Case report

Anaphylaxis and other allergic reactions to food: a global challenge

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SUMMARY

We describe a case of a biphasic anaphylactic reaction that occurred in a young woman soon after the ingestion of soy milk that led to her hospitalisation. Early recognition and appropriate treatment led to a successful outcome of this life-threatening condition. Challenges encountered in the care of this common illness are highlighted. There is a need for an increase in public awareness on dangerous allergic reactions caused by allergens present in food products in public use, thereby facilitating primary preventative measures to minimise its occurrence. Healthcare stakeholders need to implement measures of contemporary preventative medicine and efficient therapeutic protocols to safeguard the public welfare concerning this global health problem where appropriate interventions can reduce morbidity and mortality. Trial registration numbers NCT02991885 and NCT02851277.

BACKGROUND

Food allergy is recognised as a growing public health problem because there has been a dramatic increase in its prevalence (10%) in the last three decades in Westernised and industrialised regions of the world and has the potential to become life-threatening if not treated quickly and appropriately.[1] Severe food allergic reactions are often overlooked and unpredictable, and avoidance of known allergens is the critical first step in preventing these emergencies. Most cases of anaphylaxis caused by the ingestion of food are due to shellfish, walnuts, pecans, fish, soy, sesame seed, peanut, eggs, wheat and cow's milk.[2–6]

Education of the general public on the prevention of food allergy can save lives and prevent suffering.

We report an illustrative case of a young woman who ingested soy milk and developed anaphylaxis, shortly thereafter leading to hospitalisation. The local diet containing soy is typical in food such as tofu, soy sauce, soy flour, soybean oil, whole soybeans, soy bacon, soy cheese, soy hamburgers, soy hot dogs and soy-based ice cream.[2–6] Sensitisation to food, drugs and sting insects can occur to someone at any time and place.

Food allergy is a global health issue with significant opportunities for improvement by providing specialist staff, skin prick tests and drugs,and more efficient management systems. The issue of food allergy is important and needs a global approach which we aim to highlight by this report.

CASE PRESENTATION

A young woman in her 20s presented to the emergency room with difficulty breathing, wheezing, a choking sensation, generalised itching of the skin, and swelling of the face, eyelids and lips after she had ingested soy milk 20 minutes earlier. Her medical history included childhood asthma, seborrhoeic dermatitis and allergic rhinitis triggered by pollen and dust. She was not using any antiallergic agents or drugs for asthma. There was no history of recent envenomation by insects and Hymenoptera or the use of dye. There was no family history of allergies.

On examination, the patient was in respiratory distress with the use of the accessory respiratory muscles. She was unable to speak full sentences and used only short phrases. The patient weighed 68 kg, had a height of 156 cm and a body temperature of 35.2°C on admission. Her blood pressure was 138/76 mm Hg; her pulse was 120 beats/min; her respiratory rate was 28 breaths/min; and her oxygen saturation was 99% on room air. Her face, eyelids, lips and tongue were swollen, with significant periorbital oedema. The skin did not show evidence of a local reaction to an insect sting or exposure to Hymenoptera. Chest examination revealed wheezing sounds in both lung fields. The rest of the physical examination was unremarkable.

Full blood count, renal function tests, liver function tests and C reactive protein were normal. Random blood glucose was 90 mg/dL, and a urinary pregnancy test was negative. The ECG showed sinus tachycardia.

A clinical diagnosis of anaphylaxis was made, and treatment was initiated with a dose of 0.5 mg of epinephrine intramuscularly. She also received 200 mg of hydrocortisone, 10 mg of chlorpheniramine and 100 mg of ranitidine intravenously. One litre of isotonic fluid normal saline was administrated intravenously over 2 hours. A nebulisation containing 5 mg of salbutamol was given and repeated twice with an interval of 30 min. The patient improved significantly in 10 min, and she was subsequently monitored continuously. Four hours later, she developed worsening dyspnoea and wheezing. Then, the blood pressure had dropped to 101/67 mm Hg with a heart rate of 124 beats/min, and the SpO_2 was 98% on room air. She was given a second dose of epinephrine 0.5 mg intramuscularly, as well as another nebulisation with a mixture of 0.5 mg of salbutamol and 500 mcg of ipratropium bromide.

