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Repeat Epinephrine Treatments for Stinging Insect Hypersensitivity Reactions Presenting to the Emergency Department

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INTRODUCTION

Stinging insect hypersensitivity reactions (SIH) may result in the abrupt onset of multi-system and potentially life-threatening symptoms. Depending on the geographic location, 57 to 95% of people remember being stung by a Hymenoptera insect (e.g. bees, wasps, hornets, yellow jackets, fire ants) at least once in their lives.¹ Accordingly, SIH reactions are among the most common causes of anaphylaxis worldwide.² Although there are limited recent data on the epidemiology of SIH reactions, earlier studies estimate that the prevalence of systemic reactions ranges from 0.4 to 3.3%^{3,4} and cause approximately 40 to 100 deaths in the United States each year.^{5–6}

Depending on the severity of the preceding reaction, the risk of systemic reaction upon repeat sting among adults with a history of a systemic SIH reaction ranges from 20 to 70%.^{7–9} Current practice guidelines recommend that all patients with a history of systemic SIH reaction should be referred to an allergist-immunologist for diagnostic testing and to evaluate whether they are candidates for venom immunotherapy, a treatment proven to dramatically decrease an individual's risk of subsequent systemic reaction.^{7,10} In addition, patients experiencing a systemic SIH reaction should receive instructions on insect avoidance, be prescribed self-injectable epinephrine and instructed on its proper use.¹⁰

Previous studies have suggested that it may be advisable for patients with a history of anaphylaxis to carry multiple doses of self-injectable epinephrine. This recommendation is based on limited data indicating that 10–25% of patients with food-induced anaphylaxis require more than one epinephrine treatment.^{11–13} Although there are little corresponding data for patients experiencing systemic SIH reactions, current SIH practice parameters

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recommend considering this option when prescribing self-injectable epinephrine.¹⁰ To address this important information gap, we examined the likelihood of requiring >1 dose of epinephrine for a systemic SIH reaction and characterized the patients who received multiple epinephrine treatments.

METHODS

This multicenter study was performed as a part of the Multicenter Airway Research Collaboration, a division of the Emergency Medicine Network (www.emnet-usa.org). We reviewed medical records at three major academic hospitals in Boston of all patients presenting to the Emergency Department (ED) over a six-year period with a SIH reaction. The Institutional Review Boards at all three centers approved the study and informed consent was waived.

Patient Selection

We searched for all patients presenting to the ED between 1/1/01 and 12/31/06 with a SIH reaction using ICD9 diagnosis codes that our group previously determined to be relevant.¹⁴ These codes included 989.5 (toxic effect due to venom), 995.0 (other anaphylactic shock) and 995.3 (allergy, unspecified). The codes 995.1 (angioedema) and 708.X (urticaria) were partially reviewed (>50% of visits within each code). We did not identify any cases of SIH reactions within these non-specific allergy codes; therefore, they were not included.

Data Collection

A structured chart review was performed to collect data on patient demographics, past medical history, clinical presentation, pre-ED and ED therapy and disposition. All standardized data abstraction forms were reviewed by an allergist for both accuracy and internal consistency..

Definitions

A SIH reaction was defined as an acute episode of immune-mediated symptoms in which the onset was temporally related to a Hymenoptera insect sting. A normal local reaction was defined as cutaneous symptoms (redness, pain swelling) which were restricted to the sting site. In contrast, a large local reaction was defined as an extensive cutaneous manifestation contiguous with the sting site (estimated to be >10 cm in diameter).¹⁰ A cutaneous systemic reaction was defined as an immediate reaction consisting exclusively of generalized cutaneous signs/symptoms. Our definition of anaphylaxis was based on the diagnostic criteria established by the Second Symposium of the National Institute of Allergy and Infectious Disease and the Food Allergy and Anaphylaxis Network.¹⁵ Specifically, anaphylaxis was defined as an acute allergic reaction involving 2+ organ systems or hypotension alone. For consistency with our earlier work,^{16,17} hypotension was defined as a systolic blood pressure <100 mmHg for adults in an emergency situation. Using <90 mmHg as the threshold did not materially alter the findings (data not shown). Hypotension was defined as a systolic blood pressure <90 mmHg for children between 10 and 17 years and as <(70 mmHg + [age multiplied by 2]) for children younger than 10 years.¹⁵

Statistical Analysis

All analyses were performed using STATA 10.0 (StataCorp, College Station, Texas). Data are expressed as median (with interquartile range [IQR]) and proportion. Comparisons between groups with local reactions and systemic reactions were evaluated using Kruskal-Wallis rank test, Chi-square test, and Fishers exact test, as appropriate. A two-sided $P < 0.05$ was considered statistically significant.

