

Quality of the Triage of Children With Anaphylaxis at the Emergency Department

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Objective: Early recognition of symptoms is essential in anaphylaxis management. The Canadian Paediatric Emergency Triage and Acuity Scale prioritizes anaphylaxis to level I or II (resuscitation or emergency). We analyzed the accuracy of pediatric anaphylaxis triage.

Methods: This was a retrospective review of the triage charts (adaptation of the Canadian Paediatric Emergency Triage and Acuity Scale) of 137 children attended for anaphylaxis at our pediatric emergency department. Per triages' accuracy, charts were divided into TR1 (levels I–II) and TR2 (levels III–V), comparing demographics, initial triage level given by initial assessment (Paediatric Assessment Triangle), vital signs, observations recorded by the staff, and waiting times for physician.

Results: Forty-six (33.3%) were triaged correctly (TR1 group), and 91 (66.7%) were not. Median ages were similar (TR1: 5 years [interquartile range, 13.1 years] vs TR2: 4.5 years [interquartile range, 14.5 years]; $P = 0.837$). Initial triage level 5 was given by Paediatric Assessment Triangle to 69.5% of TR1 and 83% of TR2 cases ($P = 0.001$; likelihood ratio for TR2: 1.985 [95% confidence interval, 1.11–3.49]). Vital signs were normal in 71.7% of TR1 and 94.5% of TR2 patients ($P < 0.001$; likelihood ratio for TR2: 2.602 [95% confidence interval, 1.22–5.52]). Symptoms suggestive of anaphylaxis (mention of 2 different organs) were recorded in 45.6% of TR1 and 48.3% of TR2 charts ($P = 0.08$). Median waiting times were 3 minutes (interquartile range, 26 minutes) and 11 minutes (interquartile range, 111 minutes) for TR1 and TR2, respectively ($P = 0.001$).

Conclusions: Current triage, based on severity perception, missed most of the cases. Anaphylaxis-defining symptoms were overlooked. Inaccurate triage delayed medical attention. Improving measures, such as emphasizing symptom recognition and defining anaphylaxis risk discriminators, is mandatory to improve their identification.

Key Words: anaphylaxis, Canadian Paediatric Emergency Triage and Acuity Scale (PaedCTAS), Paediatric Assessment Triangle (PAT), triage (*Pediatr Emer Care* 2018;00: 00–00)

Anaphylaxis is a sudden, potentially life-threatening, generalized allergic reaction.¹ It must be recognized and treated promptly. Delays or failures in epinephrine administration have been related with fatalities.¹

Triage systems prioritize attention to patients at the emergency departments (EDs). Correct management of anaphylaxis should begin at triage, to ensure immediate identification and treatment. Triage procedures include an initial assessment, main evaluation of complaint, and a physiological assessment. Additional data

regarding age and health status adjust the priority level of patients attended for similar symptoms.

The Canadian Paediatric Emergency Triage and Acuity Scale (PaedCTAS) is a 5-level priority system, especially modified for children.^{2–4} It prioritizes anaphylaxis to level I (resuscitation) or II (emergent).³

Data on anaphylaxis triage are very limited. However, its impact on anaphylaxis identification has been described.⁵ Our main goal was to describe the accuracy of pediatric anaphylaxis triage in our hospital. Secondary goal was to describe the features of pediatric anaphylaxis at triage.

METHODS

Study Design

We performed an observational retrospective cohort trial, reviewing the triage charts of a group of children younger than 15 years attended for anaphylaxis between 2012th and 2016th April 1st.

The first pediatric triage chart adapting PaedCTAS,^{3,4} with informatics support, was implemented in our pediatric ED (PED) and included in the medical record program (Historia Clínica Informatizada [HCI]) in 2012.

Inclusion Criteria

Pediatric ED discharge charts coded as anaphylaxis were retrieved from HCI and reviewed by 2 allergists. Discharge charts contain information regarding anamnesis, physical examination, diagnosis, administered treatment, and discharge instructions. Cases meeting anaphylaxis criteria per international guidelines¹ were selected for triage chart review. Triage charts were also retrieved from HCI. Eligible charts required all of the following: triage level given by the initial assessment (Paediatric Assessment Triangle [PAT]⁶), hour of admission, main complaint, observations (recorded as free text by PED nursing staff), patients' location at PED, medical attention assignation, allergies referred by parents, and patients' referral.

