

Management of pediatric allergic reaction: Practice patterns of Canadian pediatric emergency physicians

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CLINICIAN'S CAPSULE

What is known about the topic?

Among children, anaphylaxis is an increasingly common, life-threatening allergic reaction and there are deficiencies in both diagnosis and management.

What did this study ask?

Canadian pediatric emergency medicine practitioners were surveyed to assess the knowledge and management gaps for anaphylaxis, as per evidence-based, best practice guidelines.

What did this study find?

One-half of the physicians surveyed recognized all three anaphylaxis cases and administered epinephrine, where indicated, each time.

Why does this study matter to clinicians?

Recognition of anaphylaxis without urticaria or pulmonary findings, evidence-based management, and repeat epinephrine for ongoing anaphylaxis needs to be improved.

addressed diagnosis, management, and disposition. Additional questions focused on epinephrine prescribing, observation durations, and respondent demographics.

Results: Of the 214 members invited to participate in the survey, 152 (71%) responded. Anaphylaxis was accurately recognized 93%, 82%, and 99% of the time for the NIAID criteria one through three, respectively. When anaphylaxis was recognized, epinephrine was prescribed for each case 96%, 95%, and 72% of the time, respectively. Of all respondents, 115 (76%) accurately diagnosed all three cases of anaphylaxis and 82 (54%) treated anaphylaxis with epinephrine each time it was indicated.

Conclusion: Most respondents recognized cases of anaphylaxis; however, a substantial number demonstrated gaps in management that may adversely impact this vulnerable population. The recognition of anaphylaxis without urticaria or pulmonary findings and treatment of anaphylaxis with epinephrine, where indicated, were the main gaps identified.

RÉSUMÉ

Objectif: L'anaphylaxie est une réaction allergique grave, potentiellement mortelle. D'après la documentation médicale, l'incidence de l'anaphylaxie est à la hausse, et tant la reconnaissance que la prise en charge de ce type de réaction comportent des lacunes. L'étude visait donc à examiner l'ampleur de ces lacunes en médecine d'urgence pédiatrique au Canada.

Méthode: Il s'agit d'une enquête menée parmi les médecins inscrits dans la base de données du réseau Pediatric Emergency Research Canada (PERC), à l'aide d'un questionnaire à remplir soi-même. Fondé sur un examen de la documentation, l'instrument d'enquête avait pour but de cerner les lacunes les plus courantes en matière de diagnostic et de prise en charge de l'anaphylaxie. La version définitive de l'instrument comptait quatre scénarios : trois cas distincts, représentant chacun des critères de l'anaphylaxie selon le National Institute of Allergy and Infectious Diseases (NIAID), et un dernier cas

ABSTRACT

Objectives: Anaphylaxis is a severe allergic reaction that can be life-threatening. The literature indicates that the incidence of anaphylaxis is increasing and that there are deficiencies in both recognition and management. We aimed to examine the magnitude of these gaps in Canadian pediatric emergency medicine (PEM).

Methods: We conducted a self-administered survey of the Pediatric Emergency Research Canada (PERC) physician database. The survey tool was developed through a literature review to identify recurring themes of gaps in anaphylaxis diagnosis and management. The final tool contained four scenarios; three scenarios featured each of the National Institute of Allergy and Infectious Diseases (NIAID) anaphylaxis criteria, separately, and a fourth case of non-anaphylactic allergy. Multiple-choice questions associated with each scenario

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correspondant à une réaction allergique non anaphylactique. Des questions à choix multiple portant sur le diagnostic, la prise en charge et les suites à donner accompagnaient chacun des scénarios; s'ajoutaient aussi des questions sur la prescription d'épinéphrine, la durée des observations et des renseignements démographiques sur les répondants.

Résultats: Sur le total des membres (214) invités à participer à l'enquête, 152 (71%) ont répondu au questionnaire. L'anaphylaxie a été reconnue correctement dans 93%, 82% et 99% des scénarios présentés selon les critères de 1 à 3 du NIAID, respectivement. Dans les cas de reconnaissance de l'anaphylaxie, il y a eu prescription d'épinéphrine dans une proportion de 96%, 95% et 72% de chacun d'eux, respectivement. Dans l'ensemble, 115 répondants (76%) ont diagnostiqué

correctement l'anaphylaxie dans les trois cas, et 82 (54%) ont prescrit de l'épinéphrine chaque fois qu'il y avait des indications thérapeutiques.

