

Original Article

Increasing Allergy-Related Emergency Department Visits in the United States, 2007 to 2015

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What is already known about this topic? Allergic conditions are frequently diagnosed and treated in emergency departments (EDs) in the United States and evidence suggests that they may be increasing in recent years.

What does this article add to our knowledge? There was a 14% overall increase in allergy-related ED visits between 2007 and 2015 in the United States.

How does this study impact current management guidelines? The increase in allergy-related ED visits shown by this study further reinforces the need for up-to-date and evidenced-based guidelines for the emergency management of these conditions.

BACKGROUND: Allergic reactions, angioedema, and anaphylaxis are commonly treated in the emergency department (ED). Contemporary evidence suggests that these conditions may be increasing in the United States.

OBJECTIVE: To evaluate the contemporary epidemiology and trends of ED visits for allergic reactions, angioedema, and anaphylaxis in the United States from 2007 to 2015.

METHODS: Using de-identified data from the National Hospital Ambulatory Medical Care Survey from 2007 to 2015, we identified cases of acute allergic reactions, angioedema, and anaphylaxis through *International Classification of Diseases, 9th Revision, Clinical Modification* codes and conducted a retrospective analysis of rates and trends of these allergy-related ED visits.

RESULTS: There was a 14% overall increase in allergy-related ED visits between 2007 and 2015. Approximately 10 million ED visits in this time frame were associated with allergy-related conditions accounting for 0.85% (95% CI, 0.79-0.90) of all ED

visits in the United States. Almost 3% of allergy-related ED visits were coded as anaphylaxis of which 46.1% (95% CI, 27.5-64.6) received epinephrine. Patients younger than 10 years had a higher relative risk (1.3; 95% CI, 1.0-1.6; $P = .027$) of allergy-related ED visits per 1000 ED visits than patients 65 years and older, and women also had a higher relative risk (1.4; 95% CI, 1.2-1.5; $P < .001$) than men.

CONCLUSIONS: Allergy-related ED visits increased 14% from 2007 to 2015, with the highest relative risk occurring in patients younger than 10 years. These data provide further evidence of increasing allergic conditions in the United States. © 2020 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2020;■:■-■)

Key words: Allergic reactions; Anaphylaxis; Emergency department; Epidemiology

INTRODUCTION

Allergy-related conditions such as allergic reactions to foods or drugs, angioedema, and anaphylaxis are frequently diagnosed and treated in an emergency department (ED) setting.¹⁻⁶ Between 2001 and 2009 there were nearly 1 million ED visits for angioedema and more than 8 million ED visits for allergic reactions.⁶ Epidemiologic studies suggest that rates of allergic reactions are increasing in developed countries.⁵⁻⁹ It is unclear whether increasing rates are secondary to a true increase in prevalence or due to improved diagnosis and recognition of allergic conditions and anaphylaxis.

Contemporary studies that evaluate rates of ED visits due to allergic reactions and anaphylaxis are lacking. Furthermore, nationwide data on the management of these conditions and patient outcomes are limited.

The objective of our study was to evaluate contemporary epidemiology and trends of ED visits for allergic reactions, angioedema, and anaphylaxis in the United States between 2007 and 2015.

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Abbreviations used

EAI- epinephrine autoinjector

ED- emergency department

EMS- emergency medical services

ICD-9-CM- International Classification of Diseases, 9th Revision,
Clinical Modification

NHAMCS- National Hospital Ambulatory Medical Care Survey

RR- relative risk

METHODS**Study design, settings, and data source**

We conducted a retrospective analysis of data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 2007 to 2015. The NHAMCS is a publicly available, annual, 4-stage survey by the Centers for Disease Control and Prevention and the National Center of Health Statistics that allows the study of ambulatory care services (EDs and outpatient clinics) within a representative sample of US hospitals excluding federal, military, and Veterans Affairs hospitals.¹⁰ In this analysis, we used data only from ED visits and excluded data from outpatient clinics. Public data from the NHAMCS are de-identified, obviating the need for institutional review board approval and informed consent. The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology reporting guideline.¹¹

