

Are Children with a History of Asthma More Likely to Have Severe Anaphylactic Reactions? A Retrospective Cohort Study

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Objective To assess whether a history of asthma was associated with anaphylaxis severity in children hospitalized for anaphylaxis.

Study design Retrospective cohort study of children ≤ 21 years old hospitalized for anaphylaxis from 2009 to 2016. The primary outcome was severe anaphylactic reactions defined by examination findings (stridor, respiratory distress, or hypotension) or administered therapies (≥ 2 dose of intramuscular epinephrine, continuous albuterol, vasopressors, or positive pressure ventilation). Multivariable analyses were used to assess whether a history of asthma was associated with severe anaphylactic reactions, adjusting for patient age, allergen, and history of atopic dermatitis or anaphylaxis.

Results Among 603 children hospitalized for anaphylaxis, 231 (38.3%) had a history of asthma. Children with a history of asthma were older (median age, 6.6 years [IQR, 3.6-12.1] vs 4.0 years [IQR, 1.6-9.3]), more likely to have a history of anaphylaxis (38.1% vs 18.0%), and have food as the inciting allergen (68.0% vs 52.2%). Children with a history of asthma were not more likely to have severe anaphylactic reactions (OR, 0.97; 95% CI, 0.67-1.39).

Conclusions Children hospitalized for anaphylaxis with a history of asthma were not more likely to have severe anaphylactic reactions compared with children without asthma. This study supports managing children with anaphylaxis based on the severity of symptomatology, and, if validated, clinicians should not consider asthma comorbidity as a stand-alone criterion for hospitalization. (*J Pediatr* 2019; ■:1-6).

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Anaphylaxis is a severe, potentially life threatening acute allergic reaction.¹ Clinicians in the emergency department (ED) must be able to recognize risk factors for severe anaphylactic reactions to guide resuscitative efforts and decision making about the need for prolonged ED observation or hospitalization to monitor for severe or biphasic reactions.² Although patients with a history of asthma have been considered to be at risk for serious and fatal anaphylactic reactions, the evidence for this in children cared for in EDs is limited.³⁻⁸

Despite these findings, guidelines from the American Academy of Allergy, Asthma and Immunology recommend prolonged observation periods for patients with asthma owing to the risk of severe and fatal reactions.² Similarly, a position paper from the European Academy of Allergy and Clinical Immunology identify asthma as a “risk factor for anaphylaxis and fatal anaphylaxis.”⁹ These guidelines influence clinician decision making about whether to hospitalize children with anaphylaxis and a history of asthma based on the risk of severe reactions and may contribute to unnecessary hospitalizations for children who otherwise meet ED discharge criteria. The paucity of reliable predictors of severe reactions, including whether asthma portends an increased risk of these reactions, contributes to disparate guideline recommendations of observation periods from 4 to 24 hours and wide variation in hospitalization rates for children with anaphylaxis across US EDs (12%-95%).^{2,9,10}

Thus, the objective of this study was to determine whether a history of asthma was associated with anaphylaxis severity in children hospitalized for anaphylaxis. These findings may establish the degree to which clinicians should consider asthma history when assessing children’s risk of developing severe anaphylactic reactions at the time of initial assessment. If children with a history of asthma are not more likely to have severe anaphylactic reactions, there may be opportunity to decrease hospitalizations and healthcare costs by avoiding unnecessary admissions for these children.

ED	Emergency department
EMR	Electronic medical record
ICD	International Classification of Diseases
IM	Intramuscular
NIAID/FAAN	National Institute of Allergy and Infectious Disease and the Food Allergy and Anaphylaxis Network

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Funded by the Boston Children’s Hospital House Officer Award. The authors declare no conflicts of interest.

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<https://doi.org/10.1016/j.jpeds.2019.12.019>

Methods

This was a preplanned secondary analysis of children presenting to the ED for anaphylaxis and who were hospitalized.⁸ In brief, we conducted a single-center retrospective cohort study of children 6 months to 18 years of age hospitalized with anaphylaxis, presenting to the ED from January 2009 to June 2016. Based on a local evidence-based guideline, children with anaphylaxis at our institution are typically observed for 4 hours before ED discharge and hospitalized for hypotension, persistent wheezing or respiratory distress, or receipt of ≥ 2 doses of intramuscular (IM) epinephrine in the prehospital or ED settings. Past medical history of asthma is considered a potential risk factor for severe reactions but not an absolute indication for admission. The hospital institutional review board approved this study.

