

Original Article

A Multifaceted Intervention for Patients with Anaphylaxis Increases Epinephrine Use in Adult Emergency Department

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What is already known about this topic? Inconsistent emergency anaphylaxis care and low compliance with published guidelines have been documented in studies. An algorithmic approach was shown to be effective in improving the management of anaphylaxis in pediatric patients.

What does this article add to our knowledge? This article provides an evaluation of anaphylaxis management before and after implementation of an emergency department anaphylaxis order set and the introduction of epinephrine auto-injectors, and measures the effect on anaphylaxis guideline adherence in adults.

How does this study impact current management guidelines? The multifaceted approach described here addresses the complexities of anaphylaxis management, and analysis of the data suggests that implementation of such an approach in the emergency department may increase guideline compliance in patients with anaphylaxis.

BACKGROUND: Studies have documented inconsistent emergency anaphylaxis care and low compliance with published guidelines.

OBJECTIVE: To evaluate anaphylaxis management before and after implementation of an emergency department (ED) anaphylaxis order set and introduction of epinephrine autoinjectors, and to measure the effect on anaphylaxis guideline adherence.

METHODS: A cohort study was conducted from April 29, 2008, to August 9, 2012. Adult patients in the ED who were diagnosed with anaphylaxis were included. ED management, disposition, self-injectable epinephrine prescriptions, allergy follow-up, and incidence of biphasic reactions were evaluated.

RESULTS: The study included 202 patients. The median age of the patients was 45.3 years (interquartile range, 31.3-56.4 years); 139 (69%) were women. Patients who presented after order set implementation were more likely to be treated with epinephrine (51% vs 33%; odds ratio [OR] 2.05 [95% CI, 1.04-4.04]) and admitted to the ED observation unit (65% vs 44%; OR 2.38 [95% CI, 1.23-4.60]), and less likely to be dismissed home

directly from ED (16% vs 29%, OR 0.47 [95% CI, 0.22-1.00]). Eleven patients (5%) had a biphasic reaction. Of these, 5 (46%) had the biphasic reaction in the ED observation unit; 1 patient was admitted to the intensive care unit. Six patients (55%) had reactions within 6 hours of initial symptom resolution, of whom 2 were admitted to the intensive care unit.

CONCLUSIONS: Significantly higher proportions of patients with anaphylaxis received epinephrine and were admitted to the ED observation unit after introduction of epinephrine autoinjectors and order set implementation. Slightly more than half of the biphasic reactions occurred within the recommended observation time of 4 to 6 hours. Analysis of these data suggests that the multifaceted approach to changing anaphylaxis management described here improved guideline adherence. © 2014 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2014;■:■-■)

Key words: Anaphylaxis; Emergency department; Order set; Self-injectable epinephrine; Clinical decision support

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Abbreviations used

ED- Emergency department
EDOU- Emergency department observation unit
ICU- Intensive care unit
IQR- Interquartile range
OR- Odds ratio
SIE- Self-injectable epinephrine

Several studies have demonstrated inconsistent anaphylaxis management in the emergency department (ED). A study published by Ross et al¹ that used data from 34 EDs found that only 19% of patients with food-related allergic events received epinephrine as part of management. Similarly, in a study that included 15 EDs, only 13% of patients who presented with insect sting anaphylaxis received epinephrine while in the ED.² Low rates of self-injectable epinephrine prescriptions and allergist referrals in ED patients with anaphylaxis have also been reported in several studies.²⁻⁵ In addition, guidelines recommend that patients with anaphylaxis be observed for 4 to 6 hours due to the risk of a biphasic reaction, and prolonged observation periods are recommended for patients with severe or refractory symptoms.⁶⁻⁸

Epinephrine is the first-line treatment for anaphylaxis, and delayed epinephrine administration has been associated with anaphylaxis fatality.⁸⁻¹¹ Epinephrine is available in different doses and concentrations, and can be administered via several routes. Dosing errors in epinephrine administration can have potentially lethal consequences.¹² Thus, rapid administration of epinephrine in the setting of anaphylaxis can be challenging, and uncertainty about dosing and risk of error may deter providers from treating patients with epinephrine. ED management of anaphylaxis is time and resource intensive. To ensure timely delivery of key interventions and to prevent omission of important aspects of care, experts have recommended an algorithmic approach.¹³ An algorithmic approach was shown to be effective in improving the management of anaphylaxis in pediatric patients but has never been evaluated in adults.¹⁴ The objective of this study was to evaluate anaphylaxis management before and after the implementation of a multidisciplinary consensus-based ED anaphylaxis management order set and the introduction of epinephrine autoinjectors, to determine the effect on anaphylaxis guideline adherence, and to describe the biphasic reactions that occurred in our cohort.

