

In vitro serum specific IgE testing alone reduces healthcare utilization and costs in South Carolina Medicaid-enrolled members with asthma

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Key Findings

- Results of the current study, which were shared at the South Carolina American Academy of Pediatrics CATCH Meeting Jan. 18–19, 2019, in Charleston, SC, are congruent with the concept that allergic inflammation is central to the pathogenesis of asthma, and interruption of this pathway results in improved disease control. [pg. 5](#)
- This study demonstrated that identification of environmental sensitization via serum sIgE testing resulted in significant asthma-related health utilization savings in a large Medicaid-enrolled population with asthma. [pg. 7](#)
- Significant cost savings for asthma-related inpatient and emergency department (ED)-associated cost savings on an annualized basis in the period after allergen testing compared to before. [pg. 4](#)
- There was a 75% reduction in asthma-associated hospitalizations and a 45% reduction in asthma-related ED admissions. [pg. 4](#)
- There was a shift in asthma medication utilization in the before- and after-testing period. This included a 28% reduction in the number of systemic steroid prescription fills and a 37% increase in the number of preventative inhaled corticosteroid fills. [pg. 4](#)

Abstract

In this retrospective study, Molina Health Care of South Carolina examined the impact of in vitro serum specific IgE testing (sIgE) alone utilizing asthma metrics of a large healthcare organization before and after organized, system-wide implementation of targeted allergen-reduction strategies. The study population consisted of South Carolina members of Molina Healthcare in 2017 who had a diagnosis of asthma and received serum sIgE testing. These members were both pediatric and adult, with 1,825 receiving allergen testing. There were 20 asthma-associated hospitalizations before allergen testing compared to five after testing, a 75% reduction. Before testing, there were 106 asthma-related ED visits compared to 58 in the post-test period, which was a 45% reduction (Table 3). There was a shift in asthma medication utilization in the before- and after-testing period. This included a 28% reduction in the number of systemic steroid prescription fills, a 37% increase in the number of preventative inhaled corticosteroid fills, and a slight 5% reduction in quick-relief bronchodilator fills (Table 4). There was a dramatic 80% reduction in asthma-related inpatient costs (\$100,393 cost savings on an annualized basis) and a 45% reduction in ED-associated costs (\$30,744 cost savings on an annualized basis) in the period after allergen testing compared to before (Table 5).

Introduction

Uncontrolled asthma resulting in urgent care/emergency department (ED) visits and hospitalizations remains a major problem in the United States despite dissemination of asthma management guidelines since the 1980s.¹ A plethora of research has identified multiple pathways believed to be involved in the pathogenesis of asthma. This has resulted in identification of different phenotypes of the disease and development of various new and expensive therapies targeting aberrant pathways.¹ However, the most common asthma phenotype among both children and adults with asthma is one of allergen-induced chronic airway inflammation and airway hyper-reactivity.¹

Reduction in allergen and trigger exposure has been shown to attenuate inflammation, improve asthma control, and reduce asthma-related morbidity.^{1,2} Further, allergen/trigger avoidance strategies are much less expensive compared to new biologic agents.³ Allergen trigger identification is an extremely cost-effective method to reduce asthma-related morbidity and healthcare utilization, especially when used in combination with generically available asthma-controller medications such as inhaled corticosteroids.

Several rigorous, prospective studies have shown improvements in asthma metrics after implementation of allergen/trigger avoidance strategies.^{4,5} However, these programs were of a limited-time duration and not part of any patient-enrolled healthcare system. Therefore, once the studies were completed it is possible that avoidance strategies ceased and asthma control and burden worsened. Moreover, some of these programs were labor intensive and expensive.⁴

In this retrospective study, we examined the impact of serum sIgE alone utilizing asthma metrics of a large healthcare organization before and after organized, system-wide implementation of targeted allergen-reduction strategies. The results showed reductions in asthma-related healthcare utilization, medications, and costs. Due to potential limited access to specialists and the ready availability of serum sIgE testing for primary care providers, this approach is feasible, thus maintaining the patient-centered medical home. Results of this study will form the basis for adoption of this simple, but effective strategy in national health systems to reduce the economic and health burden associated with asthma.