Participants

We used *International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)* codes to identify cases of acute allergic reactions, angioedema, and anaphylaxis. The *ICD-9-CM* codes included in the search were 995.0 (other anaphylactic shock), 995.60-995.69 (anaphylactic shock due to adverse food reaction), 999.4 (anaphylactic reaction to serum), 995.1 (angioneurotic edema), 995.20 (unspecified adverse effect of drug, medicinal, and biological substance due to correct medicinal substance properly administered), 995.27 (other drug allergy), 995.29 (unspecified adverse effect of drug, medicinal, and biological substance), and 995.3 (allergy, unspecified). NHAMCS coders assign *ICD* codes on the basis of the written physician diagnosis. Because conversion from *ICD-9* to *ICD-10 (10th Revision)* codes occurred in 2016 and the time frame of our study was 2007 to 2015, the *ICD-10* conversion did not affect this study.¹²

Variables

We analyzed ED visit rates by categorizing patients into 5 age groups (<10, 10-17, 18-39, 40-64, ≥65 years), sex, race (white, black, other), Hispanic ethnicity, insurance status (private, public [Medicare, Medicaid], self-pay, other [worker compensation, no charge, other, unknown]), and region (Northeast, Midwest, South, and West). US region categories represent standardized geographical divisions defined by the US Census Bureau. We also examined ED visit rates by seasons (Spring [March to May], Summer [June to August], Fall [September to November], and Winter [December to February]). Up to 30 medications were recorded from 2002 to 2015, with medications coded as per published definitions of the National Center for Health Statistics.⁷ Medications included epinephrine, pressor, glucagon, steroid, antihistamines (H1 and H2), bronchodilator, and intravenous fluids. Medications were also subcategorized into administered (ie, at ED) and prescribed (home-going). Means of arrival (emergency medical services [EMS]) to the ED was also included in the analysis.

Statistical analysis

Survey procedures with clustering, weighting, and stratum, as specified by the NHAMCS, were used to produce all population estimates and regression models. To produce reliable estimates, we followed the National Center for Health Statistics recommendations: (1) use $\alpha = 0.01$ for statistical tests of 2015 visits and (2) estimates with a relative error greater than 30% or estimates that are based on a cell size of less than 30 are noted as unreliable and not used for inference. We described our cohort of allergic reactions using descriptive statistics.

Status-specific population estimates on midyear age, sex, race, ethnicity, and region from the US Census Bureau were used to compute US visit rates. All rates were reported per 1000 individuals per year for the US resident population.¹³ We then performed multivariable logistic regression to determine the relative risk (RR) of an allergic reaction accounting for year, age group, sex, race, ethnicity, region, and insurance type. Univariate logistic regression was used to calculate the rates of allergic reaction per 1000 ED visits, as well as the characteristics of the allergy-related ED visits over time. We describe these trends using relative percent change between 2007 and 2015 and the χ^2 *P* value for the regression. Analysis was completed using SAS 3.7 (SAS Institute, Cary, NC) and STATA (StataCorp, College Station, Texas).

RESULTS**Population**

Overall, throughout the entire 9-year time frame of the study, an estimated 10 million ED visits were associated with allergic reactions, accounting for 0.85% (95% CI, 0.79%-0.90%) of all ED visits and an annual rate of 2.9 (95% CI, 2.7-3.2) visits per 1000 US residents (Table I) or 1.1 million ED visits per year. The median patient age was 32 years, and 62% were females (Table II), 73% were white, and 86% were non-Hispanic. The greatest proportion of allergy-related ED visits was among patients aged 18 to 39 years (32%) and occurred in the southern region of the United States (40%), and 40% had public insurance (Table II). An estimated 278,000 (2.8%; 95% CI, 1.7-3.8) allergy-related ED visits were coded as anaphylaxis within the study period. The most commonly administered and prescribed medications for allergy-related ED visits were systemic steroids (35% and 24%, respectively). Epinephrine was administered in 8% and home-going prescriptions were provided in 6% of the cases. Twelve percent of allergy-related ED visitors arrived by EMS. Among patients who were diagnosed with anaphylaxis, epinephrine was administered in 46.1% (95% CI, 27.5-64.6) of the cases and 15% (95% CI, 4.4-26) were given home-going prescriptions for epinephrine.

