Original Article

# Temporal Trends in Epinephrine Dispensing and Allergy/Immunology Follow-up Among Emergency Department Anaphylaxis Patients in the United States, 2005-2014

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***What is already known about this topic?*** Previous studies suggest poor rates of concordance with emergency department (ED) post-discharge anaphylaxis care guidelines as demonstrated by low rates of epinephrine autoinjector (EAI) prescriptions and allergy/immunology (A/I) referrals.

***What does this article add to our knowledge?*** Based on administrative claims data, 46% of patients filled an EAI prescription and 29% had A/I follow-up within 1 year of an ED anaphylaxis visit. Overall rates remained suboptimal with a minimal change from 2005 to 2014.

***How does this study impact current management guidelines?*** Low rates of EAI dispensing and A/I follow-up suggest that additional patient and physician education is needed. Guidelines could be improved by specifically addressing if EAI prescribing is necessary for patients with a medication trigger.

**BACKGROUND: Anaphylaxis is a potentially life-threatening allergic reaction; measures including prescription of an epinephrine autoinjector (EAI) and allergy/immunology (A/I) follow-up may prevent future morbidity.**

**OBJECTIVE: The objective of this study was to evaluate trends in outpatient management of anaphylaxis by studying EAI dispensing and A/I follow-up among patients seen in the emergency department (ED) for anaphylaxis from 2005 through 2014.**

**METHODS: We analyzed administrative claims data from the OptumLabs Data Warehouse database using an expanded International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis code algorithm.**

**RESULTS: The study cohort comprised 18,279 patients with a mean age of 39 years; 58% were female, and 86% were discharged from an ED. Within 1 year after discharge, 46% had filled an EAI prescription and 29% had A/I follow-up. Overall, from 2005 to 2014, annual rates of filled EAI prescriptions and A/I follow-up did not change. Among children (aged <18 years), rates increased for filled EAI prescriptions (16.1% increase; $P = .02$ for trend) and A/I follow-up (18.8% increase; $P = .048$ for trend). Rates decreased for A/I follow-up among adults (15.4% decrease; $P = .002$ for trend). Overall rates of filled EAI prescriptions were highest in those with venom-induced (73.9 per 100 ED visits) and food-induced anaphylaxis (69.4 per 100 ED visits); the lowest rates were among those with medication-related anaphylaxis (18.2 per 100 ED visits).**

**CONCLUSIONS: Over the past decade, rates of EAI dispensing and A/I follow-up after an ED visit for anaphylaxis have remained low, suggesting that patients may not be prepared to manage future episodes.** © 2017 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2017;■:■-■)

***Key words:*** *Allergist; Anaphylaxis; Concordance; Emergency department; Epinephrine autoinjector; Hospitalization; Immunologist; Postdischarge care; Prescription; Treatment guidelines*

Anaphylaxis is an acute allergic reaction with a rapid onset that may be fatal.[1] For most patients, however, anaphylaxis is a

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*Abbreviations used*
*A/I- Allergy/immunology*
*CI- Confidence interval*
*EAI- Epinephrine autoinjector*
*ED- Emergency department*
*ICD-9-CM- International Classification of Diseases, 9th Revision, Clinical Modification*
*ICU- Intensive care unit*
*IQR- Interquartile range*
*OR- Odds ratio*

disorder associated with a chronic risk of relapse. At least 30% of patients with a history of anaphylaxis will have 1 or more recurrences,[2-6] and the subsequent event is unpredictable. In a study of 139 anaphylaxis-related fatalities, 82% of deaths attributed to venom and 78% due to food-induced anaphylaxis occurred in patients without a history of a severe allergic reaction.[7] Because the severity of any anaphylactic event cannot be predicted, measures to prevent future episodes are essential.

Existing national and international guidelines[8,9] agree that comprehensive outpatient anaphylaxis management includes a filled prescription for an epinephrine autoinjector (EAI) and follow-up with an allergy/immunology (A/I) specialist. However, previous single-center and multicenter studies have shown that only 16% to 63% of patients treated in the emergency department (ED) for anaphylaxis received an EAI prescription on discharge from the ED,[10-15] and only 11% to 33% were referred to an A/I specialist.[11,12,14-16]

Although poor rates of EAI dispensing and A/I follow-up have been documented,[17,18] it is not known whether these rates have improved over time. The objective of our study was to evaluate time trends in post-ED outpatient anaphylaxis management by studying EAI dispensing and subsequent A/I follow-up among a nationwide cohort of ED anaphylaxis patients from 2005 through 2014.

