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Original Article

Real-World Assessment of Asthma Specialist Visits Among U.S. Patients with Severe Asthma

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What is already known about this topic? The 2007 guidelines of the U.S. National Heart, Lung, and Blood Institute recommend that patients with severe asthma be referred to an asthma specialist, such as an allergist or pulmonologist, for systematic assessment or comanagement.

What does this article add to our knowledge? Asthma specialist care appeared to be underutilized by commercially insured U.S. patients with severe asthma, with only 38% having an observed specialist visit within 2 years.

How does this study impact current management guidelines? There is a need to increase specialist consultation/comanagement for patients with severe asthma. This can be aided by recognizing patient characteristics associated with a reduced likelihood of specialist visits.

BACKGROUND: U.S. guidelines recommend that patients with severe asthma be referred to specialists (allergists/immunologists or pulmonologists) for systematic assessment or comanagement; however, contemporary, real-world data on the frequency and impact of specialist care among U.S. severe asthma patients are lacking.

OBJECTIVES: To quantify the frequency of asthma specialist visits among U.S. patients with severe asthma, identify patient demographic and clinical characteristics associated with specialist visits and describe health outcomes following specialist care.

METHODS: Severe asthma patients aged 6 years or older were identified between January 1, 2015, and December 31, 2017, in the IQVIA PharMetrics® Plus database of commercially insured individuals, based on Healthcare Effectiveness Data and Information Set (HEDIS) criteria and Global Initiative for Asthma (GINA) step 4 or 5 treatment regimens. The frequency of asthma specialist (allergist/immunologist or pulmonologist) visits was described over 2 years. Patient characteristics associated with having 1 or more specialist visits were analyzed using multivariate regressions. Asthma exacerbations and health care resource utilization before and after specialist visit were compared.

RESULTS: Of 54,332 patients identified, 38.2% had 1 or more specialist visits over 2 years. Patient characteristics predictive of specialist visits were asthma exacerbation frequency, younger age, and allergy/respiratory comorbidity burden (all $P < .001$). Among patients with 1 or more specialist visits, a lower prevalence of asthma exacerbations and rescue inhaler use was observed following the first observed specialist visit.

CONCLUSIONS: Specialist care was observed in fewer than half of U.S. patients with severe asthma and was least frequent among older adult patients and those with more nonrespiratory comorbidities. Increased specialist involvement in managing severe asthma may help improve care and patient outcomes. **(J Allergy Clin Immunol Pract 2021;9:3662-71)**

Key words: *Severe asthma; Global Initiative for Asthma; Specialist visits; Allergists/immunologists; Pulmonologists; Asthma exacerbation; Health care resource utilization*

INTRODUCTION

Asthma affects 25 million individuals in the United States, representing approximately 7.7% of adults and 7.5% of children

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Abbreviations used
CCI- Charlson Comorbidity Index
ED- Emergency department
GINA- Global Initiative for Asthma
HEDIS- Healthcare Effectiveness Data and Information Set
HCRU- Health care resource utilization
ICS- Inhaled corticosteroid
LABA- Long-acting beta-2 agonist
OCS- Oral corticosteroid
SABA- Short-acting beta-2 agonist

and adolescents.[1,2] Although severe asthma patients make up only a small segment of the total asthma population, they disproportionally account for a large proportion of asthma morbidity and cost based on the incidence of exacerbations, hospitalizations, and other health care utilization.[3]

The goal of asthma management is to achieve asthma control, which can be complicated by the heterogeneous nature of severe asthma.[4] The majority of patients with asthma can be well managed with low-dose inhaled corticosteroid (ICS) and long-acting beta-2 agonist (LABA) therapy; however, approximately 5% to 10% of patients have severe asthma and require higher-dose ICS with additional controllers, add-on biologics, or maintenance systemic corticosteroids.[5-8] The 2007 guidelines of the U.S. National Heart, Lung, and Blood Institute recommend patients with severe asthma be referred to an asthma specialist (allergist/immunologist or pulmonologist) for systematic assessment or comanagement to identify inflammatory endotypes, risk factors, and comorbidities.[9] Specialist referral is especially indicated for patients requiring Global Initiative for Asthma (GINA) step 4 or 5 therapy, with multiple bursts of oral corticosteroids (OCS) in a year, or patients with an exacerbation requiring hospitalization.[9]

Primary care providers play a fundamental role in asthma management, but co-management with a specialist can have several meaningful benefits. Specialists commonly evaluate a patient's asthma phenotype/endotype and investigate comorbidities, perform differential diagnoses, provide multidisciplinary team care, and more frequently, possess the infrastructure to prescribe and administer novel injectable biologic therapies.[10] There is evidence that patients may receive more guideline-based care from specialists owing to their additional training in the therapeutic area.[11]

Despite the potential value of specialist care and co-management, few studies have examined receipt of asthma specialist care in U.S. real-world clinical practice, especially in patients with severe asthma. Existing literature on specialist visits is limited to the overall asthma population and analyses based on self-reported survey data[12,13] or clinical data contributed by providers.[14] Furthermore, there is little knowledge of how patient characteristics are associated with receiving specialist care. Such knowledge could help inform the need for specialist involvement with the care of patients with severe asthma and help mitigate the burden of disease and improve outcomes.

This study was conducted to quantify the frequency of asthma specialist visits among U.S. patients with severe asthma, identify patient demographic and clinical characteristics associated with specialist visits, and describe patient health outcomes following specialist visits by analyzing data from a large U.S. health care claims database.

METHODS

Study population

This retrospective cohort study analyzed administrative claims data from the IQVIA PharMetrics® Plus database from January 1, 2014, through December 31, 2018. PharMetrics® Plus comprises de-identified, longitudinal medical and pharmacy claims as well as enrollment data of more than 150 million commercially insured individuals from all 50 states and the District of Columbia since 2006. Detailed patient selection criteria are shown in Figure 1.

The primary study population included patients who were aged 6 years or older with evidence of severe asthma between January 1, 2015, and December 31, 2017, in the PharMetrics® Plus database. Evidence of severe asthma was defined by a claims-based algorithm,[15,16] in which a patient was required to meet the adapted Healthcare Effectiveness Data and Information Set (HEDIS) definitions for persistent asthma[17] and have evidence of a GINA Step 4 or 5 treatment regimen.[10] The index date was set on the first identified prescription for a GINA step 4 or 5 regimen. Eligible patients were required to have at least 12 months of continuous enrollment for both medical and pharmacy coverage before (preindex) and after (postindex) the index date. A second study population was similarly constructed using a broader data window (January 1, 2007, to December 31, 2018) to evaluate the annual trend of asthma specialist visits from 2008 to 2017. A population of patients with moderate asthma was also identified similarly, with HEDIS definitions of persistent asthma and evidence of GINA step 3 regimens (Figure E1; available in this article's Online Repository at www.jaci-inpractice.org), to serve as a reference population for patients with severe asthma.