Relative rates of allergic reactions

Patients younger than 10 years (RR, 1.3; 95% CI, 1.0-1.6; *P* = .027) had an increased RR of allergy-related ED visits per 1000 ED visits compared with patients aged 65 years and older (Table I). Women also had a higher rate of allergy-related ED visits per 1000 ED visits (RR, 1.4; 95% CI, 1.2-1.5; *P* < .001) compared with men. Black patients had a higher rate of allergy-related ED visits (RR, 5.0; 95% CI, 4.1-5.9) than white patients when analyzed per 1000 US population, but there was no difference by race per 1000 ED visits. There were no statistically significant differences in proportions of allergy-related ED visits by ethnicity or region.

TABLE I. Overall estimates and rates for allergic reaction ED visits, 2007-2015

Characteristic	Actual no. of visits	Estimated no. of visits	Total US population	Estimated no. of all ED visits	Rate per 1,000 US population (95% CI)	Rate per 1,000 ED visits (95% CI)	RR (95% CI)	P value*
Overall	2,228	9,999,766	3,396,866,055	1,182,361,686	2.9 (2.7-3.2)	8.5 (7.9-9.0)		
Year								
2007	263	886,540	301,231,207	116,802,066	2.9 (2.4-3.5)	7.6 (6.4-8.7)	Reference	
2008	231	871,625	304,093,966	123,761,419	2.9 (2.3-3.5)	7.0 (5.7-8.4)	0.9 (0.7-1.2)	.52
2009	287	1,119,677	306,771,529	136,072,130	3.6 (3.0-4.3)	8.2 (7.0-9.5)	1.1 (0.9-1.3)	.47
2010	306	1,150,854	309,338,421	129,843,377	3.7 (3.1-4.3)	8.9 (7.6-10.1)	1.2 (1.0-1.4)	.10
2011	243	1,122,560	311,644,280	136,296,400	3.6 (2.9-4.3)	8.2 (6.9-9.6)	1.1 (0.9-1.4)	.33
2012	256	1,083,370	313,993,272	130,869,572	3.5 (2.7-4.2)	8.3 (6.9-9.7)	1.1 (0.9-1.6)	.34
2013	236	1,237,320	316,234,505	130,353,081	3.9 (3.1-4.7)	9.5 (7.8-11.1)	1.3 (1.0-1.6)	.04
2014	237	1,339,812	318,622,525	141,420,460	4.2 (3.2-5.2)	9.5 (7.2-11.8)	1.3 (1.0-1.7)	.08
2015	169	1,188,008	321,039,839	136,943,181	3.7 (2.7-4.7)	8.7 (6.8-10.5)	1.2 (0.9-1.5)	.26