METHODS**Study design and setting**

A retrospective observational cohort study of ED patients who presented with anaphylaxis was conducted from April 29, 2008, to August 9, 2012. The study was approved by the institutional review board. Patients were consecutively included at a tertiary care academic ED in southeast Minnesota with 73,000 annual patient visits. The ED includes 51 beds with an additional 10-bed observation unit and is staffed by approximately 35 attending physicians who supervise physician assistants, nurse practitioners, and residents.

Selection of participants

Patients 18 years of age and older who presented to the ED from April 29, 2008, to August 9, 2012, and who were diagnosed with anaphylaxis were eligible for inclusion. Electronic medical records were reviewed to ensure that the National

Institute of Allergy and Infectious Disease and Food Allergy and Anaphylaxis Network anaphylaxis diagnostic criteria were met.⁷

Intervention

With multidisciplinary input from specialists in emergency medicine, allergic diseases, pharmacy, and nursing, we developed an anaphylaxis management order set designed to optimize the diagnosis, management, observation, and safe dismissal of adult ED patients with anaphylaxis (Figure E1, in this article's Online Repository, available at jaci-inpractice.org), which was then refined after incorporating feedback from key stakeholders in patient care. The ED anaphylaxis management order set included a schematic of the National Institute of Allergy and Infectious Disease and Food Allergy and Anaphylaxis Network anaphylaxis diagnostic criteria to promote accurate recognition. It also included medication dosing to be used in the ED and continued dosing if the patient was admitted to the ED observation unit (EDOU). Further, the order set included nursing orders to (1) provide an anaphylaxis education packet to the patient with information about anaphylaxis, epinephrine autoinjector use, and patient advocacy organizations; (2) show a video that demonstrated the use of an epinephrine autoinjector; (3) observe the patient demonstrating the proper use of an epinephrine autoinjector; and (4) provide anaphylaxis dismissal instructions with an emphasis on allergen avoidance. A recommendation for a self-injectable epinephrine prescription was included, along with an automated allergist referral on discharge to encourage optimal follow-up. The automated allergy referral involved an order for the nurse to request an allergy clinic follow-up. The allergy clinic received information about the patient referral. The patient was then provided with contact information for the allergy clinic and was required to contact the allergy office to schedule the appointment. Epinephrine autoinjectors (0.3 mg [0.3 mL, 1:1000]) also were added to our automated medication dispensing machines in the ED to simplify dosing and administration of epinephrine.

The anaphylaxis management order set was made available on May 10, 2009, to ED providers to use at their discretion. Providers were oriented to the order set at a 1-hour grand rounds presentation before implementation. Automated medication dispensing machines were stocked with epinephrine autoinjectors shortly before order set implementation. The ED nursing committee also conducted educational sessions for the nurses on the proper use of epinephrine autoinjectors through demonstration with trainer pens. To ensure compliance with training sessions, a demonstration of the use of an epinephrine autoinjector was required as part of the ED's annual nurse competency assessment.

Data collection and outcome measures

Data were abstracted from electronic medical records by using a standardized data abstraction form. Data were collected on order set use, patient demographics, inciting allergens, epinephrine use, characteristics and management of biphasic reactions, disposition, self-injectable epinephrine prescriptions, and allergy follow-up. A biphasic reaction was defined as recurrence of symptoms within 72 hours that met the National Institute of Allergy and Infectious Disease and Food Allergy and Anaphylaxis Network criteria for anaphylaxis after symptomatic resolution of the initial event. The outcome measures of interest were administration of epinephrine in the ED, ED disposition of

TABLE I. Patient characteristics based on order set use

Characteristic	All patients (n = 202)	Order set		P value
		Before implementation (n = 48)	After implementation (n = 154)	
Women, no. (%)	139 (69)	31 (65)	108 (70)	.47
Age, y				
Median (IQR)	45.3 (31.3-56.4)	44.9 (32.8-58.6)	45.4 (31.1-56.2)	.28
Range	18-98.4	21-98.4	18-89.4	
Race, no. (%)				
African American	4 (2)	0	4 (100)	.99
White	187 (93)	47 (98)	140 (91)	.13
Asian	2 (1)	1 (2)	1 (1)	.42
Other and/or unknown	9 (5)	0	9 (6)	.46
Suspected trigger, no. (%)				
Food	60 (30)	13 (27)	47 (31)	.65
Medication	41 (20)	12 (25)	29 (19)	.35
Venom	33 (16)	8 (17)	25 (16)	.94
Other	18 (9)	4 (8)	14 (9)	.99
Unknown	50 (25)	11 (23)	39 (25)	.74
Prehospital epinephrine, no. (%)	31 (15)	7 (15)	24 (16)	.87
History of asthma, no. (%)	46 (23)	11 (23)	35 (23)	.99
History of cardiovascular disease, no. (%)	27 (13)	7 (15)	20 (13)	.81

IQR, Interquartile range.

patients, dismissal prescriptions for self-injectable epinephrine, frequency and timing of biphasic reactions, and allergist referral.