RESULTS

Overview

Within the six-year time period, 153 patients presented to the ED with a SIH reaction. Most cases presented in the late summer (July, August, September). More than half (59%) were classified as experiencing a large local reaction, while 36% presented with a systemic reaction (10% cutaneous systemic and 26% anaphylaxis). The remaining 5% of patients had a normal local reaction to an insect sting. There were no fatalities.

Demographic Factors

Overall, there was a slight predominance (54%) of males and the majority (70%) of patients were white. The median age was 33 years (IQR, 14–51). One-quarter of patients were <17 years old. When comparing the demographic characteristics of patients with large local reactions and those with systemic reactions, patients with large local reactions were older and less frequently from minority race/ethnic groups (Table 1).

Past Medical History

Approximately one-quarter (26%) of all patients reported a known hypersensitivity to stinging insects. A smaller percentage (10%) owned a self-injectable epinephrine device prior to their ED presentation. Approximately one third (34%) reported another known allergic problem, including allergic reactions to other sources, e.g. foods, medications, or latex (25%); asthma (7%); and allergic rhinitis (6%). A minority of patients reported a non-atopic chronic medical condition (39%). Atopic disease was not reported more commonly in patients presenting with systemic reactions vs. large local reactions (35% vs. 35%; $P=0.93$).

Settings and Allergens

Overall, patients most commonly reported being stung at home or other outdoor settings (Table 2). The majority (74%) of all patients reported being stung by “bees” while 15% of patients were unable to identify the stinging insect. Most patients (78%) were stung once. The most common sites were the hand, arm or head. The location of exposure and insect profile for large local reactions and systemic reactions was similar. However, patients who were stung in the neck or trunk more commonly experienced a systemic reaction.

Normal Local Reactions

A small percentage (5%) of patients presented to the ED with a normal local reaction to an insect sting. In contrast to our total population, most patients (75%) with normal local reactions were female and the median age was 53 years. A similar percentage (25%) reported a known allergy to stinging insects. However, unlike the total population, most (63%) reported a non-atopic medical problem. The majority (63%) arrived within 3 hours of the sting. None of these patients arrived by ambulance or received pre-ED treatments. In the ED, these patients received antihistamines (50%) and anti-inflammatory/analgesic medications (38%). All were discharged to home.

Large Local Reactions

59% of patients were classified as experiencing a large local reaction. As expected, these patients most commonly presented with rash and swelling at the sting site (Table 2). Most patients (72%) with large local reactions presented to the ED >12 hours after the insect sting. 30% of patients received treatment before ED arrival. Antihistamines were given most frequently; however, a small percentage (11%) received epinephrine (Table 3). In the ED, patients with large local reactions received antihistamines (40%), corticosteroids (24%), antibiotics (20%) and anti-inflammatory/analgesic medications (10%). Almost all patients

(98%) with large local reactions were discharged home (Table 4). These patients were frequently prescribed antihistamines and antibiotics upon discharge. A minority (14%) were prescribed self-injectable epinephrine.

Systemic Reactions

Approximately one-third (36%) of patients presented to the ED with a systemic SIH reaction. Specifically, 10% had a cutaneous systemic reaction and 26% met criteria for anaphylaxis. Among those with systemic reactions, patients <17 years old more commonly presented with a cutaneous systemic reaction than adults (48% vs. 13%; $P=0.005$) (Figure 1). Systemic SIH reactions commonly included cutaneous (95%), respiratory (68%) and gastrointestinal (40%) manifestations (Table 2). A smaller percentage of patients (20%) presented with cardiovascular signs/symptoms and 5% of patients met criteria for anaphylaxis by presenting exclusively with hypotension after an insect sting.