Over the next 12 hours, the patient improved with minimal dyspnoea and no pruritus by the following day. The facial and periorbital oedema and wheezing had also resolved. She also was given 100 mg of hydrocortisone intravenously three times per day, 10 mg of chlorpheniramine maleate intravenously three times per day, and 40 mg of omeprazole orally per day during hospitalisation.

On the second day of admission, the patient became asymptomatic, and the vital signs were normalised. She remained asymptomatic for 24 hours after the biphasic reaction became resolved, then she was discharged after being in the hospital for 72 hours. Oral prednisolone and omeprazole were prescribed with advice on the avoidance of eating soy-containing products. Omeprazole was prescribed to reduce cortisone-induced gastrointestinal (GI) adverse events, such as gastritis, gastric ulcer formation and GI bleeding. She was referred to an immunologist for further investigation, including skin prick tests, determination of a list of allergenic agents and specialised therapy, if feasible. Also, it was recommended that an autoinjectable epinephrine pen and a tag or bracelet with the patient's identification, address and the telephone number of the next of kin be obtained. Specialist consultation, serum specific IgE and skin prick tests were unavailable in the public healthcare setting. In our country, autoinjectable epinephrine pen is not available, and private medical care is expensive. She has not been able to see an immunologist or an allergist to the present date. Ideally, we would have liked to be able to join our patient in a regular clinic of immunology, to perform the necessary investigation to determine a list of allergenic agents for avoidance therapy, to have autoinjectable epinephrine pen regularly available and affordable in our country for this type of patients, to have access to oral immunotherapy if indicated and appropriate follow-up.

GLOBAL HEALTH PROBLEM LIST

- There is a need for epidemiological studies to assess the burden of food allergy.
- Prevention of food allergy is a challenge globally.
- The lack of provisions for the availability, distribution and affordability of the epinephrine autoinjector and essential antiallergic drugs in the public healthcare system poses hindrances to healthcare providers.
- The lack of specific legislation and its enforcement for full disclosure on warning labels on certain food products which may contain potential allergens are widespread in the food industry.
- Severe food allergic reactions can adversely impact the quality of life of patients.
- The lack of education on food allergy further hampers innovative preventative strategies and solutions.
- Allergy specialists are not widely available in underserved regions of the world to advocate for and facilitate change.

GLOBAL HEALTH PROBLEM ANALYSIS

Food allergy is defined as an adverse health effect arising from specific IgE-mediated reactions or non-IgE-mediated reactions that occur reproducibly on exposure to a given food.[1]

As a global health problem, about 200–250 million people suffer from food allergies. The prevalence of allergic diseases is increasing worldwide, especially in low-income and middle-income countries.[2–11] Food allergy is increasingly recognised as a growing public health problem. This fact is due to a dramatic increase in its prevalence (10%) in the last three decades in Westernised and industrialised regions of the world, and it has the potential to become life-threatening if not treated quickly and appropriately.[1] Food allergy affects an estimated 32 million people in the USA, including 5.6 million children.[1] Up to 10% of young children and 2%–3% of adults are affected by food allergy according to a systematic review and meta-analysis reported by Umasunthar *et al*.[3]

Many allergic reactions are mild, while others can be severe and/or life-threatening. Anaphylaxis is the most severe form of the spectrum of allergic reactions. It is a rare systemic allergic reaction that usually occurs within minutes of exposure to an allergenic agent in a highly sensitised individual, and without treatment, anaphylaxis may cause death. Anaphylaxis is characterised by a potentially life-threatening compromise in breathing and/or circulation, and it may occur without typical skin features or circulatory shock being present.[12] However, recognition of anaphylaxis can be challenging, and this is particularly true for food-induced anaphylaxis. It is also possible that severe allergic asthma and non-allergic anaphylaxis mimics, such as chronic idiopathic urticaria and hereditary angioedema, could be misclassified as anaphylaxis. A food-induced reaction with hives and vomiting could be classified as severe and consistent with anaphylaxis, but such a reaction would not be considered as anaphylaxis in the UK and Australia, in the absence of respiratory or cardiovascular symptoms. Furthermore, isolated severe respiratory reactions in the absence of skin or gut symptoms are not classified as anaphylaxis, despite this being a common presentation for fatal food anaphylaxis.[12] Severe allergic reactions can refer to anaphylaxis or other allergic reactions such as allergic asthma, urticaria, allergic conjunctivitis, atopic dermatitis and food allergy that manifest with great severity but do not meet the 2019 amended criteria for the diagnosis of anaphylaxis proposed by the World Allergy Organization Anaphylaxis Committee. Some of these non-anaphylactic severe allergic reactions can occur in children and can affect extensive areas of the body and may require hospitalisation and specialist immunologist or allergist interventions. However, they do not cause hypotension or bronchospasm or laryngeal involvement.[12]