Statistical analysis

Continuous data are presented as medians with interquartile ranges. Categorical data presented as percentage frequency of occurrence were compared by using the χ^2 test. Logistic regression models were fit to measure the association between order set use and the outcome measures previously described. Odds ratios (OR) with corresponding 95% CIs were calculated for each association. *P* values represent 2-sided hypothesis testing, and $P \leq .05$ was considered statistically significant. Statistical analyses were performed by using JMP software version 9.0 (SAS Institute Inc, Cary, NC). If no events were observed in a 2×2 table, this was corrected by adding a fixed value (+0.5) to all cells to avoid computational errors by dividing by a zero count.^{15,16}

RESULTS

There were 202 patients who presented to the ED with anaphylaxis during the study period. The median age was 45.3 years (interquartile range, 31.3-56.4 years); 139 (69%) were women. Approximately 90% of the cohort was white. A specific trigger was suspected in 75% of the patients ($n = 152$) and was unknown in 25% ($n = 50$). Overall, after ED management, 121 patients (60%) were observed in the EDOU, 39 (19%) were dismissed home from the ED, 11 (5%) were admitted to a general medical floor, and 31 (15%) were admitted to an intensive care unit (ICU). Of the 202 patients, 48 (24%) received care before implementation of the order set and 154 (76%) after implementation of the order set in our ED. After its introduction, the order set was used with 88 of the patients (57.2%). Baseline characteristics of patients treated before and after the implementation of the order set are compared in Table I. There were no significant differences between the 2

groups when comparing demographics, suspected triggers, pre-hospital use of epinephrine, or a history of asthma and cardiovascular disease.

ED management and disposition are shown in Table II. Patients who presented after order set implementation and epinephrine autoinjector introduction were more likely to be treated with epinephrine (51% vs 33%; OR 2.05 [95% CI, 1.04-4.04]) and admitted to the EDOU (65% vs 44%; OR 2.38 [95% CI, 1.23-4.60]) and less likely to be dismissed to home directly from the ED (16% vs 29%; OR 0.47 [95% CI, 0.22-1.00]). There were no statistically significant differences in the likelihood of receiving an epinephrine autoinjector prescription (62% vs 54%; OR 1.36 [95% CI, 0.71-2.62]), being admitted to the hospital (general medical floors or ICU) (19% vs 27%; OR 0.62 [95% CI, 0.29-1.33]) or allergy follow-up (42% vs 44%; OR 0.94 [95% CI, 0.49-1.81]).

Eleven patients (5%) had a biphasic reaction. All these patients were admitted to the EDOU after the initial reaction. Six of these patients received care guided by the order set on presentation of the initial reaction (Table III). Five of the reactions (46%) occurred in the EDOU. All of the reactions in the EDOU occurred within 6 hours after initial resolution of symptoms. Among these 5 patients, 4 of the biphasic reactions were treated with epinephrine; 1 patient was admitted to the general medical floor and 1 patient was admitted to the ICU. Of the remaining 6 reactions that did not occur in the EDOU, 1 patient had a reaction at 3 hours after symptom resolution and all of the rest had reactions that occurred at or after 10 hours. Among these patients, 2 were treated with epinephrine and 1 patient was admitted to the ICU.

DISCUSSION

Anaphylaxis management guidelines developed with multidisciplinary representation and endorsed by national and international allergy organizations recommend treatment with

TABLE II. Univariate analysis of ED management and patient disposition based on order set use

Characteristic	All patients, no. (%) (n = 202)	Order set		OR (95% CI)	P value
		Before implementation, no. (%) (n = 48)	After implementation, no. (%) (n = 154)		
Use of epinephrine in ED	94 (47)	16 (33)	78 (51)	2.05 (1.04-4.04)	.04
ED disposition					
Home	39 (19)	14 (29)	25 (16)	0.47 (0.22-1.00)	.05
Observation unit	121 (60)	21 (44)	100 (65)	2.38 (1.23-4.60)	.009
General hospital floor	11 (6)	4 (8)	7 (5)	0.52 (0.15-1.87)	.30
ICU	31 (15)	9 (19)	22 (14)	0.72 (0.31-1.70)	.45
General floor or ICU	42 (21)	13 (27)	29 (19)	0.62 (0.29-1.33)	.22
Outcome					
SIE prescription	121 (60)	26 (54)	95 (62)	1.36 (0.71-2.62)	.35
Allergist follow-up	86 (43)	21 (44)	65 (42)	0.94 (0.49-1.81)	.85

SIE, Self-injectable epinephrine.