Cases were identified using *International Classification of Diseases (ICD), Ninth and Tenth Revision* ED discharge codes for the broad diagnostic categories of allergic reactions, anaphylaxis, or adverse drug reactions to ensure anaphylaxis encounters were not omitted because of inaccurate coding or misdiagnosis on the part of the treating clinician (**Table I**; available at www.jpeds.com)^{6,8,11} and manually reviewed to confirm the presence of anaphylaxis using the 2006 National Institute of Allergy and Infectious Disease and the Food Allergy and Anaphylaxis Network (NIAID/FAAN) diagnostic criteria for anaphylaxis (**Table II**; available at www.jpeds.com).¹ Children who received IM epinephrine in the prehospital or ED settings were included, regardless of whether they fulfilled anaphylaxis criteria, because receipt of epinephrine may mitigate symptoms in the ED.

We excluded children transferred from outside facilities owing to difficulty in accurately assessing initial symptoms and examinations findings. Children currently receiving oral corticosteroids at the time of reaction onset were also excluded because it is difficult to discern whether the presence of respiratory symptoms was secondary to asthma exacerbations or anaphylaxis. Other exclusion criteria included anaphylactic reactions secondary to treatments administered in the ED, patients with a tracheostomy or receiving home respiratory support (eg, continuous positive airway pressure or bilevel positive airway pressure) as well as children with hereditary angioedema, mast cell activation disorders, and somatoform disorder because these groups of patients may require differing treatments or periods of observation.

The data abstraction form was developed and pilot tested by the primary investigator in conjunction with the entire research team. Data abstraction was conducted by a research coordinator (approximately 30% of the records), and the primary investigator (approximately 70%). To ensure accuracy of the records abstracted by the research coordinator, the primary investigator reviewed the first 50 encounters, and then a random sampling of 10% of charts thereafter. The senior author reviewed cases from the primary investigator and research coordinator in which there was uncertainty regarding the diagnosis of anaphylaxis or the presence or

absence of asthma comorbidity. Ambiguous cases were further resolved by group consensus.

We abstracted information from the electronic medical record (EMR), including prior history of anaphylaxis, asthma, allergic rhinitis, atopic dermatitis, and the use of inhaled corticosteroids. Asthma history and use of oral and inhaled corticosteroids were obtained by review of provider documentation in ED, admission, and hospital discharge notes and not based on prepopulated past medical history or problem lists owing to the inherent inaccuracies of these lists. Children prescribed beta agonists were not categorized as having asthma, given that these medications may be administered to children without asthma who had isolated wheezing episodes.

Our composite primary outcome was severe anaphylactic reactions, developed by group consensus from the authors based on biological plausibility.⁸ Severe reactions were defined by the presence of examination findings (stridor or hypotension or respiratory distress during the first 4 hours of ED care), or receipt of acute therapies (≥ 2 doses of IM epinephrine or use of continuous albuterol or initiation of positive pressure ventilation [high-flow nasal cannula, continuous positive airway pressure, bilevel positive airway pressure, intubation/mechanical ventilation], or administration of vasopressors [epinephrine, dopamine, or norepinephrine]) in the prehospital, ED, or inpatient settings. We did not categorize patients who received single or multiple inhaled beta agonists or fluid boluses as having severe anaphylaxis owing to subjectivity around administration of these therapies. Among children with asthma, we performed a subanalysis to assess whether children receiving inhaled corticosteroids at the time of the anaphylaxis visit modifies the risk of severe anaphylactic reactions.

Although we sought to assess anaphylaxis severity among hospitalized children, to provide further context regarding our study population, we examined overall and asthma-specific hospitalization rates for children with anaphylaxis during the study period. This approach used ICD-9 and ICD-10 codes for the identification of ED visits for anaphylaxis, and for the presence or absence of history of asthma.

