgery visit characteristics (SASD).

Results. We identified 2272 NAMCS records from physician offices (183 CRSwNP, 2089 CRSsNP). Most visits were for patients aged <65 years (78.8%, 80.6%) and privately insured (67.7%, 61.5%); CRSwNP visits had a male majority (56.3%, 35.4%). CRSwNP vs CRSsNP visits more often reported asthma (40.2%, 10.3%), allergic rhinitis (14.0%, 8.7%), and congestion (22.0%, 21.1%), with the use of glucocorticoids (21.0%, 17.7%) and nasal allergy medication (26.2%, 10.2%). In the SASD, 427,306 surgery visits were identified (71,195 CRSwNP, 356,111 CRSsNP); demographics were similar to NAMCS. CRSwNP surgeries involved more sinus types (59.3%, 41.4%). Surgeries were mostly elective (>99%) and completed quickly (<2 hours), without perioperative complications (>99%), followed by routine discharge (>91%); follow-up visits were common (14.9%, 13.9%).

Conclusion. CRSwNP compared to CRSsNP patients have a distinct clinical experience, with moderately higher medication need and more extensive surgery.

Keywords

chronic rhinosinusitis, nasal polyps, retrospective analysis, burden of illness, administrative claims, health care utilization

Received June 3, 2020; accepted July 7, 2020.

Chronic rhinosinusitis (CRS) is an inflammatory disorder of the paranasal sinuses and the lining of the nasal passages, affecting about 2% to 16% of the US population.[1] Chronic rhinosinusitis with nasal polyps (CRSwNP), a subgroup of CRS, which accounts approximately for 25% to 30% of CRS cases,[2] is characterized by inflammatory swellings occurring inside the nasal cavity and sinuses.[3] Symptoms of CRSwNP include posterior nasal drainage, anterior rhinitis, nasal blockage, facial pain, and reduction or loss of sense of smell, while comorbid conditions such as asthma and aspirin-exacerbated respiratory disease have also been reported.[1,4,5]

Health care utilization and spending on CRS are well documented,[6,7] although evidence on the added burden of nasal polyps on CRS is mixed. A 2009 hospital study comparing patients with CRSwNP to those without nasal polyps (CRSsNP) reported the incremental impact of polyps on medical resource utilization and costs to be minimal.[8] A survey analysis of antibiotic use between 2006 and 2010 found that nasal polyps had a negligible impact on antibiotic

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prescription use.[9] However, a recent claims study found that patients with CRSwNP compared to CRSsNP were more likely to receive prescriptions for steroid and macrolide antibiotic medication.[10] In addition, a study of 2009 to 2011 state-level surgery data showed that visits for CRSwNP had more extensive sinus surgeries than those for CRSsNP.[3] New investigation of CRSwNP-related burden using current data is needed to clarify our understanding of the incremental impact of nasal polyps.

This study aimed to further examine the clinical and health care burden of CRSwNP in the United States using recent survey and administrative surgery data from 2 data sources.

Methods

In this cross-sectional, retrospective study, we examined the clinical burden associated with CRSwNP using 2 databases. First, we analyzed 2012 to 2016 data from the National Ambulatory Medical Care Survey (NAMCS), which is an annual survey of visits to physician offices (nonfederally employed office-based physicians primarily engaged in direct patient care) administered by the National Center for Health Statistics (NCHS) that includes visit-level information on demographics, diagnoses and symptoms, services received, and prescribed medications. Second, we analyzed 2012 to 2015 data from the State Ambulatory Surgery and Services Databases (SASD), which comprises administrative, encounter (visit)-level data on demographics, diagnoses and procedures, and ambulatory surgeries and other outpatient services from hospital-owned facilities in participating states. We employed SASD data from a convenient sample of 7 states based on the availability of key data elements in the years of interest: Colorado, Florida, Iowa, Kentucky, New York, North Carolina, and Wisconsin. The SASD is part of the Healthcare Cost and Utilization Project, conducted by the federal Agency for Healthcare Research and Quality. Both NAMCS and SASD databases capture all payer sources. Institutional review board approval was not required as NAMCS and SASD data are recorded in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. Meeting these conditions makes this research exempt from the requirements of 45 CFR 46.101 under the Department of Health and Human Services.