Outcome assessment

The primary outcome was occurrence of an asthma specialist visit, which was assessed during the 2-year observation period (pre- and postindex periods). An asthma specialist visit was indicated by an outpatient/office visit claim with the service provider's specialty as allergy/immunology or pulmonology and an asthma diagnosis (International Classification of Diseases, Ninth or Tenth Revision [ICD-9/10] codes of 493.x and J45.x, excluding 493.2x for chronic obstructive asthma) in any position of the claim. Patient demographic characteristics, comorbidities (Charlson Comorbidity Index that excluded respiratory conditions [nonrespiratory CCI[18]] and the presence/absence of individual comorbid conditions), asthma exacerbations, and asthma-specific health care resource utilization (HCRU) were assessed separately for patients with (specialist visit cohort) and without (non-specialist visit cohort) evidence of an asthma specialist visit.

Asthma exacerbations and associated HCRU were assessed separately during the pre-index and post-index periods. Asthma exacerbations were identified using a published claims-based algorithm,[16,19,20] in which an exacerbation episode was defined in a 14-day cycle by requiring at least 1 of 3 medical events that are commonly incurred by asthma exacerbations. Such exacerbation events were (1) a hospitalization with a primary diagnosis of asthma, (2) an emergency department (ED) visit with an asthma diagnosis, and (3) an outpatient/office visit with an asthma diagnosis accompanied by at least 1 dispensing of OCS. Multiple events within 14 days were grouped as 1 episode.

All-cause and asthma-related HCRU included hospitalization, ED visits, outpatient/office visits, and pharmacy utilization. Asthma-related medical services required a coinciding asthma diagnosis. For

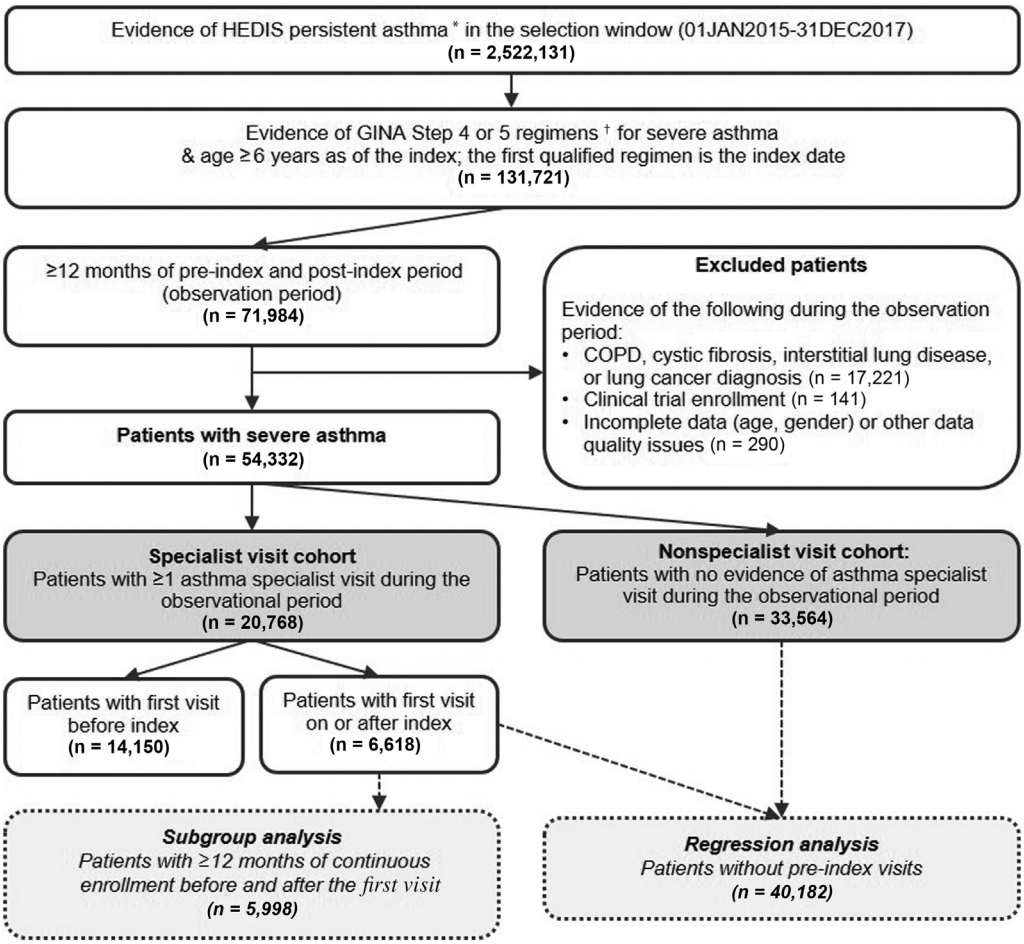

FIGURE 1. Patient attrition flow chart. *COPD,* chronic obstructive pulmonary disease. *Patients with HEDIS persistent asthma were required to have any of the following: (1) ≥1 asthma-related hospitalizations; (2) ≥1 asthma-related ED visits; (3) ≥4 asthma-related outpatient/office visits followed by ≥2 claims for asthma medications within 12 months; or (4) ≥4 claims for asthma medications within 12 mo. †Qualified GINA regimens included any of the following: (1) ≥2 claims of medium- to high-dose ICS/LABA within 90 d; (2) ≥2 claims of medium- to high-dose ICS with additional controllers within 90 d (≥2 claims of low-dose ICS with additional low-dose ICS/LABA combination or low-dose ICS with additional controller when taken together meet the definition of medium to high-dose ICS were also considered); (3) ≥1 claim of biologics; or (4) >6 mo cumulative supply of OCS within 12 mo.

asthma-related hospitalizations, an inpatient admission with a primary diagnosis of asthma was required. Asthma-related pharmacy utilization was identified by National Drug Codes of medications that are recommended for use as maintenance and/or rescue therapies for asthma.[10]

Statistical analysis

All study variables were reported separately for the specialist visit cohort and the nonspecialist visit cohort. The trend of asthma specialist visits was examined on the national level and by census region. Multivariable logistic regression was used to examine patient characteristics that were associated with having an asthma specialist visit. Adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) were estimated for all covariates. To ensure that the measurement of patient characteristics preceded the asthma specialist visit, patients with any pre-index record of an asthma specialist visit were excluded from the logistic regression analysis.

To evaluate the impact of specialist visit on exacerbations and HCRU, a subgroup analysis was performed among patients who had their first observed asthma specialist visit on or after the index date (n = 5,988; Figure 1); exacerbations and HCRU before and after the visit were compared using paired *t* test and McNemar test. All tests were conducted assuming a 2-tailed test of significance and alpha level set *a priori* at 0.05. All data management and analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

Ethics approval and informed consent

The claims data used in this study were previously collected and statistically deidentified and are compliant with the deidentification conditions set forth in Sections 164.514 (a)-(b)1ii of the Health Insurance Portability and Accountability Act of 1996 Privacy Rule. As such, the study did not require institutional review board review and approval or patient informed consent.