Anaphylaxis-related mortality has been estimated between 0.5 and 5.5 per million population.[7–10] In a survey of 83 member countries of the World Allergy Organisation and six non-member countries, over half (n=51) had no data on food allergy prevalence; a quarter (n=23) had data based on patient reports; and only 10% (n=9) had food allergy prevalence data based on oral food challenges, which is the gold standard. There are inconsistent definitions and methodologies used in the various published studies. Confirmation of food allergy to determine its prevalence by the gold standard of oral food challenge is resource intensive to prevent the risk-of death, and this approach has impeded the compilation of quality data. Despite these constraints, the available studies provide valuable information regarding the scope of the problem and risk factors that contribute to the rising prevalence.[10] Most Western countries have reported an increase in the prevalence of food allergy over the last decade. There is also growing evidence of increasing prevalence in low-income countries.[10]

It is believed that food allergy results from complex interactions of genetic and environmental factors in early life. Early life risk factors identified include more frequency in male gender, Asian and black children with familial associations, genetic predisposition through human leukocyte antigen (HLA) and specific genes, exposure to allergens leading to sensitisation, microbial and animal products and vitamin D deficiency.[1 10 11 13] An intriguing observation is that children of African and East Asian descent born in a Western environment are at higher risk

of food allergy compared with Caucasian children. This finding emphasises the importance of epigenetics and predicts increases in food allergy in Asia and Africa as economic growth continues in these regions.[8 9] In Australia, infants with parents of East Asian ethnicity had a three times higher risk of food allergy compared with infants of non-East Asian descent. Furthermore, children with Asian mothers who were born in Asia and later migrated to Australia had a lower risk of nut allergy (adjusted OR 0.1, 95% CI 0.03 to 0.31) than children with Asian mothers born in Australia. These findings suggest that genetic factors associated with Asian heritage may confer an increased risk of food allergy in infants exposed to a Western environment in early life.[14] The dual-allergen exposure hypothesis suggests that allergic sensitisation to food occurs through low-dose cutaneous sensitisation, such as skin peanut oil exposure among eczematous children, reduced diversity of the microbiota and vitamin D deficiency. In contrast, consumption of food protein (peanut) between 6 and 11 months of age, sufficient levels of vitamin D and a diverse microbiota induce oral tolerance.[1]

Six types of possible reactions can be seen after allergic reactions: local reactions, large local reactions, systematic reactions (eg, generalised urticaria, which is not an anaphylactic reaction), anaphylactic reactions, delayed-type reactions and toxic reactions. Most deaths result from type I hypersensitivity reactions and anaphylaxis.

The diagnosis of food allergy is mainly reliant on medical history, tests for sensitisation and oral food challenges, but emerging use of component-resolved diagnostic is improving diagnostic accuracy; however, many of these tests remain experimental.[1]

It can be challenging for emergency room doctors to distinguish anaphylaxis from asthma, syncope and panic attacks. Asthma typically does not entail itching or GI symptoms; syncope presents with pallor rather than a rash; and a panic attack may have flushing without hives.[2–6] However, these differentials were ruled out in our patient. She had a history of childhood asthma, seborrhoeic dermatitis and allergic rhinitis triggered by pollen and dust. She was not using any antiallergic agents or drugs for asthma due to no events of asthma attacks during her adulthood. Although she presented with difficulty breathing and wheezing, her clinical syndrome fulfilled the diagnostic criteria for food anaphylaxis without asthma. She had acute generalised itching of the skin and swelling of the face, eyelids, lips and tongue after she had ingested soy milk 20 min earlier. Her clinical syndrome responded appropriately after a single parenteral dose of epinephrine, which was not in keeping with asthma. The association with soy consumption in our patient excluded any possibility of a hypersensitivity reaction to Hymenoptera venom. Furthermore, there was no evidence of Hymenoptera envenomation, such as cutaneous erythema, oedema or pain.[1–5] No other potential trigger, associated stimuli or aetiological factor different from soy milk ingestion was found. Skin prick allergic tests and food allergy challenge were not available.