Methods

Study population

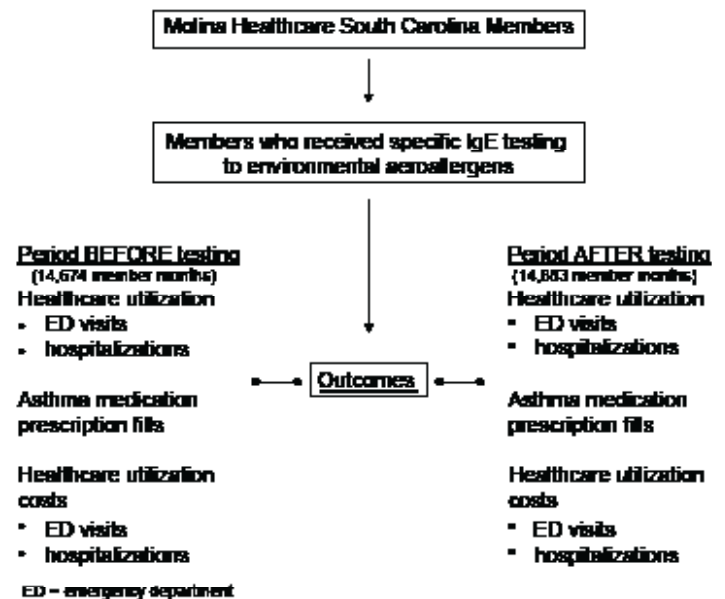
The study population consisted of South Carolina members of Molina Healthcare in 2017 who had a diagnosis of asthma and received serum sIgE testing. These members were both pediatric and adult.

Methods

This was a retrospective analysis using data from Molina Healthcare of South Carolina. From 2016 to 2017 patients with an asthma diagnosis (Table 1) were identified if they received serum sIgE tests (ImmunoCAP–Thermo Fisher Scientific, Uppsala, Sweden) against a standard panel of environmental aeroallergens, consisting of perennial and seasonal antigens (LabCorp Allergen Profile With Total IgE, Respiratory–Area 3 TEST:602629 CPT:82785; 86003(x23)).

Healthcare utilization and asthma medication use 12 months before and 12 months after allergen testing were recorded. Healthcare utilization included asthma-related ED visits and hospitalizations. Medication use consisted of prescription fills for systemic corticosteroids, quick-relief bronchodilators, and inhaled-corticosteroid controllers (Figure 1).

Figure 1. Study Design



An intervention program was started in March 2018 wherein home visits were conducted by community workers for members who had a diagnosis of asthma identified by ICD-10 codes (Table 1) and positive allergen testing. Community connectors, trained in asthma-disease management, identified allergen triggers in the home and provided allergen mitigation and avoidance strategies in accordance with published guidelines (Figure 2). Thus, some study subjects received in-home counseling and some did not.

Outcomes

The primary outcomes were changes in healthcare and medication utilization before and after allergy testing. These included reductions in asthma-related ED visits and hospitalizations, reductions in systemic corticosteroid and reliever agent (bronchodilator) prescriptions, and increases in preventative, inhaled corticosteroid prescriptions. The secondary outcome was a reduction in costs associated with fewer ED visits and hospitalizations after allergy testing. The calculation of ED visit and hospitalization costs was based upon contracted rates for providing facilities. Molina Health reimbursed an average of \$450 per ED visit and \$4500 per inpatient hospital stay (Figure 1).

Table 1. Asthma Diagnosis Codes Used to Identify Study Population

ICD-9-CM	Descriptor	ICD-10-CM	Descriptor
Lungs			
493.00	Extrinsic asthma, unspecified	J45.20	Mild intermittent asthma, uncomplicated
		J45.30	Mild persistent asthma, uncomplicated
		J45.40	Moderate persistent asthma, uncomplicated
		J45.50	Severe persistent asthma, uncomplicated
493.01	Extrinsic asthma with status asthmaticus	J45.22	Mild intermittent asthma with status asthmaticus
		J45.32	Mild persistent asthma with status asthmaticus
		J45.42	Moderate persistent asthma with status asthmaticus
		J45.52	Severe persistent asthma with status asthmaticus
493.02	Extrinsic asthma with (acute) exacerbation	J45.21	Mild intermittent asthma with (acute) exacerbation
		J45.31	Mild persistent asthma with (acute) exacerbation
		J45.41	Moderate persistent asthma with (acute) exacerbation
		J45.51	Severe persistent asthma with (acute) exacerbation
493.10	Intrinsic asthma, unspecified	J45.20	Mild intermittent asthma, uncomplicated
493.12	Intrinsic asthma with (acute) exacerbation	J45.21	Mild intermittent asthma with (acute) exacerbation
493.20	Chronic obstructive asthma, unspecified	J44.9	Chronic obstructive pulmonary disease, unspecified
493.21	Chronic obstructive asthma with status asthmaticus	J44.0	Chronic obstructive pulmonary disease with acute lower respiratory infection
493.22	Chronic obstructive asthma with (acute) exacerbation	J44.1	Chronic obstructive pulmonary disease with (acute) exacerbation
493.81	Exercise induced bronchospasm	J45.990	Exercise induced bronchospasm
493.82	Cough variant asthma	J45.991	Cough variant asthma
493.90	Asthma, unspecified type, unspecified	J45.909	Unspecified asthma, uncomplicated
		J45.998	Other asthma
493.91	Asthma, unspecified type, with status asthmaticus	J45.902	Unspecified asthma with status asthmaticus
493.92	Asthma, unspecified type, with (acute) exacerbation	J45.901	Unspecified asthma with (acute) exacerbation
786.07	Wheezing	R06.2	Wheezing