RESULTS

Prevalence of asthma specialist visits

Of 54,332 patients with severe asthma identified for the study, 38.2% (n = 20,768) had 1 or more visits to an allergist/

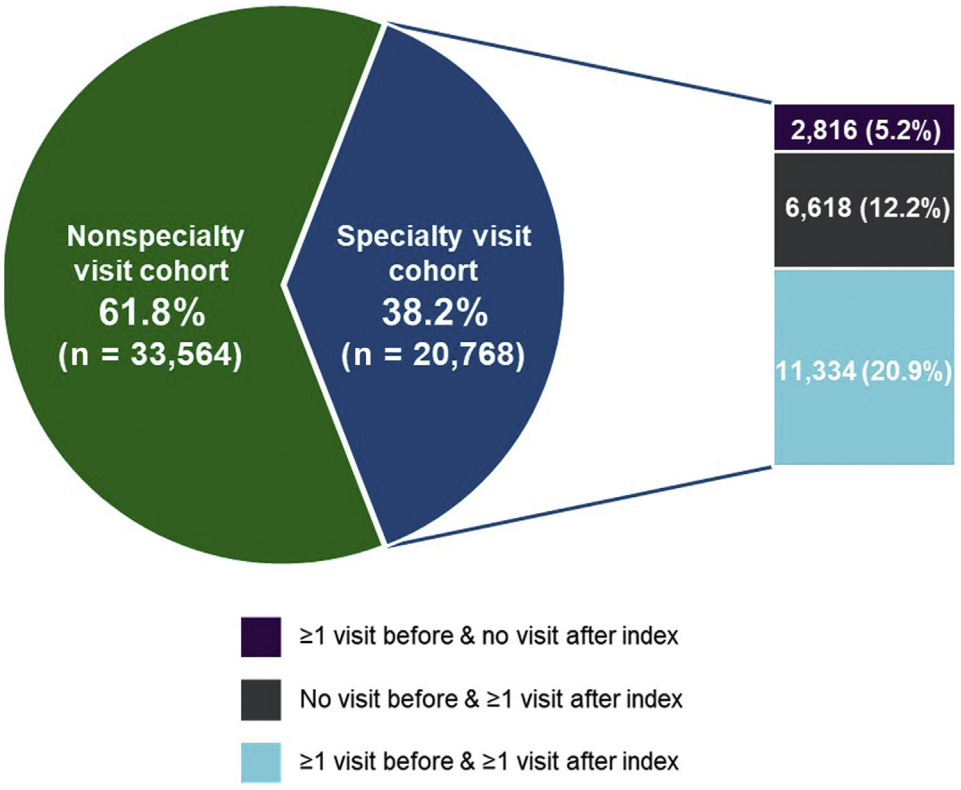

FIGURE 2. Asthma specialist visits in the 24-mo study period.

immunologist or a pulmonologist (ie, specialist visit cohort) in the 12 months before or after the first observed evidence of severe asthma for the patient in the database (Figure 1), with a mean (SD) of 5 (7) visits (median [interquartile range]: 3 [2-5]) during the 24-month period. About one-third of this specialist visit cohort had no record of an asthma specialist visit during the 12-month pre-index period (Figure 2). The majority (62.3%) of the specialist visit cohort visited an allergist/immunologist, 28.6% visited a pulmonologist, and 9.1% visited both specialties.

To contextualize the findings from the defined severe asthma cohort, specialist visits were also described among patients who met a definition of moderate asthma. Of 80,026 patients with moderate asthma identified, 30.3% (n = 24,261) had 1 or more visits to an asthma specialist in the 12 months before and/or 12 months after the first evidence of moderate asthma (Figure E1): 69.8% visited an allergist/immunologist, 24.6% visited a pulmonologist, and 5.6% visited both specialties.

National and regional trends in asthma specialist visits from 2008 to 2017

Among patients with severe asthma identified between 2008 and 2017 (n = 120,247), the proportion of patients with 1 or more visits to an allergist/immunologist or a pulmonologist during the 12 months before or after the first evidence of severe asthma increased from 32.3% in 2008 to 46.3% in 2017, with a sharp increase after 2015 (Figure 3). A similar trend was observed across all 4 geographic regions, with the largest increase observed in the Midwest (increased from 26.8% to 46.3%), and visits in the West fluctuating in recent years. Asthma specialist visits were consistently more common in patients in the Northeast and South compared with patients in the West and Midwest over time. However, regional differences reduced beginning in 2015 (Figure 3).

Patient characteristics associated with asthma specialist visits

In general, the specialist visit cohort and non-specialist visit cohort had similar demographic (Table I) and clinical characteristics (Table II). The majority of patients were female and covered by private insurers with Preferred Provider Organization plans and had a nonrespiratory CCI of 0. Allergic rhinitis and hypertension were the most common allergy/respiratory and non-allergy/respiratory comorbidities, respectively.

With regard to differences in demography between the 2 cohorts, the specialist visit cohort was younger than the non-specialist visit cohort (mean age: 37.3 vs 41.6 years, respectively). All allergy/respiratory-related conditions were more prevalent in the specialist visit cohort, whereas non-allergy/respiratory-related conditions except gastroesophageal reflux disease were more prevalent in the nonspecialist visit cohort. Furthermore, 42.9% of the specialist visit cohort had 1 or more exacerbation episodes during the pre-index period compared with 24.6% of the nonspecialist cohort.

Within the specialist visit cohort, patients visiting allergists/immunologists were younger (34.2 and 43.2 years) and had a