In each analysis, we identified visits for adult patients (at least 18 years old) with CRSwNP or CRSsNP based on the presence of at least 1 *International Classification of Diseases, 9th/10th Revision, Clinical Modification* (*ICD-9/10-CM*) diagnosis code for CRSwNP (*ICD-9-CM*: 471.x; *ICD-10-CM*: J33.x) or CRSsNP (*ICD-9-CM*: 473.x; *ICD-10-CM*: J32.x and without a code of *ICD-9-CM*: 471.x; *ICD-10-CM*: J33.x[3,5]) in any diagnosis field of a visit record during the study period. Visits for patients with a diagnosis of cystic fibrosis (*ICD-9-CM*: 277.0; *ICD-10-CM*: E84.x) were excluded to avoid confounding as co-occurrence of the inflammatory lower respiratory illness and CRS has been reported.[5,11]

Also in the SASD analysis, we further identified visits that involved a selected sinus surgical procedure known to be an appropriate intervention in CRS patients[3] using *Current Procedural Terminology* (*CPT*) codes in consultation with a clinical expert: endoscopic sinus surgery, with or without balloon sinuplasty (*CPT*: 31233, 31235, 31254, 31255, 31256, 31267, 31276, 31287, 31288, 31295, 31296, 31297); maxillary antrostomy (*CPT*: 31256, 31267); ethmoidectomy (*CPT*: 31200, 31201, 31205, 31254, 31255); sphenoidotomy (*CPT*: 31287, 31288); frontal sinusotomy (*CPT*: 31276); and septoplasty (*CPT*: 30520).

The primary outcomes were measured during the 2012-2016 (NAMCS) or 2012-2015 (SASD) study period. In NAMCS, the outcomes measures included reported comorbid conditions (based on the presence of *ICD-9/10-CM* diagnosis codes), symptoms (based on the reason for visit code), diagnostic testing, and prescribed medication. In the SASD, the outcome measures included type of surgical procedure performed, length of stay during visit, number of operated sinus types (1-4 maximum: maxillary [*CPT*: 31233, 31256, 31267, 31295], ethmoid [*CPT*: 31200, 31201, 31205, 31254, 31255], sphenoid [*CPT*: 31235, 31287, 31288, 31297], or frontal [*CPT*: 31276, 31296]) per visit, discharge status, and perioperative complication: orbital hemorrhage (*ICD-9-CM*: 376.32; *ICD-10-CM*: H05.231, H05.232, H05.233, H05.239); orbital edema (*ICD-9-CM*: 376.33; *ICD-10-CM*: H05.221, H05.222, H05.223, H05.229); cerebrospinal fluid leak (*ICD-9-CM*: 320.x, 349.81; *ICD-10-CM*: G00.x, G01), including lumbar drain or skull base repair (*CPT*: 31290, 31291, 61618, 61619, 62272); and blood transfusion (*CPT*: 36430). In a subset of states with data on follow-up visits (ie, Florida, Iowa, and, in 2013-2015 only, Wisconsin), we examined subsequent visits within 30 days. For both analyses, several patient demographic characteristics associated with the visit record were reported, including age, sex, race, and primary payer type.

In the NAMCS analysis, we applied a visit weight to each survey record to calculate nationally representative visit-level estimates for statistical analysis. All years of data were combined for analysis based on the NAMCS sampling design and weighting scheme, similar to previous studies.[12-14] We did not report estimates based on fewer than 30 survey records or that had a standard error $\geq$30% as they are considered unreliable by NCHS standards.

Descriptive statistics, including means, SDs, and relative frequencies and percentages for continuous and categorical data, respectively, were reported by CRS subtype. All data transformations and statistical analyses were performed using SAS version 9.4 (SAS Institute).

Results

Demographics for Physician Office and Ambulatory Surgery Visits

From 2012 to 2016, a total of 2272 NAMCS survey records from physician offices met the inclusion criteria (183 CRSwNP and 2089 CRSsNP), corresponding to a national

estimate of 40,501,400 visits (2,822,480 CRSwNP and 37,678,920 CRSsNP) (**Table 1**). Most visits were for patients under 65 years (CRSwNP vs CRSsNP) (18-44 years: 41.8% vs 39.5%; 45-64 years: 37.0% vs 41.1%; 65+ years: 21.1% vs 19.3%) and white (89.5% vs 84.9%). Private insurance was the most common payer for services (67.7% vs 61.5%) followed by Medicare (14.6% vs 17.8%). Visits for CRSwNP (but not CRSsNP) were more often for male patients (56.3% vs 35.4%).