We report the case of a young woman who ingested soy milk and developed anaphylaxis shortly thereafter. Her harrowing experiences are described in the patient's perspective. Although the patient stated that this was the first time she had consumed soy milk, the local diet containing soy is common in food such as tofu, soy sauce, soy flour, soybean oil, whole soybeans, soy bacon, soy cheese, soy hamburgers, soy hot dogs and soy-based ice cream. It is reasonable, therefore, to hypothesise that as soy products are common in food products in our country, that previous sensitisation may have occurred. Soy can be found everywhere in our diet, from processed foods to Asian restaurants. The Food Allergen Labelling & Consumer Protection Act (FALCPA) requires manufacturers to list soy ingredients on products labels in simple language. There are two well-established exceptions to FALCPA in the labelling of soy products, for food that contains refined soy oil and for those containing soy lecithin as a releasing agent. Research shows that soy proteins are present in soybean oil and soy lecithin. Soy ingredients may be present in waxes or horticultural oils on fruits or in raw or frozen chicken that has been processed in chicken broth. Some statements on a food label may indicate cross-contamination with soy. These warnings are generally voluntary, and some manufacturers may not include this information in the labels, even when there is soy present in their products. Soy is a common ingredient in many Asian cuisines and may be identified by its name in other languages. Some of the names for soy are bean curd, bean sprouts, edamame or fresh soybeans, kinako, miso or fermented soybean paste, natto, nimame, okara, shoyu, soy sauce, soya, soybean, tamari, tempeh, tofu or dofu or kori-dofu, and yuba.[15 16] The public need to be aware of these various names. In the English-speaking Caribbean, the majority of the population is composed of individuals of Asians and African descent. With the adaptation of Western lifestyle and the presence of fast food and other multinational brand name food outlets in most countries, urgent steps are necessary to prepare the world for a likely projected increase in food allergy.

The management of food allergies can also be challenging. There is currently no cure or approved treatment for food allergy, and the management of food allergies continues to consist of educating patients on how to avoid relevant allergens, to recognise early symptoms of an allergic reaction in case of accidental ingestion and to initiate the appropriate emergency therapy. Individual identification of food allergens for avoidance can be made by performing food allergy challenge tests when available. It is recommended that all patients at risk of anaphylaxis (IgE-mediated reaction) have an epinephrine autoinjector available since that is the only recommended medicine for anaphylactic shock.[1] Immunotherapy offers a substantial benefit of desensitisation and sustained unresponsiveness.[1] However, the balance of benefit and risk underscores the clinical equipoise for these treatments due to adverse events. The peanut vaccines are not yet approved for extensive use in humans.[1]

Prompt and timely administration of epinephrine has proven to obviate a biphasic response. A delay between anaphylaxis symptom onset and administration of epinephrine of 60–190 min has been reported to correlate with biphasic anaphylaxis.[5] Our patient received the first epinephrine dosage 10 min after initiation of symptoms. Epinephrine was administered promptly and appropriately, but it was not given repeated doses at intervals of 5–15 min for an inadequate response as per guidelines because symptoms and signs improved rapidly after the first dosage of epinephrine and steroids. Anaphylaxis requiring >1 dose of epinephrine to achieve symptom resolution has been reported to correlate with biphasic reactions.[5] The patient's respiratory and cardiovascular parameters were monitored continuously at the emergency room. Hydrocortisone was administered to our patient promptly, appropriately and timely. However, biphasic and protracted anaphylaxis may be seen despite steroid therapy.[5–8] Some reports have shown that prompt administration of corticosteroids may decrease the incidence of biphasic reactions.[5] However, no definitive conclusions about the role of corticosteroids in preventing biphasic reactions were found in an American meta-analysis.[5] Biphasic anaphylaxis was not prevented in our patient despite the administration of epinephrine and steroids. The experience obtained from the

iatrogenic anaphylactic reactions that occur during the food challenge tests and a recent meta-analysis suggest that biphasic reactions to food allergen are rare.[16] Given the low incidence and rare mortality of biphasic reactions, patients who receive epinephrine within 1 hour of symptom onset and who respond to epinephrine with rapid and complete symptom resolution can probably be discharged from the emergency room with careful return precautions and education without the need for prolonged observation.[5]