Conclusion: La plupart des répondants ont reconnu les cas d'anaphylaxie; toutefois, des lacunes dans la prise en charge ont été relevées chez un nombre important de participants, ce qui peut porter à conséquence dans cette population vulnérable. Les principales lacunes concernaient la reconnaissance de l'anaphylaxie en l'absence d'urticaire ou de manifestations pulmonaires et le traitement de l'anaphylaxie par l'épinéphrine, en cas d'indications cliniques.

Keywords: Anaphylaxis, emergency medicine, epinephrine, pediatrics

INTRODUCTION

Anaphylaxis is a serious systemic hypersensitivity reaction that is usually rapid in onset and may cause death.^{1,2} The highest incidence of anaphylaxis is in children and adolescents.^{3,4} In Canada, there is an emergency department (ED) visit for food allergy approximately every 10 minutes,⁵ and up to 80% of anaphylactic reactions in children are triggered by food.⁶ Furthermore, 8% of allergy-related ED visits are due to anaphylactic shock.³

Despite the frequency and seriousness of anaphylaxis, international studies continue to report practice gaps in management with both difficulty in recognizing anaphylaxis as well as deviation from evidence-based, best practice guidelines.⁷⁻¹⁰ The literature indicates that even when anaphylaxis is recognized, there is undertreatment with epinephrine, overtreatment with adjunctive medications, and inadequate patient education and follow-up.¹¹⁻¹⁶

The magnitude of these gaps among Canadian pediatric emergency medicine (PEM) physicians is unknown. We proposed to explore the national practice pattern in the management of children with anaphylaxis. The primary objective of this study was to examine the self-reported practice of pediatric emergency physicians across Canada with regard to the diagnosis of anaphylaxis and use of epinephrine. Secondary objectives were to explore the pediatric ED anaphylaxis resources, such as established treatment pathways (e.g., order sets) and patient education materials.

METHODS

Study design

We conducted a national census of physicians in the Pediatric Emergency Research Canada (PERC) physician database. PERC, a cross-Canada network of pediatric EDs, was formed to conduct multicentre research designed to improve the health of children¹⁷ and maintains a database of physicians who work within member institutions. The Research Ethics Board of the Children's Hospital of Eastern Ontario Research Institute approved this study.

Study setting and population

All physicians listed in the PERC physician database were surveyed; this includes both the attending physicians and fellows in training. PERC includes 13 sites across Canada. The PERC physician database contains about 70% of the physicians currently working in pediatric EDs. Two hundred fourteen members were surveyed. The annual census for EDs participating in PERC ranges from 17,000–82,000 visits per year.

Survey instrument

The vignette-based, multiple choice survey tool was developed de novo. We first undertook a literature review to identify the recurring themes of gaps in anaphylaxis diagnosis and management.^{10,15} Based on this

literature review, we then developed clinical vignettes, adapted from clinical experience and case reports, that mapped to the three separate National Institute of Allergy and Infectious Diseases (NIAID) criteria (supplemental material Appendix 1). Three vignettes matched the three NIAID anaphylaxis criteria: acute onset of skin or mucosal tissue symptoms associated with respiratory changes, acute onset of skin and gastrointestinal manifestations after exposure to a likely allergen, and anaphylactic shock with hypotension after exposure to a known allergen.^{1,18,19} A fourth vignette, a case of food protein-induced enterocolitis syndrome (FPIES) but not anaphylaxis, was added to further assess the diagnostic ability of survey participants. The multiple-choice questions associated with diagnosis reflected confidence in identifying anaphylaxis (modified Likert scale), use of epinephrine, use of adjunctive medications, outpatient prescribing, and follow-up. There was a text option for participants to add non-listed answers. Additional multiple-choice questions reflected epinephrine dosing, observation time, and respondent demographics. The 13 PERC site representatives received an additional five multiple-choice questions addressing ED volumes and availability of anaphylaxis resources in the department, such as treatment pathways and patient education materials.

The following measures were done to ensure the quality of the survey instrument:²⁰ pretesting with three PEM physicians within the author's department, review of survey instrument by a statistician and allergy specialist, and, finally, pilot testing with four PEM physicians and three trainees from three centres across Canada. Changes were made to list epinephrine concentrations in multiple units, include additional adjunctive medications, and specify time intervals between exposure and reactions. The survey was translated into French and retested with a Francophone. The final step was review and approval by the PERC executive.