In the SASD, we identified 427,306 surgery visits associated with CRSwNP (n = 71,195) or CRSsNP (n = 356,111) across the 7 states from 2012 to 2015. Of these, 41,346 visits for CRSwNP and 100,967 visits for CRSsNP involved at least one of the selected sinus surgery procedures. Most visits occurred in New York (32.9%) and Florida (30.1%), followed by North Carolina (14.2%), Wisconsin (11.8%), Kentucky (6.2%), Iowa (3.8%), and Colorado (1.1%) (not shown). Similar to NAMCS, SASD visits were mostly for patients under 65 years (CRSwNP vs CRSsNP) (18-44 years: 36.7% vs 43.1%; 45-64 years: 43.7% vs 40.1%; 65+ years: 19.6% vs 16.9%) and white (74.8% vs 77.8%). In addition, visits were primarily covered by private insurance (65.9% vs 67.6%) followed by Medicare (20.1% vs 18.6%). As with NAMCS, surgery visits for CRSwNP patients only were predominately male (59.1% vs 45.0%).

Comorbid Conditions and Symptoms

Comorbid conditions and symptoms reported during physician office visits for patients with CRS from 2012 to 2016 are shown in **Table 2** and **Figure 1**. Among conditions we examined, asthma and allergic rhinitis were reported more frequently for visits associated with CRSwNP compared to CRSsNP (asthma: 40.2% vs 10.3%; allergic rhinitis: 14.0% vs 8.7%). In addition, congestion (nasal or sinus) was slightly more common in visits for patients with CRSwNP (22.0% vs 21.1%). Several estimates for conditions or symptoms of interest were based on fewer than 30 survey records or had relative standard errors greater than 30% and thus could not be reported due to their unreliability based on NCHS standards; these included (for either CRS subtype) depression, obstructive sleep apnea, otitis media, pain, and allergic symptoms, among other examples.

Among the 2012 to 2015 SASD ambulatory surgery visits for patients with CRS, the mean (SD) number of chronic conditions was similar for CRSwNP and CRSsNP visits (2.1 [1.7] vs 2.2 [1.7]; result not displayed).

Prescribed Medication and Diagnostic Testing

Prescribed medications and diagnostic testing reported during physician office visits for patients with CRS from 2012 to 2016 are displayed in **Table 3**. Glucocorticoid or steroid medication was more often prescribed during visits for CRSwNP compared to visits for CRSsNP (21.0% vs 17.7%). In addition, orders for nasal allergy relief medication (ie, leukotriene modifiers or nasal antihistamines) were considerably more frequent during CRSwNP- vs CRSsNP-related visits (26.2% vs 10.2%). We could not make comparisons between CRS subtypes for several other medication categories of interest due to the unreliability of estimates based on small record counts for either CRS subtype; these included miscellaneous antibiotics, antihistamines, and aspirin, among other examples. Comparison of diagnostic testing, such as computed tomography (CT) scan or X-ray imaging, also could not be performed for this same reason.

Ambulatory Surgery Visit Characteristics

Characteristics of 2012 to 2015 surgery visits for patients with CRS and involving a selected sinus procedure are reported in **Table 4** and **Figure 2**. Visits for CRSwNP (vs CRSsNP) had higher proportions of nearly all sinus procedures of interest: endoscopic sinus surgery (95.0% vs 93.8%), maxillary antrostomy (83.1% vs 77.5%), ethmoidectomy (85.1% vs 72.7%), sphenoidotomy (45.2% vs 26.5%), and frontal sinusotomy (46.2% vs 33.8%); however, septoplasty was less common among CRSwNP visits compared to those for CRSsNP (39.4% vs 53.7%). Such visits for CRSwNP more frequently involved surgery on 3 or 4 (vs fewer) sinus types (59.3%) compared to visits for CRSsNP (41.4%). In addition, surgery visits for both CRS subtypes were mostly elective (>99%), were completed quickly (<2 hours), occurred without perioperative complications (>99%), and had routine discharge (>91%). Follow-up visits within 30 days were slightly more common for surgery visits for CRSwNP compared to CRSsNP (14.9% vs 13.9%).