Patients with both confirmed anaphylaxis and complete triage charts were analyzed (Fig. 1).

Exclusion Criteria

Patients without an anaphylaxis diagnosis or with incomplete PED or triage charts were excluded.

The study was approved by the Hospital Clinical Research Ethics Committee.

Setting

Complejo Hospitalario de Navarra is a tertiary care hospital with a separate PED that attends to approximately 40,500 children annually. Triage is performed by the pediatrics nursing staff in a separate room. Most of the patients refer themselves.

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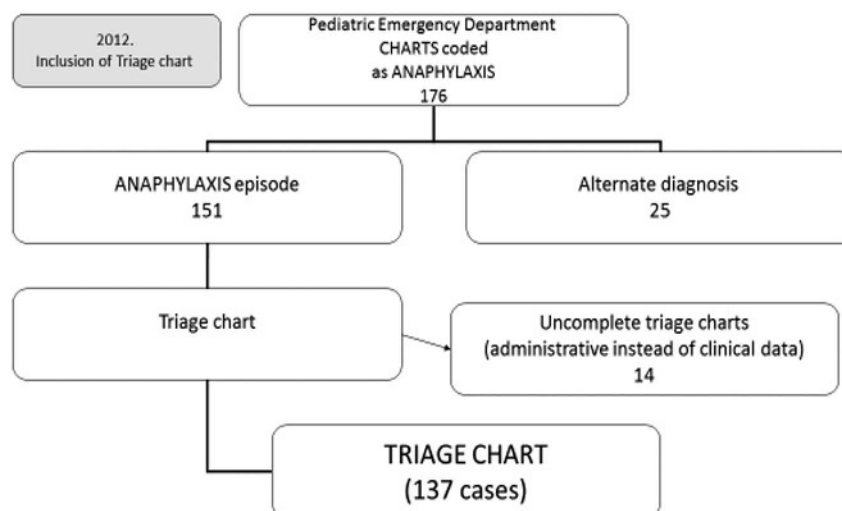


FIGURE 1. Patients' flowchart and inclusion procedure.

Triage Procedure

Data are recorded prior to medical attention to patients unless an unstable child is identified during the initial assessment.

Triage proceeds as follows:

- (1) First impression: PAT (general appearance, respiratory distress signs, circulation to skin: pallor, mottling, or cyanosis⁶) provides an initial triage level.
 - a. 3 sides unaltered: level 5
 - b. 1 side altered: level 3
 - c. 2 sides altered: level 2
 - d. 3 sides altered: level 1

There is no level 4 during initial assessment by PAT.

- (2) Main complaint: categorized by system/primary organ affected (respiratory, neurology, cardiovascular, locomotor, skin, digestive, genitourinary, ear/nose/throat, eye, allergy, endocrine, fever, psychiatric, abuse, miscellaneous symptoms, or intoxication), like current Paediatric CTAS application in complaint-oriented triage⁵

"Allergy" category includes the following:

- Anaphylaxis (respiratory distress, angioedema, digestive symptoms): level I
- moderate allergic reaction (facial and lip edema, absence of respiratory distress): level III
- localized allergic reaction (urticaria without facial symptoms, no respiratory distress, conjunctival edema): level IV

In skin-related complaints, the addition of respiratory or cardiovascular signs to urticaria should lead to an anaphylaxis suspicion: level II.

Allergy discriminators are as follows:

- (a) age younger than 3 months: level III
- (b) previous illnesses: immunodeficiency, immunosuppression, or cancer: level II
- (3) Vital signs: obtained in resuscitation room in unstable patients

- (a) fever: level III

- (b) pulse oximetry: >92% and <94%: level III, <91%: level II

- (4) Final triage level adjudication

Triage staff may add observations as free text, recording symptoms or concerns reported by parents. Finally, patients are allocated at the PED (waiting room, treatment room, or immediate attention room), and medical attention is assigned (resuscitation, emergency, and examination rooms).

