ORIGINAL ARTICLE

Management of anaphylaxis: a cross-sectional study of competence and barriers in use of epinephrine autoinjectors in northern Italy

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Summary

Background. Epinephrine autoinjectors (EAIs) are the first-line treatment for anaphylaxis, and they are recommended in guidelines on anaphylaxis management. Despite these clear indications, EAIs remain largely underused, with an alarming rate of incorrect administration.
This study evaluates patients' ability of self-administration of EAIs, the most common mistakes made, and patients' availability of their own device. **Methods.** We included patients already in follow-up at the ASST Spedali Civili in Brescia and the Casa di Cura Beato Palazzolo in Bergamo, between February and September 2025. **Results.** Of 258 patients, 64% performed the self-administration procedure incorrectly. The most frequent mistakes were not removing the safety cap (34%) and removing the device from the site of injection before 10 seconds (24%). The only statistically significant predictive factor associated with the correct use of the device was the physical availability of the autoinjector during the visit. There were no significant correlations with gender, education level, device type, years of adrenaline possession or previous anaphylactic episodes after EAI prescription. When considering new anaphylactic events occurred after the first EAI prescription, 50% of the patients did not use their device due to the lack of recognition of necessity, while 36% did not have their device available. **Conclusions.** These data confirm that underutilization and misuse of EAI are widespread and persistent problems. Even now, persistent educational path with "face to face" training and a written action plan, to be repeated at each check-up, is not enough to help patients in accepting and managing correctly adrenaline auto-injectors. Scientific community should think of additional or different types of training, maybe considering also the psychological aspects of patients' anaphylactic experience.

KEY WORDS
Anaphylaxis; adrenaline; autoinjector.

IMPACT STATEMENT

This research addresses the persistent challenge of underuse/misuse of adrenaline autoinjectors among patients, proving that regular, practical training is essential to improve emergency preparedness and prevent fatal anaphylactic outcomes.

INTRODUCTION

The definition of anaphylaxis is still very heterogeneous, however all the guidelines agree in defining it as a potentially lethal condition, given the unpredictability of the severity of the reaction. It is known that early administration of adrenaline reduces the mortality while important aspects for the diagnosis and the risk stratification are: trigger factors and their epidemiological distribution, risk factors, co-factors, phenotypes, endotypes and biomarkers, officially approved or still under study (1-4).

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In Europe, the incidence of anaphylaxis is 1.5-7.9 per 100 000 inhabitants/year. It is estimated that at least 1 in 300 people experience an anaphylactic episode during their lifetime. According to UK data, mortality is <1 per million people/year, although it is probably underestimated (5). In developed countries, the prevalence of anaphylaxis has increased over the past 20 years, with a significant increase in hospitalization for food-induced anaphylaxis, especially among children (3).

Autoinjectable epinephrine is a life-saving drug with an intramuscular administration, in the anterolateral area of the thigh, that should be used as soon as signs and symptoms of anaphylaxis are recognized (4,6-9). It's not possible to predict which patients are at risk of severe anaphylaxis, and epinephrine administration should not be denied or delayed (1,10) to prevent hospitalization and a worse prognosis, with an increased risk for hypoxemia, ischemia, encephalopathy, and death (11).

There is no absolute contraindication for the administration of epinephrine, as the potential benefits outweigh the risks for adverse reactions. These include elderly patients, even those with pre-existing cardiovascular disease (12,13).

Currently the focus is on the "anaphylaxis management", which includes a series of steps that start from the correct diagnosis, follow in the patients' education to avoid possible triggers and situations, and in the use of the emergency therapy, of which self-injectable adrenaline is the cornerstone (1,3,14).

Significant uncertainties regarding the use of epinephrine persist, particularly concerning the indications for EAI prescription and the clinical criteria and timing that should prompt its administration (15). According to the European anaphylaxis registry, of the 6221 cases of anaphylaxis collected, only 940 occur in healthcare settings, while 5281 occur in other contexts such as private homes, cities, workplaces, schools, restaurants. Most anaphylactic reactions in fact take place in these settings, therefore the availability of the self-administered emergency treatment is crucial (16,17). Despite the severity of past anaphylactic events, long-term patient adherence remains suboptimal, in fact individuals often fail to carry their emergency devices, lose the ability to use it correctly, or neglect to use it even when accessible (6,17,18). Therefore, even when correctly prescribed, EAIs are frequently underused. Numerous studies show that high rates of patients' error during administration effectively eliminate the clinical advantages of the drug (19-21).

