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| RESEARCH ARTICLE

From Fear to Preparedness: A Systematic Review of Parents' Awareness and Use of Epinephrine Autoinjectors

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| ABSTRACT

This systematic review aims to synthesize existing literature on parents' knowledge and use of epinephrine autoinjectors (EAIs) and identify factors associated with correct use and barriers to education and training. A comprehensive search was conducted on PubMed and the Directory of Open Access Journals (DOAJ) using keywords and MeSH terms. Inclusion and exclusion criteria were established, and papers were screened for eligibility. Quality assessment was performed using the Joanna Briggs Institute Critical Appraisal tool. A total of 1008 papers were initially identified, with 214 remaining after applying filters. Following screening and quality assessment, seven observational studies were included in the review. The studies found that while most caregivers claimed to carry an EAI on their person and practiced its use at home after training, it was often not used during allergic reactions. The most common reason cited for not using EAI was uncertainty about whether the symptoms were severe enough to warrant EAI use. The lack of EAI use was significantly associated with lower caregiver confidence in using EAI. Those who received EAI during oral food challenges (OFC) and in the community had increased confidence in administering the EAI from pre-OFC to follow-up compared to those who did not receive EAI at all. Targeted interventions and educational strategies should be developed to improve parent knowledge and use of EAIs.

| KEYWORDS

Epinephrine autoinjector, Parental knowledge, Epipen, educational interventions, epinephrine training, allergic reactions

| ARTICLE INFORMATION

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1. Introduction

Anaphylaxis is a severe allergic reaction that may even be fatal and can be triggered by a variety of stimuli, including foods, insect bites or stings, and medications [Reber et al., 2017]. The first-line treatment for anaphylaxis is the use of epinephrine autoinjectors, which are designed for ease of use, even by non-medical persons and those who need to quickly administer care [Muraro et al., 2022].

Research indicates that many people, including children at risk for anaphylaxis, their parents, and their caretakers lack adequate instruction on how to properly administer epinephrine autoinjectors (EAI) when needed. This lack of preparation and unwillingness to use the autoinjectors in time of need was exacerbated by fear of mistakes and not understanding how to properly use the devices [Polloni et al., 2020]. This shows that there may be a significant knowledge gap hindering the effective use of these devices.

The purpose of this systematic review is to fully investigate the scope of this problem, identify factors which may be related to the inappropriate use of the devices, and identify barriers to proper education and training. This knowledge, once obtained, can then be used to develop targeted interventions and educational strategies to improve understanding and use amongst parents and caretakers.

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2. Methodology

This study utilized the guidelines set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 to ensure a comprehensive and transparent review process [Page, 2021].

2.1 Search Strategy and Data Extraction

We used the databases PubMed and Directory of Open Access Journals (DOAJ) to conduct the search for our systematic review. The search was conducted on March 18, 2023, using a combination of keywords and MeSH (Medical Subject Headings) terms outlined in *Table 1*.

Table 1: Combinations of Keywords Used

Keywords used	Database Used	Number before	Number after
"epinephrine" AND "parent"	PubMed	149	12
“epipen” AND “parent”	PubMed	2	0
"epinephrine" AND "knowledge"	PubMed	728	142
“epipen” AND “knowledge”	PubMed	18	2
"epinephrine" AND "parent"	DOAJ	6	6
“epipen” AND “parent”	DOAJ	0	0
"epinephrine" AND "knowledge"	DOAJ	70	44
“epipen” AND “knowledge”	DOAJ	2	2
((((("Parents"[Mesh]) OR "Caregivers"[Mesh])) AND (("Epinephrine"[Mesh]) OR "Autoinjectors"[Mesh])) AND ("Knowledge"[Mesh] OR "Awareness"[Mesh] OR "Education"[Mesh] OR "Training"[Mesh])	PubMed	33	6
		1008	214

2.2 Inclusion and Exclusion Criteria

To select papers for our study, pre-defined inclusion and exclusion criteria were established. For PubMed, papers considered eligible for inclusion had to be peer-reviewed publications in English, published in the last five years (2018-2023), and have the full text available. Similarly, for DOAJ, papers published between 2018-2023 were selected. Any papers that did not meet these criteria were considered gray literature, were literature reviews, did not include the participation of parents/caretakers, or were deemed irrelevant and excluded from the study.