Figure 2. Home Visit Allergen Reduction Guidelines

Results

Study population

Members were both pediatric and adult, with 1,825 receiving allergen testing. Table 2 shows the demographics of the study population. The majority were African American, Caucasian, and Hispanic pediatric members, and were enrolled in Medicaid. All members had a diagnosis of asthma identified by ICD-10 code (Table 1). The entire enrollment of Molina Healthcare in South Carolina consists of approximately 115,000 members.

Table 2. Demographics of Study Population

Patients tested, no.	1,825	
Pediatric patients, no. (%)	1,271 (69.6)	
Mean age, years	9.05 ± 4.3	
Adult patients, no. (%)	554 (30.4)	
Mean age, years	36.7 ± 14.5	
Ethnicity	Adult	Pediatric
African American	199	388
Caucasian	213	390
Unknown/no data	129	376
Hispanic	6	96
Alaskan/American Indian	2	7
Asian/Pacific	3	12
Unspecified	2	0
Hawaiian	0	2
Insurance		
Medicaid members	1812	
Medicare-Medicaid Plan (MMP)	13	

Reduction in healthcare utilization

There were 20 asthma-associated hospitalizations before allergen testing compared to five after testing, a 75% reduction. Before testing, there were 106 asthma-related ED visits compared to 58 in the post-test period, which was a 45% reduction (Table 3).

Table 3. Asthma-Related Healthcare Utilization Before and After Allergen Testing

	Period before testing	Period after testing	Percent reduction	P Value*
Hospitalizations	20	5	75%	<0.05
Hospitalizations/1000 members	16.4	4	76%	<0.05
ED visits	106	58	45%	<0.05
ED visits/1000 members	86.7	46.8	47%	<0.05
Member months	14,674	14,883		

ED = emergency department

*P value supports 95% certainty that reduction in inpatient (hospitalizations) and emergency department (ED) visits are statistically significant.

Changes in asthma medication utilization

There was a shift in asthma medication utilization in the before- and after-testing period. This included a 28% reduction in the number of systemic steroid prescription fills, a 37% increase in the number of preventative inhaled corticosteroid fills, and a slight 5% reduction in quick-relief bronchodilator fills (Table 4).

Table 4. Changes in Asthma Medication Prescription Fills Before and After Allergen Testing

	Period before testing	Period after testing	Percent reduction
Systemic corticosteroids	1,317	947	- 28%
Systemic corticosteroids/1000 members	1,077	763.6	- 29%
Inhaled corticosteroids	1,527	2,082	+ 37%
Inhaled corticosteroids/1000 members	1,248.7	1,678.7	+ 34%
Bronchodilators	2,297	2,192	- 5 %
Bronchodilators/1000 members	1,878.4	1,767.4	- 6 %
Member months	14,674	14,883	

Reduction in healthcare utilization costs

There was a dramatic 80% reduction in asthma-related inpatient costs (\$100,393 cost savings on an annualized basis) and a 45% reduction in ED-associated costs (\$30,744 cost savings on an annualized basis) in the period after allergen testing compared to before (Table 5).

Table 5. Cost of Healthcare Utilizations Before and After Allergen Testing

	Period before testing	Period after testing	Annualized savings	Percent cost reduction (annualized)
ED visit costs (\$US)	44,443	24,228	30,744.60	45%
ED cost/member/month (\$US)	3.03	1.63		
Hospitalization costs (\$US)	91,397	17,837	110,398.83	80%
Hospitalization cost/member/month (\$US)	6.23	1.20		
Member months	14,674	14,883		

ED = emergency department

Discussion

In this study, among members with asthma enrolled in a large Medicaid managed care system, inhalant allergen testing with serum sIgE testing alone resulted in dramatically reduced asthma-related health utilization, shifts in medication use, and significant cost savings. Specifically, the number of asthma-related ED visits and hospitalizations decreased. There was a 75% and 45% reduction in hospitalizations and ED visits, respectively, after allergen testing. Systemic steroid use also fell 28%, with a 37% increase in preventative, inhaled corticosteroid prescription fills. Reliever bronchodilator use was reduced by 5%. Finally, hospitalization and ED costs were dramatically reduced by \$100,393 and \$30,744, respectively, after testing. This corresponded to 80% and 45% reductions in inpatient and ED visit costs the year after testing compared to the prior year. These results strongly support the integration of routine inhalant-allergen testing in an asthma-disease management program, especially in large managed care organizations.