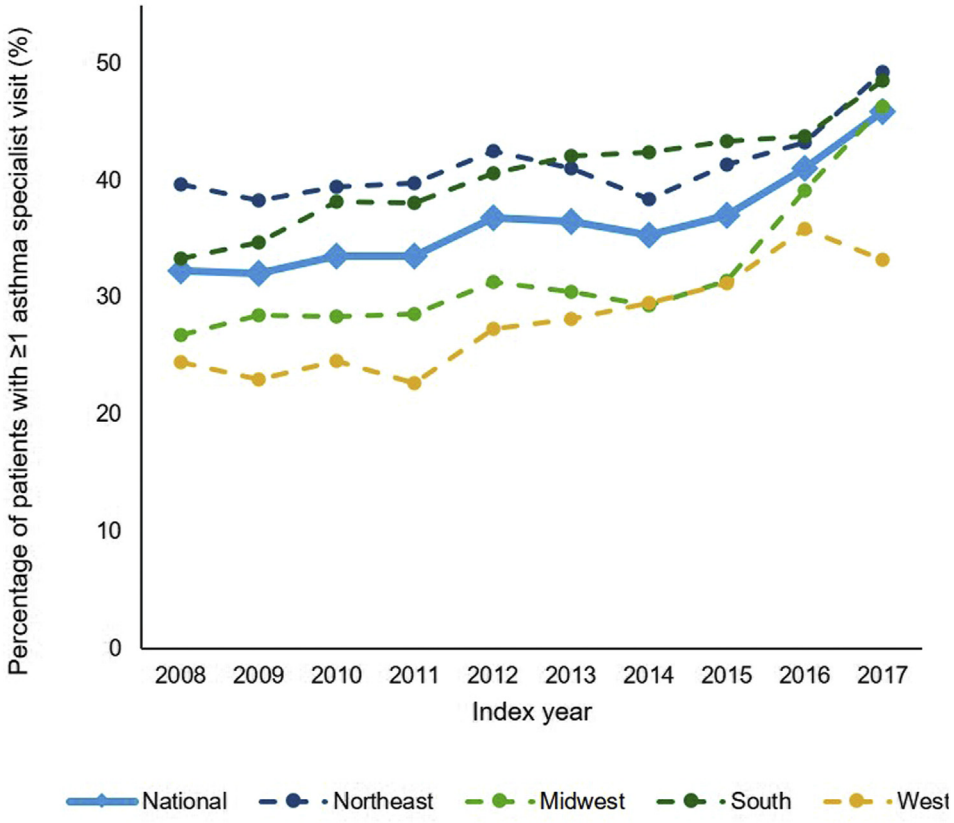

FIGURE 3. National and regional trend of asthma specialist visits from 2008 to 2017.

higher percentage of allergy/respiratory-related conditions (83.4% and 65.0%) than those visiting pulmonologists.

In adjusted analyses, the greatest predictors of having an asthma specialist visit were higher numbers of pre-index asthma exacerbations, younger age, and more recent index year (Figure 4). Patients aged 6 to 11 years were 61% more likely to have an asthma specialist visit than those aged 65 years or older (AOR, 1.61; 95% CI, 1.38-1.87; $P < .001$). Other characteristics positively associated with having asthma specialist visits included the presence of allergic rhinitis, chronic sinusitis, or gastroesophageal reflux disease, residing in the Northeast, and usage of ICS/LABA or short-acting beta-2 agonist (SABA) before being recognized as severe asthma. Conversely, a higher non-respiratory CCI was associated with lower odds of having an asthma specialist visit (eg, CCI ≥3 vs 0: AOR, 0.49; 95% CI, 0.42-0.57; $P < .001$). Other factors associated with lower odds of visit were being male, having anemia or hypertension, and using ICS monotherapy, leukotriene modifiers, or OCS before being recognized as severe asthma (Figure 4).

Patient health outcomes before and after an asthma specialist visit

A total of 5,988 patients were included in the subgroup analysis to evaluate outcomes before and after a specialist visit (Figure 1). In general, patients included in the subgroup analysis had similar demographic characteristics and baseline comorbidities of the overall specialist visit cohort. Compared with the 12 months before the first observed visit within the study period, the mean (SD) number of fills for controller medications (7.1 [5.4] pre vs 10.0 [6.7] post; $P < .001$) and the proportion of patients using any biologic for asthma (1.8% pre vs 2.5% post; $P < .001$) were significantly higher in the 12 months following the visit. The proportion of patients with any asthma exacerbations was significantly lower (37.7% post vs 49.4% pre; $P < .001$; Figure 5, *A*). Similar patterns were consistently observed for exacerbations across different levels of care (Figure 5, *A*). There was also a significantly lower proportion of patients with hospitalizations (all asthma-related 2.8% pre vs 1.1% post; all-cause 10.1% vs 8.2%), ED visits (asthma-related 15.9% pre vs 11.2% post; all-cause 34.8% vs 28.1%), or usage of rescue medications (any: 92.7% pre vs 81.7% post; SABA: 82.5% vs 66.6%; OCS: 100.0% vs 85.2%) during the 12 months after the first observed visit (all $P < .001$; Figure 5, *B*). Among patients with any rescue medication, the mean (SD) number of fills was also lower (5.2 [4.2] pre vs 4.9 [4.8] post; $P < .001$).

DISCUSSION

To our knowledge, this study is the first to provide a contemporary description of visits to allergists/immunologists or pulmonologists in commercially insured U.S. patients with severe asthma and to explore the associated impact of these visits on asthma outcomes in real-world clinical practice. Our findings suggest substantial underutilization of asthma specialist care, with only 4 in 10 patients with severe asthma seeing an allergist/immunologist or a pulmonologist over a 2-year observation period. Although it represents a higher visit

TABLE I. Patient demographic characteristics

Patient characteristics	Non-specialist visit cohort* n = 33,564	Specialist visit cohort†			
		All n = 20,768	Allergy/immunology only n = 12,940	Pulmonology only n = 5,946	Both specialties n = 1,882
Age,‡ y					
Mean (SD)	41.6 (20.3)	37.3 (20.6)	34.2 (20.6)	43.2 (19.5)	40.2 (19.7)
Median (IQR)	47 (22-58)	42 (15-55)	36 (13-53)	49 (30-59)	45 (22-57)
Minimum-maximum	6-83	6-83	6-83	6-83	6-82
Age categories (y), n (%)					
6-11	4,566 (13.6)	3,922 (18.9)	2,911 (22.5)	721 (12.1)	290 (15.4)
12-17	2,540 (7.6)	2,007 (9.7)	1,521 (11.8)	360 (6.1)	126 (6.7)
18-34	3,974 (11.8)	2,573 (12.4)	1,748 (13.5)	608 (10.2)	217 (11.5)
35-64	19,676 (58.6)	11,177 (53.8)	6,194 (47.9)	3,829 (64.4)	1,154 (61.3)
≥65	2,808 (8.4)	1,089 (5.2)	566 (4.4)	428 (7.2)	95 (5)
Sex, n (%)					
Male	13,141 (39.2)	8,156 (39.3)	5,295 (40.9)	2,187 (36.8)	674 (35.8)
Female	20,423 (60.8)	12,612 (60.7)	7,645 (59.1)	3,759 (63.2)	1,208 (64.2)
Census region, n (%)					
Northeast	7,265 (21.6)	5,221 (25.1)	2,960 (22.9)	1,700 (28.6)	561 (29.8)
Midwest	9,977 (29.7)	5,205 (25.1)	3,547 (27.4)	1,243 (20.9)	415 (22.1)
South	9,252 (27.6)	6,790 (32.7)	4,209 (32.5)	1,966 (33.1)	615 (32.7)
West	6,570 (19.6)	3,032 (14.6)	1,959 (15.1)	853 (14.3)	220 (11.7)
Unknown/missing	500 (1.5)	520 (2.5)	265 (2)	184 (3.1)	71 (3.8)
Payer type, n (%)					
Commercial Medicaid/Medicare	4,205 (12.5)	2,206 (10.6)	1,120 (8.7)	869 (14.6)	217 (11.5)
Medicaid	3,733 (11.1)	2,049 (9.9)	1,026 (7.9)	817 (13.7)	206 (10.9)
Medicare	472 (1.4)	157 (0.8)	94 (0.7)	52 (0.9)	11 (0.6)
Non−Medicaid/Medicare commercial	29,127 (86.8)	18,371 (88.5)	11,727 (90.6)	5,005 (84.2)	1,639 (87.1)
Private	17,249 (51.4)	10,997 (53)	7,103 (54.9)	2,921 (49.1)	973 (51.7)
Employer-sponsored	11,878 (35.4)	7,374 (35.5)	4,624 (35.7)	2,084 (35)	666 (35.4)
Other/unknown	232 (0.7)	191 (0.9)	93 (0.7)	72 (1.2)	26 (1.4)
Plan type, n (%)					
HMO	6,522 (19.4)	3,891 (18.7)	2,085 (16.1)	1,409 (23.7)	397 (21.1)
PPO	24,906 (74.2)	15,523 (74.7)	10,086 (77.9)	4,096 (68.9)	1,341 (71.3)
Other§	2,136 (6.4)	1,354 (6.5)	769 (5.9)	441 (7.4)	144 (7.7)