2.3 Results and Findings

Initially, searching relevant databases yielded 1008 published papers that met the criteria. After applying automatic filters, the databases reported 214 published papers. These papers were then imported into EndNote, and 23 duplicates were removed, leaving us with 191 articles. Following a thorough screening of titles, we excluded 173 articles, leaving 18 articles for further screening. Unfortunately, one of the full-text articles was unavailable; thus, only 17 articles underwent abstract and full-text screening. Out of these 17, we excluded one literature review, one paper that did not include parents or caregivers, and then seven observational studies were found to be satisfactory and underwent quality assessment using the Joanna Briggs Institute (JBI) Critical Appraisal tool, as seen in *Table 2*. *Figure 1* illustrates the PRISMA 2020 flow chart of article identification and review stages, demonstrating the systematic approach taken in this study.

2.4 Quality Appraisal

Following the application of the inclusion and exclusion criteria, we identified seven observational studies. These studies underwent quality assessment using the JBI Joanna Briggs Institute Critical Appraisal tool. The quality threshold was set at 80%, and all seven studies met the criteria for inclusion in the review. A detailed breakdown of the quality assessment for each study is provided in *Table 2*. The demographics of participants in the included studies are demonstrated in *Table 3*.

Table 2: Quality Assessment of Observational Studies using the JBI Critical Appraisal Checklist

		[Soller et al., 2018]	[Glassberg et al., 2020]	[Kose et al., 2019]	[Egan et al., 2018]	[Soller et al., 2020]	[Murata et al., 2020]	[Esenboga et al., 2019]
Selection	Were the criteria for inclusion in the sample clearly defined?	✓	✓	✓	✓	✓	✓	✓
	Were the study subjects and the setting described in detail?	✓	✓	✓	✓	✓	✓	✓
	Was the exposure measured validly and reliably?	✓	✓	✓	✓	✓	✓	✓
Comparability	Were objective, standard criteria used for the measurement of the condition?	✓	✓	✓	✓	✓	✓	✓
	Were confounding factors identified?	✓	✓	✓	✓	✓	✓	✓
Exposure	Were strategies to deal with confounding factors stated?	X	X	✓	✓	✓	X	✓
	Were the outcomes measured in a valid way?	✓	✓	✓	✓	✓	✓	✓
	Was appropriate statistical analysis used?	✓	✓	✓	✓	✓	✓	✓
Score (out of 8)		7	7	8	8	8	7	8

Figure 1: PRISMA Flowchart demonstrating the process of article selection
(PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analysis)