Sampling procedure

A self-administered, combined-mode survey (web-based and mail send-out for non-responders) was used (supplemental material Appendix 2). Participation was exclusively voluntary, with explicit consent to be approached for surveys inherent in the PERC physician database membership. The electronic questionnaires were distributed through REDcap[®], a secure web-based application that is used for building surveys and managing online databases. The survey send-outs were implemented based

on modified Dillman's Tailored Design Method survey, with a target response rate of greater than or equal to 70%. This method started with a pre-survey electronic announcement, which was sent in the spring of 2018, and then two Internet mailings at specified two-week intervals, with reminders after each. A unique link was sent to each participant to enable tracking. A third and final paper-based survey was mailed to individuals who did not respond to the electronic survey. The survey time-frame was from May to July 2018. All participants were offered a \$5 coffee gift card incentive to complete the survey, which could be converted to a donation to PERC or declined if so desired. Survey responses were aggregated in order to protect the identity of survey respondents.

Outcome measures

Our primary outcomes of interest were the correct diagnosis of anaphylaxis and treatment of anaphylaxis with epinephrine, where indicated. Secondary outcomes of interest were epinephrine prescribing practices, adjunctive medication use, practice variation in observation time and admission to hospital, and the availability of resources in the ED, such as treatment pathways and patient education materials.

Sample size and analysis

The questionnaire was administered to all PERC members ($n = 214$). Descriptive statistics were produced for all variables. Categorical variables were summarized using frequencies and percentages. Vignette-specific response choices of "definitely yes" and "probably yes" were grouped as "yes," and "definitely no" and "probably no" were grouped as "no." Proportions, with 95% confidence intervals (CI), and aggregate variables were calculated. We performed a univariate analysis using Pearson's chi-square test to explore variables associated with the primary outcome (practice setting, training designation, or years in practice). The significance level was determined as $p < 0.05$. All statistical analyses were performed using R statistical software version 3.5.2 (R Core Team, Vienna, Austria).²¹

RESULTS

Of the 214 members invited to participate in the survey, 152 (71%) responded. The demographic characteristics

Table 1. Demographic characteristics of study participants*

Variable	N = 149 n (%)	
Practice setting	Tertiary care pediatric centre	144 (96.6)
	Adult tertiary care centre hospital	1 (0.7)
	Community hospital	2 (1.3)
	Other	2 (1.3)
Practice location	Alberta	27 (18.1)
	British Columbia	11 (7.4)
	Manitoba	8 (5.4)
	Newfoundland	7 (4.7)
	Nova Scotia	10 (6.7)
	Ontario	51 (34.2)
	Quebec	32 (21.5)
	Saskatchewan	3 (2.0)
	Training	Pediatric Emergency Medicine Fellowship
	FRCPC Pediatrics	27 (18.1)
	FRCPC Emergency Medicine	17 (11.4)
	CCFP Emergency Medicine	7 (4.7)
	Other	4 (2.7)
Practice years	Currently still in-training	6 (4.0)
	0–5 years	30 (20.1)
	6–10 years	26 (17.4)
	11–15 years	27 (18.1)
	16–20 years	31 (20.8)
	>= 21 years	29 (19.5)

Note: *3 of 152 respondents with missing values.

of those participants are summarized in [Table 1](#). Most respondents work in pediatric EDs (96%) and were trained through PEM Fellowships (63.5%), followed by pediatrics (17%) and emergency medicine (11%). The majority of respondents were from Ontario Quebec and Alberta, respectively (see [Table 1](#)). There was an even distribution of respondents across career experience in five-year intervals.

Of all 152 respondents, 115 or 76% (95% CI: 69, 82) accurately diagnosed all three cases of anaphylaxis, and 82 or 54% (95% CI: 46, 62) treated with epinephrine each time it was indicated. In a comparative analysis, there was no significant relationship between the primary outcome and any of the following factors: practice setting, training designation, or years in practice ([Table 2](#)). [Table 3](#) shows participant responses to the diagnosis and management of all clinical vignettes. Respondents were able to accurately recognize anaphylaxis 93% (95% CI: 88, 96), 82% (95% CI: 75, 87), and 99% (95% CI: 96, 100) of the time for the NIAID criteria one through three, respectively (see [Table 3](#)).