Demographic characteristics, past medical history, reaction triggers, and baseline characteristics were summarized using medians and IQR for continuous variables, and proportions for categorical variables. We first determined the bivariable association between asthma history and the outcome of severe anaphylactic reaction. Then, data were analyzed using a logistic regression model with age in years (<2, 2-5, 6-9, 10-13, ≥ 14) and allergen (food, medication, or unknown trigger) as covariates as well as prior history of atopic dermatitis or anaphylaxis. We included age, allergen trigger, and prior history of atopic dermatitis or anaphylaxis as covariates because they may be independently associated with history of asthma or anaphylaxis severity.^{6,12} Binary secondary outcomes were modeled using logistic regression and nominal secondary outcome (total doses of IM epinephrine) was modeled using generalized logits model with age groups and allergen as covariates. Proportions, ORs, and

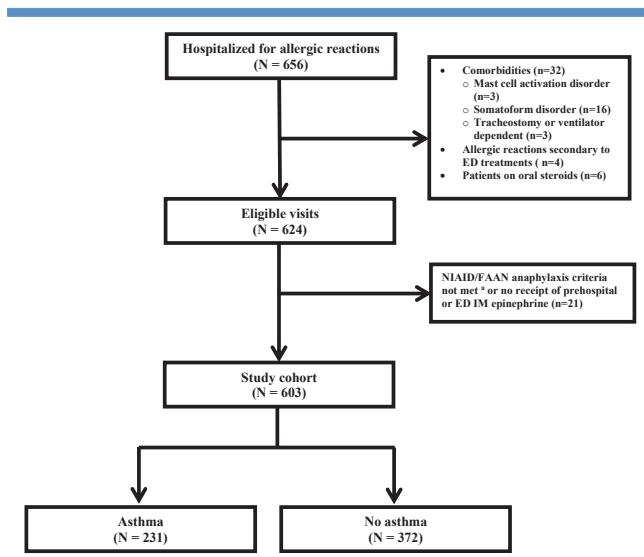


Figure. Patient flow diagram. ^a Manual chart review performed applying the 2006 NIAID/FAAN diagnostic criteria for anaphylaxis.¹

corresponding 95% CIs were calculated. All statistical analyses were conducted using SAS 9.4 (SAS Institute, Inc, Cary, North Carolina).

Results

During the study period, the hospitalization rate for children presenting to the ED with anaphylaxis based on ICD anaphylaxis codes was 61.6% for children with a history of asthma and 45.7% for children without a history of asthma.

There were 603 children who met inclusion criteria and after manual review using NIAID/FAAN anaphylaxis criteria, of whom 231 (38.3%) had a past medical history of asthma (Figure). Prehospital and ED physical examination findings of anaphylaxis are presented in Table III. Children with asthma were older and more likely to have a history of anaphylaxis and allergic rhinitis. The presence of wheezing was more common among children with a history of asthma compared with children without asthma. Receipt of inpatient IM epinephrine and inhaled beta agonists were more common among children with a history of asthma (Table IV). Among children with asthma, 52.4% (n = 121) and 43.3% (n = 100) had wheezing or respiratory distress compared with 34.4% (n = 128) and 39.2% (n = 146) without asthma. Hypotension was uncommon among children with (n = 11, 4.8%) and without asthma (n = 15, 4.0%). Among children with and without asthma, 64.1% (n = 148) vs 69.4% (n = 258) received 1 dose of IM epinephrine and 48.9% (n = 113) vs 24.2% (n = 90) received inhaled beta agonists in the prehospital setting or during ED care (Table IV). Children with asthma were more likely to receive ≥ 2 doses of inhaled beta agonists during inpatient care (9.1% [n = 21]) than children without asthma (2.7% [n = 10]).