Objectives

The primary objective of this study is to assess the practical skills of epinephrine self-administration among a cohort of patients with prior autoinjector prescription and prior specific training. Secondary objectives include: identifying common errors among non-capable subjects, verifying device availability during the clinical visit, and analyzing possible determinants for correct or incorrect administration.

MATERIALS AND METHODS

We performed a cross-sectional review of the clinical data of patients undergoing follow-up for previous anaphylaxis who visited the clinics for EAI replacement at the Allergology Unit of Spedali Civili (Brescia, Italy) and the Allergology Service of the Casa di Cura Beato Palazzolo (Bergamo, Italy). The study population consists of subjects with the following diagnoses: food allergy, allergy to hymenoptera venom, systemic mastocytosis and idiopathic anaphylaxis. Each patient was trained on EAI self-administration and post-injection protocols at their first prescription. Standard care included mandatory practical simulations with training devices and supplying the patient with a written emergency action plan and scheduling check-ups for EAI replacement before expiration

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date. During follow-up appointments for device renewal, clinicians assessed the patient's device availability, verifying their understanding of when to use adrenaline, and supervised a practical test using a training device. Following these clinical protocols, data were collected between February 1 and September 30 2025. We also attempted to categorize into 2 groups the errors made with the adrenaline injection, based on their potential consequences: type 1 errors, which allow a "margin of recovery" (e.g. failure to remove the safety cap) and type 2 errors, which result in an irreparable loss of the medication (e.g. premature removal of the device before the 10-second mark).
We evaluated caregiver skills for children aged under 11, identifying the start of middle school as the clinical threshold for assessing the subjects' autonomy in self-administration. The devices prescribed to patients were from 3 different companies, which can be classified into 2 groups: the syringe-based device Chenpen® and the cartridge-based devices Jext® / Fastjekt®. Competency in executing the emergency protocol and the use of EAI was carried out using a training device identical to the one prescribed to the patient.

Statistical analysis
Data analysis was performed using GNU PSPP version 2.0.0 (GNU Project (2015), Boston, MA). Descriptive statistics (mean ± SD or absolute frequencies/percentages) summarized clinical and demographic characteristics relative to self-administration proficiency. Administration errors were classified as type 1 (recoverable) or type 2 (irreparable), and motivations for non-use (e.g., belonephobia, device unavailability) were analyzed.
Independent predictors of correct technique were identified via multivariate logistic regression, adjusting for: sex, age, education, device type and number, years of device availability, anaphylaxis trigger, device availability and validity at follow-up, occurrence of anaphylaxis after prescription of EAI. A significant statistical value of 5% was accepted for all tests. Given the exploratory nature of the study, no corrections for multiple testing were applied; thus, results should be interpreted as hypothesis-generating.

RESULTS

We reviewed the data of 258 patients with a mean age of 41.18± 19.84 years, with a male-to-female ratio of 1:0.87. Among the 258 participants, food allergy was the primary indication for EAI prescription (162, 63%), followed by hymenoptera venom allergy (79, 30%), systemic mastocytosis (15, 6%), and idiopathic anaphylaxis (4, 1%).
During the practical assessment with the training device, 166 patients (64%) failed to perform the self-administration procedure correctly. In contrast, 92 patients (36%) completed the test without errors. Therefore, only approximately one-third of the cohort was considered proficient in autonomous self-administration (Table I).
Regarding gender distribution, a 1:1 ratio was observed among patients who failed the assessment, whereas 60% of those who passed the test were males and 40% were females, with no statistical significance (OR=0.62; 95% CI=0.36, 1.07; p=0.083). Neither the underlying diagnosis (food allergy, hymenoptera venom allergy, systemic mastocytosis, and idiopathic anaphylaxis) nor the specific anaphylactic trigger significantly influenced administration ability (OR=1.26; 95% CI=0.78, 2.06; p=0.348). Furthermore, the specific device used (Chenpen® compared to Jext®/Fastjekt®) did not result in statistically significant differences in administration ability (OR=0.90; 95% CI=0.51, 1.57; p=0.702), nor did the number of devices prescribed (OR=0.73; 95%CI=0.27, 1.98; p=0.541). When stratified by age, 86 (36%) of the 236 adult patients (≥ 18 y.o.) correctly demonstrated the adrenaline auto-injection procedure, while 150 (64%) performed it incorrectly. Among the 16 adolescents (11-17 y.o.), 3 (19%) completed the procedure correctly and 13 (81%) did not. For the 6 children (< 11 y.o.), their caregivers were assessed: 3 (50%) administered the device correctly, whereas the other

