Original Article

ANATOLIAN CURRENT MEDICAL

DOI: 10.38053/acmj.1883497

Anatolian Curr Med J. 2026;8(2):351-357

Knowledge level of anaphylaxis management and epinephrine use among health professionals: a cross-sectional evaluation of audiologists

Fatih Kaplan*[1], Bilge Kurnaz Kaplan[2], Abdulgani Gülyüz[3]

[1]*Department of Pediatric Allergy and Immunology, Malatya Training and Research Hospital, Malatya, Turkiye*
[2]*Department of Otorhinolaryngology-Head and Neck Surgery, Malatya Training and Research Hospital, Malatya, Turkiye*
[3]*Department of Pediatrics, Faculty of Medicine, Malatya Turgut Özal University, Malatya, Turkiye*

Cite this article as: Kaplan F, Kurnaz Kaplan B, Gülyüz A. Knowledge level of anaphylaxis management and epinephrine use among health professionals: a cross-sectional evaluation of audiologists. *Anatolian Curr Med J.* 2026;8(2):351-357.

Received: 06.02.2026 ◆ **Accepted**: 02.03.2026 ◆ **Published**: 10.03.2026

ABSTRACT

Aims: Anaphylaxis is a severe systemic hypersensitivity reaction with sudden onset and rapid progression that can be fatal if early intramuscular epinephrine is not administered. Although audiologists frequently work with pediatric and allergic patient populations, their competence in recognizing and managing anaphylaxis has not been systematically evaluated. The aim of this study was to assess audiologists' knowledge levels regarding anaphylaxis, to identify critical life-saving knowledge gaps, and to determine independent predictors of correct epinephrine and auto-injector use.

Methods: In this cross-sectional study, 189 audiologists completed a 22-item knowledge questionnaire covering the definition of anaphylaxis, triggers, clinical manifestations, first-line treatment, epinephrine administration route and dose, and auto-injector use. A total knowledge score (range: 0-22) was calculated. Three critical outcomes were analyzed separately: knowledge that epinephrine is the first-line treatment for anaphylaxis, knowledge that epinephrine should be administered intramuscularly, and knowledge of the correct epinephrine dose (0.01 mg/kg). Independent predictors were evaluated using multivariable logistic regression analysis.

Results: The median total knowledge score was 12 (range: 1-22), and the internal consistency of the questionnaire was good (Cronbach's α=0.793). Only 50.8% of participants correctly identified epinephrine as the first-line treatment for anaphylaxis, 34.4% knew that epinephrine should be administered intramuscularly, and 42.9% knew the correct epinephrine dose. Awareness of epinephrine auto-injectors was identified as the strongest independent predictor of correct dose knowledge (adjusted odds ratio [aOR] 4.28; 95% CI 1.94-9.46; p<0.001). Professional experience significantly predicted knowledge of intramuscular administration (aOR 1.07; p=0.008).

Conclusion: Although overall knowledge of anaphylaxis among audiologists was moderate, only 50.8% identified epinephrine as first-line treatment, 34.4% knew the intramuscular route, and 42.9% knew the correct dose. Awareness of auto-injectors was strongly associated with correct dose knowledge (aOR 4.28). These findings highlight critical gaps in life-saving knowledge and the need for targeted training programs.

Keywords: Anaphylaxis, audiologists, epinephrine, epinephrine auto-injector, emergency management, health professional education

INTRODUCTION

Anaphylaxis is a severe systemic hypersensitivity reaction involving multiple organ systems, characterized by sudden onset and rapid progression, and it can be fatal if not treated appropriately.[1] This condition typically presents with simultaneous involvement of the skin, respiratory, gastrointestinal, and cardiovascular systems and may occur in unpredictable clinical settings, particularly among children and individuals with allergic diseases.[2] Current international guidelines clearly emphasize that intramuscular epinephrine is the first and indispensable treatment for anaphylaxis, while antihistamines and corticosteroids are recommended only as adjunctive therapies.[3-5]