Most patients (82%) with systemic reactions were stung within 3 hours of ED arrival. Among those receiving pre-ED treatments, 44% received epinephrine and 9% received >1 dose (Table 3). While in the ED, patients with systemic reactions received antihistamines (76%), systemic corticosteroids (55%), intravenous fluids (32%) and epinephrine (9%). Overall, 35% of patients with systemic SIH reactions received epinephrine over the course of their reaction and among this subset, 16% received >1 dose. The percentage of patients receiving >1 dose was similar in children and adults.

Among patients with systemic reactions who received any epinephrine, 53% were male and the median age was 10 years. Patients <17 years old more frequently received epinephrine than adults for systemic SIH reactions (61% vs. 16%; $P=0.001$). When exclusively evaluating those with anaphylaxis, this difference became even more striking (92% vs. 18%; $P<0.001$). Most patients (82%) received epinephrine prior to their arrival to the ED. Pre-ED doses were given by EMS (50%), outside hospitals (36%) and patient's own epinephrine auto-injector (14%). All patients who received >1 dose of epinephrine received both doses before their arrival to the ED.

Most patients (67%) with systemic reactions were discharged to home (Table 4). At ED discharge, 11% had documentation of allergy referral, 3% had documentation of insect avoidance instructions and 68% received a prescription for self-injectable epinephrine. The remaining patients were admitted to an observation or inpatient unit. Among this group, 28% were referred to an allergist and 11% received insect avoidance instructions. All admitted patients were prescribed self-injectable epinephrine.

DISCUSSION

This study provides a comprehensive review of SIH reactions presenting to three academic EDs in Boston over a six-year time period. SIH reactions are caused by insects from the order Hymenoptera. This family of insects includes bees (honey and bumble bees), vespids (yellow jackets, wasps and hornets) and fire ants, a non-winged member common in southeastern portions of the United States. Due to vasoactive components of insect venom, most people experience transient localized pain, erythema and swelling after an insect sting.¹⁸ Presumably, patients with this form of "normal" local reaction infrequently present to an ED for medical attention. In our population, 5% of cases were classified as normal local reactions, commonly in patients who sought medical attention due to a history of SIH or other complicating factor.

In contrast to normal local reactions, large local reactions are extensive areas of swelling, which often progress in the first 48 hours after a sting and may persist for longer periods of

time. In our review, patients presenting with large local reactions were significantly older than patients with systemic reactions, which may represent an age-related pattern of immunologic response or differences in care-seeking behavior. Large local reactions were most commonly treated with antihistamines and corticosteroids. Demonstrative of a common diagnostic challenge, these patients were also frequently prescribed antibiotics for suspected bacterial super-infection. Patients with a history of large local reaction infrequently (5–10%) have a systemic reaction to a subsequent sting and are not typically candidates for immunotherapy.^{10,19} Accordingly, our patients with large local reactions were infrequently referred to an allergist or prescribed self-injectable epinephrine.

Many terms have been used to describe the range of systemic hypersensitivity reactions which may occur in response to an insect sting. Cutaneous systemic reactions, elsewhere termed Type I or mild systemic reactions,^{20,21} are unique in terms of the limited scope of their clinical presentation and improved outcome in younger age groups.²² Consistent with previous descriptions,²³ children in our population more frequently presented with cutaneous systemic reactions than adults (Figure 1). Guidelines for the acute treatment of cutaneous systemic reactions are not included in the current SIH practice parameter. However, as expected, this form of systemic reaction was less frequently treated with epinephrine than patients in our population with more severe presentations.

We have chosen to define anaphylactic SIH reactions based on the diagnostic criteria established by the Second Symposium of the National Institute of Allergy and Infectious Disease and the Food Allergy and Anaphylaxis Network.¹⁵ This definition accounts for the wide variety of presentations of anaphylaxis, including the possibility of presenting with hypotension alone. Previous reviews have identified patients with anaphylaxis due to an insect sting who presented exclusively with dizziness, faintness, weakness or coma.²⁴ A small percentage (5%) of our patients with anaphylaxis presented with hypotension alone after an insect sting. However, the vast majority presented with a broad range of cutaneous, respiratory, gastrointestinal and cardiovascular signs/symptoms, similar to the varied clinical presentations of other forms of anaphylaxis.