Variables for Analysis

Primary outcome was to describe the accuracy of pediatric anaphylaxis triage. Charts were split into 2 categories: TR1 (accurate triage [levels I–II]) and TR2 (inaccurate [levels III–V]), and we compared triage steps between both groups. Besides, all the information recorded in the charts was also described according to their final triage level (I–V) as secondary outcome.

We analyzed demographics, initial triage level given by PAT, patients' referral, waiting time for physician (time of admission at the attention rooms minus time of admission at triage), and observations.

Symptoms suggestive of anaphylaxis were defined by the mention of 2 or more different organs in "observations" item.

Anaphylaxis suggestive data added patients diagnosed in other centers, suggestive symptoms, and epinephrine autoinjector (EA) use prior to hospital attendance.

We sought non-skin symptoms during the physical examination and epinephrine administration at PED in discharge charts.

Statistical Analysis

We used the statistical software IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY), BMDP Statistical Software release 7 (BMDP Statistical Software Inc, Los Angeles, CA), and Star Xact (Cytel Software Corp, Cambridge, MA). Demographics and waiting times were compared by Mann-Whitney *U* tests. Rates of initial triage levels given by PAT, symptomatic patients, epinephrine administration, observations, and referrals were analyzed by χ^2 tests. Likelihood ratios (LRs) and 95% confidence intervals (CIs) were calculated for

TABLE 1. Anaphylaxis Criteria**Acute Onset of an Illness (Minutes to Several Hours) With Involvement of the Skin, Mucosal Tissue or Both (eg, Generalized Hives, Pruritus or Flushing, Swollen Lips-Tongue-Uvula)**

- (1) And at least one of the following:
 - Respiratory compromise (eg, dyspnea, bronchospasm, stridor, hypoxia)
 - Cardiovascular compromise (eg, hypotension, collapse)
- (2) Two or more of the following that occur rapidly after exposure to a likely allergen for that patient (minutes to several hours):
 - (a) Involvement of the skin or mucosal tissue (eg, generalized hives, itch, flushing, swelling)
 - (b) Respiratory compromise (eg, dyspnea, bronchospasm, stridor, hypoxia)
 - (c) Cardiovascular compromise (eg, hypotension, collapse)
 - (d) Persistent gastrointestinal symptoms (eg, crampy abdominal pain, vomiting)
- (3) Hypotension after exposure to a known allergen for that patient (minutes to several hours):
 - Hypotension for children is defined as systolic blood pressure <70 mm Hg from 1 mo to 1 y, $[<70 \text{ mm Hg} + (2 \times \text{age})]$ from 1 to 10 y, and <90 mm Hg from 11 to 17 y

TR1 and TR2 comparisons. All statistical tests had a significance level of 0.05.

RESULTS

Characteristics of the Study Subjects

We analyzed 137 cases. Twenty-five patients were excluded because of an alternate diagnosis (acute urticaria [15 patients], food protein-induced enterocolitis [2 cases], acute bronchospasm, and rhinoconjunctivitis [8 cases]). Fourteen did not contain enough data in the triage chart for analysis. These charts dated from the initial months after the triage system implementation and were assumed as a learning curve period (Fig. 1). Allergists agreed on 97% of the diagnoses (171 of 176 medical charts).

Main Results

Forty-six patients (33.5%) were prioritized correctly (TR1 group).

No differences were observed in demographics. TR1 and TR2 comparisons showed significant differences between the waiting times of both groups. Inaccurate triage delayed medical attention. Stable appearance according to PAT would undertriage most of anaphylaxis cases: LR for TR2 1.985 (95% CI,

1.129–3.49), and so would normal vital signs: LR for TR2 2.602 (95% CI, 1.22–5.52). Almost half of all the charts had enough data to suspect anaphylaxis, but this information was not used for prioritization ($P = 0.08$) (Table 1).

Secondary Outcomes

The most frequently given priority level was III (56.9%), followed by levels I and II. Waiting times for physician ranged between immediate attention (level I) and 17 minutes (level IV) ($P = 0.01$). Regarding PAT, initial triage level 5 was the most frequent in every group, ranging from 68% (level I) to 92.3% (level IV) ($P = 0.006$). One patient (0.7%) was attended to for a physiological category of cardiopulmonary failure⁶ (3 altered sides of the PAT), requiring admission in the pediatric intensive care unit, 3 (2.1%) because of a physiological diagnosis of decompensated shock/respiratory failure (2 altered sides of the PAT⁶). One level IV triaged patient (stable PAT) collapsed within minutes in the waiting room requiring attention at the resuscitation room and hospital admission. There were no fatalities (Table 2).