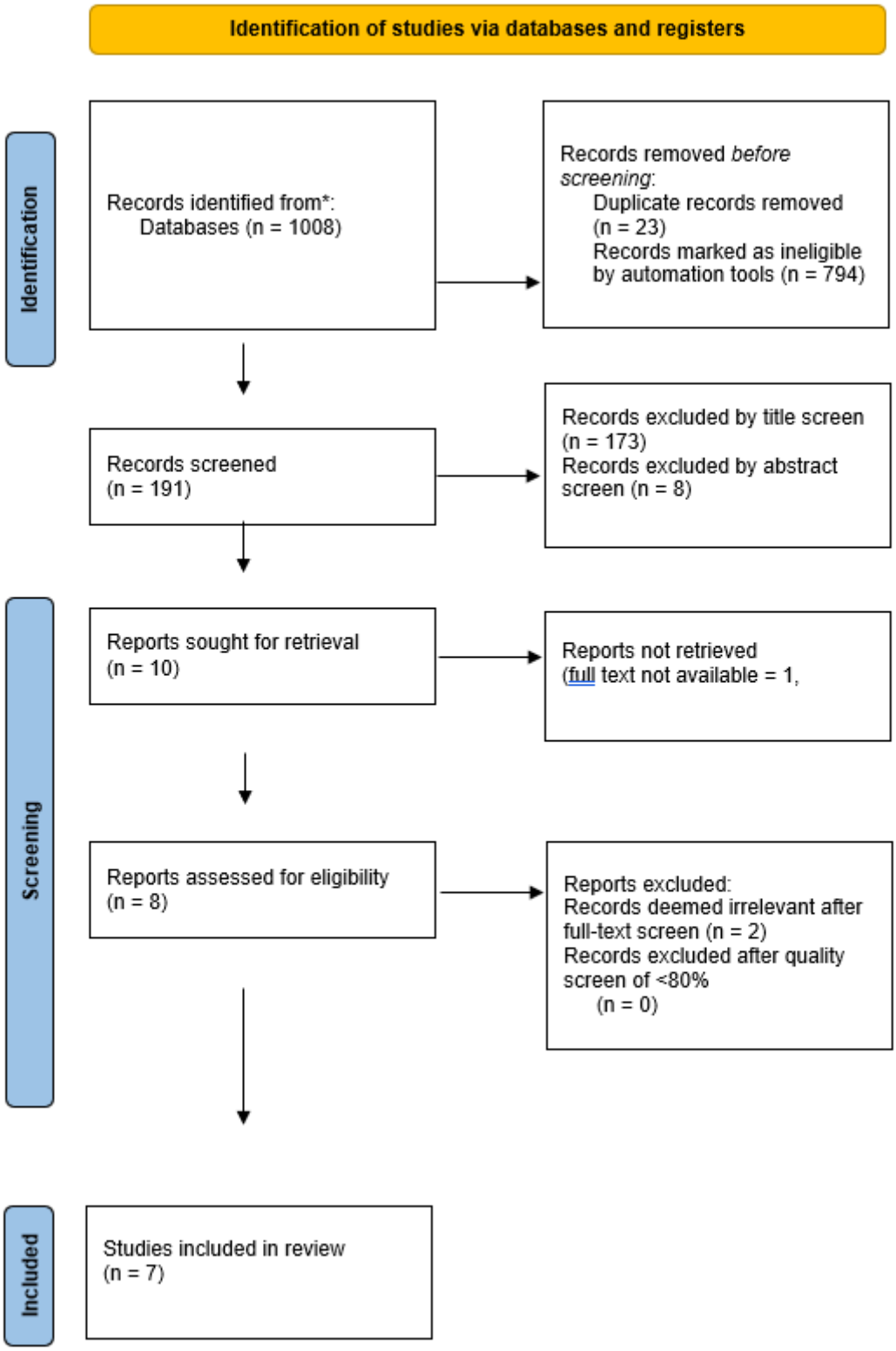

Table 3: Characteristics of Participants in the Included Studies

Study	Participant Characteristics
[Soller et al., 2018]	353 oral food challenges (OFCs) were conducted on children under 18. 317 households consented to the study. The median age of the children was 5 (interquartile range 2-10 years). 62.5% were boys.
[Glassberg et al., 2020]	164 caregivers of food-allergic children who had been prescribed epinephrine autoinjectors were studied. 76.8% were moms, 22.6% were fathers, and the average caregiver age was 40.6. Food allergy sufferers averaged 7.5 years old, and 69.5% were boys.
[Kose et al., 2019]	The study involved Penepin®-prescribed pediatric anaphylaxis caretakers. 21 (35.6%) of the 59 patients were female, and 38 (64.4%) were male. Patients had a median age of 70 months. 53 (89.8%) and 4 (6.8%) patients had food and venom allergies, respectively. Two (3.4%) had idiopathic anaphylaxis. 56 women (94.9%) and three men (5.1%) were caretakers. Caregiver median age was 37 (32–40). 24 months ago, all caregivers were EAI-trained.
[Egan et al., 2018]	The study surveyed English- and Spanish-speaking parents or caregivers of food-allergic children from the Mount Sinai Hospital pediatric allergy clinic between June 2015 and September 2016 who had an allergy follow-up visit and were prescribed an epinephrine autoinjector (EA). In a convenience sample of 102 families, 51% of caregivers had a high likelihood (15%) or potential (35%) poor health literacy.
[Soller et al., 2020]	The British Columbia Children's Hospital conducted oral food challenges with families from 2014 to 2017. Most of the 317 families who participated in 353 oral food challenges had boys (65.4%) with a median age of 6 years.
[Murata et al., 2020]	The study found 854 emergency department interactions between January 1, 2010, and May 31, 2020, with a diagnostic code for anaphylaxis or its related entities. 217 patient encounters from 194 unique patients met the study's inclusion criteria. Most of the patients in the analysis were under 18, whereas the adult group had a mean age of 33.8 years and a standard deviation of 13.7. Epinephrine administration was higher in women than men (32.3% vs. 19.8%, p=0.04).
[Esenboga et al., 2019]	190 pediatric patients with a median age of 7.83 years were studied. Boys made up 64.7% and girls 35.3%. Food allergies accounted for 78.9% of EAI prescriptions. Other indications included venom allergy (14.2%), idiopathic anaphylaxis (3.7%), mastocytosis (2.1%), and medication allergy (1.0%). Moreover, half of the parents were college graduates, with 58.6% of moms and 68.3% of fathers.

