

Clinical Communications

Trends in emergency care for anaphylaxis

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Clinical Implications

- Emergency department visits for anaphylaxis among children increased 3.2-fold from 2008 to 2016, whereas those for adults increased 1.9-fold. Focused efforts to prevent anaphylaxis are needed, particularly in children.

TO THE EDITOR:

The prevalence of allergic conditions has been increasing in the United States over the past decade, but the national age-related rates of emergency department (ED) visits for severe allergic reactions and anaphylaxis are unclear.

We performed a cross-sectional study of ED visits for anaphylaxis from 2008 to 2016 using the Healthcare Utilization Project (HCUP) Nationwide Emergency Department Sample (NEDS). The NEDS includes a 20% sample of all ED visits, allowing for nationally representative estimates.¹ We included all ED visits with a first-listed diagnosis code of an allergic condition (Clinical Classifications Code 253). Visits were further categorized as anaphylactic if the first-listed International Classification of Diseases, 9th revision (ICD-9) or International Classification of Diseases, 10th revision (ICD-10) code was anaphylaxis (ICD-9: 995.0 or 995.6×; ICD-10: T78.0 [all subcodes for initial encounters], T78.2XXA, or T88.6XXA). In addition, patients with urticaria (ICD-9: 708.9; ICD-10: L50.0, L50.1, or L50.9) and angioedema (ICD-9: 995.1 or ICD-10: T78.3XXA) were considered to have anaphylaxis.² Otherwise, visits were categorized as nonanaphylactic. In using only anaphylaxis diagnosis codes, we prioritized specificity in case identification, as we wanted to avoid the overestimation of case numbers that can occur with more sensitive case identification algorithms.^{3,4} We assigned a trigger to each anaphylaxis case based on a previous study's method⁵; diagnosis codes for trigger determinations are shown in Table E1, available in this article's Online Repository at www.jaci-inpractice.org.

The primary outcome was the annual age-specific incidence of ED visits for anaphylaxis, with at-risk person-years determined using annual age-specific population estimates from the American Community Survey.⁶ We plotted trends and then computed changes in reaction incidence using incidence rate ratios (IRRs) comparing 2016 with 2008. Secondary outcomes included the incidence of nonanaphylactic allergic reactions, ED disposition, and death. Children were defined as individuals less than 21 years of age. All analyses were performed using survey weighting in accordance with HCUP best practices.⁷ The Boston Children's Hospital Institutional Review Board exempted this analysis from review.

From 2008 to 2016, there were 405,145 ED visits for anaphylaxis in the United States, of which 61.6% were among adults. Over the study period, the overall incidence of anaphylaxis increased from 94 to 217 ED visits per million person-years (2.3-fold increase), with

the greatest increase occurring in children less than 5 years of age (Figure 1). Excluding visits coded only with urticaria and angioedema, the incidence of anaphylaxis increased from 87 to 204 ED visits per million person-years (2.3-fold increase). Among adults, the incidence of anaphylaxis increased from 44 to 84 ED visits per million person-years, IRR 1.91 (95% confidence interval [CI], 1.73-2.10), and in children from 54 to 163 visits per million person-years, IRR 3.23 (95% CI, 2.56-3.90). For adults, the incidence of non-anaphylactic allergic reactions was unchanged from 2008 to 2016 (2016 per million person-years in 2008, 2011 per million person-years in 2016, IRR 1.00; 95% CI, 0.92-1.07), whereas among children the incidence increased (3944 per million person-years in 2008, 4510 per million person-years in 2016, IRR 1.14; 95% CI, 1.02-1.27).

Hospitalization rates for adults decreased from 24.8% in 2008 to 14.5% in 2016, whereas those for children decreased from 11.2% to 6.0%. Mortality from anaphylaxis was rare during the study period among adults ($n = 806$, 0.32%) and children ($n = 44$, 0.03%).