TABLE III. Characteristics of patients with biphasic reactions

Patient no.	Age (y)	Sex	Before or after order set implementation	Allergen	Time of onset after resolution (h)	History of asthma	Location of biphasic reaction onset	Biphasic signs and/or symptoms	Treatment of biphasic reaction	Disposition after biphasic reaction
1	49	F	Before	Unknown	10	No	Outside	MC/R	H1	Home
2	40	M	Before	Medication (lidocaine)	4	No	EDOU	MC/GI	H1	GM
3	29	M	Before	Food (fish)	1	Yes	EDOU	MC/R	Epi, H1, B	Home
4	31	M	Before	Unknown	3	No	EDOU	MC/R	Epi, H1	Home
5	45	F	Before	Unknown	12-16	No	Home	MC/CV/R	Epi, S, H1, B	Home
6	30	F	After	Food (fibershake*)	36	No	Home	MC/R/GI	H2, S, B	EDOU > Home
7	64	F	After	Medication (TMP-SMX)	24-48	Yes	Home	MC/R	Epi, S, H1, H2, B	EDOU > Home
8	69	F	After	Medication (aspirin)	2	Yes	EDOU	R/GI	Epi, H1, H2, S	EDOU > Home
9	60	F	After	Medication (clindamycin)	3	No	Home	MC/GI/R	H1, H2, S, B	EDOU > GM > ICU
10	47	F	After	Food (soy)	3	No	EDOU	MC/R/CV	Epi, H1, H2, S, V, I	ICU
11	35	M	After	Unknown	24	No	Home	MC/R	H1, H2, S, B	EDOU > Home

MC, Mucocutaneous; R, respiratory; H1, H1 antihistamine; H2, H2 antihistamine; GI, gastrointestinal; GM, general medical floor; Epi, epinephrine; B, bronchodilator; CV, cardiovascular; S, corticosteroid; V, vasopressor; I, intubation; TMP-SMX, sulfamethoxazole and trimethoprim.

*A fibershake is a high fiber health drink.

epinephrine, a period of observation due to the risk of a biphasic reaction, a self-injectable epinephrine prescription, and allergy follow-up.⁶⁻⁸ We found that a significantly greater proportion of patients with anaphylaxis received epinephrine and were admitted to the EDOU after introduction of epinephrine auto-injectors and the order set implementation. Thus, analysis of these data suggests that the multifaceted approach to changing anaphylaxis management described here improved anaphylaxis guideline adherence.

Patients with anaphylaxis present with diverse signs and symptoms that involve various organ systems. Rapid diagnosis and appropriate early management are necessary to facilitate an optimal outcome. In a review on ED management of food allergies, Clark and Camargo Jr¹³ suggested that an algorithm for the diagnosis and management of anaphylaxis would allow emergency medicine practitioners to more rapidly recognize and treat allergic reactions in the ED. The ED anaphylaxis management order set described here incorporates diagnosis, management, observation, and dismissal and outpatient follow-up components of anaphylaxis care.

Intramuscular injection of epinephrine is regarded as the first-line medication in the treatment of anaphylaxis.¹⁷ Furthermore, delayed epinephrine administration has been associated with anaphylaxis fatality.⁹⁻¹¹ Despite the complexities of epinephrine dosing, many EDs do not stock epinephrine autoinjectors. A survey sent by e-mail of local hospitals in southeast Michigan revealed that 6 of 7 hospitals did not stock prefilled intramuscular dose syringes for emergency use in anaphylaxis.¹²

The cost of the epinephrine autoinjector is significantly more than the 1:1000 epinephrine vial, and this difference must be considered in this time of overall increasing health care costs.¹⁸ Although hospital medication costs are difficult to ascertain and can vary widely based on multiple factors, the average wholesale price of the autoinjector used in this study was approximately US \$75.00 for both the 0.3-mg and 0.15-mg doses compared with the average wholesale price for the 1 mg (1:1000) vial of epinephrine, which is US \$3.00.¹⁹ However, safe and accurate epinephrine administration is challenging due to the multiple possible routes of administration, associated dosages, patient acuity, and the relatively infrequent need for administration. In

addition, adverse cardiovascular complications and fatalities associated with epinephrine dosing are most commonly due to inappropriate dosing.¹² Thus, these risks must be carefully weighed against the increased cost.