Symptoms suggestive of anaphylaxis were recorded in a third of levels I to III cases. Symptomatic patients and rates of epinephrine administration were higher in level I (80% and 76%) and

TABLE 2. Comparison Between Accurate Triage (TR1) and Inaccurate Triage (TR2)

	TR1	TR2	P	LR (95% CI)
n	46	91		
Median age, y	5	4.5	0.837	
IQR	13	14.5		
Median waiting time for physician	3	11	0.001	
IQR	26	120		
Triage level according to PAT (5 = stable)	69.5%	83%	0.001	For TR1: 0.22 (0.84–0.575)
Vital signs				For TR2: 1.985 (1.12–3.49)
Normal	33 (71.7%)	86 (94.5%)	<0.001	For TR1: 0.148 (0.04–0.44)
Abnormal	13 (28.3%)	5 (5.5%)		For TR2: 2.602 (1.22–5.52)
Enough data to suspect anaphylaxis				
Yes	21	44	0.08	For TR1: 0.93 (0.22–1.04)
No	25	47		For TR2: 1.31 (0.95–1.81)

“Enough data to suspect anaphylaxis” means addition of suggestive symptoms in observations, EA use mentioned in observations, patients diagnosed in other centers.

IQR indicates interquartile range.

level II (57.1% and 61.9%) patients. However, approximately 50% of undertriaged patients were symptomatic and required epinephrine too. Forty-one patients had been referred from other health centers. Eleven (26.8%) of these cases had received epinephrine before hospital transfer (Table 3).

DISCUSSION

Early recognition of anaphylaxis is essential because delays in epinephrine administration may lead to fatalities.¹

Data regarding anaphylaxis triage are limited. Thomson et al⁵ have recently described how a high-acuity triage category improved the odds of a correct identification of anaphylaxis in the ED. Farbman et al⁷ also included acuity data per the Emergency Severity Index among other clinical features to describe a group of children with anaphylaxis. However, we found no previous data focused on triage procedures' accuracy itself.

In our study, only a third of the cases were prioritized correctly. Our program prioritizes anaphylaxis to level I of medical attention. The original PaedCTAS also included level II. We consider that both levels may be adequate to ensure at least immediate full medical evaluation and to decide necessary treatment or

observation in a controlled setting. However, the most frequent level was III,^{3,5} with a recommended waiting time of 30 minutes and allocation to the waiting room. Inadequate triage delayed these patients' medical attention. Our waiting times seemed short but depended on the number of children attending the PED and not on correct identification. Accurate triage is important especially in a crowded PED. Besides, patients' allocation to the waiting room might have complicated their surveillance.

The first step in triage is initial assessment. The Paediatric Assessment Triangle is designed to identify the type and severity of a physiological problem and guide initial treatment.⁶ It includes skin assessment, but anaphylaxis skin signs do not alter PAT because they reflect a specific cause and are not severity related. Respiratory symptoms are the second most frequently described in pediatric anaphylaxis.⁸ The Paediatric Assessment Triangle measures only external signs. Most of the patients appeared stable per PAT but were symptomatic during medical examination. Other anaphylaxis signs include digestive, cardiovascular, or neurological symptoms. These may not alter PAT unless they alter patients' general appearance. Anaphylaxis may improve spontaneously or with prehospital treatment, impairing triage assessment. Therefore, we checked the presence of non-skin symptoms and

TABLE 3. Triage Charts Analysis According to Current PaedCTAS 5-Level Triage System