However, of those who correctly identified the anaphylaxis vignettes, epinephrine treatment was appropriately prescribed 96% (95% CI: 92, 98), 95% (95% CI: 90, 98), and 72% (95% CI: 65, 79) of the time for NIAID criteria one through three, respectively. It is important to note that, in vignette 3, the patient received an auto-injector dose of epinephrine prior to ambulance transport; however, the patient was persistently in hypotensive anaphylactic shock by arrival at the hospital, therefore *repeat* epinephrine administration was indicated in this case. Except for vignette 4, there was no difference between participants' degree of confidence (i.e., definitely versus probably) with the diagnosis of anaphylaxis and epinephrine administration ([Table 4](#)).

Adjunctive treatments with antihistamines and corticosteroids were prescribed with the following frequencies in patients diagnosed with anaphylaxis: antihistamines 84% (95% CI: 77, 89), 77% (95% CI: 68, 83), and 67% (95% CI: 59, 74) for criteria one through three, respectively, and corticosteroids in 53% (95% CI: 45, 61), 44% (95% CI: 36, 53), and 59% (95% CI: 51, 67) for criteria one through three, respectively. The most frequently prescribed formulations of antihistamine and corticosteroids were diphenhydramine and dexamethasone, respectively. Among the appropriately diagnosed anaphylaxis cases, over 96% of participants provided discharge prescriptions for epinephrine. Out-patient referral to allergy and immunology varied between 80% for vignette 1 and 46% for vignette 3 (see [Table 3](#)).

[Table 5](#) outlines the epinephrine dosing selected, length of observation, and department resources reported by respondents. The correct formulation of intramuscular (IM) epinephrine in treating anaphylaxis was identified by 86% (95% CI: 80, 91) of the participants. The duration of ED monitoring after epinephrine administration varied based on whether the patient received one or two doses of epinephrine. After one epinephrine administration, 77% of survey participants observed for 4–8 hours. After two doses of epinephrine, practice variation was wide: 53% observed for 4–8 hours, 20% for >8 hours, and 24% would admit the patient to hospital.

With regard to the availability of anaphylaxis order sets and patient education resources, 4 of the 11 (36%) PERC site representatives reported that their centres have established anaphylaxis order sets, and only 1 site indicated having patient discharge communication resources, such as anaphylaxis emergency action plans and epinephrine auto-injector discharge prescription sets.

Table 2. Association between participants' characteristics with correct diagnosis and treatment of anaphylaxis vignettes

	Correct diagnosis of all anaphylaxis vignettes, n (% of that demographic of respondents)	p	Epinephrine treatment of all anaphylaxis vignettes, n (% of that demographic of respondents)	p
Hospital setting		0.376		0.263
Pediatric	111 (77)		78 (70)	
Non-pediatric	3 (60)		3 (100)	
Postgraduate training		0.332		0.274
PEM	75 (80)		53 (71)	
Pediatrics	17 (63)		14 (82)	
CCFP/Adult EM	19 (79)		11 (58)	
Other	3 (75)		3 (100)	
Years of practice		0.536		0.210
0–5	25 (69)		21 (84)	
6–10	22 (85)		18 (82)	
11–15	21 (78)		14 (67)	
16–20	22 (71)		13 (59)	
>20	24 (83)		15 (62)	

DISCUSSION

Interpretation of findings

Although the majority of PEM physicians have appropriate knowledge for the diagnosis and management of pediatric anaphylaxis, a substantial portion have knowledge gaps that may adversely impact the care of this vulnerable population. In particular, the recognition of anaphylaxis without urticaria or pulmonary findings and administering repeat doses of epinephrine for ongoing cardiorespiratory compromise are significant gaps that we identified. Across Canadian pediatric EDs, we identified a lack of structured treatment pathways, such as order sets and a lack of structured patient education or discharge resources.

Previous studies

The proportion of PEM physicians who accurately diagnosed all cases of anaphylaxis in our survey is similar to previous studies with self-reported practice patterns. For example, 70% of general practitioners in France⁷ and 70% of general pediatricians in the United States⁸ demonstrated successful recognition of cases of anaphylaxis. Similarly, in our previous survey of over 300 Canadian physicians who practise in adult or general EDs, 62% correctly identified pediatric anaphylaxis scenarios.⁹ Although ED studies found the overall performance of the anaphylaxis diagnostic criteria to

be reasonably accurate, the interpretation and application of the individual criterion in clinical practice, particularly in the pediatric population, remain challenging and likely contribute to misdiagnosis.²² A study by Wang et al. found that, while 85% of physicians correctly identified the case of anaphylaxis with prominent skin and respiratory symptoms, only 61% recognized the case without skin and respiratory symptoms as being anaphylaxis.²³ Our study also underscores this challenge, with a 93% correct diagnosis of vignette 1 (urticaria and respiratory symptoms) compared with an 82% correct diagnosis of vignette 2 (flushing and gastrointestinal symptoms after a wasp sting).