Age (y)								
<10	367	1,713,227	441,869,880	176,891,286	3.9 (3.2-4.5)	9.7 (8.3-11.1)	1.3 (1.0-1.6)	.02
10-17	205	879,525	370,174,796	90,327,660	2.4 (1.9-2.9)	9.7 (7.8-11.7)	1.2 (1.0-1.6)	.09
18-39	713	3,149,599	1,015,056,752	403,257,243	3.1 (2.7-3.5)	7.8 (7.0-8.6)	1.0 (0.8-1.2)	.97
40-64	656	2,927,317	1,116,102,388	330,757,027	2.6 (2.3-3.0)	8.9 (7.9-9.8)	1.1 (0.9-1.4)	.34
>65	287	1,330,098	453,662,239	181,128,470	2.9 (2.4-3.5)	7.3 (6.1-8.6)	Reference	
Sex								
Female	1,348	6,211,192	1,726,429,510	650,023,439	3.6 (3.2-4.0)	9.6 (8.8-10.3)	1.4 (1.2-1.5)	<.001
Male	880	3,788,574	1,670,436,545	532,338,247	2.3 (2.0-2.6)	7.1 (6.4-7.8)	Reference	
Race								
White	1,599	7,251,557	2,699,033,102	858,483,823	2.7 (2.4-3.0)	8.4 (7.8-9.1)	Reference	
Black	521	2,329,016	463,313,584	280,343,549	5.0 (4.1-5.9)	8.3 (7.2-9.4)	1.0 (0.9-1.2)	.93
Other	108	419,193	234,519,369	43,534,314	1.8 (1.3-2.3)	9.6 (7.0-12.3)	1.1 (0.8-1.5)	.40
Ethnicity								
Hispanic or Latino	302	1,363,408	552,584,062	177,095,421	2.5 (2.0-2.9)	7.7 (6.6-8.8)	0.9 (0.8-1.1)	.21
Not Hispanic or Latino	1,926	8,636,358	2,844,281,993	1,005,266,265	3.0 (2.7-3.4)	8.6 (8.0-9.2)	Reference	
Region								
Northeast	507	1,785,724	609,074,985	210,702,945	2.9 (2.3-3.5)	8.5 (7.5-9.5)	1.1 (0.9-1.3)	.47
Midwest	513	2,172,430	735,873,402	271,088,058	3.0 (2.4-3.5)	8.0 (6.9-9.2)	Reference	
South	791	3,997,363	1,260,404,426	460,927,538	3.2 (2.6-3.8)	8.7 (7.8-9.6)	1.1 (0.9-1.3)	.26
West	417	2,044,249	791,513,242	239,643,145	2.6 (2.0-3.1)	8.5 (7.3-9.7)	1.1 (0.9-1.3)	.47
Insurance								
Private	915	3,898,886	NA	354,565,260	NA	11.0 (10.0-12.0)	Reference	
Public	873	4,041,580	NA	526,926,504	NA	7.7 (6.9-8.4)	0.7 (0.6-0.8)	<.001
Self-pay	229	1,030,323	NA	160,654,690	NA	6.4 (5.2-7.6)	0.6 (0.5-0.8)	<.001
Other insurance	211	1,028,977	NA	140,215,232	NA	7.3 (5.7-9.0)	0.7 (0.5-0.9)	.003