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half failed. Overall, no statistically significant differences in performance were observed across the age groups (OR=1.27; 95%CI=0.62, 2.61; p=0.516).
Patients level of education was categorized as follows: primary education or below (35, 14%), middle school (69, 27%), high school (86, 33%), and university or master's study (68, 26%). No significant correlation was found between educational level and self-injection capability (OR=1.11; 95%CI=0.98, 1.27; p=0.104).
Notably, seventy-six patients (29%) possessed EAIs that had been expired for over six months, primarily due to missed appointments and failure to contact the reference clinic. This occurred despite all patients being provided with direct contact information for our allergy centers to facilitate urgent replacements or to reschedule appointments. No statistical significant correlation was found with this data and the correct use of the EAI (OR=0.96; 95% CI=0.53, 1.76; p=0.907).
Forty-two patients (16%) did not have the autoinjector with them at the time of the visit, having left it at home, at work or in the car. Within this subgroup, only 8 patients (19%) demonstrated correct self-administration technique. Conversely, a statistically significant factor in determining correct EAI use was device availability during the visit (OR=3.15; 95% CI=1.33, 7.45; p=0.009): 91% of those who passed the practical test had their device with them, whereas 20% of those who failed did not have their EAI available.
The mean duration for adrenaline prescription was 4.80 years (± 5.73 DS), rising slightly among those who used it correctly. However, no statistically significant correlation was found between the duration of EAI dispensing (inclusive of annual procedure reviews) and administration ability (OR=1.01; 95% CI=0.96, 1.05; p=0.800) instead. Although the exact number of prior retraining sessions for each patient is not available, their administration technique is reassessed every time their epinephrine auto-injector expires (typically every 10 to 14 months).
A total of 345 errors were recorded among the 166 patients, as just over half of the cohort (52%) committed both types of errors.
Type 1 errors, which allow for a "margin of recovery," were the most frequent, accounting for 55% of all mistakes. The most common error in this category was the failure to remove the safety cap (n=117; 34%). Conversely, type 2 errors, which result in an irreparable loss of the medication, occurred with a frequency of 45%, leading to a theoretical waste of 65% of all EAIs. These predominantly included the premature removal of the device from the injection site before the 10-second mark (n=82; 24%) and improper device orientation or an upside-down grip (n=47; 14%), which carries the risk of accidental finger injection or dose dispersion. Finally, only 10.3% of patients consulted the provided instructional documentation; notably, these individuals successfully performed the auto-injection after review, despite their initial forgetfulness (Table II).
Tweny-four patients (9%) experienced a new anaphylactic event since their initial diagnosis, but no statistical significant correlation was found with the correct use of the EAI (OR=2.64; 95% CI=0.68, 10.19; p=0.160). Of these, 15 (62% of the 24 patients) performed the procedure correctly during the follow-up visit, but only 6 (25% of the 24 patients) performed it in an emergency setting. Among those who failed to self-administer during an episode (n=14, 58% of the 24 patients), the primary barriers were a failure to recognize the severity of the reaction (50%), device unavailability (36%), and needle phobia (14%) (Table III).
Of the patients who made mistakes with the training device during the reevaluation, 3 patients had performed the procedure correctly during the anaphylaxis event, 1 patient used the EAI incorrectly, while the remaining 5 did not even make an attempt.

DISCUSSION AND CONCLUSIONS

The results of our study lead to several critical reflections.
Given that all participants in our study had a history of anaphylaxis and over half (132, 51%) had been prescribed an EAI for at least five years, one would expect high proficiency. Furthermore,

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considering that every patient receives a replacement device during a follow-up visit, which includes a mandatory practical demonstration using a trainer, the data revealed in this study are particularly concerning, in fact only a third of patients are autonomous in the self-administration procedure.
The fact that these examinations occurred in a calm, clinical environment suggests that true patient autonomy during an emergency is likely overestimated.
This is supported by our findings: even within the successful subgroup, 60% (9 out of 15) failed to administer adrenaline during a real emergency due to symptom misidentification, device unavailability, or belonephobia. These results confirm a troubling global underuse of EAIs, which stands in contrast to clinical evidence. While prompt administration significantly reduces hospitalizations and costs (22), delays remain critically associated with biphasic reactions, severe outcomes, and mortality (23,24).