Table III. Characteristics of children with anaphylaxis

Characteristics	Asthma (n = 231)	No asthma (n = 372)	P value*
Demographics			
Age (y)	6.6 [3.6-12.1]	4.0 [1.6-9.3]	<.0001
Age groups (y)			<.0001
<2	19 (8.2)	112 (30.1)	
2-5	87 (37.7)	122 (32.8)	
6-9	51 (22.1)	53 (14.2)	
10-13	31 (13.4)	31 (8.3)	
≤ 14	43 (18.6)	54 (14.5)	
Male	146 (63.2)	215 (57.8)	.12
Race			<.0001
White	75 (32.5)	177 (47.6)	
Black	73 (31.6)	50 (13.4)	
Other	72 (31.2)	119 (32.0)	
Unknown	11 (4.8)	26 (7.0)	
Ethnicity			.21
Non-Hispanic	156 (67.5)	262 (70.4)	
Hispanic	49 (21.2)	59 (15.9)	
Unknown	26 (11.3)	51 (13.7)	
Language			.30
Non-English	30 (13.0)	34 (9.1)	
English	192 (83.1)	320 (86.0)	
Unknown	9 (3.9)	18 (4.8)	
Insurance			.002
Public	114 (49.4)	130 (34.9)	
Private	115 (49.8)	239 (64.2)	
Unknown	2 (0.9)	3 (0.8)	
Past medical history			
Inhaled corticosteroids	100 (43.3)	0	
Anaphylaxis	88 (38.1)	67 (18.0)	<.0001
Atopic dermatitis	65 (28.1)	92 (24.7)	.35
Allergic rhinitis	17 (7.4)	13 (3.5)	.034
Reaction trigger			
Type of allergen			.004
Food	157 (68.0)	194 (52.2)	
Medication	10 (4.3)	25 (6.7)	
Venom	3 (1.3)	5 (1.3)	
Other	2 (0.9)	2 (0.5)	
Unknown	59 (25.5)	146 (39.2)	
Examination findings[†]			
Respiratory			
Wheezing	121 (52.4)	128 (34.4)	<.0001
Stridor	6 (2.6)	32 (8.6)	.003
Respiratory distress	100 (43.3)	146 (39.2)	.33
Cardiac			
Wide pulse pressure [‡]	102 (44.2)	140 (37.6)	.11
Hypotension [§]	11 (4.8)	15 (4.0)	.67
Inpatient disposition			.48
Floor	208 (90.0)	328 (88.2)	
Step down unit or ICU	23 (10.0)	44 (11.8)	
Inpatient length of stay (h)	17 [14-20]	18 [15-21]	.085

ICU, intensive care unit.

Data are median [IQR] or number (%).

*Categorical data were analyzed using the χ^2 test. Continuous data were analyzed using Wilcoxon rank-sum test.

[†]Examination findings from the prehospital setting and during the first 4 hours of ED care. Categories are not mutually exclusive.

[‡]Defined as a diastolic blood pressure of less than or equal to one-half the systolic blood pressure.

[§]Defined according to Pediatric Advanced Life Support guidelines: systolic blood pressure <70 mm Hg for 1-12 months of age, <70 mm Hg + (age in years $\times$ 2) for 1-10 years, and <90 mm Hg for >10 years.

In the unadjusted model, children with a history of asthma were not more likely to present with hypotension (OR, 1.19; 95% CI, 0.54-2.64) or respiratory distress (OR, 1.18; 95% CI, 0.85-1.65), and there were no differences in receipt of acute therapies (multiple doses of IM epinephrine [OR, 1.42; 95% CI, 0.97-2.07], vasopressors [OR, 0.71; 95% CI, 0.22-

Table IV. Prehospital, ED, and inpatient therapies

Characteristics	Asthma (n = 231)	No asthma (n = 372)	P value*
Prehospital and ED			
IM epinephrine (doses)			.22
None	21 (9.1)	37 (9.9)	
1	148 (64.1)	258 (69.4)	
≥2	62 (26.8)	77 (20.7)	
Inhaled beta agonist			<.0001
None	118 (51.1)	282 (75.8)	
1	72 (31.2)	63 (16.9)	
≥2	41 (17.7)	27 (7.3)	
Racemic epinephrine	8 (3.5)	20 (5.4)	.28
IV fluid bolus			.79
None	156 (67.5)	247 (66.4)	
1	61 (26.4)	97 (26.1)	
≥2	14 (6.1)	28 (7.5)	
Vasopressors	4 (1.7)	8 (2.2)	.72
Inpatient			
IM epinephrine (doses)			.002
None	226 (97.8)	369 (99.2)	
1	5 (2.2)	0	
≥2	0	3 (0.8)	
IV fluid bolus			.82
None	223 (96.5)	362 (97.3)	
1	7 (3.0)	8 (2.2)	
≥2	1 (0.4)	2 (0.5)	
Vasopressors	3 (1.3)	8 (2.2)	.44
Inhaled beta agonist			.002
None	199 (86.1)	349 (93.8)	
1	11 (4.8)	13 (3.5)	
≥2	21 (9.1)	10 (2.7)	
Continuous albuterol	1 (0.4)	1 (0.3)	
Racemic epinephrine	0	2 (0.5)	

IV, intravenous.

Data are number (%).

*Data were analyzed using the χ^2 test or Fisher exact test.