Epinephrine is the most important treatment for anaphylaxis. Several studies have shown the critical role of prompt administration of IM epinephrine in the prevention of severe and fatal anaphylaxis.^{24–27} Interestingly, however, our survey identifies a discrepancy between diagnosis and treatment of anaphylaxis. While the treatment with epinephrine for the individual anaphylaxis vignettes is higher than previous studies,^{11,12,14} only 53% of the physicians who correctly identified all three cases of anaphylaxis treated with epinephrine each time that it was indicated. This discrepancy towards undertreatment was more marked in the case of hypotensive anaphylactic shock that required repeat epinephrine dosing for ongoing hypotension. Although nearly all participants made the correct diagnosis, only 72% treated with epinephrine. Whether this is related to a lack of

Table 3. Summary of clinical vignettes diagnoses and treatments (n = 152 respondents)

	Anaphylaxis			Non-anaphylaxis
	Vignette 1 (diffuse hives and chest wheeze 30 min after ingestion of egg) n (%)	Vignette 2 (generalized flushing and intense abdominal pain shortly after a wasp sting) n (%)	Vignette 4 (anaphylactic shock with hypotension after ingestion of a known allergen) n (%)	Vignette 3 (delayed onset profuse vomiting and diarrhea, after exposure to food [FPIES]) n (%)
ED management				
Correct diagnosis	142 (93)	124 (82)	149 (99)	109 (73)
Treatment with epinephrine	137 (96)	118 (95)	108 (72)	4 (4)
Antihistamines	119 (84)	95 (77)	100 (67)	11 (10)
Steroids	75 (53)	55 (44)	88 (59)	4 (4)
Salbutamol	100 (70)	2 (2)	3 (2)	0 (0)
Fluid resuscitation	11 (8)	22 (18)	104 (70)	63 (58)
Other*	1 (1)	4 (3)	6 (4)	35 (32)
Outpatient management				
Epinephrine auto-injector prescription upon discharge	140 (99)	120 (97)	148 (99)	14 (13)
Follow-up with family doctor	18 (13)	19 (15)	53 (36)	19 (17)
Referral to pediatrician	5 (4)	6 (5)	7 (5)	34 (31)
Referral to Allergy and Immunology	119 (84)	98 (79)	68 (46)	53 (49)
No follow-up required, return to ED as needed	0 (0)	1 (1)	21 (14)	3 (3)

Note: *all respondents indicated ondansetron.

Table 4. Comparing the proportion of epinephrine prescribing between “definitely yes” and “probably yes”

	Anaphylaxis diagnosis	Number of respondents n	Epinephrine checked n (%)	% Difference (95% CI) p-value
Vignette 1 (diffuse hives and chest wheeze 30 min after ingestion of egg)	Definitely yes	103	101 (98.1)	5.8 (-1.2, 18.5) 0.097
	Probably yes	39	36 (92.3)	Reference
Vignette 2 (generalized flushing and intense abdominal pain shortly after a wasp sting)	Definitely yes	41	41 (100)	7.2 (-2.2, 14.9) 0.078
	Probably yes	83	77 (92.8)	Reference
Vignette 4 (anaphylactic shock with hypotension after ingestion of a known allergen)	Definitely yes	112	91 (81.2)	35.3 (17.6, 51.4) <0.001
	Probably yes	37	17 (45.9)	Reference

Table 5. Epinephrine dose and management (n = 152 respondents)

		n	%
Routine epinephrine dose	Epinephrine (1 mg/mL = 1:1000) 0.01 mg/kg*	128	86
	Epinephrine (1 mg/mL = 1:1000) 0.1 mg/kg	14	10
	Epinephrine (0.1 mg/mL = 1:10000) 0.01 mg/kg	4	3
	Epinephrine (0.1 mg/mL = 1:10000) 0.1 mg/kg	2	1
Preferred epinephrine route of administration	Intramuscular*	147	99
	Intravenous	1	1
	Subcutaneous	1	1
Length of observation after 1 dose?	<4 hours	31	21
	4–5 hrs:59 mins	100	67
	6–7 hrs:59 mins	15	10
	>8 hours	1	1
Length of observation after 2 doses?	Admit	1	1
	<4 hours	5	3
	4–5 hrs:59 mins	35	24
	6–7 hrs:59 mins	43	29
	>8 hours	29	20
	Admit	35	24

Note: *Correct answer.

knowledge, apprehension about administering repeated doses of IM epinephrine, or a failure to recognize hypotension for age is unclear.