NA, Not available.

*P values are for RR, which correspond to the rates per 1,000 ED visits.

Time trends of allergy-related ED visits

Over this time period, the rate of allergy-related ED visits increased by 14.4% (7.6-8.7 per 1000 ED visits; *P* value for trend, .024) (Table III). Females had significantly increased rates of ED visits for acute allergic reactions over the study time frame (8.4-10.5/1000 ED visits; *P* value for trend, .014).

The northeastern region showed a decrease over the study period in the rate of allergy-related ED visits (8.9-6.5/1000 ED visits; *P* value for trend, .043), whereas the midwestern, southern, and western regions showed no significant changes

(Table III). There were no statistically significant changes in the rate of allergy-related ED visits on the basis of age or race.

Time trends of ED allergic reaction treatment

The percentage of patients with allergic reactions receiving a home-going steroid prescription increased over the 9-year time frame (from 219 to 330 per 1000 allergy-related ED visits; *P* value for trend, .031) (Table IV). There were no statistically significant changes over time in the percentages of patients with allergic reactions who received a steroid, H1 antihistamine, or

TABLE II. Characteristics of ED allergic reaction cohort

Characteristic	% (95% CI)
Age (y)	
Median (IQR)	32.2 (16.4-52.5)
Mean $\pm$ SD	35.4 $\pm$ 0.78
<10	17.13 (15.00-19.26)
10-17	8.80 (7.23-10.36)
18-39	31.50 (28.50-34.50)
40-64	29.27 (26.48-32.06)
>65	13.30 (11.16-15.45)
Sex	
Female	62.11 (59.23-65.00)
Male	37.89 (35.00-40.77)
Race	
White	72.52 (69.00-76.04)
Black	23.29 (19.95-26.63)
Other	4.19 (3.00-5.38)
Ethnicity	
Hispanic or Latino	13.63 (11.40-15.87)
Not Hispanic or Latino	86.37 (84.13-88.60)
Region	
Northeast	17.86 (14.62-21.10)
Midwest	21.72 (18.35-25.10)
South	39.97 (34.98-44.97)
West	20.44 (16.75-24.13)
Insurance	
Private	38.99 (36.03-41.95)
Public	40.42 (37.30-43.53)
Self-pay	10.30 (8.35-12.26)
Other	10.29 (7.83-12.75)
Anaphylaxis—overall	2.78 (1.74-3.82)
Anaphylaxis—food	1.31 (0.69-1.92)
Angioedema	10.67 (8.82-12.52)
Drug allergy	23.69 (20.81-26.58)
Allergic reaction	63.67 (60.75-66.59)
Arrival by EMS	12.11 (10.17-14.04)
Admit to observation unit	1.68 (0.99-2.37)
Admit to hospital	5.16 (3.89-6.43)
Season	
Spring	27.67 (24.56-30.79)
Summer	28.26 (25.06-31.47)
Fall	23.90 (20.80-26.99)
Winter	20.17 (17.55-22.79)
ED medical management	
Overall cohort	
Administered medications	
Epinephrine	7.93 (6.20-9.67)
H1 antihistamine	28.61 (25.99-31.24)
H2 antihistamine	19.37 (16.83-21.91)
Steroid	35.33 (32.31-38.34)
IV fluids	7.19 (5.48-8.90)
Prescribed medications	
Epinephrine	6.65 (5.24-8.07)
H1 antihistamine	18.60 (16.30-20.91)
H2 antihistamine	5.02 (3.59-6.44)
Steroid	23.59 (20.98-26.19)

(continued)

TABLE II. (Continued)

Characteristic	% (95% CI)
Anaphylaxis cohort	
Epinephrine	46.10 (27.50-64.64)
H1 antihistamine	48.40 (28.43-68.30)
H2 antihistamine	55.82 (41.15-70.50)
Steroid	62.44 (48.14-76.74)
IV fluids	30.23 (14.27-46.20)
Discharged with epinephrine	15.20 (4.37-26)

IV, Intravenous.

H2 antihistamine for acute management while in the ED. Because of small sample sizes, accurate estimates of time trends for epinephrine administration and home-going prescription rates were not possible.

DISCUSSION

In this study of nearly 10 million ED visits due to acute allergic reactions in the United States between 2007 and 2015, we found a 14% increase in rates of allergy-related ED visits per 1000 ED visits. Patients younger than 10 years had a higher RR of allergy-related ED visits compared with patients aged 65 years and older. The percentage of patients who received home-going prescriptions for steroids increased during this 9-year time frame.

Our 14% overall increase in allergy-related ED visits is in contrast to a previous report evaluating national trends in the rate of allergy-related ED visits on the basis of data from the NHAMCS from 1993 to 2004 that showed no significant change.¹⁰ Furthermore, 2.8% of allergy-related ED visits were coded as anaphylaxis in our study compared with 1% in the previous corresponding study. However, our findings are consistent with other more contemporary studies demonstrating increases in ED visits for anaphylaxis. Motosue et al⁵ found an increase of 101% overall in ED visits in the United States for anaphylaxis between 2005 and 2014. It remains unclear to what degree these findings represent a true increase in anaphylaxis or whether they are the reflection of better anaphylaxis recognition. In another study, the same authors showed that ED visits for food-induced anaphylaxis increased 214% in children over the same time frame.¹⁴ Similarly, a study of ED visits and hospitalizations in Illinois demonstrated an annual increase of 29% for food-induced anaphylaxis and 23% for non-food-related anaphylaxis from 2008 to 2012.¹⁵