The primary treatment of anaphylactic SIH reactions, like all other forms of anaphylaxis, is the prompt administration of epinephrine.^{10,15,25} A delay in the administration of epinephrine is a well-described risk factor for poor outcomes and in most cases of fatal anaphylaxis, epinephrine was either not given or given late.^{26,27} Our study highlights a reluctance among emergency physicians to use epinephrine in adults. Only a minority of adult anaphylaxis patients (18%) were treated with epinephrine either before or during their ED stay. However, almost all children with anaphylactic SIH reactions (92%) received epinephrine. Epinephrine was frequently administered prior to the children's arrival to the ED, which may reflect a greater level of urgency among first-responders when dealing with younger patients.

Appropriate disposition of patients experiencing a systemic SIH reaction is critical and should include referral to an allergist, insect avoidance instructions, prescription for self-injectable epinephrine and teaching on its appropriate use. Previous studies have demonstrated inadequacies in the disposition of patients with anaphylaxis due to stinging insects.^{16,28,29} In our review, we found continued disappointing concordance with the recommendation to refer patients to an allergist. This could reflect inadequate documentation or a lack of education in the general medical community regarding the potentially life-saving benefits of venom immunotherapy. Furthermore, we report a large percentage of patients who were unable to identify the offending insect or reported being stung by a "bee", a common colloquialism for stinging insects. Insect identification is a critical component of the diagnosis and long-term management of systemic SIH reactions.

Therefore, this data further highlights the need to refer patients to an experienced allergist. Encouragingly, the percentage of patients with systemic reactions who were prescribed self-injectable epinephrine (68%) was slightly improved from earlier studies.

Recent studies have suggested that it may be advisable for patients with a history of anaphylaxis to carry multiple doses of self-injectable epinephrine. This recommendation is based on estimates that 10–25% of patients with food-related anaphylaxis receive multiple doses of epinephrine.^{11–13} However, there is little known about the risk of multiple epinephrine use among patients experiencing a systemic SIH reaction. In a study of patients receiving immunotherapy injections, including a small percentage receiving venom immunotherapy, 16% of patients received >1 dose of epinephrine for systemic reactions.³⁰ In a more recent study, Manivannan et al report that 3 out of 20 cases of anaphylaxis due to insect stings in Olmstead County, Minnesota between 1990 and 2000 were treated with >1 dose of epinephrine.³¹ In the present study, we found a similar percentage (16%) of patients presenting to the ED with a systemic SIH reaction who received multiple doses of epinephrine. This result is also strikingly similar to observations in food-related anaphylaxis and suggests similarities in the treatment of anaphylaxis regardless of the inciting allergen.

These results support the current recommendation that physicians should consider prescribing multiple doses of self-injectable epinephrine to patients with a history of systemic SIH reaction. Assessment of risk factors may enable more cost-effective implementation of this recommendation. Due to small sample size, we were unable to formally evaluate risk factors for multiple epinephrine use in our population. However, this recommendation is especially relevant to patients previously described to be at greater risk for severe systemic SIH reaction (e.g., the elderly, patients with severe preceding reactions, cardiovascular disease, mastocytosis or elevated baseline tryptase levels).^{1,8,32} In addition, patients in settings distant from immediate medical attention should be given careful consideration³³ as all patients in our population who received >1 dose of epinephrine received both doses before their arrival to the ED. Many severe and fatal SIH reactions do occur in those with no preceding history of stinging insect allergy;^{6,19} however, this recommendation could be potentially life-saving to patients perceived to be at greater risk for severe systemic SIH reaction.