HMO, Health maintenance organization; *IQR,* interquartile range; *PPO,* preferred provider organization.
*Patients without any specialist visit for asthma within 12 mo before and 12 mo after the index date (including the index date).
†Patients with ≥1 asthma specialist visit in the 24-mo observation period (12 mo before and 12 mo after the index date, including the index date).
‡Patient age is capped at 85 y in the database.
§Other plan types included point-of-service, consumer-directed, indemnity, and others.

frequency than that observed among patients with moderate asthma, the finding that only 38% of commercially insured U.S. patients with severe asthma saw an asthma specialist during a 2-year window is an important observation that is consistent with previous work and represents a potential target for future asthma care improvement. Although not specific to the severe asthma population for whom specialist consultation is recommended in guidelines, previous studies have similarly suggested under-utilization of specialist care in U.S. patients with asthma. Murphy et al[13] reported only 22% of patients had visited a specialist for asthma management in the past 12 months and almost 50% had never visited an asthma specialist, based on a telephone survey of 2,500 patients and their physicians. Also, in a study analyzing 2008 to 2017 data from Asthma IQ (a tool developed by the American Academy of Allergy, Asthma, and Immunology to help asthma specialists provide guideline-based care), 44% of patients with asthma had specialist visits. However, this prevalence likely represents an overestimation because Asthma IQ was more commonly used by specialists than by primary care providers.[14]

When examining trends in asthma specialist visits over a 10-year period, we observed a trend of more specialist visits over time in all regions of the United States. The proportion of patients having a specialist visit increased by 43% overall, with reduced regional differences over time. The increase in specialist visits in recent years may be related to improved access to care led by legislative health care reforms (eg, coverage expansion in 2014[21]), increased patient education from various sources (eg, information availability via the internet, marketing materials of novel therapies such as biologics), and/or enhanced coding of asthma through ICD-10 implementation in administrative claims. However, future studies are warranted to understand barriers to asthma specialist visits to continue expansion of this trend, especially in areas with lower visit rates (eg, West region).

We found that number of exacerbations in the 12 months prior to visit, younger age, residency in the Northeast, and more

TABLE II. Patient clinical characteristics in the 12-month pre-index period

Patient characteristics	Non-specialist visit cohort* n = 33,564	Specialist visit cohort†			
		All n = 20,768	Allergy/immunology only n = 12,940	Pulmonology only n = 5,946	Both specialties n = 1,882
Nonrespiratory CCI‡					
Mean (SD)	0.7 (1.4)	0.4 (0.9)	0.3 (0.8)	0.6 (1.2)	0.4 (1.0)
Median (IQR)	0 (0-1)	0 (0-0)	0 (0-0)	0 (0-1)	0 (0-0)
Minimum-maximum	0-17	0-10	0-9	0-10	0-10
Nonrespiratory CCI categories, n (%)					
0	22,174 (66.1)	16,644 (80.1)	10,993 (85.0)	4,205 (70.7)	1,446 (76.8)
1	5,487 (16.3)	2,225 (10.7)	1,098 (8.5)	894 (15.0)	233 (12.4)
2	2,943 (8.8)	1,135 (5.5)	546 (4.2)	471 (7.9)	118 (6.3)
≥3	2,960 (8.8)	764 (3.7)	303 (2.3)	376 (6.3)	85 (4.5)
Comorbidities of interest, n (%)					
Allergy/respiratory-related	16,496 (49.1)	16,285 (78.4)	10,790 (83.4)	3,862 (65.0)	1,633 (86.8)
Allergic rhinitis	9,922 (29.6)	13,487 (64.9)	9,728 (75.2)	2,359 (39.7)	1,400 (74.4)
Chronic sinusitis	3,654 (10.9)	4,066 (19.6)	2,538 (19.6)	979 (16.5)	549 (29.2)
Nasal polyps	643 (1.9)	1,008 (4.9)	684 (5.3)	203 (3.4)	121 (6.4)
Obstructive sleep apnea	2,741 (8.2)	2,131 (10.3)	755 (5.8)	1,037 (17.4)	339 (18.0)
Pneumonia	2,240 (6.7)	1,732 (8.3)	770 (6.0)	682 (11.5)	280 (14.9)
Eczema/atopic dermatitis	3,900 (11.6)	3,441 (16.6)	2,412 (18.6)	708 (11.9)	321 (17.1)
Nonallergy/respiratory-related	22,474 (67.0)	12,782 (61.5)	7,171 (55.4)	4,277 (71.9)	1,334 (70.9)
Anemia	3,794 (11.3)	1,536 (7.4)	752 (5.8)	619 (10.4)	165 (8.8)
Avascular necrosis	82 (0.2)	36 (0.2)	20 (0.2)	11 (0.2)	5 (0.3)
Cataracts	1,949 (5.8)	932 (4.5)	483 (3.7)	357 (6.0)	92 (4.9)
Cerebrovascular disease	1,009 (3.0)	386 (1.9)	184 (1.4)	165 (2.8)	37 (2.0)
Depression/anxiety	7,528 (22.4)	4,500 (21.7)	2,596 (20.1)	1,424 (23.9)	480 (25.5)
Diabetes (type II)	4,013 (12.0)	1,655 (8.0)	761 (5.9)	709 (11.9)	185 (9.8)
Dyslipidemia	9,260 (27.6)	4,690 (22.6)	2,434 (18.8)	1,769 (29.8)	487 (25.9)
Dyspepsia	827 (2.5)	481 (2.3)	248 (1.9)	167 (2.8)	66 (3.5)
Fracture	1,540 (4.6)	923 (4.4)	559 (4.3)	260 (4.4)	104 (5.5)
Gastrointestinal ulcers/bleeds	28 (0.1)	20 (0.1)	9 (0.1)	9 (0.2)	2 (0.1)
GERD	6,281 (18.7)	4,928 (23.7)	2,614 (20.2)	1,663 (28.0)	651 (34.6)
Heart failure	889 (2.6)	326 (1.6)	117 (0.9)	173 (2.9)	36 (1.9)
Hypertension	10,785 (32.1)	4,810 (23.2)	2,348 (18.1)	1,953 (32.8)	509 (27.0)
Metabolic syndrome	259 (0.8)	139 (0.7)	67 (0.5)	51 (0.9)	21 (1.1)
Obesity	5,272 (15.7)	3,168 (15.3)	1,515 (11.7)	1,257 (21.1)	396 (21.0)
Osteoporosis	1,319 (3.9)	551 (2.7)	256 (2.0)	235 (4.0)	60 (3.2)
Rheumatoid arthritis	3,348 (10.0)	644 (3.1)	282 (2.2)	290 (4.9)	72 (3.8)
Pre-index exacerbation episodes,§ n (%)					
0	25,314 (75.4)	11,854 (57.1)	7,836 (60.6)	3,303 (55.5)	715 (38.0)
1	5,540 (16.5)	5,031 (24.2)	3,081 (23.8)	1,466 (24.7)	484 (25.7)
2	1,702 (5.1)	2,149 (10.3)	1,199 (9.3)	665 (11.2)	285 (15.1)
≥3	1,008 (3.0)	1,734 (8.3)	824 (6.4)	512 (8.6)	398 (21.1)
Type of exacerbation,‖ n (%)					
Defined by asthma-related hospitalization	210 (0.6)	281 (1.4)	107 (0.8)	109 (1.8)	65 (3.5)
Defined by asthma-related ED visit	2,927 (8.7)	2,632 (12.7)	1,396 (10.8)	859 (14.4)	377 (20.0)
Defined by asthma-related outpatient/office visit followed by OCS fills	6,211 (18.5)	7,492 (36.1)	4,327 (33.4)	2,150 (36.2)	1,015 (53.9)

