

Original Article

Outcomes of Emergency Department Anaphylaxis Visits from 2005 to 2014

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What is already known about this topic? Emergency department (ED) anaphylaxis visits are increasing.

What does this article add to our knowledge? The proportions of ED anaphylaxis patients being admitted for observation or inpatient hospitalization and for intensive care unit admission increased from 2005 to 2014. Furthermore, the proportion of ED anaphylaxis patients undergoing endotracheal intubation increased during this time period.

How does this study impact current management guidelines? Physicians, scientists, and health care policy makers should be aware of these rising trends so that efforts can be made to identify and mitigate the underlying causes.

BACKGROUND: Although the incidence of anaphylaxis appears to be increasing, trends in anaphylaxis-related health care utilization are not well understood.

OBJECTIVE: To better understand the potential increasing health care burden, we analyzed the changes in anaphylaxis-related health care utilization, including emergency department (ED) discharges, observation stays, inpatient admissions, intensive care unit admissions, and endotracheal intubations.

METHODS: We conducted an observational study examining outcomes of anaphylaxis-related ED visits between January 1, 2005, and December 31, 2014. We analyzed administrative claims data from OptumLabs Data Warehouse, which includes more than 100 million Medicare Advantage and privately insured enrollees in the United States. We studied trends in the proportions of ED-related anaphylaxis visits based on demographic characteristics, triggers, and ED disposition for our study population.

RESULTS: Among 56,212 anaphylaxis-related ED visits during a 10-year period, the proportion of patient observation/inpatient

admissions increased by 37.6% ($P = .02$), from 13.2% of anaphylaxis-related ED visits in 2005 to 18.2% in 2014. The proportion of patients admitted to the intensive care unit increased by 27.4% ($P = .001$), from 4.5% in 2005 to 5.8% in 2014. Proportions of endotracheal intubation increased by 145.2% ($P < .001$).

CONCLUSIONS: The increasing proportions of observation/inpatient admissions, intensive care unit admissions, and endotracheal intubations suggest an increase in anaphylaxis severity. Enhanced awareness of these trends among patients, practitioners, and the community is necessary to create effective strategies to prevent anaphylaxis and decrease associated adverse consequences. © 2017 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2017;■:■-■)

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Anaphylaxis is “a serious allergic reaction that is rapid in onset and may cause death.”¹ Anaphylaxis can present with a broad range of signs and symptoms with varying levels of severity.² A recent national survey³ estimated that at least 1.6% of the US population has a history of anaphylaxis, and studies suggest that the rates of anaphylaxis-related hospitalizations are increasing. A study by Lin et al⁴ found a greater than 4-fold increase in the rate of anaphylaxis-related hospitalizations in New York state from 1990 to 2006. Ma et al⁵ reported a substantial increase in rates of anaphylaxis-related hospitalizations in the United States from 21.0 per million population in 1999 to 25.1 per million in 2009.

Few epidemiologic studies of anaphylaxis in the United States have been reported, and comparisons between studies have been limited by several factors, including the use of different methods and small population sizes.^{4,6,7} Through the use of OptumLabs Data Warehouse (OLDW), a national database including administrative claims data on more than 100 million enrollees in the United States, we recently reported a 101% increase in emergency department (ED) visits for anaphylaxis between 2005 and 2014.⁸ Although prior studies⁴⁻⁸ have suggested an increasing incidence of anaphylaxis, it is unclear if these changes

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Abbreviations used

ACE- Angiotensin-converting enzyme
 ED- Emergency department
 ICU- Intensive care unit
 OLDW- OptumLabs Data Warehouse

represent true increases in severity or are primarily reflective of the overall rise in the incidence of anaphylaxis.

The objective of our study was to examine time trends in anaphylaxis-related ED visit outcomes, including observations, inpatient (non-intensive care unit [ICU]) admissions, ICU admissions, and endotracheal intubations from 2005 through 2014 reported as proportions of ED anaphylaxis visits. Evaluating outcomes as proportions of ED anaphylaxis visits rather than overall rates provides a more accurate depiction of trends in anaphylaxis severity.

METHODS**Data source**

An observational study was performed using the OLDW, which includes administrative data for both Medicare Advantage enrollees and privately insured patients in the United States,⁹ along with longitudinal health information for more than 100 million enrollees over the past 20 years. Data originate from geographically diverse regions across the United States and include enrollee demographic information and medical claims.¹⁰ This study was exempt from institutional review board approval because all data were preexisting and were deidentified before analysis.