	Final Triage Level					P
	I	II	III	IV	V	
No. patients	25 (18.1%)	21 (15.2%)	78 (56.9%)	13 (9.5%)	—	
Age, median (IQR), y	8.83 (13–41)	4.41 (13)	4.5 (14.5)	5.58 (12.83)	—	0.09 [†]
Waiting time for physician, min	0 (22)	7 (26)	10 (111)	17 (72)	—	[†] 0.01
Triage according to PAT						
5	17 (68%)	15 (71.4%)	71 (91%)	12 (92.3%)		
3	5 (20%)	5 (23.8%)	7 (9%)	1 (7.7%)		[‡] 0.006
2	2(8%)	1 (4.8)	—	—		
1	1 (4%)	—	—	—		
Referral						
Self-initiative	15 (60%)	14 (66.7%)	58 (74.4%)	100%	—	[‡] 0.02
Other health center	10 (40%)	11 (33.3%)	20 (25.6%)	—		
Recorded observations						
Allergic reaction	10 (40%)	3 (14.3%)	24 (30.8%)	5 (38.5%)		
Skin symptoms only	3 (12%)	6 (28.6%)	7 (9%)	6 (46.2%)		
Symptoms suggestive of anaphylaxis	7 (28%)	7 (33.3%)	29 (37.2%)	1 (7.7%)		
Diagnosed at other health center	3 (12%)	3 (14.3%)	9 (11.5%)	—	—	—
None	—	1 (4.8%)	2 (2.6%)	—		
EA use	—	1 (4.8%)	5 (6.4%)	—		
Enough data for anaphylaxis*						
Yes	10 (40%)	11 (52.4%)	43 (55.1%)	1 (7.6%)	—	[‡] 0.07
No	15 (60%)	10 (47.6%)	35 (48.9%)	12 (92.4%)		
Symptomatic patient						
Yes	20 (80%)	13 (57.1%)	38 (48.7%)	7 (53.8%)	—	[‡] 0.056
No	5 (20%)	8 (38.1%)	40 (51.3%)	6 (46.2%)		
Epinephrine at PED						
Yes	19 (76%)	13 (61.9%)	38 (48.7%)	6 (46.2%)	—	0.089 [‡]
No	6 (24%)	8 (38.1%)	40 (51.3%)	7 (53.8%)		

"Symptoms suggestive of anaphylaxis" means 2 different organs mentioned in "observations."

*The addition of suggestive symptoms, EA use and diagnoses made in other health centers.

[†]Mann-Whitney U test.

[‡] χ^2 Test.

EA indicates epinephrine autoinjector; IQR, interquartile range; PAT, pediatric assessment triangle; y, years.

epinephrine administration rates in the medical charts. There were no significant differences between TR1 and TR2 patients. Undertriage was not related to spontaneous recovery. Our epinephrine administration rates were higher than the figures reported by other authors.⁹ Anaphylaxis triage based on PAT only would undertriage most of the patients.

Next step in triage procedure includes main complaint, vital signs assessments, and modifiers' record.

In triage, parents' reports of symptoms are the only source of information. There is no time to review the patients' medical records. In our medical program, data regarding previous allergies are documented. A significant number of the triage charts contained enough information as reported by parents to suspect an anaphylaxis. The comparisons between TR1 and TR2 did not reach statistical significance. Therefore, anaphylaxis symptoms were overlooked during triage. We are aware that anaphylactic shock is the most severe presentation of anaphylaxis, but it is not the most frequent, especially among children. Unfortunately, even for some people working at the ED, the presence of shock is necessary to consider the diagnosis of anaphylaxis.

Besides, useful data such as EA use confused patients' triage and further attitude. Six patients (5 patients triaged as level III) had used an EA prior to hospital attendance. Epinephrine autoinjector prescriptions and use represent current anaphylaxis, a previous one, or an anaphylaxis risk allergy. Current PaedCTAS triages EA users to level II,^{3,4} but our system does not. Patients are told to attend to a hospital after an anaphylaxis for observation and further treatment if needed. The rate of biphasic anaphylaxis is estimated at less than 3% in adults and 15% in children.¹⁰ However, almost 20% of the patients with anaphylaxis require repeated epinephrine doses to resolve the symptoms.¹¹ Current anaphylaxis guidelines recommend a period of observation.¹ Recommended duration varies, ranking between 4 and 6 hours and longer periods (12–24 hours) in patients with respiratory or cardiovascular symptoms.¹ Hospital admission is not necessary in most of the cases.⁷

Previous treatment and EA prescriptions should have been used as diagnostic elements and as risk discriminators or modifiers. Regarding observation assessment, some of them, such as “skin symptoms only” or “allergic reaction,” are insufficient to suspect anaphylaxis, and they may reflect different situations: parents' or staffs' interpretation of symptoms, natural progression of the disease, and so on.