We found a significant increase in epinephrine administration in our ED after the introduction of the changes described here (33% to 51%). The rate of ED epinephrine administration in our study cohort was higher than in other ED studies of anaphylaxis. Prior studies showed that 13% to 24% of patients with anaphylaxis received epinephrine in the ED in the absence of specific interventions to modify anaphylaxis management.^{2,4} However, our findings are similar to a study by Arroabarren et al,¹⁴ who increased epinephrine use with an order set in their pediatric ED, from 27% to 57.6%.

Anaphylaxis management does not end with resolution of the acute episode. Patients must be prepared to treat symptom recurrence in case of a biphasic reaction or accidental re-exposure to the trigger. Although the differences in self-injectable epinephrine prescriptions (62% vs 54%) did not reach statistical significance, the point estimate favored an increase after interventions (OR 1.36 [95% CI, 0.71-2.62]). Furthermore, our preimplementation proportion was higher than those reported in previous studies, including an earlier study at our center in which we found that, between 1990 and 2000, 36.6% of patients were prescribed self-injectable epinephrine before ED discharge.^{3,20} Arroabarren et al¹⁴ found an increase from approximately 7% before anaphylaxis order set implementation to 55% after order set implementation, a proportion similar to our preimplementation proportion. Thus, it is likely that implementation of similar changes in other adult EDs would result in significant increases in self-injectable epinephrine prescriptions.

Despite the inclusion of an automated referral in the order set, we did not find an increase in allergy follow-up. The reasons for this are unclear but may be related to the already relatively high proportion of patients who were followed-up before order set implementation (44%).^{2,4} This is higher than the postimplementation referral rate in the study by Arroabarren et al¹⁴ in pediatric patients (38%). Furthermore, it may be that a significant number of patients already had established allergy care before the ED visit. We did not collect data on how many patients had been evaluated by an allergist before the ED visit. However, we did collect data on the proportion of patients who had a prior prescription for self-injectable epinephrine and found that 40% of patients in our cohort did have a previous autoinjector prescription (data not shown), which suggests that they had previously been evaluated for anaphylaxis. Finally, because the referral was automated, providers may not have spent as much time discussing the importance of follow-up with the patient. Further studies are needed to elucidate methods to ensure appropriate follow-up after an ED visit for anaphylaxis.

Patients who present with anaphylaxis should be observed due to the risk of a biphasic reaction. However, the time period of observation is controversial. Guidelines recommend that patients be observed for 4 to 6 hours and for longer periods if they present with severe or refractory symptoms.⁷ The relatively low incidence of biphasic reactions and the time range of onset in our study are consistent with other retrospective studies.²¹⁻²³ Overall, 6 of the patients (55%) had onset of biphasic symptoms during the recommended time frame of observation in published guidelines. We found that, after the implementation of the order set, patients were more likely to be admitted to the EDOU and less

likely to be dismissed to home. Although not statistically significant, admissions to the ICU or the general medical floor decreased somewhat. We also found that all but one of the patients who experienced the onset of biphasic symptoms in the EDOU were treated with epinephrine, and 1 patient (20%) was admitted to the ICU, which demonstrates the need for additional interventions and underscores the importance of observation. However, the benefits of observation must be weighed against the increased length of stay when considering that the vast majority of patients did not experience a biphasic reaction. Additional studies are needed to evaluate the cost-effectiveness of observation and to identify patients who have the greatest risk of experiencing a biphasic reaction.

Limitations

Our study was limited by its retrospective design and relatively small sample size. Although the uneven cohort sizes (before and after implementation) could introduce statistical bias, when comparing these 2 groups, we found no significant differences. Also the “before implementation” cohort was the closest to the standard practice in our ED, and going back further in time (earlier than 2008) to increase the cohort before implementation would potentially introduce even more biases secondary to different treatments and standards of care. Furthermore, this is a single center study and the findings may not be generalizable to other academic centers or community practices. Multicenter prospective studies are needed for further evaluation.