Study population

We used 2 validated methods to identify ED anaphylaxis visits from January 1, 2005, to December 31, 2014.¹¹ Codes for anaphylactic shock (995.60-995.69) were used to identify patients for Method 1. An algorithm of International Classification of Diseases, 9th Revision, Clinical Modification codes of symptom combinations was used to identify patients for Method 2.¹¹ Each method was performed separately, with a combination of both methods performed to identify and exclude duplicate cases. Patients were required to have at least 30 days of medical coverage before the ED visit. The total number of enrollees with medical coverage for at least 30 days in the given calendar year was used as the denominator for percentage calculations.

Patient characteristics

We obtained patients' baseline characteristics, including age, sex, race, census region, and anaphylaxis trigger. We also analyzed outcomes that included ED discharge, observations (including ED observation unit admissions and hospital observations), non-ICU hospital admission, ICU admission, and endotracheal intubation (Current Procedural Terminology code 31500; International Classification of Diseases, 9th Revision, Clinical Modification codes 96.04, 96.05).

Methods and measurements

This study adheres to the RECORD (REporting of studies Conducted using Observational Routinely-collected health Data) Statement.¹² We examined trends over time for demographic characteristics, triggers, and ED disposition for our study population. Age groups were stratified into 5 categories to identify patient subgroups: 0-4 years (infant, toddler, and preschool-aged children),

5-17 years (school-aged children), 18-34 years (young adult), 35-64 years (middle adulthood), and 65 years and older (retirement age and older). Race was grouped into 5 categories: Asian, black, Hispanic, white, and unknown (includes missing).

Statistical analysis

Patient characteristics (age, sex, race, census region, and trigger) were reported using descriptive statistics, as appropriate for the data distribution. Annual proportions were calculated by using the number of outcomes as the numerator and total number of ED anaphylaxis visits as the denominator. We compared proportions across time using regression models (trend analysis). We calculated percentage change in proportions from 2005 to 2014 among anaphylaxis ED visits for observations/inpatient admission, ICU admission, and endotracheal intubation by age group and by trigger. The denominator for these calculations was the total number of visits for the specified age group or trigger. Change in proportions was analyzed with the χ^2 test. All significance tests were 2-sided, and $P < .05$ was considered statistically significant. SAS software version 9.4 (SAS Institute Inc., Cary, NC) was used for all statistical analysis.

We planned an *a priori* sensitivity analysis by excluding patients taking angiotensin-converting enzyme (ACE) inhibitors, because intubations in these patients could have been secondary to ACE inhibitor-induced angioedema and not anaphylaxis.

RESULTS

During the 10-year study period, we identified a total of 56,212 ED visits for anaphylaxis (Fig 1).⁸ At the time of the ED visit, the median (interquartile range) age was 36 (17-52) years; approximately one-fourth of the patients were younger than 18 years.⁸ The majority of patients were female (57.5%), and slightly more than half the cohort was white (51.3%). After an evaluation in the ED, the majority (77.1%) of the patients were dismissed home (Table E1, available in this article's Online Repository at www.jaci-inpractice.org). Other outcomes are described below (Table I, Fig 2).

Observation and inpatient (non-ICU) admissions

A total of 9881 patients (17.6%) seen in the ED for anaphylaxis were observed (either in ED observation units or in hospital beds) or admitted to a non-ICU hospital unit (Table E1, available in this article's Online Repository at www.jaci-inpractice.org). The proportion of observation/non-ICU admissions increased significantly during the study period by 37.6% ($P = .02$), from 13.2% of ED anaphylaxis visits in 2005 to 18.2% in 2014 (Table I). The proportions of observation/non-ICU admissions increased the greatest amount in those aged 0 to 4 years (94.9%; $P = .03$) (Fig 3, A). Proportions of observation/non-ICU admissions significantly increased in patients with a food ($P = .04$) or unspecified trigger ($P = .01$) (Table I).

ICU admissions

Over the 10-year study period, 5.3% ($n = 3000$) of those seen in the ED for anaphylaxis were admitted to the ICU (Table E1, available in this article's Online Repository at www.jaci-inpractice.org). Proportions of patients admitted to the ICU increased by 27.4%, from 4.5% in 2005 to 5.8% of ED anaphylaxis visits in 2014 ($P = .001$). Of all triggers, anaphylaxis due to an unspecified trigger leading to ICU admissions increased the most (51.8%; $P < .001$). Proportions of those

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