GERD, Gastroesophageal reflux disease; *IQR,* interquartile range.

*Patients without any specialist visit for asthma within 12 mo before and 12 mo after the index date (including the index date).

†Patients with ≥1 asthma specialist visit in the 24-mo observation period (12 mo before and 12 mo after the index date, including the index date).

‡Nonrespiratory CCI was estimated with the Quan approach, excluding chronic pulmonary disease.

§An asthma exacerbation episode was evaluated for each 14-d period by having any of the following: (1) an hospitalization with asthma as the primary diagnosis; or (2) an asthma-related ED visit (mutually exclusive from inpatient and outpatient/office visit claims); or (3) an OCS prescription fill within 14 d of an asthma-related outpatient/office visit (an asthma-related ED visit or outpatient/office visit was defined as having an asthma diagnosis in any position on claims; exacerbation events that occur during a 14-d period were considered as 1 exacerbation episode, the 14-d period started with the first claim for an evidence of exacerbation).

‖The type of exacerbation was defined by the event on the first date of an episode; patients could have multiple events on the same day.

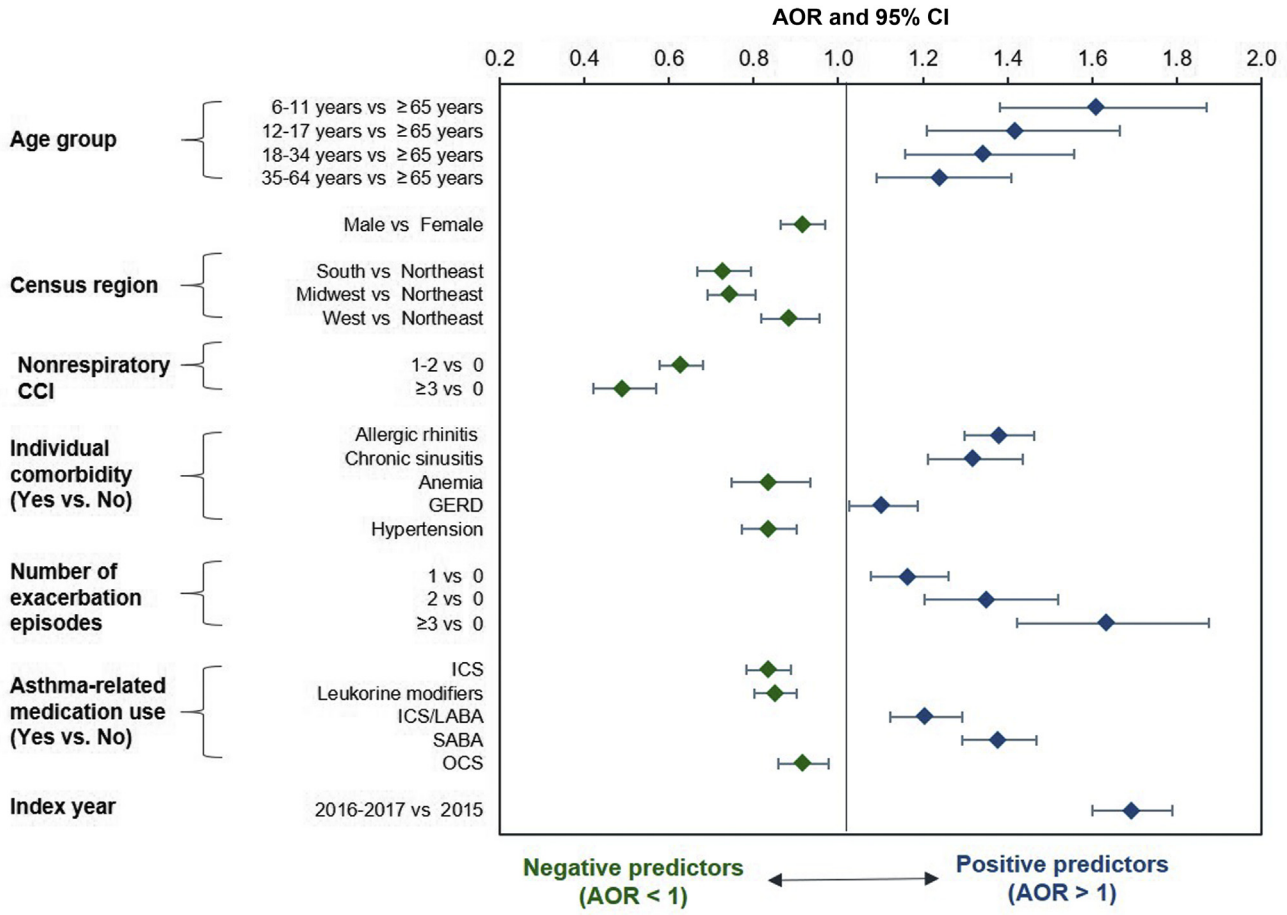

FIGURE 4. Patient characteristics associated with having an asthma specialist visit. *GERD,* gastroesophageal reflux disease.

