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Cost Burden and Resource Utilization in Patients With Chronic Rhinosinusitis and Nasal Polyps

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Objectives/Hypothesis: Establish treatment patterns and economic burden in US patients with chronic rhinosinusitis with nasal polyposis (CRSwNP) versus without chronic rhinosinusitis (CRS). Determine comparative costs of subgroups with high clinical burden.

Study Design: Observational, retrospective, case-control study.

Methods: This study matched patients with CRSwNP to patients without CRS (1:1) using the Truven Health MarketScan US claims database. Categorical and continuous variables were compared using McNemar test and paired *t* test (normal distribution) or Wilcoxon signed rank tests (non-normal distribution). Within subgroups, χ^2 and Wilcoxon or *t* tests were used (normal distribution).

Results: There were 10,841 patients with CRSwNP and 10,841 patients without CRS included. Mean age in the CRSwNP cohort was 45.8 years; 56.2% were male. During follow-up, patients with CRSwNP had an increased diagnosis of asthma versus patients without CRS (20.8% vs. 8.1%, respectively; $P < .001$). Annual incremental costs were $11,507 higher for patients with CRSwNP versus those without CRS. Costs were higher in subgroups of patients with CRSwNP undergoing functional endoscopy sinus surgery (FESS), with a comorbid diagnosis of asthma, receiving oral corticosteroids, or macrolides versus the overall CRSwNP group. Patients with CRSwNP undergoing FESS had the highest costs of the four subgroups ($26,724, $22,456, $20,695, and $20,990, respectively).

Conclusions: Annual incremental costs were higher among patients with CRSwNP versus without CRS. Patients with CRSwNP with high clinical burden had higher overall costs than CRSwNP patients without.

Key Words: Disease burden, economic burden, chronic rhinosinusitis with nasal polyposis, cost of illness, healthcare resource utilization.

Level of Evidence: NA

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INTRODUCTION

Chronic rhinosinusitis (CRS) is a chronic inflammatory condition characterized by nasal mucosa and paranasal sinus inflammation.[1] Clinical symptoms include nasal congestion, postnasal drip, loss of sense of smell, facial pain/pressure, and headache.[2] Using nasal endoscopy and/or radiological examinations, CRS can be divided into CRS without nasal polyposis (NP) and CRS with NP (CRSwNP).[3] Nasal polyps originate in the sinuses and can obstruct the sinuses and nasal passages.[4]

In 2007 in the United States (US), ~11.1 (±0.48) million adults had CRS (4.9% ± 0.2% of US population).[5] The prevalence of NP among patients with diagnosed CRS in the US varies from 25% to 30%.[6] Additionally, CRS and asthma are strongly associated[7,8] with a 50% asthma prevalence in patients with CRSwNP.[9]

Medical management of CRSwNP focuses on tissue inflammation control and possible bacterial infection treatment. Treatment options include intranasal corticosteroids, macrolides, or oral corticosteroids (OCS).[2,10] When medical management is unsuccessful, polypectomy and functional endoscopy sinus surgery (FESS) are options.[10]

Extensive healthcare resource utilization (HCRU) is associated with CRS treatment. In 2007, a study utilizing

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the Medical Expenditure Panel Survey (MEPS) with a cost-estimation model (regression model), estimated the national healthcare cost of CRS in the US to be approximately $8.6 billion per year.[5] A further study utilizing the MEPS with four established cost-estimation protocols found that in the US, the estimated cost of illness associated with CRS in 2011 was $60.2 to $64.5 billion.[11] The variation in overall cost observed between the studies, is likely related to the estimation model used and prevalence assumed. Both studies found costs to predominantly arise from ambulatory costs, followed by prescription and in-hospital costs,[11] consistent with a study that found costs relating to CRS to predominately arise from outpatient costs, prescription drug costs, ambulatory care costs, and emergency room (ER) visits.[12] Additionally, a significant proportion of patients with CRS require chronic treatment, and although sinus surgery can reduce CRS-related healthcare use, the procedure is associated with substantial costs.[13] Furthermore, nasal polyposis recurrence is common following surgery,[14] which could also increase patient care costs. As CRSwNP frequently coexists with asthma,[7–9] medical management may extend further than CRSwNP treatment, increasing patient care costs.