Already in 2015, Ridolo et al. identified significant challenges within the Italian population, reporting that only 39% of patients used their EAI correctly. Their study also noted a frequent device unavailability (18% did not carry the EAI with them) and an inability to recognize clinical indications for use (25). Our current findings suggest a further decline in efficiency, with the proportion of autonomous patients dropping to just 24%.

Errors identified during the practical assessment were categorized based on their consequences. Type 1 errors, which allow for a "margin of recovery", were the most frequent, accounting for 55% of all mistakes but allowing the patient to restart the procedure. Conversely, type 2 errors, resulting in an irreparable loss of the medication, occurred with alarming frequency (45%), resulting in a theoretical waste of 65% of EAIs. Because these errors leave no room for correction, they underscore the ongoing debate regarding the necessity of prescribing two autoinjectors per patient.

The 2021 EAACI guidelines (4) support the prescription of two EAIs, emphasizing that a second dose should be administered if symptoms persist or worsen after 5 to 10 minutes. This recommendation aims to ensure optimal patient protection, a vital standard of care. Accordingly, these guidelines advocate for the dual-injector approach, aligning with European Medicines Agency (EMA) standards. Although approximately 90% of anaphylactic episodes resolve with a single dose, the remaining 10% represent a life-threatening and refractory scenario (26,27). Perhaps this strategy should be reserved for high-risk patients with a confirmed history of anaphylaxis (28,29) but on the other side it's not possible to predict which patients will experience such severe reaction (1,10). Therefore, the universal provision of a second device acts as an indispensable safety net, especially when medical assistance may be delayed (e.g., travel or remote locations).
Even though we agree with the EAACI guidelines as the best option for patient's protection, the number of auto-injectors available for each patient is still an open area of discussion. Balancing these clinical pros with real-world cons, our data highlight a critical barrier: the theoretical benefit of a second injector is frequently undermined by the underuse or misuse of the first. Both in our cohort and the literature (30), a significant percentage of patients (34%-50%) fail to administer the initial dose due to device unavailability, symptom misidentification, or fear-induced hesitation. This latency negates the benefits of timely intervention. Therefore, while dual EAI prescription remains the indisputable gold standard, its ultimate efficacy is severely limited, particularly in patients prone to type 2 errors. The needle-free adrenaline nasal spray Neffy® promises to overcome needle phobia, though its widespread adoption and ultimate impact on compliance remain to be seen (31-32).
Equally concerning is the frequency with which patients are found without their devices. In our cohort, 42 patients (16%) did not have their EAI in their possession; even for those capable in its use, the lack of availability entirely negates any potential clinical advantage. This aligns with data from the European Anaphylaxis Registry, which identifies EAI unavailability as the cause of 22.4% of all administration failures (33). Similarly, a survey in Saudi Arabia underscores these critical gaps, reporting that only 17.4% of patients consistently carry their EAI, with a majority remaining unaware

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of adrenaline's life-saving priority, the correct injection site, and the necessity of allergen avoidance (34).

Contrary to expectations, our analysis didn't reveal any statistical significant differences in self-administration ability based on gender, educational level, or the specific type of device owned (Chenpen® VS Jext®/Fastjekt®). These findings align with existing literature, which consistently demonstrates a success rate exceeding 90% only when audio-prompt devices are used (10,12,15,35,36). This suggests that while the procedure is fundamentally simple, it requires the effective memorization of physical "automatisms"/muscle memory, which is independent of a patient's general cognitive skills.

No significant error rates are observed among the pediatric subgroup (caregivers), as half of these patients were able to use the device. Even though the sample is quite small, these findings are consistent with the literature, with Umasunthar et al. reporting that fewer than 50% demonstrate true competence. This lack of preparation likely extends to school environments, where errors in removing safety devices and timing the injection are common (36). Even the adolescents appear to struggle with autonomous use. In our study, only 19% were proficient compared to 81% who were unable to use the device correctly. Again the subgroup isn't quite numerous, but a hypothesis could be attributed to a continued reliance on caregivers and the heightened personal insecurity typical of this developmental stage.