A potential limitation of our study is reliance on the medical record and the possibility that the documentation was inaccurate or incomplete. Symptoms associated with SIH reactions (e.g. chest tightness, dyspnea, dizziness, nausea) can be complicated by fear/anxiety and can be difficult to differentiate both at the time of the patient's evaluation and retrospectively. Studies have shown the majority of anaphylaxis cases are treated in the ED;³⁴ however, limiting our review to the ED may affect our estimate of the percentage of patients receiving multiple doses of epinephrine. Lastly, our data may not be nationally representative as the three academic hospitals are located in Boston. However, in areas of overlap, our results are consistent with a previous multicenter, international study,¹⁶ which could support the applicability of our findings regarding multiple epinephrine treatments on a broader level.

In summary, we report that among ED patients with systemic SIH reactions who received epinephrine, 16% received a second dose. Although systemic SIH reactions represent a unique form of anaphylaxis, this percentage is strikingly similar to that found in other forms of anaphylaxis. These data supports the recommendation that physicians should consider prescribing two doses of epinephrine for patients with a history of systemic SIH reaction. Further study is warranted to replicate these findings in other areas of the country where SIH reactions are encountered more commonly and to further elucidate risk factors for multiple epinephrine use. In addition, prospective studies should be performed to determine how this recommendation influences clinical outcome, including fatalities.

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Figure 1.
Types of stinging insect hypersensitivity reactions in children (<17 years) vs. adults.

Table 1

Demographic characteristics of patients presenting to the Emergency Department with a stinging insect hypersensitivity reaction.

	Overall (n=153) n (%)	Large Local Reaction (n=90) n (%)	Systemic Reaction* (n=55) n (%)	P value
<i>Demographic characteristics</i>				
Age, median (IQR)	33 (14 – 51)	41 (23 – 53)	21 (9 – 42)	<0.001
Male	82 (54)	54 (60)	26 (47)	0.14
Race/ethnicity				0.04
White	99 (70)	64 (78)	31 (61)	
Black	20 (14)	11 (13)	6 (12)	
Hispanic	11 (8)	4 (5)	6 (12)	
Asian	5 (4)	2 (2)	3 (6)	
Other race	6 (4)	1 (1)	5 (10)	
<i>Medical history</i>				
Known allergy to stinging insects	35 (26)	16 (24)	15 (30)	0.43
Known allergic problems	51 (34)	31 (35)	19 (35)	0.93
Prior allergic reactions to other sources	37 (25)	23 (26)	14 (25)	0.93
Asthma	11 (7)	4 (5)	6 (11)	0.15
Hayfever	9 (6)	5 (6)	4 (7)	0.70
Eczema	1 (1)	1 (1)	0 (0)	0.62
Hives	0 (0)	0 (0)	0 (0)	--
Angioedema	0 (0)	0 (0)	0 (0)	--
Patient owns epinephrine auto-injector	14 (10)	5 (6)	8 (16)	0.13
Other documented medical problems	60 (39)	35 (39)	20 (36)	0.72
Patient on any chronic medications	57 (39)	33 (39)	19 (35)	0.61

Abbreviations: IQR, interquartile range.

* Systemic reactions include cutaneous systemic reactions and anaphylaxis. Anaphylaxis was defined as allergic reaction involving 2+ organ systems or hypotension. Please see Methods section for complete description.

Table 2

Clinical presentation of patients presenting to the Emergency Department with a stinging insect hypersensitivity reaction.