Although the economic burden among patients with CRS is known,[5,11,13,15,16] the economic burden among patients with CRSwNP has not been fully investigated. Given the chronicity of CRSwNP and associated comorbidities, the disease poses substantial clinical, humanistic, and economic burden. Additional data are required to better inform healthcare and health-policy decision making for these patients.

The primary aim of this study was to establish the economic burden of disease in patients with CRSwNP in the US. The secondary aim was to determine the economic burden in subgroups with a high clinical burden (receiving sinus surgery, comorbidity with asthma, or receiving steroids or macrolides).

MATERIALS AND METHODS

Study Design and Sample Population

This observational, retrospective case-control study, used existing and deidentified claims data from the Truven Health MarketScan (IBM Watson Health/Truven, Ann Arbor, MI) US claims database, which is considered representative of the US health population regarding health coverage. The study was exempt from Institutional review board/ethics committee review and approval. Data were collected between January 1, 2013 through December 31, 2014. Patients were included in the CRSwNP cohort if they were aged ≥18 years, had one or more CRS and NP diagnosis (identified by *International Classification of Diseases, Ninth Revision* codes [471.x and 473.x, respectively]) occurring between January 1, 2013 and December 31, 2014, had no CRS or NP diagnosis in the baseline (clean) period (1 year before the index date [ID]), had no FESS or polypectomy within the baseline period, had no diagnosis of nasal cavity or sinus cancer in the study period, and had 1 year continuous enrollment pre- and post-ID. *Current Procedural Terminology* codes for functional endoscopic sinus surgeries selected for the analysis are shown in Table I. Patients were included in the reference group if they were aged ≥18 years and never had a CRS or NP diagnosis, FESS or polypectomy, or any diagnosis of nasal cavity or sinus cancer during the study period.

TABLE I.
Current Procedural Terminology Codes for Sinus and Nasal Polyposis Surgeries Selected for the Current Analysis.

Current Procedural Terminology Code	Description
31255	Nasal/sinus endoscopy, surgical; with ethmoidectomy, total (anterior and posterior)
31267	Nasal/sinus endoscopy, surgical, with maxillary antrostomy; with removal of tissue from maxillary sinus
31276	Nasal/sinus endoscopy, surgical with frontal sinus exploration, with or without removal of tissue from frontal sinus
31256	Nasal/sinus endoscopy, surgical, with maxillary antrostomy
31288	Nasal/sinus endoscopy, surgical, with sphenoidotomy; with removal of tissue from the sphenoid sinus
31287	Nasal/sinus endoscopy, surgical, with sphenoidotomy
31254	Nasal/sinus endoscopy, surgical; with ethmoidectomy, partial (anterior)

The CRSwNP cohort and reference group were matched (1:1) at baseline by age, gender, asthma, chronic obstructive pulmonary disease diagnosis, and Charlson Comorbidity Index (CCI) level.[17] The ID was the first date of CRS or NP diagnosis between January 1, 2013 and December 31, 2014 for the case cohort, and the ID of the matched case for the reference group. The baseline period was 1 year before the ID, whereas the follow-up period was 1 year after the ID.

Baseline Data

Baseline patient demographic data on the ID included mean age, sex, and US geographic region (Northeast, North Central, South, West, or unknown). CCI, systemic treatments (OCS, macrolides relevant for NP), annual healthcare costs, and HCRU were extracted and computed.

Outcomes Measures

During follow-up, data on CCI, type 2 inflammatory comorbidities (asthma, allergic rhinitis), radiographic imaging (computed tomography scan [CT] scan, endoscopy), medical (OCS and macrolides), and surgical treatment (FESS and polypectomy) were obtained.