Current guidelines and research by Topal et al. which identifies regular follow-ups and a history of severe reactions as critical drivers of patients' competence. Similarly, as evidenced by our results, the only influential factor for successful EAI administration was whether the patient actually carried the device to their appointment. Even if it's not statistically significant in our study, we think that both clinical reinforcement and lived experience could be relevant for the preservation of life-saving skills, as other authors report (37-39).

The literature also highlights significant training gaps among health care workers (39,40), which require the urgent implementation of specific training and counseling skills. The responsibility of the prescription also remains controversial (27,41-43): although required at discharge from emergency departments for anaphylaxis from food or hymenoptera sting, under-prescription is frequent in this setting (29,36,44,45). The present study, based on patients in follow-up, does not provide data on this aspect.

The failure to identify systemic symptoms often leads patients to resort to antihistamines or hesitate during a crisis. Consistent with our findings, the study by Glassberg et al. on pediatric caregivers demonstrates that EAI underutilization is primarily driven by a failure to assess symptom severity, emotional distress, and a preference for alternative treatments, such as antihistamines (46).

Although a "watch and wait" strategy may be feasible in a hospital under medical supervision, it is controversial in a community setting. At the same time, recommending adrenaline administration for every minor allergic symptom may obscure the gravity of truly lethal signs and doesn't do much to overcome the pervasive hesitation toward using an EAI (47,48).

Despite the correct use during retraining, 10% failed to administer epinephrine during an actual prior anaphylactic episode, while 3% was able to do so. This discrepancy between demonstrated competence and real-world application may be explained by fear, anxiety, or a failure to recognize the severity of anaphylaxis symptoms. Notably, within our cohort, belonephobia was identified as a major barrier to self-administration, accounting for 14% of the failures. As recommended by the EAACI 2021 guidelines (4), these findings highlight the critical need to develop targeted interventions (e.g. dedicated psychological counseling or peer support groups) to address these psychological barriers, which will be a topic we are going to focus for the future.

Educational efforts must prioritize the early recognition of "red flag" symptoms (Table IV) and the implementation of personalized, written emergency action plans. These plans should account for specific triggers, the patient's anaphylactic history, and relevant comorbidities, such as asthma (3,4,8,12). Regarding training methodologies, "face to face" sessions remain the most used approach

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for enhancing awareness among patients and caregivers, but it's not enough to help patients in accepting and managing correctly adrenaline auto-injectors. In contrast, there is currently limited evidence regarding the efficacy of digital tools, simulations, dedicated hotlines, or the impact of specific school and workplace regulations (49). The scientific community should explore alternative or supplementary training modalities for patients, that not only focus on practical skills but also integrate the psychological aspects of the patient's anaphylactic experience.

In conclusion, fortunately, data from large cohort studies and patient registries suggest that approximately 80% of anaphylactic episodes resolve spontaneously without epinephrine intervention (16,50).

However, our case series reveals a significant gap between device availability and patient competence. Although 216 patients possessed EAIs at the time of renewal, only 39% of previously trained individuals were able to correctly perform the administration procedure in an outpatient setting (regardless of having the device with them in real life). These errors often result in the irretrievable loss of the medication dose.

Notably, factors such as gender, age, education level, the specific trigger for the initial prescription, years of prescription, device type, validity and number, and the occurrence of new anaphylactic episodes showed no statistical significance.

Furthermore, among those who have proven to be competent in self-administration, only roughly 50% used the device in a subsequent reaction. This underscores the need for enhanced training models involving healthcare professionals, with communication and counseling experts to improve patient motivation.

Our data confirm that underutilization and misuse of EAIs are widespread and persistent problems. Even now persistent educational path with "face to face" training and written action plan, to be repeated at each check-up, is not enough to help patients in a routinary outpatient setting and managing correctly adrenaline autoinjectors. The scientific community should think of additional or different types of training, maybe considering also the psychological aspects of patients' anaphylactic experience.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

CONTRIBUTIONS

GM, CDP, PM, AV, MC, MKG: conceptualization. AV, MKG, PM: data curation. AV, MKG: formal analysis. GM, CDP, PM, AV, MC, MKG: investigation. AV, CDP: methodology. GM, MKG: project administration. MC, PM: resources. AV, MKG: software. GM, PM: supervision. MC, CDP: validation. AV, MKG: visualization. GM, CDP, PM, AV, MC, MKG: writing – original draft. GM, CDP, PM, AV, MC, MKG: writing – review & editing

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TABLE I. Difference of characteristics between correct and incorrect self administration of EAI during the re-training