Discussion

In this cross-sectional study of physician office visits and ambulatory surgery visits for patients diagnosed with CRS, we found evidence of additional clinical burden experienced by patients with nasal polyps compared to those without polyps. Office visits for patients with CRSwNP vs CRSsNP more often reported asthma (4 times as much) and allergic rhinitis as well as prescription orders for steroid medication and nasal relief treatments. In addition, surgery visits for CRSwNP had more extensive sinus surgery procedures, involving a greater number of sinuses, than procedures for patients without polyps. These findings point to a moderate but meaningful difference in burden between patients with different CRS subtypes.

This study demonstrates that patients with nasal polyps have clinical and health care experiences that are, in some ways, distinct from those without polyps. Patients with polyps more often had comorbidities of asthma and allergic rhinitis, need for steroid treatment, and extensive surgery. As such, patients with polyps may require special considerations in their disease management, including care for such comorbid conditions, monitoring of steroid-related adverse events, and closer follow-up after sinus surgery.

Our findings are mostly compatible with prior research comparing CRS subtypes. For example, asthma[4,5] and allergic rhinitis[5,15] have been shown to correlate positively with CRS and have a higher association with CRSwNP.[5,10] Interestingly, this past work also found that CRS patients

Table 1. Patient Demographics Reported During Physician Office Visits and Surgery Visits Involving Selected Procedures for Chronic Rhinosinusitis, 2012-2016 (NAMCS) and 2012-2015 (SASD).

	NAMCS				SASD	
	Survey records[a]		Office visits (weighted)		Surgery visits	
Characteristic	CRSwNP (n = 183)	CRSsNP (n = 2089)	CRSwNP (n = 2,822,480)	CRSsNP (n = 37,678,920)	CRSwNP (n = 41,346)	CRSsNP (n = 100,967)
Age group, n (%)						
18-44	63	755	1,180,955 (41.8)	14,889,323 (39.5)	15,187 (36.7)	43,473 (43.1)
45-64	70	852	1,044,665 (37.0)	15,504,685 (41.1)	18,050 (43.7)	40,440 (40.1)
65+	50	482	596,859 (21.1)	7,284,911 (19.3)	8,109 (19.6)	17,054 (16.9)
Sex, n (%)						
Female	75	1326	1,231,334 (43.6)	24,338,370 (64.5)	16,917 (40.9)	55,510 (55.0)
Male	108	763	1,591,145 (56.3)	13,340,549 (35.4)	24,429 (59.1)	45,457 (45.0)
Race, n (%)						
White	166	1877	2,526,182 (89.5)	32,010,546 (84.9)	30,905 (74.8)	78,554 (77.8)
Primary payer, n (%)						
Private insurance	114	1297	1,911,299 (67.7)	23,206,712 (61.5)	27,265 (65.9)	68,262 (67.6)
Medicare	38	447	414,202 (14.6)	6,716,080 (17.8)	8288 (20.1)	18,799 (18.6)
Medicaid or CHIP[b]	—[c]	116	—[c]	2,274,647 (6.0)	3440 (8.3)	8475 (8.4)
Other/unknown	—[c]	229	—[c]	—[c]	2353 (5.7)	5431 (5.4)

Abbreviations: CHIP, Children's Health Insurance Program; CRSsNP, chronic rhinosinusitis without nasal polyps; CRSwNP, chronic rhinosinusitis with nasal polyps; NAMCS, National Ambulatory Medical Care Survey; SASD, State Ambulatory Surgery and Services Databases.

[a]An individual patient could represent multiple survey records (ie, if seen by multiple sampled providers); however, this was not accounted for.

[b]CHIP data available only in NAMCS.

[c]Estimates based on <30 records or that have relative standard errors >30% are considered unreliable according to NCHS standards.

Table 2. Comorbid Conditions and Symptoms Reported During Physician Office Visits for Patients With Chronic Rhinosinusitis, 2012-2016 (NAMCS).