We found that 8.5 (95% CI, 7.9-9.0) visits per 1000 ED visits were allergy-related between 2007 and 2015. This is slightly lower than what was reported by Gaeta et al,¹⁰ who found 10.2 (95% CI, 9.3-11.0) allergy-related visits per 1000 ED visits between 1993 and 2004. Correspondingly, during their 12-year time frame, they also found an annual rate of ED visits for acute allergic reactions of 3.8 (95% CI, 3.4-4.1) visits per 1000 people in the United States,¹⁰ which is also slightly higher than our rate of 2.9 (95% CI, 2.7-3.2) visits per 1000 US population. These differences are likely secondary to the availability of ICD-9 subcodes for code 995.2, which became available in the NHAMCS in 2007. Because of the availability of subcodes, we were able to exclude visits that were unlikely to be related to acute allergic reactions, including codes for arthus

TABLE III. Rates of allergic reactions per 1000 ED visits, 2007-2015

Characteristic	2007	2008	2009	2010	2011	2012	2013	2014	2015	Overall % change	P value
Overall	7.59	7.04	8.23	8.86	8.24	8.28	9.49	9.47	8.68	14.36	.02
Age (y)											
<10	6.56	*	11.61	11.52	10.27	9.34	11.43	13.01	*	13.26	.11
18-39	7.33	7.60	6.12	8.79	7.74	7.55	9.47	7.00	8.74	19.24	.35
40-64	8.29	7.28	8.61	8.87	8.31	7.07	9.90	9.63	11.49	38.6	.09
>65	7.50	7.65	7.07	6.09	7.21	9.48	8.28	8.29	*	−40	.73
Sex											
Female	8.36	7.77	8.97	8.94	10.11	9.71	9.92	11.26	10.51	25.72	.01
Male	6.68	6.18	7.33	8.77	5.97	6.49	8.95	7.32	6.39	−4.34	.73
Race											
White	8.32	6.69	8.42	8.74	8.46	8.10	9.69	9.03	8.41	1.08	.18
Black	5.49	8.18	7.80	8.79	7.57	8.75	9.49	8.81	9.61	75.05	.08
Region											
Northeast	8.89	4.29	7.54	8.09	8.88	8.60	11.95	12.40	6.50	−26.88	.04
Midwest	8.69	8.05	8.18	8.74	6.29	4.87	9.79	7.80	9.46	8.86	.83
South	6.76	7.92	8.32	9.15	9.08	8.28	9.02	10.90	8.61	27.37	.05
West	6.98	6.98	8.77	9.16	8.09	11.19	8.50	6.99	9.69	38.83	.46

*Sample size <30.

TABLE IV. Trends in medication management associated with allergy-related ED visits, 2007-2015*

Characteristic	2007	2008	2009	2010	2011	2012	2013	2014	2015	% Change	P value
Administered											
Steroid	33.8	42.2	32.8	35.3	37.2	37.8	36.8	34.7	28.9	−14.5	.41
H1 antihistamine	24.8	32.0	27.2	25.5	34.4	35.2	32.0	20.8	27.0	8.87	.72
H2 antihistamine	15.8	23.6	15.8	12.2	24.8	19.2	23.7	15.2	24.6	55.7	.25
Prescribed											
Steroid	21.9	26.7	18.1	18.2	20.0	19.8	25.2	28.1	33.0	50.68	.03
H1 antihistamine	21.8	17.1	22.2	19.7	20.5	14.5	19.5	21.2	†	−50	.11

*Values are expressed as a percentage of allergy-related ED visits.

†Sample size <30.

phenomenon, adverse effects of anesthesia or insulin, and failed procedural sedation.

Five percent of patients were admitted to the hospital, which is similar to the proportion of patients admitted for allergic reactions between 1993 and 2004.¹⁰ As noted earlier, although there are data demonstrating increasing hospital admissions for anaphylaxis,^{5,9,15} we suspect that we did not observe increased hospitalizations because most allergic reactions do not require hospital admission and patients with anaphylaxis comprised a small proportion of our cohort.