The primary outcome was to compare the incremental difference in total costs and HCRU between patients with CRSwNP and without CRS during follow-up. Total healthcare costs included all direct medical and pharmacy costs averaged over 1 year at an individual patient level. Direct medical and pharmacy costs were based on paid amounts of adjudicated claims, including insurer and health plan payments and patient cost-sharing in the form of copayment, deductible, and coinsurance. Dollar estimates were adjusted to 2016 US dollars using the Medical Care Component of the Consumer Price Index. HCRU included the proportion of patients with hospitalizations, ER, ambulatory, and office visits, and mean number of days/visits. The proportions of patients were calculated based on the cohort, whereas numbers of days/visits were based on the mean of observed values among the cohort.

The secondary objective was to analyze four CRS patient subgroups determined *a priori* from a clinical perspective to likely exhibit a higher disease burden. The four subgroups evaluated during follow-up were: patients undergoing FESS; patients diagnosed with asthma; patients with an OCS prescription, and patients with a macrolide prescription.

Statistical Analysis

For continuous variables, the mean and standard deviation (SD) were calculated. For categorical variables, the frequency and percent were calculated. A matched design was used to identify CRSwNP and reference groups, and categorical and continuous variables were compared using the McNemar test and paired *t* test if the distribution was normal or Wilcoxon signed rank tests if the distribution was nonnormal. For comparisons within each subgroup, categorical and continuous variables were compared using χ^2 and Wilcoxon or *t* test (if the distribution was normal), respectively.

RESULTS

Baseline Characteristics

There were 21,682 patients (CRSwNP cohort, n = 10,841; reference group, n = 10,841) included in the study; 56.2% were male with a mean (SD) age of 45.8 (11.9) years, and most were from the South (Delaware, Florida, Texas, Georgia, Maryland, North and South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, District of Columbia) (CRSwNP cohort, 38.7%; reference group, 38.5%).

At baseline, the mean (SD) CCI among all patients was 0.4 (0.85), signifying a comparable comorbidity health state. In both cohorts, 12.4% of patients had asthma. Allergic rhinitis was significantly more common among the CRSwNP cohort versus the reference group (25.6% vs. 7.5%, respectively; $P < .001$) (Table II).

TABLE II.
Baseline Characteristics for Patients With and Without Chronic Rhinosinusitis With Nasal Polyposis.

	CRSwNP, N = 10,841	Reference Group, N = 10,841	*P* Value
Gender, % male	56.2	56.2	NS
Age, yr, mean (SD [median])	45.84 (11.86 [48.0])	46.84 (11.86 [48.0])	NS
Region, %	NE (20.5), NC (21.5), S (38.7), W (18.3)	NE (18.6), NC (22.7), S (38.5), W (19.0)	.001
Drug treatment, n (%)			
OCS prescription	3,169 (29.2)	1,497 (13.8)	<.001
Macrolide prescription	3,085 (28.5)	1,663 (15.3)	<.001
CCI, mean (SD)	0.4 (0.85)	0.4 (0.87)	.729
Comorbidities, n (%)			
Asthma	1,348 (12.4)	1,348 (12.4)	NS
Allergic rhinitis	2,774 (25.6)	811 (7.5)	<.001
Healthcare costs, $, mean (SD)			
Total costs	8,004 (18,643)	6,937 (22,324)	<.001
Pharmacy costs	2,034 (6,565)	1,531 (5,452)	<.001
Medical costs*	5,970 (16,658)	5,406 (20,848)	.03

*Medical costs include: inpatient charge, emergency room charge, ambulatory charge, office charge, and other outpatient charge.

CCI = Charlson Comorbidity Index; CRSwNP = chronic rhinosinusitis with nasal polyposis; NC = North-Central; NE = North-East; OCS = oral corticosteroids; S = South; SD = standard deviation; W = West.

Baseline Results: Treatment Patterns, HCRU, and Costs

Significantly more patients in the CRSwNP cohort had one or more OCS or macrolide prescription versus the reference group (29.2% vs. 13.8% and 28.5% vs. 15.3%, respectively; both $P < .001$) (Table II).