The National Institute for Health and Care Excellence of the UK recommends that people who have had a severe allergic reaction be monitored for 6–12 hours within a hospital setting because of the risk of a biphasic reaction.[17] However, a meta-analysis report showed a mean time to onset between the resolution of initial anaphylaxis and biphasic reaction ranging widely from 1 to 72 hours, with the majority of studies reporting the mean time to onset at >8 hours.[18] However, clinicians should tailor observation periods for patients individually based on clinical characteristics.[17] Our patient had factors associated with increased risk of fatal and near-fatal reactions. Among those factors are as follows: she was a young female adult living in a remote area with a strong history of asthma, seborrhoeic dermatitis and allergic rhinitis.[19] The patient was not using any antiallergic agents or drugs for asthma and developed for the first time an anaphylactic reaction to the ingestion of soy milk in a low-resource setting without the support of an allergist or immunologist or the availability of an autoinjectable epinephrine device. Her first dosage of intramuscular epinephrine and intravenous steroids did not prevent the biphasic reaction. During the first 36 hours, she was dependent on oxygen therapy, and her nebulisations with salbutamol did not control her respiratory manifestations (cough and wheezing) appropriately. The patient improved gradually and eventually; she was discharged.

Risk stratification of anaphylaxis and its implications for the prescription of epinephrine autoinjectors or immunotherapy is another fundamental issue. In a sensitised individual, there is no specific test that can reliably predict the outcome of exposure to an allergen. However, research can help us identify markers that can guide our decision making with affected patients.

Appropriate education, food labelling, allergen avoidance and anaphylaxis management strategies remain essential.[3 15] The lack of research and specialists in the discipline of allergy and immunology means that the regions with low-resource settings remain ill-prepared to deal with the problem. The public health sector in our country and in many other countries lack specialists in allergy and/or immunology. Our patient attempted to seek allergy testing privately, but the cost was prohibitive. Epinephrine autoinjectors are also unavailable in the region. These gaps in our healthcare sector need to be addressed for improved patient care and outcome.

Primary prevention of food allergy seeks to prevent the onset of IgE sensitisation, and secondary prevention seeks to interrupt the development of food allergy in IgE-sensitised children.[1] To achieve these goals, The USA National Institutes of Health and the UK National Institute for Health and Care Excellence actively encourage the early introduction of peanut for the prevention of peanut allergy, and other countries recommend the inclusion of potential common food allergens, including peanut and hen's egg, in complementary feeding regimens commencing at approximately 6 months but not before 4 months of age.[1] Further studies that explore the efficacy of oral tolerance induction to other common food allergens, such as fish, cow milk or hydrolysed formula, and that focus on optimal timing, duration and adherence are required.[1] Some food allergies have a high rate of resolution in childhood, such as milk (>50% by age 5–10 years), egg (approximately 50% by ages 2–9 years), wheat (50% by age 7 years) and soy (45% by age 6 years), with continued resolution into adolescence. Other food allergies typically persist or have low rates of childhood resolution: peanut allergy (approximately 20% by age 4 years), tree nut allergy (approximately 10%), and allergy to seeds, fish and shellfish are also considered persistent, but studies are lacking to define the course of the allergy.[1] Our patient described her fear of death and anxiety after the incident, a feeling of helplessness and fear of eating new foods for some months after her terrific experience. She subsequently