Strengths and limitations

This is the first national survey that has explored anaphylaxis practice patterns of Canadian PEM physicians and we had a high response rate. The inherent limitation in this study, as with any survey of practice pattern, is self-reporting. Although self-reported anaphylaxis management might not accurately reflect actual practice, but rather what is perceived as the expected practice, our findings are consistent with the data from a Canadian anaphylaxis registry, which showed that 48.2% of children presenting with anaphylaxis to the ED were treated with epinephrine.⁶ The identified practice gaps are concerning even if we assume that the reported practice represents the “best,” rather than the “real” practice of PEM physicians. This study is also limited by potential coverage error as most, but not all, practicing physicians in PEM were approached. Finally, since we purposefully did not ask individual participants in which Canadian pediatric centre they practise to avoid identifying individual respondents, we are not able to explore the association between the presence of order sets and the primary outcome.

Clinical implications

This study highlights specific gaps in practice, particularly the increased challenge of diagnosing anaphylaxis without urticaria or pulmonary findings. To address this critical issue, in 2019, the World Allergy Organization (WAO) recently refined the diagnostic criteria for anaphylaxis. The updated criteria reflect the reality that the occurrence of hypotension or objective respiratory signs, in isolation, following exposure to a known or highly probable allergen is indicative of anaphylaxis.² Translating Emergency Knowledge for Kids (TREKK) is a national centre for knowledge translation.²⁸ The TREKK recommendations for anaphylaxis are consistent with the WAO update.²⁹ Therefore, clinicians are encouraged to adopt these updated criteria in clinical practice to overcome the diagnostic dilemma and ultimately improve the management of anaphylaxis.

Several recent studies investigated the utility of corticosteroids as adjunctive therapy for anaphylaxis.³⁰ Corticosteroids have not been shown to reduce the severity of initial anaphylaxis or reduce the risk of biphasic reactions.³¹ In fact, recent evidence showed that prehospital use of corticosteroids is associated with admission to hospital and the intensive care unit, even after adjusting for severity, treatment with epinephrine and antihistamines, asthma, sex, and age.⁶ Further, a meta-analysis by Shaker et al. found that compared

with adults, children who received corticosteroid therapy for the initial reaction were at higher risk of developing a biphasic reaction (odds ratio [OR], 1.5; 95% CI: 1.01, 2.38).³² Therefore, corticosteroids should not be routinely administered to children with anaphylaxis.²⁹ Similarly, due to the safety concerns of first-generation H1 antihistamines, such as diphenhydramine, these agents should not be used in the treatment of anaphylaxis. These concerns are also outlined in the TREKK recommendations²⁹ and the position statements from several scientific societies.^{33,34} These guidelines recommend newer generation antihistamines as a safe and effective alternative to first-generation H1 antihistamines.

Clinical pathway and preprinted orders have emerged as a potentially important knowledge dissemination strategy to promote patient safety and evidence-based healthcare practice.³⁵⁻³⁷ The free, open-access anaphylaxis resources developed by TREKK target several aspects of the practice gaps identified in our survey.

Research implications

The wide variation in practice for the duration of ED monitoring confirms a high degree of uncertainty regarding the best and most cost-effective disposition practices. This clinical uncertainty originates from the lack of validated clinical predictors for biphasic anaphylaxis. The international research agenda for anaphylaxis recognized this critical gap in current knowledge and called for prospective studies to derive a robust risk stratification model.³²

CONCLUSIONS

The majority of respondents recognized cases of anaphylaxis; however, there were demonstrated gaps in management that may adversely impact this vulnerable population. The recognition of anaphylaxis without urticaria or pulmonary findings and administering repeated doses of epinephrine for ongoing cardiopulmonary compromise are the most significant identified gaps. In order to improve the uptake of evidence-based best practice guidelines, there is an urgent need for knowledge dissemination and the uptake of departmental resources to facilitate this implementation.

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