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Title page

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Myths, facts and controversies in the diagnosis and management of anaphylaxis

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Capsule Summary:

Anaphylaxis is a serious systemic allergic reaction that is rapid in onset and may cause death. Despite numerous national and international guidelines and consensus statements, common misconceptions still persist in terms of diagnosis and appropriate management, both amongst healthcare professionals and patient/carers. We address

some of these misconceptions and highlight the optimal approach for patients who experience potentially-life threatening allergic reactions.

Keywords: allergy, anaphylaxis, vaccines, food, adrenaline, auto-injector

Word count: 3475

Anaphylaxis is a serious systemic allergic reaction that is rapid in onset and may cause death.[1] Recent data suggest that the incidence is increasing, particularly to food.[2,3,4] The lifetime prevalence of anaphylaxis is estimated to be between 0.5-2%.[5] Despite numerous national and international guidelines, misconceptions continue to persist amongst both healthcare professionals and patients/carers, which result in under-recognition and suboptimal management of this medical emergency. In this review, we address some of these misconceptions and highlight areas of best practice.

Myth 1: 'Anaphylaxis often results in death'

Anaphylaxis can be life-threatening, but in reality the majority of reactions do not result in severe outcomes.[6 7] Many reactions are not treated appropriately (discussed below), yet fatal anaphylaxis is (fortunately) a rare event, with a case fatality rate under 0.001%.[8] Severe anaphylaxis, however, is unpredictable, and severe reactions may mimic more mild anaphylaxis reactions in the first instance [9]. Delay in appropriate treatment almost certainly contributes to fatalities [10]. Therefore, **it is critical that all anaphylaxis reactions are treated as a medical emergency**.

While hospitalisations in the UK and elsewhere due to anaphylaxis have increased over the last 2 decades, there has been no increase in fatalities. [2 11 12 13 14] For the food-allergic individual, the incidence of fatal anaphylaxis is 1.81 per million person years – less than death due to accidental causes or murder.[7 15] Nonetheless, this needs to be interpreted appropriately: allergic individuals (and their parents) perceive risk very differently: a "one in a million" risk may be acceptable in terms of public health but with respect to their own child, parents will consider their child to be the "one in a million" who will die from anaphylaxis [16]. Indeed, the adverse impact of a diagnosis

of food allergy on health-related quality-of-life is greater than that seen in diabetes and other chronic disease These data are perhaps best framed in the context of safety-netting: just as we manage everyday risks (such as driving, with safety standards on cars, airbags and crumple zones, adhering to a highway code), can we help our patients and their families take a similar approach to the food allergy, with safety-netting allowing affected individuals to lead as normal a life as possible?

DIAGNOSIS OF ANAPHYLAXIS

Anaphylaxis has been defined as a systemic or multi-organ allergic reaction, however not all systemic reactions are anaphylaxis. For example, many reactions have only cutaneous manifestations (e.g. generalized urticaria) – clearly a systemic phenomenon, but (in the absence of other symptoms) not anaphylaxis according to most guidelines. In practice, anaphylaxis in the UK (and also Australia) is **characterised by the presence of "Airway/Breathing/Circulation" (respiratory or cardiovascular) symptoms** as part of an allergic reaction. Skin or mucosal changes alone are not a sign of an anaphylactic reaction.

There are 2 areas of potential controversy: the most common criteria to diagnose anaphylaxis are those developed by the National Institute of Allergy and Infectious Diseases (NIAID) and subsequently adopted by the World Allergy Organisation (Table 1),[17] which were designed to capture 95% of cases. However:

1. According to criterion 2, skin and gut symptoms together constitute anaphylaxis. However, the prevailing consensus in the UK (and Australia) with respect to food-induced reactions is that skin and gut symptoms, in the absence of respiratory or cardiovascular symptoms, are *not* anaphylaxis.[18] For

food, gastrointestinal symptoms are caused by the presence of *local* allergen in the gut rather than a systemic reaction. This is in contrast to venom-induced reactions, where the presence of gastrointestinal symptoms (e.g. vomiting) would constitute anaphylaxis (as the gut is remote from the site of allergen exposure).[18] There is also no consensus as to what constitutes *persistent* gut symptoms. This distinction is important, as many food-induced reactions are classified as anaphylaxis in the USA (and therefore should be treated with adrenaline), but not in the UK and Australia, something important to consider when making comparisons to US data.

2. Fatal (and in our experience, near-fatal) anaphylaxis reactions often present as acute bronchoconstriction without any other symptoms being present (which often leads to uncertainty as to whether some fatalities are due to anaphylaxis or severe asthma).[19 20] Such reactions, according to the NIAID criteria, do not constitute anaphylaxis.