3. Discussion

3.1 Prevalence of food allergies and Anaphylaxis in Children

In recent years, there has been an increase in the frequency of food allergies and anaphylaxis among children in the United States. According to a study, 8% of children under the age of 18 have a food allergy [Yu et al., 2016]. According to another study, 40% of people with food allergies have had an allergic reaction that could have been fatal [Yu et al., 2016]. According to Wang et al., the incidence of anaphylaxis in children varies greatly over the world, falling between 1 and 761 per 100,000 person-years for overall anaphylaxis and between 1 and 77 per 100,000 person-years for food-induced anaphylaxis [Wang et al., 2019].

The first-line treatment for anaphylaxis is epinephrine, which is delivered quickly using epinephrine autoinjectors. These autoinjectors have characteristics that encourage safe and effective administration during crises while also being user-friendly and convenient [Greenberger et al., 2017].

3.2 Demographics

The included studies all have various study populations and characteristics. Families who participated in oral food challenges were included in studies by Soller et al. [Soller et al., 2018] [Soller et al., 2020]. The first study comprised children under the age of 18 and their parents, while the latter study involved families of patients whose parents had completed a follow-up survey. Both Glassberg et al. and Egan et al. concentrated on parents or caregivers of children with food allergies who had previously received prescriptions for epinephrine autoinjectors, with Egan et al. also considering a subset of parents with low health literacy [Glassberg et al., 2020] [Egan et al., 2018]. Kose et al. focused primarily on patients with a food or venom allergy, while Esenboga et al. involved parents of young patients diagnosed with anaphylaxis and prescribed an autoinjector [Kose et al., 2019] [Esenboga et al., 2019]. These studies vary in terms of the study populations' ages and genders, the types of allergies and anaphylaxis diagnoses, and the carers' educational backgrounds.

3.3 Parents' Awareness and Use of Epinephrine Autoinjectors

Even when an EAI is recommended, according to Soller et al., it is frequently not utilized during allergic responses [Soller et al., 2018] [Soller et al., 2020]. In contrast to patients who did not receive the EAI at all, [Soller et al., 2020] also discovered that patients who got the EAI during the oral food challenges (OFC) and those who received the EAI in the community had greater confidence in giving the EAI from prior to the OFC to follow-up.

Nearly all caregivers, according to Glassberg et al., said they had previously received training in using the advised EAI [Glassberg et al., 2020]. However, several claimed that they did not apply it when they ought to have, at the child's most extreme reaction.

The reasons offered for not utilizing the EAI included the fact that the reactions did not seem to be severe enough, it was the patient's first allergic reaction, usage of other medications, and fear of using EAI.

While most of the caregivers claimed to always have an EAI on them and to have practiced using one after receiving training at the hospital, Kose et al. observed that only 69.5% of users accurately demonstrated all steps of EAI use [Kose et al., 2019]. Turning the trigger step was shown to be the error that occurred most frequently. The education level of caregivers who could appropriately show the application of EAI was greater, and the interval since the last EAI training was the most important factor influencing proficiency with EAIs.

Egan et al. stated that about half of the carers had a high risk of having inadequate health literacy or the potential for having limited health literacy [Egan et al., 2018]. Each extra step in the use of EAI that was correctly demonstrated was associated with an increase in health literacy, and 30% of severe reactions required the administration of epinephrine.

According to Murata et al., there was evidence of prompt on-scene epinephrine administration by a bystander, patient or parent in 25.3% of the interactions [Murata et al., 2020]. The study did not, however, provide detailed statistics on parental or caregiver knowledge of and utilization of epinephrine autoinjectors.

The majority of parents and caregivers were aware of EAI, but Esenboga et al. discovered that they were unsure of how to use it [Esenboga et al., 2019]. Within the previous five years, anaphylaxis necessitated the use of AAI in one-fourth of patients who were prescribed it. Only 30% of the patients, however, dared to use AAI, and only 75% of them did so correctly. The study also found that parental knowledge of allergies and educational level had a significant impact on the use of EAI.