Current modifiers are not anaphylaxis risk factors, although age is a discriminator in other conditions.^{3,4} Vital signs were normal in many patients, despite being symptomatic during medical examination.

We have taken into account the recommendations regarding chart review studies.¹² However, our study has several limitations. Anaphylaxis diagnoses have been confirmed by 2 allergists according to clinical criteria validated for their use in epidemiological studies.¹ Both specialists agreed in more than 95% of the charts, so we are confident in the accuracy of the medical diagnoses. Triage should at least identify at-risk patients; thus, we opted for analyzing confirmed anaphylaxis cases only. Future research on anaphylaxis triage should also require assessing other conditions that may mimic anaphylaxis to include missed cases and assess consequences of overtriage. Regarding data collection, our main goal (priority level allocation) is a variable independent from investigators' interpretation. Vital signs do not depend on observers' interpretation either. Nevertheless, PAT and observations are completed by nursing staff during the acute event. The Paediatric Assessment Triangle systematizes patients' initial assessment, but its application depends on staffs' experience. Besides,

“observations” are recorded as free text. Required data to suspect anaphylaxis included the simultaneous mention of 2 organs or EA use. Absence of symptom description may be related to different reasons including staffs' or parents' interpretation (summarizing all the symptoms in “allergic reaction”). We cannot rule out that anaphylaxis may have progressed between triage and medical assessment either. The latter would stress the importance of a correct triage.

Finally, our results are not translatable to other pediatric triage systems. Each system has peculiarities and requires specific training to perform correctly.² We encourage authors familiar with other triage systems to share their comments.

Anaphylaxis features include potential severity, risk of new episodes, and need for observation. Current anaphylaxis triage in our PED is primarily based on severity perception and does not account for these peculiarities. Our programs' discriminators are not related with anaphylaxis. We identified the lack of knowledge regarding anaphylaxis symptoms as an obstacle in patient identification. Symptom recognition must be emphasized because symptoms suggestive of anaphylaxis were recorded in many charts. We also identified the lack of specific discriminators in the program as a barrier to an accurate assessment. Both circumstances jointly underestimated anaphylaxis. We are confident that improving triage accuracy will improve anaphylaxis management, as has already been suggested.^{5,7} Anaphylaxis education to health care personnel must include triage staff to improve these patients' identification. Anaphylaxis-specific discriminators should also be added to triage systems with that purpose. We propose the following:

Symptom recognition¹ must be emphasized over initial appearance, including apparently mild non-skin symptoms (sudden cough, stridor, digestive symptoms, rhinoconjunctivitis, etc) and even ceased at PED arrival.

A previous anaphylaxis predicts new episodes. Seventeen percent of anaphylaxis admissions had previous episodes, and 30% were triggered by the same elicitor.¹³ Epinephrine autoinjector prescriptions and use mark current or previous episodes.⁴

Symptom duration is useful to make differential diagnosis with acute urticaria.

Bronchial asthma is a risk factor for severe anaphylaxis.¹

Besides, designing specific algorithms for patients with resolved anaphylaxis may improve these patients' follow-up.

In our sample, if all the patients referring compatible symptoms (ceased or not) or referred from other health centers, and/or EA users had been recognized correctly, accurately triaged patients' rate would be 47.8% (66 patients overall). Moreover, previous anaphylaxis episodes had been recorded in 14 cases (10.1%). The addition of previous anaphylaxis as a marker of new anaphylaxis to a modified version of PaedCTAS would have prioritized 7 additional cases of patients in absence of compatible observations' record. Therefore, in our sample, 73 patients (53.2%) could have been identified correctly, instead of 46 (33.3%). Data regarding urticaria and asthma were insufficient to modify triage results.

The effect of specific training measures in symptom recognition or observations record and the influence of the addition of data regarding urticaria duration or asthma would require a prospective design.

In summary, our current pediatric anaphylaxis triage procedure is based on severity perception. Suggestive symptoms are overlooked during triage. Specific discriminators for anaphylaxis are necessary to ensure immediate attention to these patients.

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