No significant difference was observed in HCRU except for office visits (95.3% vs. 88.4%; $P < .001$) (Table III). The mean number of office visits (SD) per patient per year was significantly greater; 12.3 (13.6) for the CRSwNP cohort versus 9.6 (12.5) for the reference group ($P < .001$) (Table III).

Total mean annual costs (SD) were significantly higher among the CRSwNP cohort ($8,004 [$18,643]) versus the reference group ($6,937 [$22,324]) ($P < .001$). This difference was significant for pharmacy and medical costs ($P < .05$). The overall incremental difference between the CRSwNP cohort and the reference group was $1,067 (Table II).

Follow-up Results

Comorbidities. The CRSwNP cohort had a greater mean (SD) CCI versus the reference group, indicating a greater comorbidity burden (0.6 [1.1] vs. 0.4 [1.0], respectively). During follow-up, a significantly higher proportion of patients had a diagnosis of asthma and allergic rhinitis in the CRSwNP cohort versus the reference group (20.8% vs. 8.1% and 53.3% vs. 7.4% respectively; both $P < .001$) (Table IV).

TABLE III.
Mean Number of Systemic Prescriptions and Healthcare Resource Utilization for Patients With and Without Chronic Rhinosinusitis With Nasal Polyposis at Baseline for Patients With at Least One Consumption.*

	CRSwNP, N = 10,841	Reference Group, N = 10,841	*P* Value
Drug, n; mean (SD)			
OCS prescription	3,169; 1.88 (1.77)	1,497; 1.60 (1.41)	<.001
Macrolide prescription	3,085; 1.56 (1.06)	1,663; 1.32 (0.70)	<.001
Healthcare utilization, n; mean (SD)			
Inpatient days†	530; 5.31 (5.79)	518; 6.17 (9.45)	.075
Hospital admissions‡	530; 1.22 (0.64)	518; 1.27 (0.72)	.207
ER visits	2,242; 1.56 (1.42)	1,816; 1.52 (1.22)	.362
Ambulatory visits	1,154; 1.38 (1.15)	963; 1.40 (1.65)	.746
Office visits	10,329; 12.34 (13.64)	9,579; 9.63 (12.52)	<.001

*Data are for observed values only.

†Inpatient days included the number of days for patients staying in the hospital during baseline.

‡Hospitalization admissions were the number of episodes of hospitalizations during baseline.

CRSwNP = chronic rhinosinusitis with nasal polyposis; ER = emergency room; OCS = oral corticosteroids; SD = standard deviation.

TABLE IV.
Comorbidities, Treatment and Procedure Patterns, and Healthcare Resource Utilization Among Chronic Rhinosinusitis With Nasal Polyposis Patients and Controls at Follow-up.

	Follow-up		
	CRSwNP, N = 10,841	Reference Group, N = 10,841	*P* Value
CCI, mean (SD)	0.58 (1.09)	0.40 (0.98)	<.001
Comorbidities, n (%)			
Asthma	2,255 (20.8)	873 (8.1)	<.001
Allergic rhinitis	5,776 (53.3)	806 (7.4)	<.001
Drug treatment, n (%)			
OCS prescription	6,673 (61.6)	1,386 (12.8)	<.001
Macrolide prescription	3,237 (29.9)	1,480 (13.7)	<.001
Procedure, n (%)			
Sinus surgery (FESS), with or without polypectomy	4,624 (42.7)	0 (0.0)	<.001
Polypectomy only	348 (3.2)	0 (0.0)	<.001
Nasal endoscopy	6,548 (60.4)	27 (0.2)	<.001
CT scan	7,496 (69.1)	28 (0.4)	<.001

CCI = Charlson Comorbidity Index; CRSwNP = chronic rhinosinusitis with nasal polyposis; CT = computed tomography; FESS = functional endoscopy sinus surgery; OCS = oral corticosteroids; SD = standard deviation.