The research findings generally imply that although many parents and caregivers are aware of EAI, there are gaps in their understanding and confidence in applying it. The use of EAI can be improved, and potentially serious allergic reactions can be avoided by education and training on EAI use, including proper technique and when to use it.

3.4 Solutions to Lack of Parents' Awareness and Use of Epinephrine Autoinjectors

Soller et al. demonstrated that supervised EAI delivery during oral meal challenges can boost parents' and children's confidence in anaphylaxis recognition and use [Soller et al., 2018]. This shows the need to give parents and children supervised EAI practice to boost their confidence, knowledge, and capacity to notice and respond to allergic reactions outside the clinic.

Glassberg et al. indicated that even though most caregivers had received EAI training, a significant number did not use them after severe allergic responses [Glassberg et al., 2020]. The study found that lack of EAI use was linked to knowledge, patient food allergies, and caregiver confidence. The study underscores the need for healthcare practitioners to examine the effectiveness of current techniques for training caregivers on EAI use and consider establishing new tactics to address the identified variables preventing EAI use.

Kose et al. stresses the need for continual EAI training for anaphylactic patient carers [Kose et al., 2019]. Caregivers with greater education and recent EAI training were more likely to apply EAI correctly. The study also indicated that home practice enhanced EAI accuracy. These findings emphasize the necessity for continued education and training for parents and caregivers to properly utilize EAIs and potentially save lives in anaphylactic reactions.

Egan et al. emphasize the relevance of health literacy in food allergy management and preventing harmful reactions in youngsters [Egan et al., 2018]. The study advises providing more accessible and understandable educational materials and hands-on training and knowledge reinforcement to overcome this issue.

Soller et al. support the idea that hands-on EAI training might boost parents' and kids' allergy-recognition and treatment confidence [Soller et al., 2020]. The EAI during an oral meal challenge or in the community improved confidence more than not administering it.

Murata et al. imply that some parents may have been trained to administer epinephrine in anaphylaxis [Murata et al., 2020]. Esenboga et al. emphasize the importance of clinicians in informing parents about EAI use at each clinical visit [Esenboga et al., 2019].

Finally, parents and caregivers need EAI training to recognize and treat allergic reactions. Healthcare practitioners must evaluate their caregiver education practices and propose novel approaches to address the barriers preventing EAI use. Continuous education and training, accessible and clear educational materials, hands-on training, and knowledge reinforcement can assist assure EAI use and prevent adverse responses.

4. Conclusion

This systematic review aimed to investigate the inadequate use of epinephrine autoinjectors (EAI) among parents and caregivers in managing anaphylaxis. The study revealed a significant knowledge gap and barriers to proper education and training. The findings emphasize the need for targeted interventions, continuous education, and accessible materials to improve understanding and confidence in EAI use. The study highlights the importance of addressing these barriers to enhance anaphylaxis management. However, limitations include study heterogeneity. Future research should focus on evaluating the effectiveness of educational interventions and exploring the perspectives of parents and caregivers. By addressing these issues, healthcare practitioners can improve EAI utilization and potentially save lives.

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References

[1] Dretchen, K., Mesa, Z., Robben, M., Slade, D., Hill, S., Croutch, C., … & Mesa, M. (2020). Intranasal Epinephrine In Dogs: Pharmacokinetic and Heart Rate Effects. *Pharmacol Res Perspect, 2*(8). https://doi.org/10.1002/prp2.587

[2] Egan, M., Yin, H. S., Greenhawt, M., & Wang, J. (2019). Low caregiver health literacy among pediatric food-allergic patients is associated with poorer food allergy management knowledge. *The Journal of Allergy and clinical immunology. In practice, 7*(2), 655–658. https://doi.org/10.1016/j.jaip.2018.05.021

[3] Esenboga, S., Ocak, M., Cetinkaya, P. G., Sahiner, U. M., Soyer, O., Buyuktiryaki, B., & Sekerel, B. E. (2020). Physicians prescribe adrenaline autoinjectors; do parents use them when needed? *Allergologia et immunopathologia*, *48*(1), 3–7. https://doi.org/10.1016/j.aller.2019.07.009