Characteristic	CRSwNP		CRSsNP	
	Survey records[a] (n = 183)	Office visits (weighted) (n = 2,822,480)	Survey records[a] (n = 2089)	Office visits (weighted) (n = 37,678,920)
Comorbid conditions, n (%)				
Asthma	62	1,135,877 (40.2)	296	3,916,064 (10.3)
Allergic rhinitis	37	395,797 (14.0)	223	3,313,684 (8.7)
Depression	—[b]	—[b]	176	2,684,695 (7.1)
Gastroesophageal reflux disease	—[b]	—[b]	65	770,705 (2.0)
Otitis media	—[b]	—[b]	86	1,210,277 (3.2)
Symptoms, n (%)				
Congestion (nasal or sinus)	41	621,574 (22.0)	500	7,957,853 (21.1)
Pain (sinus, facial, or head)	—[b]	—[b]	355	5,335,883 (14.1)
Inflammation (sinus or nose)	—[b]	—[b]	143	2,762,477 (7.3)
Allergic symptoms	—[b]	—[b]	30	257,909 (0.6)
Other benign neoplasms	32	349,058 (12.3)	—[b]	—[b]

Abbreviations: CRSsNP, chronic rhinosinusitis without nasal polyps; CRSwNP, chronic rhinosinusitis with nasal polyps; NAMCS, National Ambulatory Medical Care Survey.

[a]An individual patient could represent multiple survey records (ie, if seen by multiple sampled providers); however, this was not accounted for.

[b]Estimates based on <30 records or that have relative standard errors >30% are considered unreliable according to National Center for Health Statistics standards and not reported. Additional measures of interest that had unreliable estimates for both chronic rhinosinusitis subtypes and were not reported in the table include (comorbid conditions) adenotonsillitis, aspirin-exacerbated respiratory disease, immunodeficiency, viral infections, obstructive sleep apnea, systemic diseases, and dental infections, as well as (symptoms) breathing problems, not elsewhere classified.

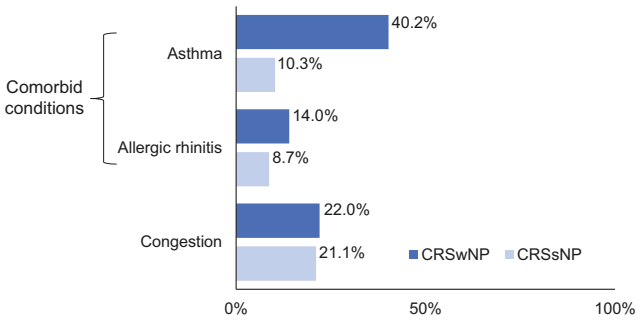

Figure 1. Comorbid conditions and symptoms reported in physician office visits for chronic rhinosinusitis, 2012-2016 (National Ambulatory Medical Care Survey). CRSsNP, chronic rhinosinusitis without nasal polyps; CRSwNP, chronic rhinosinusitis with nasal polyps.

without polyps (compared to CRSwNP) may be linked to other conditions, including pneumonia, respiratory tract infections, and various skin conditions,[5] which we did not examine in our study. Furthermore, a recent claims study similarly found that significantly more (2 times) CRSwNP patients received prescriptions for steroid medication than patients without CRS of any type.[10] By contrast, a 2009 analysis found similar disease burden and health care use between CRS subtypes; however, the sample sizes may have been too small to detect significant differences.[8] Finally, our finding that CRSwNP patients have a higher frequency of and more extensive sinus surgeries was previous shown by Ference et al[3] using SASD data from 2009 to 2011. The present study thus confirms this prior work using more recent data.

This study has the following limitations. First, our analysis of NAMCS data may have underestimated the number of visits associated with CRSwNP due to underdiagnosis of nasal polyps in primary care visits, which make up a portion of surveyed visits. Many diagnoses of CRSwNP require specialist examination, while diagnoses captured in the primary care setting would likely be for more severe (and visually apparent) cases of nasal polyps extending well beyond the middle meatus; for this reason, we believe the CRSwNP visits identified in our study are for patients who likely have the condition. Similarly, we contend that patients who received surgical intervention for nasal polyps (ie, those with visits for CRSwNP in the SASD) would have accurate diagnoses of CRSwNP. Second, we could not examine burden related to several comorbidities and health care measures of interest because of their unreliable estimates due to small sample sizes in NAMCS; this issue, along with our selection of comorbidities, narrowed our findings on CRSwNP burden considerably. Third, the data sources we used in this study reflected data on visits, not necessarily individual patients, which led to visit-level reporting of results. Consequently, in both databases, an individual patient could have had multiple visit records, either by seeking care from multiple sampled providers (NAMCS) or by undergoing multiple ambulatory surgeries (SASD), which was not accounted for. Finally, postoperative visits in the

Table 3. Medication and Diagnostic Testing Ordered During Physician Office Visits for Patients With Chronic Rhinosinusitis, 2012-2016 (NAMCS).