TABLE V.
Mean Number of Systemic Prescriptions and Healthcare Utilization for Patients With and Without Chronic Rhinosinusitis With Nasal Polyposis at Follow-up for Patients With at Least One Consumption.*

	CRSwNP, N = 10,841	Reference Group, N = 10,841	*P* Value
Drug and procedure, n;† mean (SD)‡			
OCS prescription	6,673; 2.14 (1.75)	1,386; 1.58 (1.44)	<.001
Macrolide prescription	3,237; 1.52 (1.03)	1,480; 1.29 (0.65)	<.001
Healthcare utilization, mean (SD)			
Total no. of inpatient days	657; 6.54 (9.91)	568; 6.90 (10.44)	.536
Total no. of hospital admissions	657; 1.29 (0.71)	568; 1.30 (0.90)	.741
Total no. of ER visits	2,589; 1.64 (1.60)	1,759; 1.55 (1.39)	.06
Total no. of office visits	10,836; 18.63 (15.76)	9,604; 9.79 (12.86)	<.001
Total number of ambulatory visits	3,536; 1.34 (1.17)	947; 1.52 (2.22)	<.001

*Data are for observed values only.
†Number of patients with at least one prescription.
‡Mean number of prescriptions.
CRSwNP = chronic rhinosinusitis with nasal polyposis; ER = emergency room; OCS = oral corticosteroids; SD = standard deviation.

Treatment patterns and procedures. Prescriptions for one or more OCS or macrolide were significantly higher in the CRSwNP cohort versus the reference group (61.6% vs. 12.8% and 29.9% vs. 13.7%; both $P < .001$) (Table IV). Patients with CRSwNP received significantly more mean yearly OCS prescriptions than the reference group (2.1 [1.8] vs. 1.6 [1.4], respectively; $P < .001$) (Table V). Among patients with CRSwNP, FESS was the primary surgical procedure, and within 1 year of diagnosis, 42.7% of patients underwent FESS (with or without polypectomy) (Table IV).

Healthcare resource utilization and costs during follow-up. During follow-up, the CRSwNP cohort had 3.7 times greater usage of ambulatory care services versus the reference group (32.6% vs. 8.7%, respectively; $P < .001$). All patients with CRSwNP (100%) had an office visit versus 88.6% of the reference group ($P < .001$), and visits were twice as frequent (18.6 [15.8] vs. 9.8 [12.9], respectively; $P < .001$) (Table V). In the year before diagnosis, ambulatory visits did not differ significantly between the cohorts; however, a difference was observed in office visits, although the magnitude of difference (1.3 times) was much lower than during follow-up (18.6 [15.8] vs. 9.8 [12.9], respectively; $P < .001$) (Table V).

During follow-up, the CRSwNP cohort had significantly higher mean annual total healthcare costs versus the reference group (Fig. 1; all $P < .001$). Increased costs resulted in a total cost of $18,964 for the CRSwNP cohort and $7,457 for the reference group, equating to a significant incremental cost of $11,507 for the CRSwNP cohort. Incremental cost differences for medical and pharmacy expenses versus the reference group were $10,475 and $1,033, respectively (both $P < .001$). In the year before diagnosis, the CRSwNP cohort had a significant overall incremental difference of $1,067 versus the reference population. This difference increased almost 11 times at follow-up versus the reference population. Among the CRSwNP cohort at follow-up, medical costs made up the largest proportions of costs ($16,247 of $18,964) (Fig. 1).

Costs Across Different Subgroups

Among patients with CRSwNP undergoing FESS, a total cost of $26,724 was incurred, equating to an incremental cost of $13,532 among patients with CRSwNP undergoing FESS versus patients with CRSwNP not undergoing FESS (Fig. 2A). Among patients with CRSwNP