[4] Glassberg, B., Nowak-Wegrzyn, A., & Wang, J. (2021). Factors contributing to underuse of epinephrine autoinjectors in pediatric patients with food allergy. *Annals of Allergy, asthma & Immunology: official publication of the American College of Allergy, Asthma, & Immunology*, *126*(2), 175–179.e3. https://doi.org/10.1016/j.anai.2020.09.012

[5] Greenberger, P., Wallace, D., Lieberman, P., Gregory, S. (2017). Contemporary Issues In Anaphylaxis and The Evolution Of Epinephrine Autoinjectors. *Annals of Allergy, Asthma & Immunology*, *4*(119), 333-338. https://doi.org/10.1016/j.anai.2017.07.030

[6] Kose, S., Asilsoy, S., Tezcan, D., Al, S., Atay, O., Kangalli, O., Uzuner, N., & Karaman, O. (2020). Is There an Optimal Training Interval to Improve the Correct Use of Adrenaline Auto-Injectors? *International Archives of Allergy and Immunology*, *181*(2), 136–140. https://doi.org/10.1159/000504365

[7] Muraro, A., Worm, M., Alviani, C., Cardona, V., DunnGalvin, A., Garvey, L. H., Riggioni, C., de Silva, D., Angier, E., Arasi, S., Bellou, A., Beyer, K., Bijlhout, D., Bilò, M. B., Bindslev-Jensen, C., Brockow, K., Fernandez-Rivas, M., Halken, S., Jensen, B., Khaleva, E., … European Academy of Allergy and Clinical Immunology, Food Allergy, Anaphylaxis Guidelines Group (2022). EAACI guidelines: Anaphylaxis (2021 update). *Allergy, 77*(2), 357–377. https://doi.org/10.1111/all.15032

[8] Murata, M. A., & Yamamoto, L. G. (2021). Patient/parent administered epinephrine in acute anaphylaxis. *The American Journal of emergency medicine, 46*, 499–502. https://doi.org/10.1016/j.ajem.2020.10.060

[9] Page, M., McKenzie, J., Bossuyt, P., Boutron, I., Hoffmann, T., & Mulrow, C. et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Systematic Reviews, 10*(1). DOI: 10.1186/s13643-021-01626-4

[10] Polloni, L., Baldi, I., Amadi, M., Tonazzo, V., Bonaguro, R., Lazzarotto, F., Toniolo, A., Gregori, D., & Muraro, A. (2022). Management of Children With Food-Induced Anaphylaxis: A Cross-Sectional Survey of Parental Knowledge, Attitude, and Practices. *Frontiers in pediatrics*, *10*, 886551. https://doi.org/10.3389/fped.2022.886551

[11] Reber, L. L., Hernandez, J. D., & Galli, S. J. (2017). The pathophysiology of anaphylaxis. *The Journal of Allergy and clinical immunology*, *140*(2), 335–348. https://doi.org/10.1016/j.jaci.2017.06.003

[12] Soller, L., Teoh, T., Baerg, I., Wong, T., Hildebrand, K. J., Cook, V. E., Biggs, C. M., Lee, N., Yaworski, L., Cameron, S. B., & Chan, E. S. (2019). Extended analysis of parent and child confidence in recognizing anaphylaxis and using the epinephrine autoinjector during oral food challenges. *The Journal of Allergy and clinical immunology. In practice*, *7*(2), 693–695. https://doi.org/10.1016/j.jaip.2018.09.025

[13] Soller, L., Teoh, T., Baerg, I., Wong, T., & Chan, E. S. (2020). One-year sustained impact of supervised epinephrine autoinjector administration during food challenge on parent confidence. *Annals of Allergy, asthma & Immunology: official publication of the American College of Allergy, Asthma, & Immunology*, *125*(6), 705–707. https://doi.org/10.1016/j.anai.2020.07.028

[14] Wang, Y., Allen, K., Suaini, N., McWilliam, V., Peters, R. (2019). The Global Incidence and Prevalence Of Anaphylaxis In Children In The General Population: A Systematic Review. *Allergy, 6*(74), 1063-1080. https://doi.org/10.1111/all.13732

[15] Yu, W., Freeland, D., Nadeau, K. (2016). Food Allergy: Immune Mechanisms, Diagnosis and Immunotherapy. *Nat Rev Immunol*, *12*(16), 751-765. https://doi.org/10.1038/nri.2016.111