CONCLUSION

Patients treated after implementation of the order set and introduction of the epinephrine autoinjectors were more likely to receive epinephrine in the ED and be admitted to the EDOU, and were less likely to be discharged directly from the ED. The multifaceted approach described here addresses the complexities of anaphylaxis management, and analysis of the data suggests that implementation of such an approach in the ED may increase guidelines compliance in patients with anaphylaxis. Additional multidisciplinary collaborations, including with allergists and emergency physicians, are needed to encourage the use of algorithms such as the one presented here to continue to improve ED anaphylaxis care and to identify barriers to allergy follow-up after the ED visit.

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Outpatient, Adult	Order Set
 Emergency Department and Emergency Department Observation Unit Anaphylaxis Management	
Orders apply to patients (18 years and older) who are admitted to the Emergency Department and/or the Emergency Department Observation Unit. Mark the ☒ for desired orders. If ☐ are blank order is inactive. All preprinted doses are based on normal renal and hepatic function and must be assessed for adjustment against the individual patient's renal and hepatic function and for interactions with other medications.	
(Mayo Clinic Number and Name Above)	
EMERGENCY DEPARTMENT ONLY Admit to: Emergency Department. Allergy module reviewed. Select one: ☐ No additional allergies identified, or ☐ Additional allergies identified and MICS Allergies module updated.	
ALERT • Clinical criteria for the diagnosis of anaphylaxis are on back of order set. • There are no absolute contraindications to Epinephrine in the occurrence of anaphylaxis. • Patients requiring continuous nebulator treatments should have serial Potassium monitoring and be admitted to an intensive care unit. • Steroids may decrease risk of biphasic reaction.	
INTRAVENOUS FLUIDS: ☐ 0.9% NaCl at _____ mL/hour. ☐ 0.9% NaCl 20 mL/kg bolus once via 18 gauge or larger IV over 15-30 minutes. ☐ Other: _____	
MEDICATIONS: Epinephrine Intramuscular: Strongly consider for respiratory symptoms, hypotension or progressive symptoms. Continuous cardiac monitoring strongly recommended. Patient weighing less than 50 kg: (Select All That Apply) ☐ Epinephrine (1:1000) 1 mg/mL, 0.3 mg IM into the anterolateral aspect of thigh, may repeat every 5 minutes as directed by physician. (Consultant must be made aware prior to administration.) ☐ Epinephrine (EpiPen®) 0.3 mg IM for rapid administration. (Consultant must be made aware prior to administration.) Patient weighing greater than or equal to 50 kg: (Select All That Apply) ☐ Epinephrine (1:1000) 1 mg/mL, 0.5 mg IM into the anterolateral aspect of thigh, may repeat every 5 minutes as directed by physician. (Consultant must be made aware prior to administration.) ☐ Epinephrine (EpiPen®) 0.3 mg IM for rapid administration. (Consultant must be made aware prior to administration.) Bronchodilators: ☒ Albuterol (Ventolin®) 2.5 mg in 3 mL 0.9% NaCl via nebulizer every 20 minutes PRN wheezing or dyspnea. Maximum of 3 doses. ☐ Albuterol (Ventolin®) 2.5 mg in 3 mL 0.9% NaCl via nebulizer every hour PRN wheezing or dyspnea for 12 hours. ☐ Albuterol (Ventolin®) 20 mg in 240 mL 0.9% NaCl via HEART nebulizer 30 mL/hour (delivers 2.5 mg/hour). Order from Central Pharmacy. ☐ Albuterol (Ventolin®) 40 mg in 240 mL 0.9% NaCl via HEART nebulizer 30 mL/hour (delivers 5 mg/hour). Order from Central Pharmacy. Steroids: ☒ Other: _____ ☐ Methylprednisolone Sodium Succinate (Solu-Medrol®) 125 mg IV once. ☐ Dexamethasone (Decadron®) 10 mg IV once. Antihistamines: (Select All That Apply) ☐ Diphenhydramine (Benadryl®) 50 mg IV once. ☐ Famotidine (Pepcid®) 20 mg IV once.	
ANAPHYLACTIC SHOCK Signs of tissue hypoperfusion, systolic blood pressure less than 90 mmHg or a 40 mmHg drop below baseline or mean arterial pressure less than 60 mmHg. Epinephrine infusion: For hypotension unresponsive to IM Epinephrine and IV fluids. ☐ Epinephrine infusion (4 mg in 250 mL 0.9% NaCl) at 0.02 mg/kg/minute. Titrate rate to keep mean arterial blood pressure greater than 60 mmHg. Discontinue medication from central pharmacy. Alert the pharmacist the infusion is needed STAT. ☐ Recommend use only with central lines, but in extreme emergency may be given for a brief period of time via peripheral site with constant monitoring for extravasation. ☐ Continuous cardiac monitoring required.	
Respiratory Care: ☒ Oxygen _____ Lpm via nasal cannula PRN for oxygen saturations less than 92%. ☐ Oxygen (2 - 6 Lpm) ☐ Oxygen (5 - 10 Lpm) Lpm via face mask PRN for oxygen saturations less than 92%.	
Prescriber Signature: _____ Prescriber Page #: _____ Service Page #: _____ Prescriber Printed Name: _____ Part 1 - Pharmacy Part 2 - Nursing Part 3 - Order Book Date: <u>MM/DD/YYYY</u> Time: <u>h:m</u> (24 hour clock) This order set has been developed to reflect the practice patterns of the clinicians who wrote it. It sets forth recommendations as to practice, not rigid rules.	