This study did not examine some indirect asthma metrics that incur a significant economic and social burden. These metrics should also improve with disease control. Congruent with other studies, it is likely that the cohort of members who received allergy testing would experience reduced school and work absenteeism.^{6,7} Secondly, parents of asthmatic children would likely also have less work absence themselves. Work, school and exercise activity would likely improve, resulting in overall increased

quality of life for both adults and children in the tested cohort. Finally, medication use would likely decrease with a reduction in the number of prescriptions for fast-acting reliever-inhalers and systemic steroids. Once the asthma is well controlled for these members, it is likely that the controller medications could be weaned to a lower dose. Taken together, there would likely be an overall reduction in asthma-related prescription costs.

Results of the current study are congruent with the concept that allergic inflammation is central to the pathogenesis of asthma, and interruption of this pathway results in improved disease control. The U.S. Inner-City Asthma Study provided moderate/severe asthma patients with vigorous environmental allergen controls and education resulting in more symptom-free days and fewer ED visits over a two-year period.⁴ A novel nocturnal temperature-controlled laminar airflow treatment, which displaces inhaled allergens from an individual breathing zone, improved quality of life and airway inflammation in both children and adults with atopic asthma.⁸

To the best of our knowledge, this is the first study in which testing for allergic sensitization without known specific allergen avoidance interventions was associated with significant reductions in ED visits and hospitalizations in asthmatics. Studies which show clinical improvements associated with allergen testing have always included allergen-avoidance interventions.^{9,10} This study was carried out during the beginning of a novel intervention program in which a small number of members received in-home allergen-reduction instructions. It is unclear whether members who received testing and allergen-reduction education achieved similar results compared to those who only received allergen testing. We speculate that the combination of testing and education may result in synergistic improvements in asthma metrics compared with either intervention alone.

This study demonstrated a dramatic reduction in cost of healthcare utilization after allergen testing with 80% and 45% reductions in inpatient and ED visit costs, respectively. These cost reductions occurred in the absence of home allergen-reduction visits for most of the study subjects. It may be argued that the cost of allergen testing for the majority of asthma patients is higher than the inpatient and ED visit savings incurred by a small number of members with high utilization rates, especially when the tested

cohort is likely comprised of asthmatics with different asthma severity and risk, some of whom never require hospitalization or ED visits. We counter that this contention is flawed. Allergen testing is typically a one-time event and, therefore, costs are incurred only for a single fiscal year. Asthma patients not given specific interventions are likely to experience similar exacerbations in the subsequent years.¹ Current national asthma guidelines state that the best predictor of future asthma attacks is the presence of previous exacerbations before treatment.¹ Therefore, it is evident that reduction in inpatient and ED visit costs will continue to remain low for many years after a one-time allergen test. Cumulative savings will therefore offset higher initial testing costs in subsequent years. The cost of allergen testing varies with different payers and there are likely health systems wherein the lower cost could result in immediate first-year cost savings.

While it is unclear why patients tested for allergens without receiving standardized, targeted exposure-reduction education as part of a comprehensive asthma program had less healthcare utilization, it is generally accepted that increased health literacy results in improved disease control. Poor understanding of disease and treatment is associated with poor outcomes in both children and adults with asthma.^{11,12} We did not measure whether any asthma education was provided beyond the usual standard of care among members who received allergen testing from the ordering providers. Members may have sought additional asthma information from providers once they were informed of their specific allergen sensitizations. Conversely, the availability of test results may have been a stimulus for providers to supply additional education for their patients. To this end, patients with low education and literacy may be more likely to obtain information regarding their disease from providers, rather than external sources such as the internet.¹³

Other indirect reasons may have contributed to better asthma control in our members who received testing without allergen intervention. Providers and their patients, armed with serum sIgE results, may have elected to implement allergen interventions themselves. Providers may be likely to prescribe more antiallergic agents and treat comorbid conditions, such as allergic rhinitis, resulting in better asthma control. Additionally, their patients may become more adherent to asthma controller medications if they have a better understanding of their disease.