	Overall (n=153) n (%)	Large Local Reaction (n=90) n (%)	Systemic Reaction * (n=55) n (%)	P value
<i>Presentation and clinical course</i>				
Arrive to ED by ambulance	25 (19)	6 (8)	19 (43)	<0.001
Time since exposure				<0.001
<1 hour	12 (8)	6 (7)	5 (10)	
1–3 hours	48 (34)	8 (9)	36 (72)	
>3 hours	83 (58)	71 (84)	9 (18)	
Onset of symptoms				<0.001
<1 hour	12 (10)	5 (7)	6 (13)	
1–3 hours	42 (34)	8 (11)	32 (71)	
>3 hours	69 (56)	61 (82)	7 (16)	
Location of exposure				0.22
Home	25 (50)	15 (63)	9 (39)	
Work	4 (6)	1 (4)	1 (4)	
Other	22 (43)	8 (33)	13 (57)	
Insect reported to cause reaction				
Bee sting	113 (74)	70 (78)	37 (67)	0.16
Wasp sting	5 (3)	4 (4)	1 (2)	0.65
Hornet sting	5 (3)	3 (3)	1 (2)	1.00
Yellow Jacket sting	7 (5)	3 (3)	4 (7)	0.43
Unknown Insect sting	23 (15)	10 (11)	12 (22)	0.08
Number of stings				0.92
1	120 (78)	71 (79)	43 (78)	
>1	33 (22)	19 (21)	12 (22)	
Body part stung				
Arm	37 (26)	27 (31)	8 (16)	0.04
Hand	35 (24)	25 (29)	8 (16)	0.08
Leg	18 (12)	13 (15)	4 (8)	0.29
Foot	14 (10)	8 (9)	6 (12)	0.65
Head	36 (25)	23 (27)	12 (24)	0.68
Neck	8 (6)	0 (0)	8 (16)	<0.001
Trunk	11 (8)	2 (2)	7 (14)	0.01
Other	8 (6)	2 (2)	5 (10)	0.10
Signs and symptoms				
Skin rash	114 (75)	65 (72)	46 (84)	0.12
Itching	39 (25)	25 (28)	13 (24)	0.58
Swelling	132 (86)	84 (93)	45 (82)	0.03
Peripheral edema	2 (1)	2 (2)	0 (0)	0.53

	Overall (n=153) n (%)	Large Local Reaction (n=90) n (%)	Systemic Reaction* (n=55) n (%)	P value
Angioedema	5 (3)	0 (0)	5 (9)	0.007
Trouble swallowing	16 (10)	0 (0)	16 (29)	<0.001
Trouble breathing	25 (16)	0 (0)	25 (45)	<0.001
Wheezing	5 (3)	0 (0)	5 (9)	0.007
Hoarse voice	4 (3)	0 (0)	4 (7)	0.02
Stridor	1 (1)	0 (0)	1 (2)	0.38
Nausea/vomiting	7 (5)	0 (0)	7 (13)	0.001
Abdominal pain/cramps	2 (1)	0 (0)	2 (4)	0.14
Diarrhea	0 (0)	0 (0)	0 (0)	--
Abdominal tenderness	0 (0)	0 (0)	0 (0)	--
Dizziness/fainting	11 (7)	0 (0)	11 (20)	<0.001
Altered mental status	3 (2)	0 (0)	3 (5)	0.053
Organ system involvement				
Respiratory	27 (18)	0 (0)	27 (49)	<0.001
Cutaneous	149 (97)	90 (100)	53 (96)	0.14
Gastrointestinal	22 (14)	0 (0)	22 (40)	<0.001
Cardiac	11 (7)	0 (0)	11 (20)	<0.001

Abbreviations: ED, emergency department.

* Systemic reactions include cutaneous systemic reactions and anaphylaxis. Anaphylaxis was defined as allergic reaction involving 2+ organ systems or hypotension. Please see Methods section for complete description.

Table 3

Treatment of patients presenting to the Emergency Department with a stinging insect hypersensitivity reaction.