Respiratory symptoms are far more common than cardiovascular symptoms in food-induced-anaphylaxis, especially in those with asthma [21]. In a retrospective study from Sweden, children with asthma presenting with anaphylaxis were more likely to have lower airway symptoms and wheeze than children without an underlying diagnosis of asthma (odds ratio 2.7)[22].

Table 1 : Clinical Criteria for the diagnosis of anaphylaxis [17]

Anaphylaxis is highly likely when any one of the following three criteria is fulfilled
1. Acute onset of an illness (minutes to several hours) with involvement of the skin, mucosal tissue, or both (e.g. generalized urticaria, itching or flushing, swollen lips-tongue-uvula)

AND AT LEAST ONE OF THE FOLLOWING:
A) Respiratory compromise (e.g. dyspnoea, wheeze-bronchospasm, stridor, reduced peak flow, hypoxemia)
B) Reduced blood pressure or associated symptoms of end-organ dysfunction (eg. hypotonia [collapse], syncope, incontinence) OR
2. Two or more of the following that occur rapidly after exposure to a likely *allergen* for that patient (minutes to several hours)
A) Involvement of the skin-mucosal tissue
B) Respiratory compromise
C) Reduced blood pressure or associated symptoms
D) Persistent gastrointestinal symptoms (eg, crampy abdominal pain, vomiting) OR
3. Reduced blood pressure after exposure to known *allergen* for that patient (minutes to several hours)

Myth 2: 'There are no hives so it can't be anaphylaxis'

Cutaneous symptoms (most commonly urticaria or 'hives') are absent in around 10% of anaphylaxis reactions, and where present may be delayed in onset.[8] This is consistent with a case series of 6 paediatric fatalities due to food-anaphylaxis, where only one child had evidence of skin involvement: the lack of skin signs may have delayed diagnosis and appropriate treatment with adrenaline, contributing to the fatal outcome.[23] The Australasian Society of Clinical Immunology and Allergy (ASCIA) recently issued new guidelines[18] which define anaphylaxis as:

- Any acute onset illness with typical skin features (urticarial rash or erythema/flushing, and/or angioedema), PLUS involvement of respiratory and/or cardiovascular and/or persistent severe gastrointestinal symptoms; or

- Any acute onset of hypotension or bronchospasm or upper airway obstruction where anaphylaxis is considered possible, even if typical skin features are not present.

These criteria better reflect increasing recognition that cutaneous manifestations are often absent or appear late in near-fatal and fatal anaphylaxis.

The safe management of anaphylaxis depends on early recognition and treatment with intramuscular adrenaline. The British Society for Allergy & Clinical Immunology (BSACI), in conjunction with the Royal College of Paediatrics and Child Health, has recently updated its Allergy Management Plans for children (Figure 1), highlighting the potential for skin symptoms to be absent in anaphylaxis.

Myth 3: 'No trigger for the reaction is identified, therefore it is not anaphylaxis'

Anaphylaxis is a *clinical* diagnosis. The most common trigger in young people is food: symptoms typically begin within 15-30 minutes of exposure and progress rapidly.[24] Other triggers, such as medication or insect stings, are far less common in children.[8 25] In around 20% of cases, no trigger is identified; this is known as idiopathic anaphylaxis. Many such reactions will be due to undisclosed or "hidden" food allergens. Identifying the culprit allergen can be challenging and referral to an allergy specialist is advised: a thorough review of the circumstances surrounding the reaction including a detailed dietary history supported by ingredients lists is likely to be required. Of note, if a child is consuming a food regularly without problem, it is unlikely to be the cause. This might seem obvious, but dietary manipulation along these lines are often recommended by non-specialists for idiopathic, non-anaphylaxis

reactions presenting with only skin symptoms: such episodes are generally due to immune activation (often viral-triggered) rather than allergen exposure.

The most common food trigger for fatal anaphylaxis in children in the UK is milk, followed by peanut and tree nuts.[2] While there is broad public recognition of the risks posed by nuts, cow's milk allergy is often perceived as being less severe. However, milk allergy persisting into school-age is often associated with other co-existing atopies (such as asthma) and more severe reactions, particularly in the 30%-40% of milk-allergic children who are unable to tolerate milk in well-baked foods (such as biscuits or cakes) [9]. Such exposure often results in delayed reactions which mimic asthma; under such circumstances, it may not be obvious that the child has been exposed to milk. Therefore, **always consider anaphylaxis in someone with a known food allergy who has sudden breathing difficulty**.