2.34], or continuous albuterol [OR, 1.61; 95% CI, 0.10-25.91]) (Table IV). Overall, severe anaphylactic reactions were not more common among children with a history of asthma (OR, 1.07; 95% CI, 0.77-1.50).

Similarly, in the adjusted model, children with a history of asthma were not more likely to have severe anaphylactic reactions than children without asthma (OR, 0.97; 95% CI, 0.67-1.39), and there were no statistically significant differences in rates of severe examination findings (hypotension, respiratory distress, or stridor) or therapies (multiple IM epinephrine doses, vasopressors, or continuous albuterol) (Table V).

Among children with asthma, the use of inhaled corticosteroids was not associated with severe anaphylactic reactions (OR, 1.14; 95% CI, 0.68-1.94) (Table VI; available at www.jpeds.com).

Discussion

In this cohort of 603 children hospitalized with anaphylaxis, >50% of patients had severe reactions, defined by the presence of examination findings (hypotension, stridor, or respiratory distress) or receipt of acute therapies (≥2 doses of IM epinephrine, vasopressors, continuous albuterol, or noninvasive ventilation). Severe anaphylactic reactions were not

more common among children with a history of asthma in either the unadjusted or the adjusted models, or after controlling for asthma severity in a subanalysis of children with asthma on inhaled corticosteroids.

In 2014, new guidelines were published by the American Academy of Allergy, Asthma and Immunology about the ED diagnosis and treatment of anaphylaxis. The practice recommendations identify asthma history as a risk factor for “severe and potentially fatal anaphylaxis” and advise observation periods of >4-8 hours for patients with asthma owing to the risk of severe anaphylaxis.² History of asthma has been found to increase the risk of wheezing (OR, 2.2; 95% CI, 1.1-4.5) and respiratory arrest (OR, 6.9; 95% CI, 1.4-34.2) among patients with food-induced anaphylaxis.¹³ In case series of fatal or near-fatal anaphylaxis, almost all patients had a history of asthma; however, these data were limited by their retrospective (postmortem) sources, and paucity of information around initial examination findings data (presence or absence of wheezing, stridor, or respiratory distress) or cause of death (eg, respiratory or cardiovascular).^{3,4,14}

Recent studies conducted in ED settings have failed to identify a history of asthma as a risk factor for repeat epinephrine administration or biphasic anaphylaxis.^{6,12,15,16} Hypotension, wheezing, and administration of beta agonists have been identified as potential risk factors for biphasic anaphylaxis or need for repeat epinephrine administration; however, these studies have not assessed whether children with a history of asthma are more likely to present to the ED with wheezing, stridor, respiratory distress, or hypotension compared with children without asthma.^{5-7,17} Uncertainty as to whether asthma portends an increased risk of severe anaphylactic reactions likely influences decision making around ED observation periods or the need for hospitalization to monitor for recurrent reactions. This finding is supported by a study of children and adult ED visits for food-related allergic reactions in which patients with a history of asthma were more likely to be hospitalized.¹⁸

This study addresses an important gap in anaphylaxis literature, specifically whether children with asthma are at increased risk of severe anaphylactic reactions. We developed our own definition of severe anaphylaxis based on group consensus and biological plausibility because there is no validated pediatric anaphylaxis severity grading system.¹⁹ Although our composite outcome of severe anaphylaxis may have skewed the results toward nonsignificance, we sought to develop a definition that included clinically relevant symptoms, physical examination findings, and therapies that may warrant prolonged ED observation or hospitalization. For the primary outcome, we intentionally did not include examination findings for which there may be inconsistent recognition or documentation (eg, mild wheezing) or for therapies in which there may be subjectivity around administration (eg, inhaled beta agonists given to children without wheezing who report dyspnea).

If validated, these findings may help to standardize anaphylaxis hospitalization criteria and potentially reduce

Table V. Anaphylaxis severity among patients with asthma history

Characteristics	Asthma (n = 231)	No asthma (n = 372)	Unadjusted model	Adjusted model*
Severe anaphylaxis encounters [†]	132	206	1.07 (0.77-1.50)	0.97 (0.67-1.39)
Examination findings				
Hypotension	11	15	1.19 (0.54-2.64)	0.79 (0.33-1.91)
Stridor	6	32	0.28 (0.12-0.69)	—
Respiratory distress	100	146	1.18 (0.85-1.65)	1.12 (0.78-1.61)
Therapies				
IM epinephrine (doses) [‡]			1.42 (0.97-2.07)	1.24 (0.83-1.84)
0-1	166	293	Ref	Ref
2	55	62		
≥3	10	17		
Vasopressors [§]	4	9	0.71 (0.22-2.34)	—
Continuous albuterol	1	1	1.61 (0.10-25.91)	—
Positive pressure ventilation [¶]	0	0	—	—

Data are number or OR (95% CI).