Janson et al. performed a randomized controlled trial evaluating 84 adults with moderately severe asthma.⁵ Patients were managed with an individualized action plan whose elements included environmental controls based on the results of allergy testing. Patients randomized to the individualized management plan maintained consistently higher inhaled-corticosteroid adherence, decreased nighttime awakenings, more symptom-free days, and less use of beta-agonist reliever therapy. Finally, providers may reinforce adherence more effectively. We postulate that in our ongoing study, as more members receive home allergen intervention, asthma-related health expenditures will continue to decline.

National asthma guidelines recommend testing for allergen sensitization for patients with persistent asthma in conjunction with avoidance of relevant allergens in management of these patients. The value of identifying and reducing exposure to offending allergens is well supported by category A evidence where either serum sIgE testing or skin prick testing is recommended.¹

Platts Mills et al. summarized the role of IgE testing in patients with allergy and asthma in their 2007 review *The Role of Allergens in Asthma*.¹⁴ They noted that allergy testing can be accomplished by either skin prick testing or serum sIgE testing.

In the United States, skin prick testing is usually performed by allergy/immunology specialists, while serum sIgE testing is a standard clinical laboratory test that can be ordered by primary care providers. The Centers for Disease Control and Prevention estimates that the major reason for close to 40% of primary care visits is a chronic condition.¹⁵ The majority of patients with asthma are managed by primary care physicians in the United States.¹⁶ Moreover, most asthma patients remain poorly controlled and are therefore candidates to prioritize for allergy testing according to the National Institutes of Health guidelines.¹ The REACT study documented that 68.6% of poorly controlled patients with asthma were managed by primary care physicians.¹⁷ Therefore, it is not possible for every poorly controlled asthmatic to see an allergist for testing.

Compounding this is a current shortage of both primary care and allergy/immunology specialists in the United States. In a study by the American Medical Association, it is estimated that there will be a shortage of primary care physicians of between 7,300 and 43,100 physicians by

2030 and, concurrently, a shortage of between 33,500 and 61,800 specialty physicians.¹⁸ Additionally, wait times to see providers have increased dramatically in the past decade. Wait times to see any physician increased by 30% from 18.5 days in 2014 to 24 days in 2017.¹⁹ Even in areas with a high density of medical centers and providers, wait times have increased. In fact, the longest wait time to see a physician was in the Boston area, where average time to see a provider was 52 days in this study.¹⁹

Taken together these data strongly support an unmet need for expedient allergen testing in the face of provider shortages and long wait times. This may result in poor ability to adhere to practice guidelines recommending allergen testing as part of the management of persistent asthma. We have shown that serum sIgE testing can be performed efficiently in a large health maintenance organization. Serum sIgE testing can be ordered and interpreted by primary care providers, thereby increasing adherence to asthma practice parameters for health systems.¹⁶

Allergen testing using serum sIgE testing has been shown to be cost effective in comparison to skin testing.¹⁶ Costs of individual skin tests compared to serum tests may be lower in most healthcare systems. However, prices of serum tests are decreasing, especially when bundled in test profiles. Moreover, in systems operating with capitated laboratory service arrangements, serum sIgE testing is customarily included in the per-patient per-month fee. Thus, making use of these tests is more cost effective than skin testing, which may require additional payments, such as out-of-pocket co-pays and higher specialist fees.

Results of this study should be interpreted with some considerations in mind. This was a single-cohort study with no control cohort that compared reductions in health utilization before and after allergen intervention. Members were selected from asthma diagnosis and allergen testing claims, based on ICD-10 codes, and were not stratified by asthma severity and control. Therefore, it is unclear whether the intervention will be effective in members across asthma severity and control or if only members with less severe disease will benefit. It is not known if the tested members received any specific intervention. Therefore, it is unclear what mechanism resulted in reduced asthma burden and associated healthcare utilization. The study cohort was from a large managed care organization comprised of Medicaid-

enrolled members in South Carolina. Results may not be applicable to other populations, such as those enrolled in other health systems, geographic locations, and different types of healthcare insurance (e.g., preferred provider organizations). Finally, this is a retrospective claims review, and may not be as robust in nature as a prospective investigation. Again, this shortcoming may be a strength, as this was a real-world study with a large cohort and likely to be more applicable to real-life health systems.

Conclusion

In conclusion, this study demonstrated that identification of environmental sensitization via serum sIgE testing, even in the absence of active allergen-reduction interventions, resulted in significant asthma-related health utilization savings in a large Medicaid-enrolled population with asthma. This supports the widespread use of in vitro allergen testing in management of asthma patients enrolled in large health systems to improve asthma control and reduce asthma-related morbidity and costs.

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