recent calendar year, increased the odds of having 1 or more asthma specialist visits among patients with severe asthma. Consistent with previous literature,[14,22] patients with another allergy/respiratory comorbidity (eg, chronic sinusitis, allergic rhinitis) were more likely to visit an asthma specialist, particularly an allergist/immunologist. However, there is a clear gap in asthma specialist care for older adult patients and those with nonrespiratory comorbidities. One could speculate that patients with serious nonrespiratory comorbidities (eg, heart disease, diabetes mellitus) may prioritize care for these other conditions over seeing a specialist for asthma.[23] For some, financial constraints may require trade-off decisions between diseases. Our findings also suggest that geographic proximity to specialists plays an important role in receipt of specialist care. According to the 2019 Area Health Resource File, the number of asthma specialists per population is the highest in the Northeast (7.6 per 100,000 population vs 3.5, 4.6, and 4.8 per 100,000 in the West, Midwest, and South, respectively).[24,25] To that end, efforts to increase the number of asthma specialists or expand the reach of available specialists (eg, via telehealth technologies) may help increase asthma specialist visits.

Our results showed that, among patients with an asthma specialist visit, patient characteristics varied by the type of asthma specialist visited. Consistent with the findings of a previous study,[26] patients visiting a pulmonologist were more likely to be older adult patients with more nonrespiratory comorbidities and more frequent asthma exacerbations than those visiting an allergist/immunologist. Such findings most likely relate to differences in asthma specialist referral patterns and behaviors.

Our findings indicate that younger age was positively associated with having an asthma specialist visit, whereas the opposite was reported by 2 previous studies analyzing Asthma IQ data.[14,22] However, it is important to note that previous analyses did not adjust for asthma severity and the distribution of different comorbidities, which are likely important confounders of the association between age and an asthma specialist visit.[27] Another explanation of the observed discrepancy between our findings and previous studies may lie in the fact that, to increase the specificity of a severe asthma diagnosis, we excluded patients with chronic obstructive pulmonary disease, which can co-occur with asthma in older patients[28] and require care from a specialist, usually a pulmonologist.

Lastly, our results support the current evidence regarding the benefits of asthma specialist visits in managing severe asthma. Consistent with a prior survey study, we found a significantly lower proportion of patients with any asthma exacerbations, all-cause and asthma-related medical services (ie, hospitalization, ED visits), and the usage of rescue medications (SABA, OCS) within the 12 months following the first asthma specialist visit compared with before the specialist visit.[12] The lower prevalence of asthma exacerbations and lower HCRU observed may be linked to the increased use of controller medications observed in

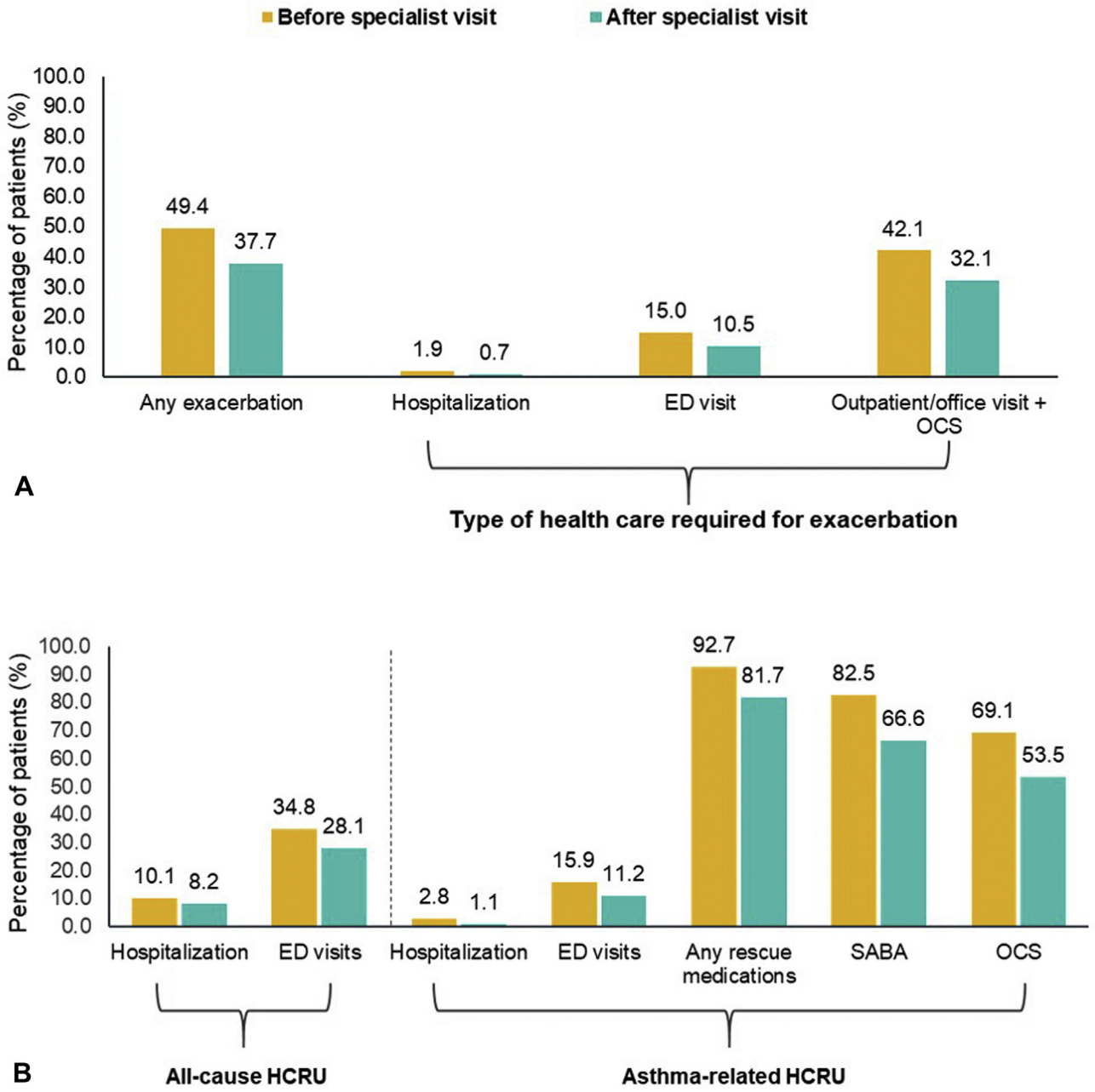

FIGURE 5. (**A**) Asthma exacerbations and (**B**) HCRU before and after the first asthma specialist visit.