Characteristic	CRSwNP		CRSsNP	
	Survey records[a] (n = 183)	Office visits (weighted) (n = 2,822,480)	Survey records[a] (n = 2089)	Office visits (weighted) (n = 37,678,920)
Medication, n (%)				
Glucocorticoids	44	595,101 (21.0)	357	6,705,067 (17.7)
Miscellaneous antibiotics	—[b]	—[b]	82	1,387,896 (3.6)
Antihistamines	—[b]	—[b]	513	8,673,295 (23.0)
Nasal allergy relief medications	37	742,182 (26.2)	282	3,858,359 (10.2)
Furosemide (topical)	—[b]	—[b]	36	600,513 (1.5)
Aspirin	—[a]	—[a]	125	1,914,610 (5.0)
Diagnostic testing, n (%)				
Computed tomography scan	—[b]	—[b]	158	2,624,461 (6.9)
X-ray	—[b]	—[b]	69	1,332,365 (3.5)

Abbreviations: CRSsNP, chronic rhinosinusitis without nasal polyps; CRSwNP, chronic rhinosinusitis with nasal polyps; NAMCS, National Ambulatory Medical Care Survey.

[a]An individual patient could represent multiple survey records (ie, if seen by multiple sampled providers); however, this was not accounted for.

[b]Estimates based on <30 records or that have relative standard errors >30% are considered unreliable according to National Center for Health Statistics standards and not reported. Additional measures of interest that had unreliable estimates for both chronic rhinosinusitis subtypes and were not reported in the table include (medication) omalizumab, topical antibiotics, and topical antifungal agents, as well as (diagnostic testing) magnetic resonance imaging, sensitization test, biopsy, and tissue excision.

Table 4. Characteristics of Surgery Visits Involving Selected Procedures for Chronic Rhinosinusitis, 2012-2015 (SASD).

Characteristic	CRSwNP Surgery visits (n = 41,346)	CRSsNP Surgery visits (n = 100,967)
Selected procedures performed, n (%)		
Endoscopic sinus surgery	39,268 (95.0)	94,680 (93.8)
Maxillary antrostomy	34,347 (83.1)	78,203 (77.5)
Ethmoidectomy	35,191 (85.1)	73,401 (72.7)
Sphenoidotomy	18,670 (45.2)	26,752 (26.5)
Frontal sinusotomy	19,081 (46.2)	34,089 (33.8)
Septoplasty	16,290 (39.4)	54,226 (53.7)
Length of stay, mean (SD), d	0.06 (0.3)	0.05 (0.3)
No. of operated sinus types, n (%)		
0	1808 (4.4)	5473 (5.4)
1	5283 (12.8)	20,664 (20.5)
2	9735 (23.6)	33,062 (32.8)
3	11,204 (27.1)	25,254 (25.0)
4	13,316 (32.2)	16,514 (16.4)
Perioperative complications, n (%)		
Orbital hemorrhage	—[a]	—[a]
Orbital edema	—[a]	—[a]
Cerebrospinal fluid leak	38 (0.1)	99 (0.1)
Blood transfusion	—[a]	—[a]
Discharge status, n (%)		
Routine	38,009 (91.9)	92,735 (91.9)
Transfer to short-term hospital	38 (0.1)	90 (0.1)
Transfer other	24 (0.1)	40 (0.04)
Home health care	30 (0.1)	72 (0.1)
Against medical advice	—[a]	—[a]
Died in hospital	—[a]	—[a]
Missing	3242 (7.8)	8012 (7.9)
No. of chronic conditions, mean (SD)	2.1 (1.7)	2.2 (1.7)
Ambulatory follow-up visits within 30 days, n (%)[b]	2661 (14.9)	5935 (13.9)

Abbreviations: CRSsNP, chronic rhinosinusitis without nasal polyps; CRSwNP, chronic rhinosinusitis with nasal polyps; SASD, State Ambulatory Surgery and Services Databases.

[a]Frequencies <11 not reported in accordance with Agency for Healthcare Research and Quality confidentiality statute.

[b]Total number of visits with follow-up data: CRSwNP = 17,813 and CRSsNP = 42,696, available for Florida, Iowa, and Wisconsin (excluding Wisconsin 2012).