*Covariates adjusted for in the multivariable model included age (<2, 2-5, 6-9, 10-13, ≥14 years) allergen (food, medication, or unknown), and history of atopic dermatitis or anaphylaxis. Adjusted models were not performed for stridor, vasopressors, and continuous albuterol because the event was rare.

†Clinical characteristics are not mutually exclusive.

‡Includes receipt of epinephrine in the prehospital, ED, or inpatient settings.

§Intravenous epinephrine, dopamine, or norepinephrine.

¶High-flow nasal cannula, continuous positive airway pressure, bilevel positive airway pressure, or intubation/mechanical ventilation.

hospitalizations by not including asthma history as a criterion for prolonged ED observation or hospitalization.^{1,2} Our findings are intended to support and not replace clinical judgement. Patients who have persistent wheezing or hypotension after treatment with IM epinephrine and beta agonists likely require inpatient hospitalization. Additionally, decision making about the need for hospitalization should be guided by reaction severity and response to therapies rather than by a history of asthma in isolation. Patients who fulfill ED discharge criteria require close outpatient follow-up with an allergist and should have access to and education about using epinephrine autoinjectors.

Our study is subject to limitations, mainly related to the retrospective design. Symptoms, examination findings, and past medical history may not have been accurately documented in the EMR. However, given the importance of accurately assessing asthma history and the use of inhaled corticosteroids, we closely reviewed provider documentation about past medical history and home medications in the ED, admission, and discharge notes and did not use EMR diagnostic or problem list codes to categorize history of asthma. Although there may be an underdocumentation of a history of asthma in ED notes, we felt it unlikely for this information to also be omitted from hospital admission and discharge notes.

Although we developed a practical definition of severe anaphylactic reactions, this study highlights the need to develop and validate consensus anaphylaxis outcomes definitions, including a severity grading system to inform clinical care and for application in research.¹⁹ Additionally, this was a single-center study conducted at a tertiary care pediatric hospital, and thus may not be generalizable to the care of children at other institutions with differing levels of asthma and/or anaphylaxis severity.

Clinicians may have had a lower threshold to hospitalize children with asthma who otherwise met discharge criteria,

which may decrease the overall reaction severity in the asthma cohort. To account for this factor, we assessed anaphylaxis hospitalization rates during the study period for children with and without a history of asthma using ICD codes. Despite the potential for children with less severe reactions to be hospitalized based solely on a prior history of asthma, this is not evident when comparing the prevalence of examination findings consistent with more serious reactions (wheezing [52.4% vs 34.4%], respiratory distress [43.3% vs 39.2%], and hypotension [4.8% vs 4.0%]) among children with and without a history of asthma. Additionally, children may have been hospitalized owing to asthma exacerbations from allergic triggers and not anaphylaxis. To account for this, we only included encounters that fulfilled NIAID/FAAN anaphylaxis criteria and the primary investigator manually reviewed encounters in which there was diagnostic uncertainty.¹

Although we sought to assess indications for hospitalization, this was not possible because of limited disposition documentation in the EMR. We did not assess the outpatient course of patients discharged from the ED. However, 72-hour ED revisits for anaphylaxis were rare (2.1%) at our institution during the study period.^{20,21} This made it feasible to accrue a large cohort of children who had severe anaphylactic reactions, and it offers a conservative approach for extrapolation to a population of children with less severe symptoms because discharged children likely have less severe reactions. Finally, discharged patients may have visited different EDs after being discharged from our ED, although this was likely uncommon and we would expect these patients to revisit our institution given it is a large referral center.²²

In conclusion, children hospitalized for anaphylaxis with a past medical history of asthma were not more likely to have severe anaphylactic reactions compared with children without asthma. This study supports managing children

with anaphylaxis based on severity of symptomatology, and if validated, clinicians should not consider asthma comorbidity as a stand-alone criterion for hospitalization. ■

Submitted for publication Aug 19, 2019; last revision received Nov 4, 2019; accepted Dec 11, 2019.