ED visits for anaphylaxis increased from 2008 to 2016, with the greatest increase occurring in children less than 5 years of age. Age had a dose-response relationship, with incremental increases in age corresponding to a smaller change in emergency visit incidence (Figure 1). The Spearman correlation between increasing age group and change in incidence from 2008 to 2016 was -0.96 . Thus, age was a strong determinant of increased incidence in anaphylaxis. Given the increase in anaphylaxis cases, efforts to improve its prehospital and ED care are more important than ever.

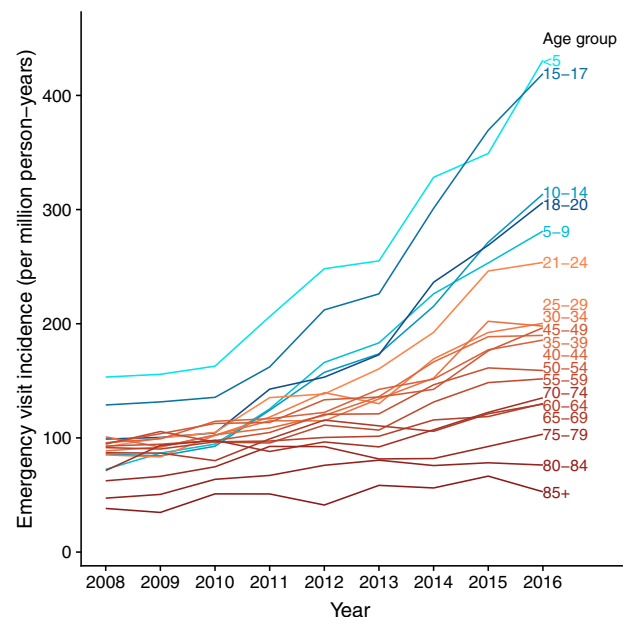


FIGURE 1. National population incidence of emergency department visits for anaphylaxis by age from 2008 to 2016. Children and adolescents are shown in blue hues; adults are shown in orange hues.

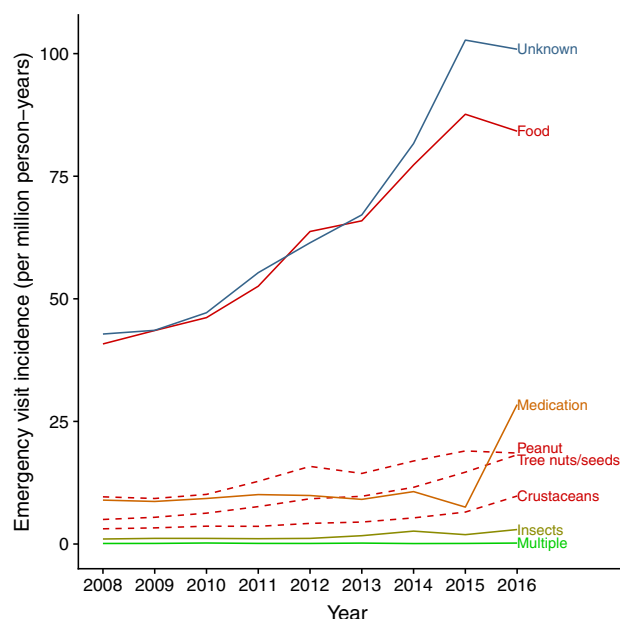


FIGURE 2. Changing population incidence of an anaphylaxis trigger. The dashed red lines indicate the 3 most common specific food triggers, which are included in the total incidence estimate for food (solid red line).

The changing incidence of anaphylaxis triggers is shown in Figure 2. The incidence of idiopathic and food-related anaphylaxis increased steadily over the study period. Medication-induced anaphylaxis seldom occurred before the fourth quarter of 2015, suggesting that diagnosis codes were not used for it before the transition to ICD-10.