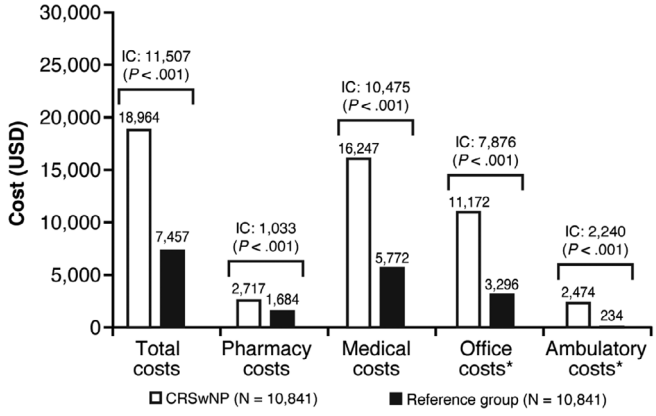

Fig. 1. Difference in healthcare costs between patients with chronic rhinosinusitis with nasal polyposis and controls at follow-up. *Office costs and ambulatory costs make up medical costs. CRSwNP = chronic rhinosinusitis with nasal polyps; IC = incremental costs; USD = United States dollars.

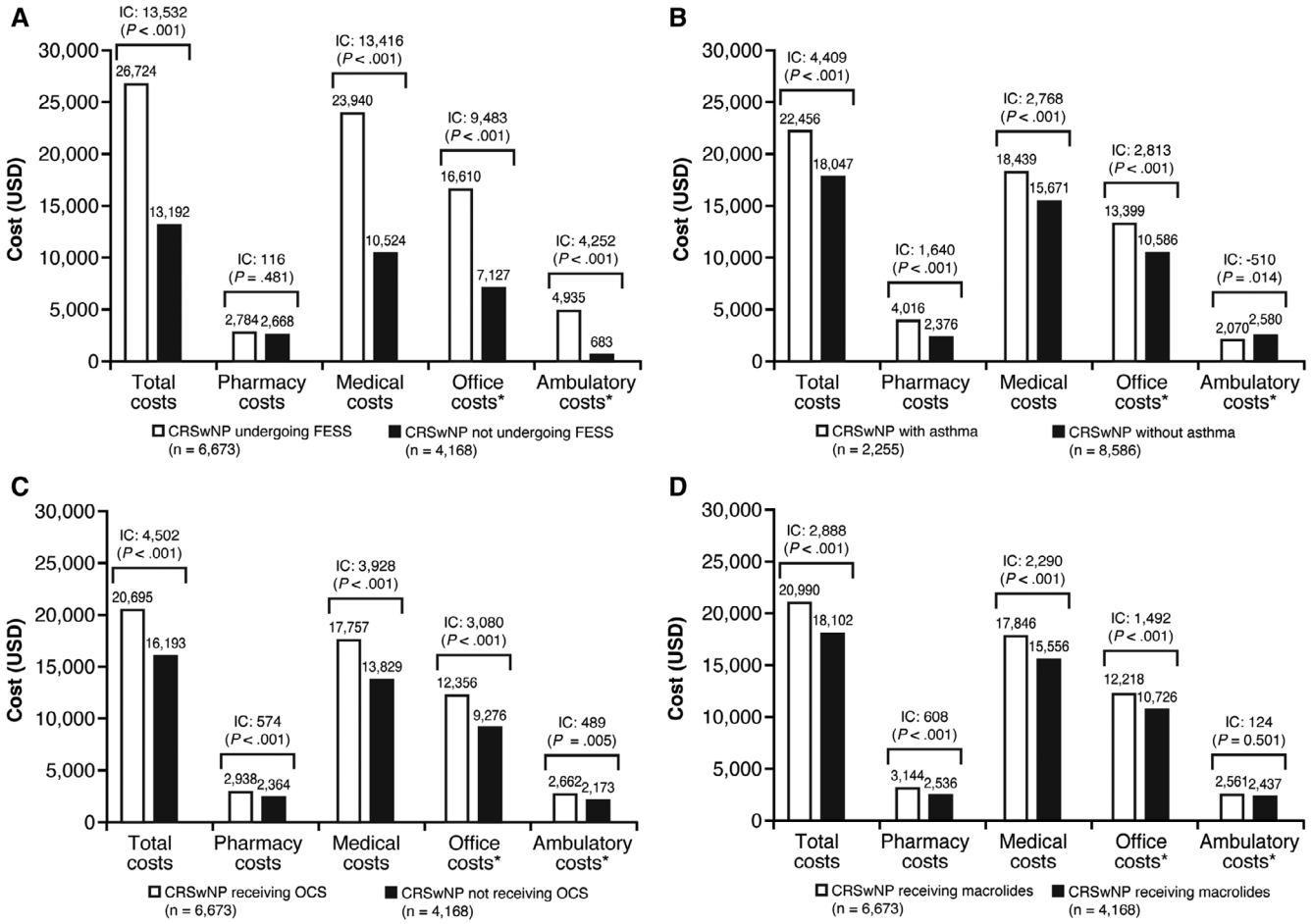

Fig. 2. Mean annual healthcare costs among patients with chronic rhinosinusitis with nasal polyposis. (A) Undergoing and not undergoing functional endoscopic sinus surgery. (B) With and without asthma. (C) Receiving and not receiving oral corticosteroids. (D) Receiving and not receiving macrolides. CRSwNP = chronic rhinosinusitis with nasal polyposis; IC = incremental costs; USD = United States dollar *Office costs and ambulatory costs make up medical cost.

with comorbid asthma, a total cost of $22,456 was incurred, equating to an incremental cost of $4,409 among patients with CRSwNP with comorbid asthma versus patients with CRSwNP without comorbid asthma (Fig. 2B). Patients with CRSwNP receiving OCS, had higher total costs than patients with CRSwNP not receiving OCS ($20,659 vs. $16,193, respectively), resulting in an incremental cost of $4,502 (Fig. 2C). Patients with CRSwNP receiving a macrolide had higher total costs than patients not receiving a macrolide ($20,990 vs. $18,102, respectively), resulting in an incremental cost of $2,888 (Fig. 2D).

DISCUSSION

In the US, ~11.1 million adults have diagnosed CRS, equating to 4.9% of the US population.[5] The prevalence of NP among patients with CRS in the US varies from 25% to 30%[6]; however, the Centers for Disease Control and Prevention believe the overall population prevalence in the US is higher.[18] Although costs and HCRU have been determined among patients with CRS, no data exist on the disease management costs of CRSwNP. Given the prevalence and chronicity of CRSwNP, its association with type-2 inflammatory comorbidities, and the utilization of systemic treatments[19] and surgery, it is important to establish the disease-specific clinical and economic burden of CRSwNP. This evidence would assist in healthcare policy decision making and cost containment relating to this population.