	Overall (n=153) n (%)	Large Local Reaction (n=90) n (%)	Systemic Reaction* (n=55) n (%)	P value
<i>Pre-ED Therapy</i>				
Pre-ED treatments (≤ 3 hrs before triage)	60 (39)	27 (30)	33 (60)	<0.001
Epinephrine	17 (11)	3 (3)	14 (26)	<0.001
Diphenhydramine	49 (32)	22 (25)	27 (49)	0.003
Other antihistamines	9 (6)	2 (2)	7 (13)	0.01
Corticosteroids	8 (5)	0 (0)	8 (15)	<0.001
IV fluids	2 (1)	0 (0)	2 (4)	0.14
Inhaled β -agonists	2 (1)	0 (0)	2 (4)	0.14
Oxygen	5 (3)	1 (1)	4 (7)	0.07
Other	4 (3)	2 (2)	2 (4)	0.49
Number of pre-ED epinephrine doses				<0.001
0 doses	134 (89)	86 (97)	40 (74)	
1 dose	14 (9)	3 (3)	11 (20)	
>1 dose	3 (2)	0 (0)	3 (6)	
<i>ED Therapy</i>				
Electrocardiogram performed	11 (7)	1 (1)	10 (18)	<0.001
Chest x-ray performed	1 (1)	0 (0)	1 (2)	0.38
Oxygen	9 (6)	2 (2)	7 (13)	0.03
Ventilatory support required in ED	0 (0)	0 (0)	0 (0)	--
IV established	40 (26)	12 (13)	28 (51)	<0.001
IV fluids given	12 (30)	3 (25)	9 (32)	0.73
ED antihistamines given	81 (53)	35 (39)	42 (76)	<0.001
Diphenhydramine	75 (49)	33 (37)	38 (69)	<0.001
Other H1 blockers	1 (1)	1 (1)	0 (0)	0.62
H2 blockers	43 (28)	14 (16)	28 (51)	<0.001
ED corticosteroids given				<0.001
Prednisone	34 (22)	18 (20)	15 (27)	
Methylprednisolone	18 (12)	3 (3)	15 (27)	
Inhaled β -agonists given	3 (2)	0 (0)	3 (5)	0.06
Antibiotics given	18 (12)	18 (20)	0 (0)	<0.001
Analgesics/Anti-inflammatory agents given	20 (13)	9 (10)	8 (15)	0.42
Additional medications given	14 (9)	8 (9)	5 (9)	0.98
Number of epinephrine doses given in ED				0.007
0 doses	148 (97)	90 (100)	50 (91)	
1 dose	5 (3)	0 (0)	5 (9)	
Total number of epinephrine doses given				0.001
0 doses	39 (64)	24 (89)	15 (44)	
1 dose	19 (31)	3 (11)	16 (47)	

	Overall (n=153) n (%)	Large Local Reaction (n=90) n (%)	Systemic Reaction* (n=55) n (%)	P value
>1 dose	3 (5)	0 (0)	3 (9)	
Total number of epinephrine doses given among patients receiving any epinephrine				1.00
1 dose	19 (86)	3 (100)	16 (84)	
>1 dose	3 (14)	0 (0)	3 (16)	

Abbreviations: ED, emergency department.

* Systemic reactions include cutaneous systemic reactions and anaphylaxis. Anaphylaxis was defined as allergic reaction involving 2+ organ systems or hypotension. Please see Methods section for complete description.

Table 4

Disposition of patients presenting to the Emergency Department with a stinging insect hypersensitivity reaction.

	Overall (n=153) n (%)	Large Local Reaction (n=90) n (%)	Systemic Reaction * (n=55) n (%)	P value
<i>Disposition</i>				
Admitted	20 (13)	2 (2)	18 (33)	<0.001
Among discharged to home				
Prescribed self-injectable epinephrine	37 (28)	12 (14)	25 (68)	<0.001
Referred to allergist	5 (4)	1 (1)	4 (11)	0.03
Instructions to avoid future stings	6 (5)	5 (6)	1 (3)	0.67
Discharge diagnosis included term "anaphylaxis"	3 (2)	0 (0)	3 (8)	0.03
Among admitted to hospital				
Prescribed self-injectable epinephrine	19 (95)	1 (50)	18 (100)	0.10
Referred to allergist	5 (25)	0 (0)	5 (28)	1.00
Instructions to avoid future stings	2 (10)	0 (0)	2 (11)	1.00
Discharge diagnosis included term "anaphylaxis"	13 (65)	0 (0)	13 (72)	0.11
Antihistamines prescribed at discharge	117 (77)	70 (80)	45 (82)	0.74
H1 blockers prescribed	116 (77)	70 (80)	44 (80)	0.95
H2 blockers prescribed	35 (23)	16 (18)	18 (33)	0.047
Corticosteroids prescribed at discharge	52 (34)	21 (24)	30 (55)	<0.001
Antibiotics prescribed at discharge	23 (46)	23 (59)	0 (0)	0.004
Other medications prescribed at discharge	50 (33)	39 (44)	8 (15)	<0.001

* Systemic reactions include cutaneous systemic reactions and anaphylaxis. Anaphylaxis was defined as allergic reaction involving 2+ organ systems or hypotension. Please see Methods section for complete description.