Despite these clear recommendations, numerous studies based on real-life data and conducted among healthcare professionals have demonstrated persistent and substantial knowledge gaps in the recognition of anaphylaxis, particularly regarding the appropriate route and dose of epinephrine administration.[6] Even in studies involving physicians, nurses, and emergency medical personnel, the proportion of participants who correctly identify intramuscular administration and the

***Corresponding Author:** Fatih Kaplan, drfthkpln@gmail.com

This work is licensed under a Creative Commons Attribution 4.0 International License.

appropriate epinephrine dose remains below expected levels.[7,8] These deficiencies pose a direct threat to patient safety by increasing the risk of delayed or incorrect intervention in an emergency condition where time is critical.[9]

Audiologists are healthcare professionals who frequently work with patient groups at potential risk for anaphylaxis, including pediatric patients, individuals with allergic rhinitis or asthma, and children with cochlear implants.[10] During clinical practice, exposure to medications, latex, vaccines, or environmental allergens may occur, and although rare, acute allergic reactions can develop during hearing assessments, vestibular evaluations, or rehabilitation sessions.[11] Nevertheless, the existing literature is largely lacking in studies that systematically evaluate audiologists' knowledge and preparedness regarding anaphylaxis management.

This knowledge gap affects not only individual clinical safety but also the continuity of multidisciplinary patient care. The ability of audiologists to recognize anaphylaxis at an early stage, administer epinephrine at the correct dose and via the appropriate route, and effectively use epinephrine auto-injectors is of vital importance, particularly in out-of-hospital settings or environments with limited immediate medical support.

The aim of this study was to evaluate audiologists' overall knowledge levels regarding anaphylaxis and critical life-saving knowledge domains, as well as to identify independent predictors associated with correct epinephrine and auto-injector knowledge. In this context, the findings of the present study aim to highlight the importance of emergency preparedness among non-physician healthcare professionals in terms of patient safety and to provide a scientific basis for the development of profession-specific, targeted, and effective educational strategies. We hypothesized that awareness of epinephrine auto-injectors and professional experience would be independently associated with correct life-saving anaphylaxis knowledge among audiologists.

METHODS

Ethics

This study was approved by the Institutional Clinical Researches Ethics Committee of Malatya Turgut Özal University (Date: 22.01.2025, Decision No: 2026-32). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Participants

This study was designed as a cross-sectional, descriptive, and analytical investigation aimed at evaluating audiologists' knowledge levels regarding anaphylaxis and their awareness of epinephrine auto-injectors.[12] Audiologists actively working in clinical, rehabilitative, or diagnostic audiology settings were eligible for inclusion. The questionnaire was administered online, and participation was based on voluntary consent. Questionnaires with incomplete or inconsistent responses were excluded from the analysis. The final analysis was conducted using complete data obtained from 189 participants.

Data Collection Instrument

Data were collected using a structured questionnaire developed by the researchers based on key clinical domains of anaphylaxis management recommended in the literature.[13] The questionnaire consisted of three main sections:

Sociodemographic and Professional Characteristics

This section collected information on participants' age, sex, duration of professional experience, previous encounter with a patient who developed anaphylaxis, and awareness of epinephrine auto-injectors.

The questionnaire items were developed based on current international guidelines and previously published studies on anaphylaxis knowledge among healthcare professionals. Content validity was assessed through expert review by specialists in allergy and emergency medicine to ensure clinical relevance and clarity. Formal pilot testing was not conducted.

Anaphylaxis Knowledge Items

Anaphylaxis knowledge was assessed using 22 dichotomous (true/false) items. These items covered the following domains:

- Definition of anaphylaxis
- Triggering factors (foods, medications, insect stings, exercise, hormones, enzymes, and idiopathic causes)
- Clinical manifestations (cutaneous, respiratory, gastrointestinal, cardiovascular, and neurological systems)
- First-line treatment
- Route of epinephrine administration
- Epinephrine dose
- Injection site for epinephrine auto-injectors

Each correct response was scored as 1 point, while incorrect or "do not know" responses were scored as 0 points. Accordingly, the total anaphylaxis knowledge score ranged from 0 to 22, with higher scores indicating better knowledge levels.