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Outpatient, Adult	Order Set																																																												
 Emergency Department and Emergency Department Observation Unit Anaphylaxis Management																																																													
Orders apply to patients (18 years and older) who are admitted to the Emergency Department and/or the Emergency Department Observation Unit. Mark the ☒ for desired orders. If ☐ are blank order is inactive. All preprinted doses are based on normal renal and hepatic function and must be assessed for adjustment against the individual patient's renal and hepatic function and for interactions with other medications.																																																													
(Mayo Clinic Number and Name Above)																																																													
EMERGENCY DEPARTMENT OBSERVATION UNIT ONLY Admit to: ED Observation Unit.																																																													
ALERT Guidelines suggest a minimum of 4 - 6 hours of observation depending on the severity of the reaction. Suggested outpatient prescriptions: The EpiPen® 2-Pak (carton contains two EpiPen® auto-injectors plus a free trainer). Benadryl® 25-50 mg PO every 4-6 hours. (Efficacy unknown.) Prednisone 50 mg PO daily for 2-3 days. (May decrease risk of biphasic reaction.)																																																													
INTRAVENOUS FLUIDS: ☐ 0.9% NaCl at _____ mL/hour. ☐ Peripheral saline IV lock. ☐ Other: _____																																																													
MEDICATIONS: Bronchodilators: (Select All That Apply) ☒ Albuterol (Ventolin®) 2.5 mg in 3 mL 0.9% NaCl via nebulizer every 20 minutes PRN wheezing or dyspnea. Maximum of 3 doses. ☐ Albuterol (Ventolin®) 2.5 mg in 3 mL 0.9% NaCl via nebulizer every hour PRN wheezing or dyspnea for 12 hours. ☐ Albuterol (Ventolin®) 20 mg in 240 mL 0.9% NaCl via HEART nebulizer 30 mL/hour (delivers 2.5 mg/hour). Order from Central Pharmacy. ☐ Albuterol (Ventolin®) 40 mg in 240 mL 0.9% NaCl via HEART nebulizer 30 mL/hour (delivers 5 mg/hour). Order from Central Pharmacy. ☐ Albuterol (Ventolin®) 2 puffs via metered-dose inhaler (MDI) with spacer every 4 hours PRN wheezing or dyspnea (may hold if patient sleeping). Initiate MDI when interval between nebulized Albuterol treatments is at least 3 hours. Antihistamines: ☒ Diphenhydramine (Benadryl®) 50 mg IV every 4 hours. ☐ Diphenhydramine (Benadryl®) 50 mg PO every 4 hours. ☐ Famotidine (Pepcid®) 20 mg IV every 12 hours. ☐ Famotidine (Pepcid®) 20 mg PO every 12 hours. Other Medications: <table border="1"> <thead> <tr> <th>Medication</th> <th>Dose</th> <th>Route</th> <th>Frequency</th> <th>Indication</th> <th>Medication</th> <th>Dose</th> <th>Route</th> <th>Frequency</th> <th>Indication</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>		Medication	Dose	Route	Frequency	Indication	Medication	Dose	Route	Frequency	Indication																																																		
Medication	Dose	Route	Frequency	Indication	Medication	Dose	Route	Frequency	Indication																																																				
DIET: ☐ General. ☐ Consistent carbohydrate (diabetic). ☐ kcal. ☐ Clear liquids. ☐ NPO. ☐ Other: _____ ☐ Bedrest with bathroom privileges.																																																													
ACTIVITY: ☐ Continuous pulse oximetry. ☐ Oxygen 2 Lpm via nasal cannula PRN for oxygen saturation less than 92% for 5 minutes, or for shortness of breath or chest pain.																																																													
ADDITIONAL ORDERS: • Continuous cardiac monitoring. • Vital signs every 2 hours. • Give anaphylaxis education packet to patient/family. • Patient/family to view "How to Use EpiPen® (Epinephrine) Auto-Injector" video while in Observation Unit. (Go to www.epipen.com and click on "How to Use EpiPen® (Epinephrine) Auto-Injector" on the left hand side of the screen.) • After viewing the video, patient/family should demonstrate the proper use of an EpiPen® using the EpiPen® trainer. • Prior to discharge from Observation Unit, nurse to contact Emergency Department Control desk and have an Allergy Clinic follow-up appointment scheduled for the next business day, unless other arrangements have been specified. • Provide anaphylaxis dismissal instructions (emphasize allergen avoidance if allergen is known).																																																													
NOTIFY OBSERVATION CONSULTANT FOR: • Chest pain. • Respiratory rate greater than 20 breaths/minute. • Rash. • Significant change in cardiac rhythm. • Oxygen saturation less than 92%. • Development of any new symptoms. • Shortness of breath. • Vomiting or diarrhea.																																																													
Prescriber Signature: _____ Prescriber Page #: _____ Service Page #: _____ Prescriber Printed Name: _____ Part 1 - Pharmacy Part 2 - Nursing Part 3 - Order Book Date: <u>MM/DD/YYYY</u> Time: <u>h:m</u> (24 hour clock) This order set has been developed to reflect the practice patterns of the clinicians who wrote it. It sets forth recommendations as to practice, not rigid rules.																																																													