Most anaphylaxis patients are not hospitalized, but given the low morbidity of anaphylaxis with optimal management, further reductions may be possible. Indeed, recent evidence suggests that only 16% of hospitalized children receive acute treatments while inpatient, indicating that many hospitalizations are unnecessary.⁸ The incidence of nonanaphylactic allergic reactions did not increase in adults but did increase in children. Nonanaphylactic allergic reactions may generally be managed in the outpatient setting. Taken together, our findings indicate that reductions in ED visits for nonanaphylactic reactions and in hospitalizations for anaphylaxis are possible.

This study has limitations, including the possibility of over- and under-ascertainment of cases through the use of administrative data instead of clinical criteria, though a sensitivity analysis excluding children with urticaria and angioedema did not alter our findings, and coding differences are unlikely to explain incidence increases with degree of confounding

correlated with age. We believe that this limitation is balanced by the national representativeness of the findings, given the lack of generalizability of more local studies that use clinical criteria to identify cases. In addition, we lacked clinical data that may have provided more context to these findings; however, we believe that the generalizability of the findings outweighs this limitation.

It is clear that ED visits for anaphylaxis are increasing rapidly, tripling between 2008 and 2016 among children. Younger age was strongly correlated with increasing visit incidence. These findings could guide future research, public health interventions, and policies to improve the care of adults and children with allergic conditions.

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TABLE E1. Diagnosis codes in ICD-9 and ICD-10 used to assign a trigger for anaphylaxis

Diagnosis code	Diagnosis	Trigger
<i>ICD-9</i>		
6930	Dermatitis due to drugs and medicines taken internally	Medication
6931	Dermatitis due to food taken internally	Food
9895	Toxic effect of venom	Bees
9950	Other anaphylactic reaction	Unknown
99520	Unspecified adverse effect of unspecified drug, medicinal and biological substance	Medication
99527	Other drug allergy	Medication
99529	Unspecified adverse effect of other drug, medicinal and biological substance	Medication
9954	Shock due to anesthesia, not elsewhere classified	Medication
99560	Anaphylactic reaction due to unspecified food	Food
99561	Anaphylactic reaction due to peanuts	Peanut
99562	Anaphylactic reaction due to crustaceans	Crustaceans
99563	Anaphylactic reaction due to fruits and vegetables	Fruit/vegetable
99564	Anaphylactic reaction due to tree nuts and seeds	Tree nuts/seeds
99565	Anaphylactic reaction due to fish	Fish
99566	Anaphylactic reaction due to food additives	Additive
99567	Anaphylactic reaction due to milk products	Milk
99568	Anaphylactic reaction due to eggs	Eggs
99569	Anaphylactic reaction due to other specified food	Food
9957	Other adverse food reactions, not elsewhere classified	Food
E9053	Sting of hornets, wasps, and bees causing poisoning and toxic reactions	Bees
E9055	Other venomous arthropods causing poisoning and toxic reactions	Bees
E9300	Penicillins causing adverse effects in therapeutic use	Medication
E9301	Antifungal antibiotics causing adverse effects in therapeutic use	Medication
E9302	Chloramphenicol group causing adverse effects in therapeutic use	Medication
E9303	Erythromycin and other macrolides causing adverse effects in therapeutic use	Medication
E9304	Tetracycline group causing adverse effects in therapeutic use	Medication
E9305	Cephalosporin group causing adverse effects in therapeutic use	Medication
E9306	Antimycobacterial antibiotics causing adverse effects in therapeutic use	Medication
E9307	Antineoplastic antibiotics causing adverse effects in therapeutic use	Medication
E9308	Other specified antibiotics causing adverse effects in therapeutic use	Medication
E9309	Unspecified antibiotic causing adverse effects in therapeutic use	Medication
E9310	Sulfonamides causing adverse effects in therapeutic use	Medication
E9311	Arsenical anti-infectives causing adverse effects in therapeutic use	Medication
E9312	Heavy metal anti-infectives causing adverse effects in therapeutic use	Medication
E9313	Quinoline and hydroxyquinoline derivatives causing adverse effects in therapeutic use	Medication
E9314	Antimalarials and drugs acting on other blood protozoa causing adverse effects in therapeutic use	Medication
E9315	Other antiprotozoal drugs causing adverse effects in therapeutic use	Medication
E9316	Anthelmintics causing adverse effects in therapeutic use	Medication
E9317	Antiviral drugs causing adverse effects in therapeutic use	Medication
E9318	Other antimycobacterial drugs causing adverse effects in therapeutic use	Medication
E9319	Other and unspecified anti-infectives causing adverse effects in therapeutic use	Medication
<i>ICD-10</i>		
T360X1A	Poisoning by penicillins, accidental (unintentional), initial encounter	Medication
T360X5A	Adverse effect of penicillins, initial encounter	Medication
T361X5A	Adverse effect of cephalosporins and other beta-lactam antibiotics, initial encounter	Medication
T365X5A	Adverse effect of aminoglycosides, initial encounter	Medication
T368X5A	Adverse effect of other systemic antibiotics, initial encounter	Medication
T3695XA	Adverse effect of unspecified systemic antibiotic, initial encounter	Medication
T370X5A	Adverse effect of sulfonamides, initial encounter	Medication
T378X5A	Adverse effect of other specified systemic anti-infectives and antiparasitics, initial encounter	Medication
T39315A	Adverse effect of propionic acid derivatives, initial encounter	Medication