## METHODS

### Data source

For our analysis we queried the OptumLabs Data Warehouse, which includes administrative claims data for privately insured and Medicare Advantage enrollees in the United States.[19] This database contains longitudinal health information for more than 100 million enrollees in the past 20 years, from geographically diverse regions of the United States. The data cover several domains, including enrollee information (insurance plan, sex, age, race/ethnicity, dates of eligibility), pharmacy claims (prescribing physician, pharmacy, fill data, days of supply, dosages), and medical claims (including International Classification of Diseases, 9th Revision, Clinical Modification [ICD-9-CM] diagnosis codes, ICD-9 procedure codes, Current Procedural Terminology, Version 4 procedure codes, Healthcare Common Procedure Coding System procedure codes, site of service codes, standardized costs, and provider specialty codes).[20] This study involved analysis of pre-existing, deidentified data and was deemed exempt from institutional review board approval.

### Study population

To identify the analytic cohort of ED visits for anaphylaxis from 2005 to 2014, we used 2 methods validated in a previous study.[21] Method 1 identified patients who had ICD-9-CM diagnosis codes for anaphylactic shock (995.60-995.69 and 995.0). Method 2 identified patients through a validated algorithm of ICD-9-CM codes of symptom combinations.[21] Patients were selected if they had medical and pharmacy coverage at the time of the ED visit and for at least 1 year after the date of ED or hospital discharge, to evaluate whether they filled an EAI prescription (EAI dispensing) and whether they had an A/I follow-up evaluation.

### Methods and measurements

This article adheres to the RECORD (REporting of studies Conducted using Observational Routinely-collected health Data) Statement.[22] We characterized our study population by demographics, anaphylaxis triggers, and ED disposition. Age was grouped into 5 categories: 0-4, 5-17, 18-34, 35-64, and ≥65 years. Census regions were grouped into the following categories: Midwest, Northeast, South, West, and other/unknown. ED disposition was categorized as ED discharge (including patients with or without observation), inpatient (non−intensive care unit [ICU]) admission, and ICU admission. Postindex prescription EAI dispensing and A/I visits were identified. Time to first EAI dispensing and time to first A/I visit in the postindex period were determined.

### Statistical analysis

Patient characteristics (age, sex, census region) were described using median (interquartile range [IQR]) or count (percentage), as appropriate. Annual rates of filled EAI prescriptions and A/I follow-up were expressed as outcomes per 100 ED visits. We performed linear regression analysis to assess for trends across years. All significance tests were 2-sided, and $P < .05$ was considered statistically significant. All statistical analyses were performed using SAS software version 9.3 (SAS Institute Inc., Cary, NC). Logistic regression was used to assess the association between A/I follow-up and EAI dispensing, and results are reported as odds ratios (ORs) and 95% confidence intervals (CIs). Because EAI prescription fills and A/I follow-up before the index event may be confounding factors, sensitivity analyses were planned *a priori* and included analysis of time trends after excluding those with prior EAI, A/I follow-up preceding the index event, or both, and also excluding patients who did not have 1 year of medical and pharmacy coverage before the index ED visit.

## RESULTS

### Patient demographics and clinical characteristics

A total of 65,946 unique ED visits for anaphylaxis between 2005 and 2014 were initially identified using method 1 and method 2 of the Harduar-Morano algorithm.[21] After exclusion of patients without medical and pharmacy coverage 1 year after the index event (because of lack of ability to measure their follow-up), 18,279 patients seen in the ED for anaphylaxis were included in our analytic cohort (Figure 1). Patients excluded because of the absence of medical or pharmacy coverage for at least 1 year after the date of ED or hospital discharge were similar to the included cohort with regard to median age (39.0 vs 40.0 years), age group distribution, gender (58.2% vs 58.1% female), trigger, and ED outcomes (data not shown). As shown in Table I, most anaphylaxis ED visits involved patients aged 35 to 64 years (41.9%), and most patients (58.1%) were female. The cohort was primarily from the South (46.9%), followed by the Midwest (25.6%), West (13.7%), and Northeast (13.7%).

### Index event characteristics

Overall, 25.9% of cases were associated with food, 12.2% were medication related, and 4.0% were due to insect venom