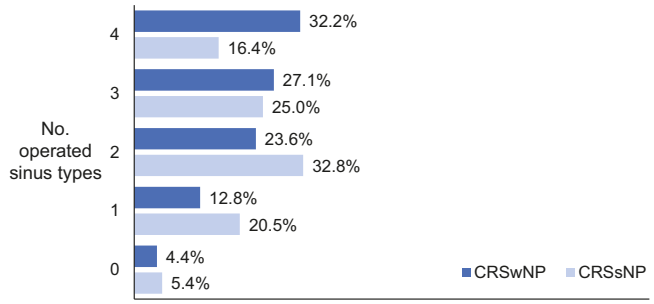

Figure 2. Number of operated sinus types during surgery visits for chronic rhinosinusitis, 2012-2015 (State Ambulatory Surgery and Services Databases). CRSsNP, chronic rhinosinusitis without nasal polyps; CRSwNP, chronic rhinosinusitis with nasal polyps.

SASD capture only visits to a hospital, emergency department, or ambulatory surgery center and do not capture visits to outpatient offices not associated with one of these entities.

Conclusion

Chronic rhinosinusitis patients with and without nasal polyps represent different disease states with unique considerations in real-world settings. Patients with polyps may have moderately higher medication utilization and, for those needing surgical intervention, extensive surgery compared to patients without polyps. Use of survey data to assess burden for patients with CRSwNP may pose some analytic challenges, while administrative surgical visit data appear more robust. Additional research that uses a larger database, such as claims, and that examines indirect medical costs, such as work productivity, would help to further elucidate the picture of burden associated with nasal polyps.

Author Contributions

Elisabeth H. Ference, design and interpretation of work, revising work for important intellectual content, final approval, accountable; **Sheila R. Reddy**, design of work, acquisition and interpretation of data, revising work for important intellectual content, final approval, accountable; **Ryan Tieu**, design of work, acquisition and interpretation of data, revising work for important intellectual content, final approval, accountable; **Sohum Gokhale**, acquisition of data, drafting work for important intellectual content, final approval, accountable; **Siyeon Park**, interpretation of data, revising work for important intellectual content, final approval, accountable; **Jason LeCocq**, interpretation of data, revising work for important intellectual content, final approval, accountable.

Disclosures

Competing interests: Elisabeth H. Ference is a consultant for Novartis Pharmaceuticals. Sheila R. Reddy is an employee of PHAR, LLC, which was paid by the following companies to conduct research during the time of the study: AbbVie, Akcea, ASPC, Amgen, AstraZeneca, BMS, Boston Scientific Corporation, Celgene, Eisai, Ethicon, GRAIL, Helsinn, Illumina, Innovation and Value Initiative, Ionis, Jazz, Kite, Novartis, Otsuka, Pathnostics, PhRMA, Prothena, Sage, Verde Technologies, Genentech, Greenwich Biosciences, and Mirum Pharmaceuticals. Ryan Tieu is a former employee of PHAR, LLC, which was paid by the following companies to conduct research during the time of the study: AbbVie, Akcea, ASPC, Amgen, AstraZeneca, BMS, Boston Scientific Corporation, Celgene, Eisai, Ethicon, GRAIL, Helsinn, Illumina, Innovation and Value Initiative, Ionis, Jazz, Kite, Novartis, Otsuka, Pathnostics, PhRMA, Prothena, Sage, Verde Technologies, Genentech, Greenwich Biosciences, and Mirum Pharmaceuticals. Sohum Gokhale is a former employee of PHAR, LLC, which was paid by the following companies to conduct research during the time of the study: AbbVie, Akcea, ASPC, Amgen, AstraZeneca, BMS, Boston Scientific Corporation, Celgene, Eisai, Ethicon, GRAIL, Helsinn, Illumina, Innovation and Value Initiative, Ionis, Jazz, Kite, Novartis, Otsuka, Pathnostics, PhRMA, Prothena, Sage, Verde Technologies, Genentech, Greenwich Biosciences, and Mirum Pharmaceuticals. Siyeon Park was an employee of University of Maryland and provided services to Novartis Pharmaceuticals during the time of manuscript development. Jason LeCocq is an employee and shareholder of Novartis Pharmaceuticals.

Sponsorships: None.

Funding source: Novartis Pharmaceuticals Corporation.

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