Patient's perspective

This experience, dating back to 2016, was definitely the scariest event of my life. I drank soy milk on the morning of the allergic reaction. Twenty minutes after leaving home for work, I experienced some itching in the ears then I felt it in the throat. Almost immediately after, I began feeling a tightening in my throat and I gasped for breath. After 5 min, I began to lose sight and my eyes were swollen. By the time I got to the hospital, I was blind and had trouble breathing. The staff acted immediately as I got inside the emergency room. I was administered an epinephrine injection and then there was a blurred gap where I do not remember exactly what happened thereafter. Following that unclear period, I remember waking up, and the staff of the hospital was asking me continuously how I was feeling. My blood pressure, heart rate, respiratory rate and oxygen saturation were continuously monitored for 24 hours. That comforted me a bit. However, I cannot describe the extent to which I felt scared; it was beyond explanation, because of the overwhelming emotions. The doctors then explained what happened to me and counselled me on selecting purchasing products. At that moment, I was worried and scared because the ingredient that possibly caused the reaction is present in a lot of products on the market. I was worried about what I can and cannot eat. After being discharged, I was scared to eat anything. I kept thinking to myself, what if it happens again? What will happen if I do not get to hospital on time? These were my recurrent thoughts for about 3 months. The doctor instructed me to purchase an epinephrine autoinjector in case I have another anaphylactic reaction; however, this was really frustrating. I ventured to various pharmacies looking for this device, and it was unavailable. I asked for the medication and to my great surprise, it was expensive. I was unable to afford the medication that could save my life in case the anaphylactic reaction recurs. I believe that this epinephrine autoinjector should be available to members of the public who are are at risk of suffering from anaphylactic reactions. Many other people in a similar situation may not be unable to afford this important medication. Also, I was advised on visiting an immunologist. There is no immunologist employed in the public health sector; therefore, I needed to visit one privately. I enquired about the cost of the visit and the allergic tests. It was costly for me again, something I could not and still have not been able to afford. Most people cannot afford healthcare privately, and this should be taken into consideration because the lack of these facilities increases the fear of a fatal outcome due to the risk of dangerous allergic reactions.

adapted and reverted to her usual self, but this experience has left an indelible scar on her psyche. Dangerous allergies can mentally and physically affect patients. Some persons take extreme lifestyle modifications, and this may be a source of anxiety and worry, leading to a decrease in quality of life.[3] The likelihood of a fatal food allergic reaction may be low, but fear, uncertainty and lifestyle self-restrictions are high among affected patients.[20 21] Patients with a severe food allergy reaction may experience a compromised quality of life due to fear to death due to unavailability of drugs, autoinjectable epinephrine devices, specialists in the field, affordable allergy tests and surveillance systems in the public healthcare sector. Furthermore, allergic diseases lead to socioeconomic burden to families and countries. This fact is a result of high healthcare costs and unavailability of drugs in some areas, negative impact on the quality of life, absenteeism and decreased work performance.[9]

The most important triggers of anaphylaxis worldwide, apart from foods, are drugs, Hymenoptera venoms and latex. Hymenoptera venom is responsible for most cases of anaphylaxis caused by stinging insect venoms. Severe allergic reactions occurring in remote regions of the world are mainly associated with the exposure to Hymenoptera (bees, wasps, yellow jackets, hornets, sawflies and ants) and other insects, such as mosquitoes, kissing bugs, bedbugs, fleas and certain flies.[2–6]

Although drug-induced anaphylaxis is under-recognised, the most common drugs associated with anaphylaxis are non-steroidal anti-inflammatory drugs, beta-lactam and non-beta-lactam antibiotics (the most common of which are fluoroquinolones), radiocontrast media, proton pump inhibitors and neuromuscular blocking agents. Other important factors triggering anaphylaxis are blood and blood products, physical exercise, iodinated radiocontrast media, gadolinium-based contrast agents, intravenous fluorescein and natural rubber latex.[2–6]

In summary, anaphylaxis and food allergy are global health problems, and there are significant opportunities for improvement in management. These are common problems that are prevalent in both high-income and low-income countries. United global actions are needed to identify opportunities and to achieve optimal systems and interventions leading to better outcomes. Further research into the field and the enlightenment of the public can save lives, as well as decrease disability and suffering. More robust studies using standardised methodologies and objective methods of assessment are necessary for accurate detection so as to understand better the true extent of these problems and their impact on health services. There is ongoing research in the area of food allergy immunotherapy to potentially induce tolerance to affected patients, and this may prove useful in the future, especially in developing settings.

Learning points

- Food allergy and anaphylaxis are two important public health issues that require research and education and measurement of their global burden, management and prevention.
- The availability of epinephrine autoinjector can save lives, decrease disability and improve quality of living among people at risk of suffering from anaphylaxis.
- Stakeholders should facilitate an increase in training on allergies and immunology and provide incentives for staff to work in underserved regions of the world.
- Laboratory support for early diagnosis and availability of reliable allergic testing systems in public healthcare facilities are essential.
- Public awareness campaigns on food allergy and anaphylaxis and measures to combat them are recommended.