The link between CRSwNP and asthma is well established. A previous study showed a 3.5-fold increase in comorbid asthma prevalence among patients with CRS,[20] and other studies have shown that asthma tends to be more severe and exacerbation-prone in this patient population.[7,9,12,21–23] Similarly, our study indicates that the CRSwNP cohort had a higher burden of asthma and allergic rhinitis versus the reference group (20.8% vs. 8.1% and 53.3% vs. 7.4%, respectively; both $P < .001$), signifying the importance of holistic management of CRSwNP across different specialties. A decrease in asthma prevalence was observed in the reference group from baseline to follow-up (12.4% to 8.1%); however, this could be due to real-world practice, not a decrease in asthma diagnosis, and is similar to the population estimates of asthma in the US.[24] Potentially, patients may not have sought care for asthma during follow-up, possibly due to having milder disease, thus were not diagnosed during the study period. Conversely, patients with CRSwNP were more likely to visit their

physicians (all patients with CRSwNP had an office visit versus 88.6% of the reference group; $P < .001$), increasing the chance of asthma diagnosis.

In our study, the CRSwNP cohort had a greater use of OCS and macrolides versus the reference group during follow-up; however, macrolides were used less frequently (61.6% vs. 12.8% and 29.9% vs. 13.7%, respectively; both $P < .001$). These findings are similar to previous studies, demonstrating that OCS are most consistently recommended as acute oral therapy to treat patients with moderate-to-severe CRSwNP[25]; therefore, our results are as expected. However, this is the first study demonstrating the increased use of OCS and macrolides among patients with CRSwNP. Although it is not possible to completely attribute the greater use of OCS and macrolides purely to CRSwNP treatment with the current methodology, these results, which are based on adjustment for the presence of asthma and chronic obstructive pulmonary disease, show the number of patients receiving OCS and macrolides in real practice and the impact on the economic burden of the disease.