Auto-Injector Awareness

Awareness of epinephrine auto-injectors was assessed using the question "Do you know about epinephrine auto-injectors?" This variable was analyzed independently from the total knowledge score.

Outcome Measures

The primary outcome measure was the total anaphylaxis knowledge score (range: 0-22). Secondary outcomes were defined as three critical knowledge domains essential for life-saving anaphylaxis management:

- Knowledge that epinephrine is the first-line treatment for anaphylaxis
- Knowledge that epinephrine should be administered intramuscularly
- Knowledge of the correct epinephrine dose (0.01 mg/kg)

These outcomes were coded as binary variables (correct/incorrect), and their independent predictors were analyzed separately.

Reliability of the Questionnaire

The internal consistency of the knowledge questionnaire was evaluated using Cronbach's alpha coefficient. The alpha value obtained from the 22-item scale was 0.793, indicating good reliability.

Statistical Analysis

Analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean±standard deviation or median (minimum-maximum), while categorical variables were expressed as numbers and percentages. The distribution of the total knowledge score was assessed using the Shapiro–Wilk test and was found to be non-normally distributed; therefore, non-parametric methods were applied.

Comparisons of knowledge scores according to sex, auto-injector awareness, and prior encounter with anaphylaxis were performed using the Mann-Whitney U test. The relationship between professional experience duration and knowledge score was evaluated using Spearman's correlation coefficient.

For secondary outcomes (first-line treatment, route of administration, and dose knowledge), univariate analyses were initially conducted. Subsequently, multivariable logistic regression analyses were performed by including professional experience duration, sex, auto-injector awareness, and prior encounter with anaphylaxis in the models. Results were reported as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). A two-sided p value <0.05 was considered statistically significant.

RESULTS

A total of 189 audiologists were included in the study. The mean age of the participants was 27.33±6.34 years. Of the participants, 71.4% (n=135) were female and 28.6% (n=54) were male. The median duration of professional experience was 2 years (IQR: 1-7). While 14.8% (n=28) of the participants reported having previously encountered a patient who developed anaphylaxis, only 20.6% (n=39) stated that they were aware of epinephrine auto-injectors (Table 1).

Table 1. Demographic and professional characteristics of the participants (n=189)

Variable	Value
Age (years), mean±SD	27.33±6.34
Female, n (%)	135 (71.4)
Male, n (%)	54 (28.6)
Professional experience (years), median (IQR)	2 (1-7)
Previous encounter with anaphylaxis, n (%)	28 (14.8)
Awareness of epinephrine auto-injector, n (%)	39 (20.6)

Continuous variables are presented as mean±standard deviation or median (interquartile range, IQR), and categorical variables are presented as number and percentage, SD: Standard deviation, IQR: Interquartile range

The total anaphylaxis knowledge score derived from the 22-item questionnaire ranged from 0 to 22. The median knowledge score was 12 (minimum-maximum: 1-22), and the mean score was 11.68±4.59. The internal consistency of the scale was good, with a Cronbach's alpha coefficient of 0.793 (Table 2).

Table 2. Descriptive statistics of audiologists' anaphylaxis knowledge scores

Measure	Value
Score range	0-22
Mean±SD	11.68±4.59
Median (minimum–maximum)	12 (1-22)
Cronbach's alpha	0.793

Total scores range from 0 to 22, with higher scores indicating better knowledge of anaphylaxis. Cronbach's alpha reflects the internal consistency of the scale, SD: Standard deviation

Only 44.4% of the participants correctly identified anaphylaxis as a life-threatening systemic reaction. Among triggering factors, insect stings (83.1%) and foods (58.7%) were the most commonly recognized causes, whereas exercise-induced anaphylaxis (28.0%) and idiopathic anaphylaxis (32.8%) were the least recognized.

Regarding clinical manifestations, cutaneous symptoms were the most frequently identified (75.7%), while recognition rates for gastrointestinal (50.8%) and respiratory (55.6%) symptoms were lower (Table 3).