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Table 1. ICD-9 and ICD-10 ED discharge codes for allergic reactions, anaphylaxis, or adverse drug reactions

Codes	Description
ICD-9	
995.0	Other anaphylactic shock
995.1	Angioneurotic edema
995.2	Unspecified adverse effect of drug, medicinal, and biological substance [due] to correct medicinal substance properly administered
995.3	Allergy, unspecified
995.6	Anaphylactic shock due to adverse food reaction
ICD-10	
T78.01	Anaphylactic shock due to shell fish (crustaceans)
T78.02	Anaphylactic shock due to other fish
T78.03	Anaphylactic shock due to fruits and vegetables
T78.04	Anaphylactic shock due to tree nuts and seeds
T78.06	Anaphylactic shock due to milk and dairy products
T78.07	Anaphylactic shock due to eggs
T78.08	Anaphylactic shock due to other food products
T78.09	Anaphylactic shock due to unspecified food products
T78.1	Other adverse food reactions, not classified elsewhere
T78.2	Anaphylactic shock, unspecified
T78.4	Allergy, unspecified

Table II. Clinical criteria for diagnosing anaphylaxis**Anaphylaxis is highly likely when any one of the following 3 criteria are fulfilled:**

1. Acute onset of an illness (minutes to several hours) with involvement of the skin, mucosal tissue, or both (eg, generalized hives, pruritus or flushing, swollen lips-tongue-uvula)
And at least one of the following
 - a. Respiratory compromise (eg, dyspnea, wheeze-bronchospasm, stridor, reduced peak expiratory flow, hypoxemia)
 - b. Reduced blood pressure or associated symptoms of end-organ dysfunction (eg, hypotonia [collapse], syncope, incontinence)
2. Two or more of the following that occur rapidly after exposure to a likely allergen for that patient (minutes to several hours):
 - a. Involvement of the skin-mucosal tissue (eg, generalized hives, itch-flush, swollen lips-tongue-uvula)
 - b. Respiratory compromise (eg, dyspnea, wheeze-bronchospasm, stridor, reduced peak expiratory flow, hypoxemia)
 - c. Reduced blood pressure or associated symptoms (eg, hypotonia [collapse], syncope, incontinence)
 - d. Persistent gastrointestinal symptoms (eg, crampy abdominal pain, vomiting)
3. Reduced BP after exposure to known allergen for that patient (minutes to several hours):
 - a. Infants and children: low systolic BP (age specific) or >30% decrease in systolic BP*
 - b. Adults: systolic BP of <90 mm Hg or >30% decrease from that person's baseline

BP, blood pressure.

*Low systolic blood pressure for children is defined as <70 mm Hg from 1 month to 1 year, less than (70 mm Hg + [2 x age]) from 1 to 10 years, and <90 mm Hg from 11 to 17 years.

Table VI. Anaphylaxis severity among children with asthma on inhaled corticosteroids

Clinical characteristics	Inhaled corticosteroid use		Or (95% CI)
	Yes (n = 100)	No (n = 131)	
Severe anaphylaxis encounters*	59 (59.0)	73 (55.7)	1.14 (0.68-1.94)
Examination findings			
Hypotension	8 (8.0)	3 (2.3)	3.71 (0.96-14.36)
Stridor	3 (3.0)	3 (2.3)	1.32 (0.26-6.68)
Respiratory distress	40 (40.0)	60 (45.8)	0.79 (0.47-1.34)
Therapies			
IM epinephrine (doses) [†]			
0-1	71 (71.0)	95 (72.5)	Reference
2	25 (25.0)	30 (22.9)	1.12 (0.60-2.06)
≥3	4 (4.0)	6 (4.6)	0.89 (0.24-3.28)
Vasopressors [‡]	1 (1.0)	3 (2.3)	
Continuous albuterol	0	1 (0.8)	
Positive pressure ventilation [§]	0	0	

IV, intravenous.

Values are number (%) unless otherwise indicated.

*Clinical characteristics are not mutually exclusive.

[†]Includes receipt of epinephrine in the prehospital, ED, or inpatient settings.[‡]IV epinephrine, dopamine, or norepinephrine.[§]High-flow nasal cannula, continuous positive airway pressure, bilevel positive airway pressure, or intubation/mechanical ventilation.