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REFERENCES

1 Sicherer SH, Sampson HA, Sampson HA. Food allergy: A review and update on epidemiology, pathogenesis, diagnosis, prevention, and management. *J Allergy Clin Immunol* 2018;141:41–58.
2 Sahiner UM, Durham SR. Hymenoptera venom allergy: how does venom immunotherapy prevent anaphylaxis from bee and wasp stings? *Front Immunol* 2019;10:1959.
3 Umasunthar T, Leonardi-Bee J, Hodes M, *et al*. Incidence of fatal food anaphylaxis in people with food allergy: a systematic review and meta-analysis. *Clin Exp Allergy* 2013;43:1333–41.
4 Beyer K, Eckermann O, Hompes S, *et al*. Anaphylaxis in an emergency setting - elicitors, therapy and incidence of severe allergic reactions. *Allergy* 2012;67:1451–6.
5 Umasunthar T, Leonardi-Bee J, Turner PJ, *et al*. Incidence of food anaphylaxis in people with food allergy: a systematic review and meta-analysis. *Clin Exp Allergy* 2015;45:1621–36.
6 Simons FER, Ebisawa M, Sanchez-Borges M, *et al*. 2015 update of the evidence base: world allergy organization anaphylaxis guidelines. *World Allergy Organ J* 2015;8:32.
7 Oya S, Nakamori T, Kinoshita H. Incidence and characteristics of biphasic and protracted anaphylaxis: evaluation of 114 inpatients. *Acute Med Surg* 2014;1:228–33.
8 Golden DBK. Anaphylaxis: recognizing risk and targeting treatment. *J Allergy Clin Immunol Pract* 2017;5:1224–6.
9 Loh W, Tang M. The epidemiology of food allergy in the global context. *Int J Environ Res Public Health* 2018;15:15.
10 Sicherer SH, Sampson HA. Food allergy: A review and update on epidemiology, pathogenesis, diagnosis, prevention, and management. *J Allergy Clin Immunol* 2018;141:41–58.
11 Pawankar R. Allergic diseases and asthma: a global public health concern and a call to action. *World Allergy Organ J* 2014;7:12–13.
12 Turner PJ, Campbell DE, Motosue MS, *et al*. Global trends in anaphylaxis epidemiology and clinical implications. *J Allergy Clin Immunol Pract* 2019;28. doi:10.1016/j.jaip.2019.11.027. [Epub ahead of print: 28 Nov 2019].
13 du Toit G, Tsakok T, Lack S, *et al*. Prevention of food allergy. *J Allergy Clin Immunol* 2016;137:998–1010.
14 Koplin JJ, Peters RL, Ponsonby A-L, *et al*. Increased risk of peanut allergy in infants of Asian-born parents compared to those of Australian-born parents. *Allergy* 2014;69:1639–47.
15 USA Food and Drug Administration. Guidance for industry: questions and answers regarding food allergens, including the food allergen labeling and consumer protection act of 2004 (edition 4); final guidance. Fda.gov, 2019. Available: https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ucm059116.htm
16 Dunn Galvin A, Hourihane J O'B. Health-related quality of life in food allergy : Impact, correlates, and predictors. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2016;59:841–8.
17 Lee S, Bellolio MF, Hess EP, *et al*. Time of onset and predictors of biphasic anaphylactic reactions: a systematic review and meta-analysis. *J Allergy Clin Immunol Pract* 2015;3:408–16.

18 Pourmand A, Robinson C, Syed W, *et al*. Biphasic anaphylaxis: a review of the literature and implications for emergency management. *Am J Emerg Med* 2018;36:1480–5.
19 Fishbein AB, Makhija MM, Pongracic JA. Anaphylaxis to food. *Immunol Allergy Clin North Am* 2015;35:231–45.
20 Simons FER, Ardusso LRF, Bilò MB, *et al*. World allergy organization guidelines for the assessment and management of anaphylaxis. *World Allergy Organ J* 2011;4:13–37.
21 Burks AW, Sampson HA, Plaut M, *et al*. Treatment for food allergy. *J Allergy Clin Immunol* 2018;141:1–9.