(continued)

TABLE E1. (Continued)

Diagnosis code	Diagnosis	Trigger
T402X1A	Poisoning by other opioids, accidental (unintentional), initial encounter	Medication
T451X5A	Adverse effect of antineoplastic and immunosuppressive drugs, initial encounter	Medication
T464X5A	Adverse effect of angiotensin-converting-enzyme inhibitors, initial encounter	Medication
T490X5A	Adverse effect of local antifungal, anti-infective and anti-inflammatory drugs, initial encounter	Medication
T508X5A	Adverse effect of diagnostic agents, initial encounter	Medication
T50901A	Poisoning by unspecified drugs, medicaments and biological substances, accidental (unintentional), initial encounter	Medication
T50905A	Adverse effect of unspecified drugs, medicaments and biological substances, initial encounter	Medication
T50995A	Adverse effect of other drugs, medicaments and biological substances, initial encounter	Medication
T63441A	Toxic effect of venom of bees, accidental (unintentional), initial encounter	Bees
T63443A	Toxic effect of venom of bees, assault, initial encounter	Bees
T63444A	Toxic effect of venom of bees, undetermined, initial encounter	Bees
T63451A	Toxic effect of venom of hornets, accidental (unintentional), initial encounter	Bees
T63461A	Toxic effect of venom of wasps, accidental (unintentional), initial encounter	Bees
T63464A	Toxic effect of venom of wasps, undetermined, initial encounter	Bees
T7800XA	Anaphylactic reaction due to unspecified food, initial encounter	Food
T7801XA	Anaphylactic reaction due to peanuts, initial encounter	Peanut
T7802XA	Anaphylactic reaction due to shellfish (crustaceans), initial encounter	Crustaceans
T7803XA	Anaphylactic reaction due to other fish, initial encounter	Fish
T7805XA	Anaphylactic reaction due to tree nuts and seeds, initial encounter	Tree nuts/seeds
T7806XA	Anaphylactic reaction due to food additives, initial encounter	Additive
T7807XA	Anaphylactic reaction due to milk and dairy products, initial encounter	Milk
T7808XA	Anaphylactic reaction due to eggs, initial encounter	Eggs
T7809XA	Anaphylactic reaction due to other food products, initial encounter	Food
T782XXA	Anaphylactic shock, unspecified, initial encounter	Unknown
T8089XA	Other complications following infusion, transfusion and therapeutic injection, initial encounter	Medication
T886XXA	Anaphylactic reaction due to adverse effect of correct drug or medicament properly administered, initial encounter	Medication
T887XXA	Unspecified adverse effect of drug or medicament, initial encounter	Medication

ICD-9, International Classification of Diseases, 9th revision; ICD-10, International Classification of Diseases, 10th revision.