Laboratory tests (such as mast cell tryptase, MCT) may support a diagnosis of anaphylaxis, but these are not specific for anaphylaxis, nor are results available quick enough to impact on acute management.[26] Measuring MCT may be helpful where the cause of the reaction is unclear: a serum sample should be collected within 15-180 minutes of symptom onset, with a further convalescent sample at least 6 hours later.[26] However, MCT is often not raised in food-induced reactions, even in the most severe and fatal reactions [27]. In a Canadian study, only 19.2% of children presenting with anaphylaxis had elevated MCT; even with severe reactions (cyanosis, hypoxia, respiratory arrest, hypotension, loss of consciousness) MCT was only raised in 50% of cases[28]. A negative MCT does not, therefore, rule out anaphylaxis.

ACUTE MANAGEMENT

Adrenaline is the first line treatment for anaphylaxis according to all guidelines [10]. It has both α- and β-sympathomimetic actions, causing peripheral vasoconstriction, increased cardiac output, bronchodilation; importantly, it is the only drug which inhibits the further release of inflammatory mediators from mast cells and basophils.

Myth 4: Adrenaline is dangerous

Adrenaline given by intramuscular injection into the outer mid-thigh is very safe and starts to work within minutes. Adrenaline can either be injected using a needle-syringe (using 1:1000 adrenaline, which results in a lower volume, less painful injection than if using 1:10,000) or by auto-injector device (e.g. Emerade, Epipen, Jext). Where an auto-injector is used, note that both Epipen and Jext are only available in 150mcg and 300mcg doses, which means that the 300mcg is effectively an under-dose in someone over 30kg (this may explain why some patients require a second adrenaline dose). Younger children should be transitioned to a 300mcg dose when their body weight is >25kg, and some centres advocate doing so from 20kg. Around 10-20% of patients report transient effects including pallor, anxiety, palpitations, dizziness and headache (although these symptoms may also be due to the reaction and/or the patient's own endogenous adrenaline production).

Adrenaline is underused in the treatment of anaphylaxis, both pre-hospital and in Emergency Departments [6 10 22 24 29]. Further intramuscular doses of adrenaline should be administered in the event of persisting respiratory or cardiovascular symptoms. Adrenaline can and should be repeated after 5 minutes; the administration of other

medication such as antihistamines or steroids must not cause delay or distraction, as these are not first (or even second) line treatments for anaphylaxis [25] (Figure 2A). An alternative summary of anaphylaxis treatment, consistent with national and international guidelines, is shown in Figure 2B.

Myth 5: Antihistamines can be used to treat anaphylaxis initially; adrenaline is only needed if symptoms worsen

Histamine is only one of many inflammatory mediators released during anaphylaxis. Oral antihistamines take around 30 minutes for onset of effect; intravenous chlorphenamine has a faster onset, but can cause hypotension. Antihistamines are not effective against anaphylaxis: their prophylactic use during controlled immunotherapy does not prevent anaphylaxis, and any apparent response during acute management of reactions is most likely due to the patient's own endogenous adrenaline [30].

Antihistamines have now been relegated to third line therapy in international guidelines; their use is limited to the relief of cutaneous symptoms, and should never delay the administration of adrenaline or fluid resuscitation during patient stabilisation [10].

Myth 6: Corticosteroids prevent delayed or biphasic reactions in anaphylaxis

Historically, corticosteroids have been used to prevent protracted and biphasic reactions (the latter defined as a recurrence of symptoms within 72 hours of initial anaphylaxis, without re-exposure to the trigger). However, this has never been tested in a randomized clinical trial; more recent evidence has cast doubt over their efficacy.[31] A recent systematic review and meta-analysis included 27 studies with 4114 anaphylaxis cases, of whom 192 (4.7%) had biphasic reactions [32]. Steroid

administration did not affect the likelihood of a late phase reaction (odds ratio 1.52, 95%CI 0.96-2.43). In fact, there was a non-significant trend towards increased risk, although this is probably because steroid use was more common with severe reactions. Biphasic reactions were more common where hypotension was present at initial reaction (OR 2.18, 95%CI: 1.14-4.15), but this is unusual in food-induced anaphylaxis. The median time to onset of biphasic symptoms was 11 (range 0.2-72) hours i.e. 50% of reactions occurred >11 hours *after* initial reaction. This is relevant because current guidance from the National Institute for Health and Care Excellence (NICE) recommends patients over 16 years are observed for 6-12 hours after anaphylaxis (children under 16 should be admitted) [33]. In reality, it is generally accepted that prolonged observation may not be required following a straightforward reaction in someone who already has a comprehensive management plan and rescue medication (including adrenaline auto-injectors) in place.