Table 3. Correct response rates for anaphylaxis knowledge items

Item	Correct, n (%)
Anaphylaxis is a life-threatening systemic reaction	84 (44.4)
Foods can cause anaphylaxis	111 (58.7)
Medications can cause anaphylaxis	114 (60.3)
Insect stings can cause anaphylaxis	157 (83.1)
Exercise can cause anaphylaxis	53 (28.0)
Immunotherapy vaccines can cause anaphylaxis	105 (55.6)
Latex can cause anaphylaxis	102 (54.0)
Hormones can cause anaphylaxis	95 (50.3)
Enzymes can cause anaphylaxis	89 (47.1)
Idiopathic anaphylaxis may occur	62 (32.8)
Cutaneous manifestations occur	143 (75.7)
Respiratory manifestations occur	105 (55.6)
Gastrointestinal manifestations occur	96 (50.8)
Cardiovascular manifestations occur	115 (60.8)
Neurological manifestations occur	119 (63.0)
Other manifestations (sweating, incontinence, death)	111 (58.7)
Epinephrine is the first-line treatment in anaphylaxis	96 (50.8)
Antihistamines are not first-line treatment	108 (57.1)
Steroids are not first-line treatment	129 (68.3)
Epinephrine should be administered intramuscularly	65 (34.4)
Correct epinephrine dose is 0.01 mg/kg	81 (42.9)
Correct injection site for auto-injector is the thigh	72 (38.1)

Bolded items represent critical life-saving knowledge domains in anaphylaxis management (first-line treatment, route of administration, dose, and auto-injector injection site)

Marked knowledge deficiencies were identified in life-saving aspects of anaphylaxis management. Only 50.8% of participants knew that epinephrine is the first-line treatment

for anaphylaxis, 34.4% correctly identified the intramuscular route of epinephrine administration, and 42.9% knew the correct epinephrine dose of 0.01 mg/kg (Table 3). The proportion of participants who correctly identified the appropriate injection site for epinephrine auto-injectors was 38.1% (**Table 3**).

Audiologists who were aware of epinephrine auto-injectors had significantly higher total knowledge scores compared with those who were not aware (median 14 vs. 11.5; p=0.0037). A moderate positive correlation was observed between professional experience duration and total knowledge score (Spearman's ρ=0.55; p<0.001). Sex and prior encounter with anaphylaxis were not significantly associated with total knowledge scores (**Table 4**).

Table 4. Comparison of total anaphylaxis knowledge scores according to participant characteristics

Variable	Median (IQR)	p value
Female	12 (9-15)	
Male	11 (8-14)	0.064
Aware of auto-injector	14 (11-16.5)	
Not aware of auto-injector	11.5 (8-14)	0.0037
Encountered anaphylaxis	12 (7.75-15)	
Not encountered anaphylaxis	12 (8-15)	0.712

Data are presented as median (IQR). Groups were compared using the Mann–Whitney U test, IQR: Interquartile range

Awareness of epinephrine auto-injectors was identified as the strongest independent predictor of correct knowledge of epinephrine dosing (aOR 4.28; 95% CI 1.94-9.46; p<0.001). In addition, participants who were aware of auto-injectors were more likely to correctly identify epinephrine as the first-line treatment for anaphylaxis (aOR 2.30; p=0.034).

Participants who were aware of epinephrine auto-injectors demonstrated significantly higher rates of correct knowledge across multiple critical domains of anaphylaxis management, including identification of epinephrine as the first-line treatment, correct epinephrine dosing, and appropriate use of auto-injectors, compared with those who were not aware (**Table 5**). In contrast, no significant differences were observed between the groups regarding recognition of gastrointestinal symptoms or prior exposure to anaphylaxis

Professional experience duration independently predicted correct knowledge of intramuscular epinephrine administration (aOR 1.07; p=0.008), and female sex was also significantly associated with this knowledge domain (aOR 2.27; p=0.034). In contrast, prior encounter with anaphylaxis did not emerge as an independent predictor for any of the critical knowledge domains (**Table 6**).