the study. Although not specifically explored in this study, the improvements in asthma-specific outcomes are likely also attributable to the systematic evaluation of asthma by specialists. A French study of 175 patients referred to pulmonologists for severe asthma indicated that expert evaluation reduced OCS daily dose and hospitalization rates regardless of step-up in asthma therapy.[29] Similarly, a recent Australian study reported that nearly 90% of patients had significant improvement in at least 1 key asthma outcome after undergoing systematic assessment for difficult asthma in an expert center.[30]

Taken together, these findings underscore the need to increase specialist consultation/co-management for U.S. patients with severe asthma. However, several limitations should be considered when interpreting these study findings. First, the study estimated the proportion of patients with asthma specialist visits using claims data and did not directly capture asthma specialist referrals by primary care providers. This is important because the proportion of patients receiving specialist referrals is likely higher than those visiting the specialist, owing to barriers such as cost or proximity to specialists.[31] Second, patients seeking asthma care from providers identified as other specialties recorded on claims (eg, nurse practitioners or physician assistants certified in asthma care) or outside of the 24-month observation period would not have been captured in this study, resulting in potential underestimation of total asthma specialist visits. Third, there may be variation of asthma care between allergists/immunologists and

pulmonologists as well as across different specialists within the same subspecialty. Future studies are needed to explore the impact of specialist characteristics on asthma management and patient health outcomes. Furthermore, patient characteristics such as socioeconomic status and race/ethnicity are not captured in this database. These could be important predictors of receipt of specialist care and, therefore, could potentially confound the results. Given that patients with more asthma-related HCRU and asthma exacerbations were more likely to have an asthma specialist visit, the observed reductions in these outcomes after a specialist visit could be influenced by regression to the mean. The impact of specialist care on asthma outcomes needs to be further evaluated in studies that systematically and statistically compare outcomes between patients with and without a specialist visit, ideally between prospectively randomized cohorts. Lastly, although the study leveraged one of the largest commercial claims databases in the country, the study findings cannot be generalized to patients insured by public insurance (eg, Medicare/Medicaid) or uninsured patients. We anticipate lower utilization of specialist care in these patient populations who have more barriers to care. Studies examining asthma specialist visits in Medicare- and Medicaid-insured populations are warranted.

Based on analysis of a contemporary, real-world cohort, asthma specialist care was underutilized among commercially insured U.S. patients with severe asthma. A substantial gap in specialist care for severe asthma was present for older adult patients and those with more nonrespiratory comorbidities. The observed lower usage of rescue medications and medical services as well as lower prevalence of asthma exacerbations following a specialist visit highlight the potential benefit of specialists' involvement in managing severe asthma. Future studies are needed to further evaluate the impact of specialist involvement on asthma management. There is a need to increase appropriate specialist consultation/comanagement in this patient population by identifying and removing critical barriers to referral and receipt of beneficial care.

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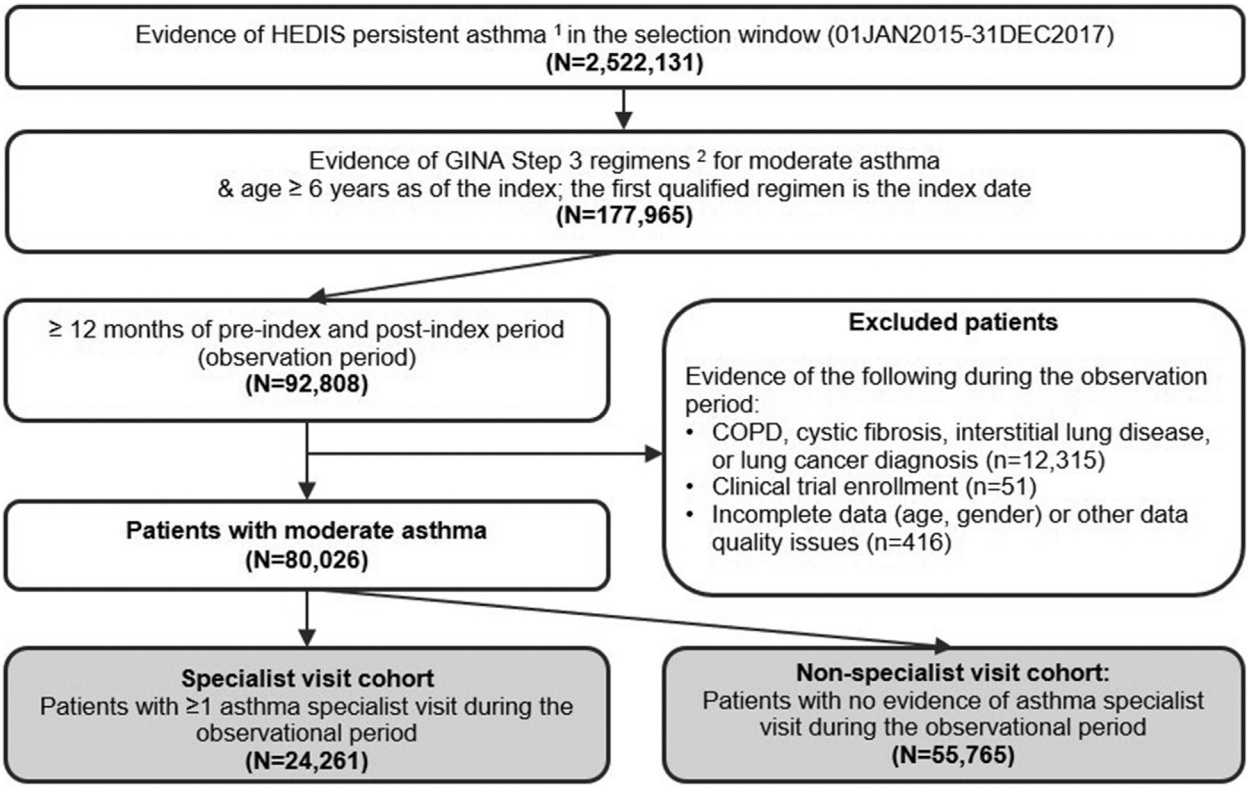

FIGURE E1. Attrition flow chart of patients with moderate asthma. *COPD,* Chronic obstructive pulmonary disease. *Patients with HEDIS persistent asthma were required to have any of the following: (1) ≥1 asthma-related hospitalizations; (2) ≥1 asthma-related ED visits; (3) ≥4 asthma-related outpatient/office visits followed by ≥2 claims for asthma medications within 12 mo; or (4) ≥4 claims for asthma medications within 12 mo. †Qualified GINA regimens included any of the following: (1) ≥2 claims of low dose ICS/LABA; (2) ≥2 claims of medium-dose ICS; (3) ≥2 claims of low-dose ICS with additional controllers.