MANAGING CHILDREN AT RISK OF ANAPHYALXIS

Although research in ongoing into potential treatments for food allergy, the mainstay of management remains dietary avoidance and provision of a management plan/rescue medication in the event of accidental reactions.

Myth 7: Only children who have had anaphylaxis need an adrenaline auto-injector

Allergy skin prick tests and/or allergen-specific IgE blood tests do not predict reaction severity, and anaphylaxis can occur in patients with high, low, and even negative tests. A recent European Consensus concluded that it is very difficult if not impossible to accurately predict who is at risk of severe anaphylaxis: a number of risk factors acting together are involved (Figure 3).[9]

Clearly someone with previous anaphylaxis is at risk of subsequent anaphylaxis. However, most children who present with anaphylaxis as their initial reaction do not experience further anaphylaxis. Ewan & Clark followed-up 747 allergic children, of whom 220 had initial anaphylaxis to peanut/tree nuts; 25% had further accidental reactions over a median 3 year follow-up, with only one experiencing further anaphylaxis [34]. Other studies report a higher rate of anaphylaxis in those with initial mild reactions. In a UK survey of 969 young people attending allergy clinics, 48% had experienced an accidental reaction in the previous year, with 245 (25%) having anaphylaxis [6] However, the occurrence of anaphylaxis is likely to depend on a number factors, including dose or level of exposure [35] (Figure 3). In a unique study of 89 children with suspected peanut allergy, Wainstein et al. demonstrated that up to 75% will have anaphylaxis if exposed to sufficient peanut at challenge [36] Thus, lack of prior anaphylaxis is more likely due to insufficient exposure rather than some inherent lack of predisposition. Importantly, **there are no data indicating that allergic reactions get worse with each subsequent exposure**. Nor is there any evidence to suggest that anaphylaxis risk "runs in the family".

Various risk factors for severe anaphylaxis have been proposed, based on limited case-series of fatal anaphylaxis. Interestingly, food-induced anaphylaxis is most common is the 0-5 age group, but death from anaphylaxis in this age group is rare [2]. Teenagers and young adults appear to have an age-dependent predisposition towards severe outcomes, which cannot be easily explained by risk-taking behaviours.[2] Asthma is considered a risk factor, however in the UK Fatal Anaphylaxis Registry, 22% of cases did not have a prior diagnosis of asthma [2]. Around 50% of children with food allergies have asthma: the vast majority will never have a severe allergic

reaction, thus asthma has poor predictive value for severe reactions (although this does not negate the imperative to improve asthma control in food-allergic individuals as a means of reducing risk) [9].

Delays in treating with adrenaline are a risk factor for fatal outcome [10 37]: it is this, as well as our inability to predict severe reactions, which drives the provision of adrenaline auto-injectors. A summary of recent guidelines on who should be prescribed auto-injectors is summarised in Table 2. Healthcare professionals must consider the patient/family preference: if prescription boosts patient confidence and allows them to lead a less restrictive life, then auto-injectors should be part of the management plan. However, this requires actual carriage: the auto-injectors need to be available at all times, otherwise prescription is pointless.

Table 2: Factors to be considered as part of the risk assessment on whether to prescribe adrenaline auto-injectors.

	UK (BSACI) [38]	Europe (EAACI) [10]	Australia (ASCIA) [18]	Evidence
Previous history	• Anaphylaxis and at risk of ongoing exposure • Mild reaction to "trace" amount of allergen • History of co-factors (e.g. exercise) impacting on reaction severity	• **Anaphylaxis** • Mild reaction to "trace" amount of allergen • **Venom allergy in adults with systemic symptoms**	• **Anaphylaxis and at ongoing risk of exposure** • Generalised urticaria alone without anaphylaxis due to insect sting in adults	Previous anaphylaxis indicates potential for future reactions, although risk of fatal anaphylaxis remains low.[7,15] No evidence that individuals who react to very low amounts of allergen are more likely to experience severe anaphylaxis.[9] Children with local or generalised skin rashes only to venom are at very low risk of anaphylaxis with subsequent stings.[10,38]
Allergen-specific risk factors	• high-risk allergens e.g. nuts • Allergen difficult to avoid	• high-risk allergens e.g. nuts	• high-risk allergens e.g. nuts, seafood	In UK, cow's milk and peanut / tree nuts are the most common cause of fatal anaphylaxis.[2]
Patient-specific risk factors	• Teenage/young adults • Food allergy* to high risk allergens (e.g. nuts) *and* other risk factors (e.g. asthma) • Raised baseline serum tryptase • Limited access to emergency medical care e.g. remote location, social factors	• Teenager or young adult with a food allergy* • **Food allergy* and co-existing unstable or moderate-severe, persistent asthma** • **Underlying mast cell disorders or raised baseline serum tryptase** • Remote from medical help	• Teenagers and young adults with food allergy • **Food allergy* *and* co-existing unstable or moderate-severe, persistent asthma.** • **Underlying mast cell disorders (e.g. systemic mastocytosis or raised baseline serum tryptase)** • Limited access to emergency medical care e.g. remote location, foreign travel. • Cardiovascular disease	Data suggests a specific vulnerability to severe outcomes from food-induced allergic reactions in teenagers and young adults[2,9] Poor asthma control increases risk of severe reactions; most cases of fatal food-induced anaphylaxis have asthma, but asthma itself is poorly predictive of severe outcomes as it is so prevalent in food-allergic individuals.[9] Underlying mast cell disorders are a known risk factor for venom- and idiopathic anaphylaxis.[10,18,38] Remote access to medical support causes delays in emergency treatment.