Table 5. Association between epinephrine auto-injector awareness and critical anaphylaxis knowledge

Critical knowledge (correct)	Aware (%)	Not aware (%)	OR (95% CI)	p
Epinephrine is first-line treatment	66.7	46.7	2.29 (1.09-4.79)	0.041
Correct epinephrine dose	69.2	36.0	4.00 (1.88-8.53)	<0.001
Intramuscular route	35.9	34.0	1.09 (0.52-2.27)	0.974
Correct auto-injector site	48.7	35.3	1.74 (0.85-3.54)	0.178

OR: Odds ratio, CI: Confidence interval. Percentages indicate the proportion of participants within each group who answered correctly

DISCUSSION

In the present study, audiologists were found to have a moderate overall level of knowledge regarding anaphylaxis; however, substantial knowledge gaps were identified in critical life-saving domains.[14] Only half of the participants correctly identified epinephrine as the first-line treatment for anaphylaxis, and fewer than one-third knew that epinephrine should be administered via the intramuscular route.[15] Similarly, knowledge of the correct epinephrine dose and the appropriate injection site for auto-injectors was inadequate.[16] These findings indicate a clinically meaningful risk of delayed or incorrect intervention in an emergency condition such as anaphylaxis, where time-sensitive and accurate management is essential.[17] Recent comprehensive reviews of updated anaphylaxis guidelines consistently emphasize intramuscular epinephrine as the cornerstone of first-line management, highlighting the clinical relevance of these identified knowledge gaps.[18]

Consistent with previous studies involving physicians, nurses, and emergency medical personnel, inadequate knowledge regarding intramuscular epinephrine administration and correct dosing remains a persistent issue, even among healthcare professionals directly responsible for acute care.[19,20] Recent evidence from emergency department settings demonstrates that despite clear guideline recommendations, appropriate management of anaphylaxis-especially timely intramuscular epinephrine administration-remains suboptimal in practice.[21] The present study is distinctive in demonstrating that this knowledge gap is not limited to professions with direct emergency intervention duties but

Table 6. Independent predictors of critical life-saving knowledge domains in anaphylaxis management

Independent variable	First-line epinephrine aOR (95% CI)	p	IM administration aOR (95% CI)	p	Correct dose aOR (95% CI)	p
Professional experience (years)	1.06 (1.00-1.11)	0.045	1.07 (1.02–1.13)	0.008	1.02 (0.97-1.08)	0.410
Female sex	1.53 (0.78-2.99)	0.212	2.27 (1.06–4.84)	0.034	1.46 (0.73-2.93)	0.283
Auto-injector awareness	2.30 (1.06-4.99)	0.034	0.90 (0.41–1.97)	0.796	4.28 (1.94-9.46)	<0.001
Previous anaphylaxis encounter	0.69 (0.29-1.67)	0.412	1.48 (0.60–3.67)	0.394	0.62 (0.25-1.57)	0.311

All models were adjusted for professional experience, sex, awareness of epinephrine auto-injectors, and previous encounter with anaphylaxis. aOR: adjusted odds ratio; CI: confidence interval. Statistical significance was defined as p<0.05

also extends to other healthcare professionals who have face-to-face contact with patients, specifically audiologists.[22,23] However, the knowledge levels observed in audiologists appear to be lower than those reported in studies involving physicians and nurses, likely reflecting differences in emergency training requirements and clinical responsibilities.

One of the most notable findings of this study is that awareness of epinephrine auto-injectors emerged as the strongest independent predictor of correct knowledge regarding epinephrine dosing.[24] The low level of epinephrine auto-injector awareness (20.6%) may reflect gaps in audiology education and training. Audiologists typically receive limited formal instruction in emergency anaphylaxis management and have little exposure to auto-injector devices in routine practice, which may contribute to underrecognition of their importance despite potential risks in clinical settings. The approximately fourfold higher likelihood of correct dose knowledge among audiologists familiar with auto-injectors suggests that familiarity with a practical treatment device may reinforce not only awareness but also pharmacological accuracy.[23-24] This observation supports the notion that anaphylaxis education programs should not be limited to theoretical instruction but should incorporate hands-on, auto-injector-based training components.[24-25] Recent safety reviews further confirm that the benefits of prompt epinephrine administration clearly outweigh potential harms, underscoring the importance of minimizing hesitation and strengthening professional competence in its timely use.[26]