Patients younger than 10 years and those aged 10 to 17 years had the highest rates of allergy-related ED visits per 1000 ED visits in our study. This is in contrast to the 1993 to 2004 NHAMCS study of allergy-related ED visits by Gaeta et al,¹⁰ which found that patients aged 50 to 59 years had the highest rate of ED visits for allergic reactions per 1000 ED visits. Our findings likely reflect the increase in pediatric food allergy and are consistent with numerous previous studies showing increasing pediatric rates of ED visits for food-related allergies^{8,16} and anaphylaxis.^{5,14,17}

Consistent with findings reported by Gaeta et al¹⁰ in their study of ED acute allergic reactions from 1993 to 2004, we found greater rates of ED allergic reactions among women

relative to men. Differences in rates of allergic conditions on the basis of sex have been previously described, with higher rates in women compared with men in adult patients, and higher rates in boys than in girls in the pediatric population.¹⁸⁻²⁰ Race has also been reported to influence rates of allergic diseases; for example, black patients have been found to have higher rates of eczema, asthma, and food allergies compared with white patients.²¹ Similarly, we also found that black patients had a greater rate of allergy-related ED visits compared with white patients when analyzed per 1000 US population but no difference by race per 1000 ED visits.

Among all allergy-related ED visits, we found that corticosteroids were the most frequently administered medication (35%), followed by H1 antihistamines (29%), H2 antihistamines (19%), and epinephrine (8%). In contrast, Gaeta et al¹⁰ found in their study of ED allergic reaction visits between 1993 and 2004 that H1 antihistamines were the most commonly administered medication (62%), followed by corticosteroids (38%), H2 antihistamines (11%), and epinephrine (11%). Despite the high rates of corticosteroid administration seen in our study, the use of these medications has been increasingly deemphasized in anaphylaxis, and current practice parameters include steroids as adjunctive therapy only for anaphylaxis.²²

However, their use in the management of allergic reactions is less well defined, and they can be considered for the treatment of other conditions, such as urticaria, on a short-term basis.²³ The role of corticosteroids in conditions other than anaphylaxis warrants further study. It is possible that the lower proportions of patients receiving H1 antihistamines and epinephrine in our study may be due to patients taking them at home or receiving them from EMS before ED arrival. A previous study found that between 2005 and 2014 there was an increase in rates of epinephrine autoinjector dispensing in patients younger than 18 years.²⁴ In addition, a study published in 2015 showed that although more than 60% of ED patients with anaphylaxis did not receive epinephrine in the ED, 46% of patients had received epinephrine before ED arrival.²⁵ Furthermore, after manual review of all anaphylaxis cases, allergists-immunologists deemed ED management appropriate in 98% of cases.

Study limitations

Some important limitations of this study should be considered. As is the case with most studies that use large databases such as the NHAMCS, elimination of unmeasured confounders is sometimes not feasible; data may be subject to a lack of standardization in diagnostic coding, individual diagnoses, selection bias, and errors in the abstraction of the data itself. For example, regarding the cases of drug allergy, we were unable to confirm whether the code for drug allergy was input in a confirmed case of drug allergy or whether it was an adverse drug reaction rather than a true allergic reaction. Furthermore, there are numerous other ICD-9 codes that could include allergic drug reactions, such as 693 (dermatitis due to drug), which were not included in this analysis.²⁶ In addition, anaphylaxis is generally underdiagnosed and this could result in an underestimation of the rate of anaphylaxis.²⁷ These limitations are inherent to this type of studies. The characteristics of this large cohort make the study's results generalizable to similar populations in the United States.

CONCLUSIONS

Our study demonstrates a 14% overall increase in allergy-related ED visits from 2007 to 2015, with the highest RR among patients aged 0 to 17 years. This study shows contemporary trends in rates of allergy-related ED visits and provides information on how these cases are being treated in the ED and upon ED dismissal. It is consistent with contemporary studies and provides further evidence of the increasing incidence of allergy-related ED visits in the United States. Further nationwide studies of acute allergic reactions and anaphylaxis are needed to better understand epidemiologic trends and ED management to optimize patient care and public health initiatives.

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