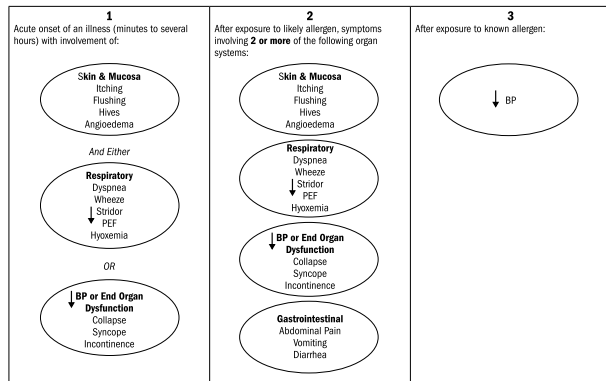
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National Institutes of Health/the Food Allergy and Anaphylaxis Network criteria for anaphylaxis¹

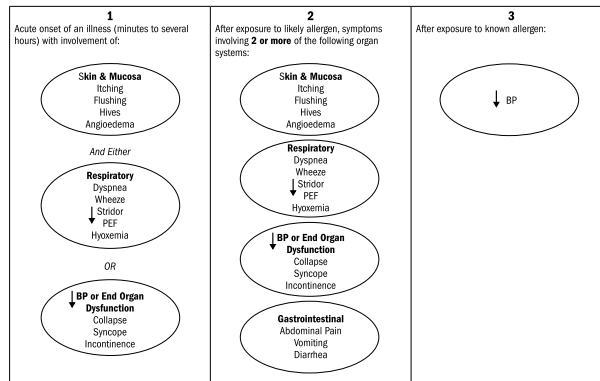
Anaphylaxis is likely when any one of the 3 criteria are fulfilled:



J Allergy Clin Immunol 2006; 117:391-7.

National Institutes of Health/the Food Allergy and Anaphylaxis Network criteria for anaphylaxis¹

Anaphylaxis is likely when any one of the 3 criteria are fulfilled:



J Allergy Clin Immunol 2006; 117:391-7.

References:

1. Sampson HA, Muñoz-Furlong A, Campbell RL, Adkinson NF Jr, Bock SA, Brannan A, et al. Second symposium on the definition and management of anaphylaxis: summary report: second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium. J Allergy Clin Immunol 2006;117:391-7.
2. Runge JW, Martinez JC, Caravati EM, Williamson SG, Hartsell SC. Histamine antagonists in the treatment of acute allergic reactions. Annals of Emergency Medicine. 21(3):237-42, 1992 Mar.
3. Ellis AK, Day JH. Incidence and characteristics of biphasic anaphylaxis: a prospective evaluation of 103 patients. Annals of Allergy, Asthma, & Immunology 98(1):64-9, 2007 Jan.

References:

1. Sampson HA, Muñoz-Furlong A, Campbell RL, Adkinson NF Jr, Bock SA, Brannan A, et al. Second symposium on the definition and management of anaphylaxis: summary report: second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium. J Allergy Clin Immunol 2006;117:391-7.
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FIGURE E1. ED anaphylaxis management order set.