The finding that professional experience independently predicted correct knowledge of intramuscular epinephrine administration suggests that increased clinical exposure and time spent in practice may strengthen competence in this critical knowledge domain.[27] The association between female sex and correct knowledge of intramuscular administration is consistent with similar observations reported in other healthcare professional groups.[28] In contrast, prior encounter with an anaphylaxis case did not independently improve knowledge levels.,[29] indicating that incidental clinical exposure alone may not substitute for structured and systematic educational interventions.[30] Although alternative delivery systems such as intranasal epinephrine formulations are currently being evaluated and discussed in the literature, intramuscular administration remains the recommended first-line approach, further underscoring the need for comprehensive and standardized training in its correct application.[31,32]

Audiologists frequently work in close contact with pediatric patients and individuals with allergic conditions or chronic diseases. During hearing assessments, rehabilitation sessions, and device-related procedures, exposure to medications, latex, or environmental allergens may occur, and the risk of anaphylaxis cannot be entirely eliminated. Therefore, audiologists' ability to recognize anaphylaxis and initiate appropriate first-line management is of critical importance for patient safety. The findings obtained from audiologists in this study may also serve as a reference for other healthcare professionals working with similar patient profiles. In addition, audiological assessments are often performed in enclosed environments such as soundproof booths, which may delay recognition of acute symptoms and access to emergency care. Recent comprehensive updates of anaphylaxis management guidelines further emphasize the importance of standardized emergency protocols and preparedness across diverse healthcare settings, reinforcing the relevance of adequate training for all professionals involved in patient care.[33]

Overall, the results of this study strongly support the need for profession-specific anaphylaxis training programs tailored to audiologists.[34] In particular, structured, auto-injector-based hands-on educational interventions are likely to improve not only awareness but also accurate knowledge of epinephrine dosing and appropriate routes of administration, in alignment with contemporary guideline recommendations and emerging evidence.[30-34]

Strengths and Limitations of the Study

This study is among the first large-sample investigations to focus on anaphylaxis knowledge among audiologists, a professional group that has been rarely examined in the literature. The good internal consistency of the 22-item knowledge questionnaire (Cronbach's α=0.793) supports the reliability of the findings. Moreover, evaluating not only the total knowledge score but also three critical life-saving knowledge domains in anaphylaxis management-first-line treatment, route of administration, and correct dosing-enhances the clinical relevance of the study. Prior formal training in anaphylaxis management was not assessed, which may have influenced participants' knowledge levels.

However, the cross-sectional design of the study does not allow for causal inferences. The use of self-reported data introduces the possibility of social desirability and recall bias. In addition, participants' prior exposure to formal anaphylaxis training was not assessed in detail, which may have limited the interpretation of some associations.

CONCLUSION

This study demonstrated that although audiologists have a moderate overall level of knowledge regarding anaphylaxis, substantial knowledge gaps exist in critical life-saving domains, including epinephrine dosing, route of administration, and the use of epinephrine auto-injectors. Awareness of auto-injectors and duration of professional experience were identified as the factors most strongly associated with correct knowledge. These findings indicate that anaphylaxis management should not be considered solely within the scope of physicians and nurses; rather, structured, profession-specific, and practice-based educational programs are required for all healthcare professionals who have direct contact with patients. Targeted anaphylaxis training programs for audiologists are likely to make a meaningful contribution to improving patient safety. Within this framework, the findings of the present study may contribute to the development of health education policies at the national level.

Incorporating mandatory Basic Life Support and anaphylaxis management certification into audiology training programs may improve preparedness for life-threatening allergic emergencies.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the Institutional Clinical Researches Ethics Committee of Malatya Turgut Özal University (Date: 22.01.2025, Decision No: 2026-32).

Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights-including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

Author Contributions

Concept: FK, BKK, AG; Design: FK, BKK; Supervision: FK, AG; Data Collection and/or Processing: FK, BKK; Analysis and/or Interpretation: BKK, AG; Literature Review: FK, BKK; Writing the Article: FK, AG, BKK; Critical Review: All authors.