During follow-up, significantly more patients within the CRSwNP cohort underwent endoscopy or had a CT scan versus the reference group (60.4% vs. 0.2% and 69.1% vs. 0.4, respectively; both $P < .001$), which correlates with the use of endoscopy and CT scans for clinical assessment and diagnosis of CRSwNP. In the US, FESS is widely considered the standard surgical intervention for CRSwNP,[12,26] and in this study, 42.7% of patients with CRSwNP underwent FESS. A previous study of patients with CRS found that 46.2% underwent endoscopic sinus surgery[13]; therefore, although our results were as expected, we believe that this is one of the first times such data have been reported in patients with CRSwNP specifically.

Medical costs were the major drivers for higher cost among the CRSwNP cohort. Although it is possible that the higher burden of comorbidities in the CRSwNP group may have contributed to the increased costs and HCRU, the results of this study are similar to previous studies in which patients with CRS had 6% more total costs than the general population of adults.[15] It should be noted that patients were matched based on CCI, and patients in both cohorts had to have at least one comorbidity, which could differ. Therefore, the reference group does not represent a healthy population norm, and the incremental burden is comparative to a nonhealthy reference group.

Patients with CRSwNP with comorbid asthma, receiving OCS or macrolides, or undergoing FESS are considered to be high-burden patients; therefore, associated costs were examined accordingly in these subgroups ($26,724, $22,456, $20,695, and $20,990, respectively). These subgroups are also considered to be refractory, as OCS is the last medical treatment for this particular patient group, before patients move on to surgery.

Study Limitations

There are several explanations for the increase in asthma during follow-up. As asthma is associated with CRSwNP, patients could also have been assessed for their asthma while being treated for NP. Alternatively, as CRSwNP makes underlying asthma poorly controlled and symptomatic, it may draw attention to the consideration of an asthma diagnosis. Future studies with a longer follow-up may help to understand the relationship between CRSwNP and asthma development.

The study used the Truven Health MarketScan US database, which includes enrollees insured commercially or as part of the national Medicare program. Therefore, costs for medical services reimbursed by other insurers or paid solely by beneficiaries out-of-pocket might not be captured, potentially underestimating the cost burden.

Our study did not consider the economic burden of indirect costs such as missed work or school in relation to CRSwNP, as they are not sufficiently reported in the US claims data to allow such investigation; therefore, the overall cost to society in relation to CRSwNP may be underestimated.

Additionally, the economic burden could be reflective of more recently diagnosed patients or patients not using or accessing the healthcare system frequently. Patients included in the study did not have a CRSwNP diagnosis or sinus surgery during the year before the index date; however, whether patients ever had a CRSwNP diagnosis or sinus surgery was not assessed.

Finally, it would have been beneficial to observe the change in economic burden over time, to determine whether costs stabilized after surgery. However, our study only examined patients for 1 year after the index date; therefore, it was not possible to assess this within the current dataset. In addition, the recurrence rate of CRSwNP after surgery varies from 20% to 60% within 18 months to 4 years follow-up, depending on the study period, which may also affect cost and HCRU over time. Future studies with a longer follow-up may help to understand whether the economic burden levels out or decreases following medical therapy, and may help to better understand the lifetime economic burden of the disease.

CONCLUSION

Patients with CRSwNP had more asthma and allergic rhinitis diagnoses, greater utilization of OCS and macrolides, and more office and ambulatory care visits versus patients without CRS, translating into significantly higher annual incremental costs. When extrapolated to the US population, patients with CRSwNP display an annual overall healthcare cost burden of $5.7 billion. In addition, patients with CRSwNP with high disease burden had higher overall costs and HCRU versus patients with CRSwNP only. Taken together, these data suggest an unmet clinical need for more effective therapies for patients with CRSwNP. Further research among chronic patients with less frequent usage of the healthcare system would be beneficial to assess economic burden across a wider population. However, we hope that this study will aid policy makers and stakeholders to understand the direct costs of CRSwNP.

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