Characteristic	**Correct procedure (n=92)**	**Incorrect procedure (n=166)**
Female sex	37 (40%)	83 (50%)
Age	38.8 ± 18.8	42. 5 ± 20.4
Adults (≥ 18 y.o.)	86 (93%)	150(90%)
Adolescents (11-17 y.o.)	3 (3%)	13 (8%)
Children (<11y.o.)	3 (3%)	3 (3%)
Education		
Primary school non completed	3 (3%)	8(5%)
Primary school	9 (10%)	15(9%)
Middle school	21 (23%)	48(29%)
High school	34 (36%)	52(31%)
University/Master degree	25 (27%)	43(26%)
Indication		
Food allergy	61 (66%)	101 (61%)
Hymenoptera allergy	25 (27%)	54 (33%)
Idiopathic anaphylaxis	0 (0%)	4 (2%)
Systemic mastocytosis	6 (7%)	7 (4%)
Device		
Chenpen®	57 (62%)	99 (60%)
Fastjekt® or Jext®	35 (38%)	67 (40%)
One device	84 (91%)	151 (91%)
Two devices	8 (9%)	15 (9%)
Duration of EAI prescription (years ± DS)	6.15 ± 5.75	4.06 ± 5.71
Availability during the examination		

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Available	84 (91%)	132 (80%)
Unavailable	8 (9%)	34 (20%)
Device validity		
Valid	66 (72%)	116 (70%)
Expired	26 (28%)	50 (30%)
Anaphylactic reaction after previous dispensing		
Self-administered	6 (7%)	4 (2%)
Not administered	9 (10%)	5 (3%)
Self-administrered without necessity	0 (0%)	1 (1%)

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TABLE II. Epinephrine self-administration errors.

Errors	Events (n=345)	Patients (166)
TYPE 1 ERRORS	190 (55%)	58 (35%)
Safe not removed	117 (34%)	
More than 1 minute to administrate	27 (8%)	
Button not pressed (Chenpen)	20 (6%)	
Device not pressed (Fastjekt, Jext)	16 (5%)	
Had to read instruction to administrate	10 (3%)	
TYPE 2 ERRORS	155 (45%)	**29 (17%)**
Removed before 10 seconds	82 (24%)	
Inverted device orientation	47 (14%)	
Wrong injection site	26 (8%)	
BOTH		**79 (48%)**
EAIs wasted		**108 (65%)**

Type 1 errors: wich allow for a "margin of recovery"; Type 2 errors: resulting in an irrepalable loss of the medicaion

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TABLE III. Motivation for not self-administration

Motivation	Events (n=14)
Not recognized necessity	7 (50%)
Device not available	5 (36%)
Belonephobia	2 (14%)

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TABLE IV.
Clinical criteria for diagnosis of anaphylaxis according to EAACI 2021 (4)

Anaphylaxis is highly likely when any one of the following three criteria is fulfilled
• **1.Acute onset of an illness (minutes to several hours) with involvement of the skin, mucosal tissue or both (eg generalized hives, pruritus or flushing, swollen lips–tongue–uvula AND AT LEAST ONE OF THE FOLLOWING**: • a.Respiratory compromise (eg dyspnoea, wheeze–bronchospasm, stridor, reduced PEF and hypoxemia) • b.Reduced BP or associated symptoms of end-organ dysfunction (eg hypotonia [collapse], syncope, incontinence)
• **2.Two or more of the following that occur rapidly after exposure to a likely allergen for that patient (minutes to several hours):** • a.Involvement of the skin–mucosal tissue (eg generalized hives, itch-flush, swollen lips–tongue–uvula • b.Respiratory compromise (eg dyspnoea, wheeze–bronchospasm, stridor, reduced PEF, hypoxemia) • c.Reduced BP or associated symptoms (eg hypotonia [collapse], syncope, incontinence) • d.Persistent gastrointestinal symptoms (eg crampy abdominal pain, vomiting)
• **3.Reduced BP after exposure to known allergen for that patient (minutes to several hours):** • a.Infants and children: low systolic BP (age specific) or >30% decrease in systolic BP* • b.Adults: systolic BP of <90 mmHg or >30% decrease from that person's baseline
PEF, peak expiratory flow; BP, blood pressure. *Low systolic blood pressure for children is defined as <70 mmHg from 1 month to 1 year, less than (70 mmHg + [2 × age]) from 1 to 10 years and <90 mmHg from 11 to 17 years.

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