REFERENCES

1. Cardona V, Ansotegui IJ, Ebisawa M, et al. World allergy organization anaphylaxis guidance 2020. *World Allergy Organ J*. 2020;13(10):100472. doi:10.1016/j.waojou.2020.100472
2. Muraro A, Worm M, Alviani C, et al. EAACI guidelines: anaphylaxis (2021 update). *Allergy*. 2022;77(2):357-377. doi:10.1111/all.15032
3. Resuscitation Council UK. Emergency treatment of anaphylaxis: guidelines for healthcare providers. London: RCUK; 2021.
4. Golden DBK, Motosue MS, et al. Anaphylaxis: a practice parameter update. *Ann Allergy Asthma Immunol*. 2024;132(2):124-176. doi:10.1016/j.anai.2023.09.015
5. Shaker MS, Wallace DV, Golden DBK, et al. Anaphylaxis-a 2020 practice parameter update, systematic review, and GRADE analysis. *J Allergy Clin Immunol*. 2020;145(4):1082-1123. doi:10.1016/j.jaci.2020.01.017
6. Sampson HA, Muñoz-Furlong A, Campbell RL, et al. Second symposium on the definition and management of anaphylaxis: summary report-Second NIAID/FAAN symposium. *J Allergy Clin Immunol*. 2006; 117(2):391-397. doi:10.1016/j.jaci.2005.12.1303
7. Brown JC, Simons E, Rudders SA. Epinephrine in the management of anaphylaxis. *J Allergy Clin Immunol Pract*. 2020;8(4):1186-1195. doi:10.1016/j.jaip.2019.12.015
8. Dodd A, Hughes A, Sargant N, Whyte AF, Soar J, Turner PJ. Evidence update for the treatment of anaphylaxis. *Resuscitation*. 2021;163:86-96. doi:10.1016/j.resuscitation.2021.04.010
9. Australasian Society of Clinical Immunology and Allergy (ASCIA). Guidelines-acute management of anaphylaxis. ASCIA; 2023.
10. Turner PJ, Gowland MH, Sharma V, et al. Increase in anaphylaxis-related hospitalizations but no increase in fatalities: UK national anaphylaxis data, 1992-2012. *J Allergy Clin Immunol*. 2015;135(4):956-963. doi:10.1016/j.jaci.2014.10.021
11. Baseggio Conrado A, Ierodiakonou D, Gowland MH, Boyle RJ, Turner PJ. Food anaphylaxis in the United Kingdom: analysis of national data, 1998-2018. *BMJ*. 2021;372:n251. doi:10.1136/bmj.n251
12. Whyte AF, Soar J, Dodd A, Hughes A, Sargant N, Turner PJ. Emergency treatment of anaphylaxis: concise clinical guidance. *Clin Med (Lond)*. 2022;22(4):332-339. doi:10.7861/clinmed.2022-0073
13. Leung ASY, Tham EH, Pacharn P, et al. Disparities in pediatric anaphylaxis triggers and management across Asia. *Allergy*. 2024;79(5):1317-1328. doi:10.1111/all.16098
14. Grabenhenrich LB, Dölle S, Moneret-Vautrin A, et al. Anaphylaxis in children and adolescents: the European Anaphylaxis Registry. *J Allergy Clin Immunol*. 2016;137(4):1128-1137.e1. doi:10.1016/j.jaci.2015.11.015
15. Ring J, Beyer K, Biedermann T, et al. Guideline (S2k) on acute therapy and management of anaphylaxis: 2021 update. *Allergo J Int*. 2021;30(1):1-25. doi:10.1007/s40629-020-00158-y
16. Sim M, Sharma V, Li K, et al. Adrenaline auto-injectors for preventing fatal anaphylaxis. *Clin Exp Allergy*. 2025;55(1):19-35. doi:10.1111/cea.14565
17. El Turki A, Smith H, Llewellyn C, Jones CJ. A systematic review of patients', parents', and healthcare professionals' adrenaline auto-injector administration techniques. *Emerg Med J*. 2017;34(6):403-416. doi:10.1136/emermed-2016-205742
18. Antolín-Amérigo D, Vidal-Albareda C, González de Olano D, de la Hoz-Caballer B. Current update on anaphylaxis: anaphylaxis management in recent guidelines. *Eur Ann Allergy Clin Immunol*. 2024;56(2):51-64. doi:10.23822/EurAnnACI.1764-1489.306
19. Arga M, Topal E, Yılmaz S, Erdemli PC, Bıçakcı K, Bakırtaş A. Healthcare workers' knowledge level regarding anaphylaxis and usage of epinephrine auto-injectors. *Turk J Pediatr*. 2021;63(3):372-383. doi:10.24953/turkjped.2021.03.004
20. Narchi H, Elghoudi A, Al Dhaheri K. Barriers and challenges affecting parents' use of adrenaline auto-injector in children with anaphylaxis. *World J Clin Pediatr*. 2022;11(2):151-159. doi:10.5409/wjcp.v11.i2.151
21. Perot A, Ancion A, Paquay M, Ghuysen A. Management of anaphylaxis in the emergency department: applying recommendations for good clinical practice. *Rev Med Liege*. 2025;80(5-6):339-347.
22. Ehrhard S, Gautschi D, Eyb V, et al. Use of epinephrine in anaphylaxis: a retrospective cohort study at a Swiss university emergency department. *Swiss Med Wkly*. 2023;153:40065. doi:10.57187/smw.2023.40065
23. Resuscitation Council UK. Anaphylaxis: IM adrenaline injection site (anterolateral thigh)-clinical guidance. 2021.
24. World Allergy Organization. Anaphylaxis: diagnosis and treatment (clinical tool). WAO; 2020.
25. Australasian Society of Clinical Immunology and Allergy (ASCIA). Anaphylaxis action plans & acute management resources. ASCIA; 2021.
26. Bernstein DI, Blaiss M, Dellon ES, Rance K. Benefits of epinephrine for anaphylaxis outweigh potential harm-a safety review. *J Allergy Clin Immunol Pract*. 2025;13(12):3188-3194. doi:10.1016/j.jaip.2025.04.018
27. Turner PJ, Campbell DE, Motosue MS, Campbell RL. Global trends in anaphylaxis epidemiology and clinical implications. *J Allergy Clin Immunol Pract*. 2020;8(4):1169-1176. doi:10.1016/j.jaip.2019.11.027
28. Simons FE, Ardusso LRF, Bilò MB, et al. International consensus on (ICON) anaphylaxis. *World Allergy Organ J*. 2014;7(1):9. doi:10.1186/1939-4551-7-9
29. Tanimoto S, Kaliner M, Ellis AK, Lowenthal R. Comparison of the pharmacokinetics between intramuscular and subcutaneous manual epinephrine administration. *Ann Allergy Asthma Immunol*. 2023;130(4):515-516. doi:10.1016/j.anai.2022.12.010
30. Kemp SF, Lockey RF, Simons FER. Epinephrine: the drug of choice for anaphylaxis-A WAO statement. *World Allergy Organ J*. 2008;1(Suppl 7):S18-S26. doi:10.1097/WOX.0b013e31817c9338
31. Bekis Bozkurt H, Pençe İ. Evaluating the use of nasal epinephrine in anaphylaxis: current status. *Turk Arch Pediatr*. 2025;60(6):572-576. doi:10.5152/TurkArchPediatr.2025.25050

32. Crescioli G, Giovannini M, Pessina B, Barni S, Muraro A, Vannacci A, Mori F. Epinephrine nasal spray for the treatment of anaphylaxis: perspectives in pediatrics. *Curr Opin Allergy Clin Immunol*. 2025;25(6): 511-517. doi:10.1097/ACI.0000000000001109
33. Muraro A, Roberts G, Worm M, et al. Anaphylaxis: guidelines from the European Academy of Allergy and Clinical Immunology. *Allergy*. 2014; 69(8):1026-1045. doi:10.1111/all.12437
34. Alataş ET, Alataş ÖD, Acar E. Epinephrine auto-injector use on YouTube: is it really useful? *Eurasian J Emerg Med*. 2019;18(2):68-71. doi: 10.4274/eajem.galenos.2017.36035