*excluding pollen food allergy syndrome. Factors in **bold** are specified as "absolute" (EAACI) or "recommended" (ASCIA) indications.

Controversy exists over the number of auto-injectors to be prescribed. The BSACI and ASCIA in general recommend one device (for school children, one device for home and a second for school, while in the USA, physicians will generally prescribe two devices) [10 18]. In 2014, following an extensive review of adrenaline auto-injectors prompted by a coronial inquest, the Medicines and Healthcare products Regulatory Agency (MHRA) issued guidance that individuals at risk of anaphylaxis should carry two adrenaline auto-injectors at all times, due to "uncertainties about the site of drug delivery and the speed of adrenaline action within the body" which, together with device mis-use or malfunction, might result in a second dose being needed [39]. The BSACI guidance (issued after the 2014 statement) recommends a single device on the basis that one dose is usually effective for most reactions. The MHRA recently reiterated its policy [40], in line with new Department of Health guidance for school children at risk of anaphylaxis [41] The MHRA review also addressed a concern that in some individuals (predominantly adolescent and adult females), the needle length in some auto-injectors may be insufficient to deliver an intramuscular (rather than subcutaneous) injection, although data to inform this is limited. At the current time, prescribing practice remains divided amongst UK healthcare professionals.

Myth 8: 'Adrenaline auto-injectors are overprescribed and overused in anaphylaxis'

Auto-injectors are under-used to treat anaphylaxis in the community. In a study of infants aged 3-15 months with anaphylaxis (US definition), adrenaline was administered in under one third, most commonly because the caregiver did not recognise the severity of reaction or the auto-injector was not available.[42] In a UK

study, only 16.7% of young people used an auto-injector to treat anaphylaxis, the most common reason being they did not recognise that the reaction needed treatment with adrenaline.[6] A Scottish study amongst adolescents with previous anaphylaxis reported a number of barriers to the effective use of auto-injectors, including: failure to recognise anaphylaxis; uncertainty and fear over how and when to use the auto-injector; and lack of carriage due to size/design.[43] In the USA, these issues have led to some management plans (by FARE) offering the suggestion to use an adrenaline auto-injector for all reactions *regardless of severity*, but this remains controversial and is not accepted as standard practice amongst many healthcare professionals [44]. It must be noted that anaphylaxis morbidity/mortality is no lower in the USA compared with UK and Australia where adrenaline is only recommended for reactions with respiratory or cardiovascular involvement [37]

Myth 9: Prescription of an adrenaline auto-injector <u>in isolation</u> is lifesaving

Optimal management of food allergic patients and treatment of anaphylaxis has many facets and is not limited to a prescription for an adrenaline auto-injector. Improving patient/carer knowledge on the recognition and treatment of anaphylaxis, and addressing the complex psychosocial dimensions of allergic emergencies, form the cornerstone of successful anaphylaxis management.[6,43] One third of fatalities in the UK occur despite timely adrenaline administration [21]. Adrenaline auto-injectors potentially buy valuable minutes while an emergency medical response is summonsed. Such devices need to be prescribed as part of a comprehensive management plan, which includes advice on dietary avoidance and on when to administer adrenaline. **Patients and their families need to be told to use their auto-injector in the event of *any* respiratory symptoms, where anaphylaxis might the**

cause, irrespective of severity. Patients with asthma may not realise the importance of this; they may perceive mild wheezing following food allergen exposure as equivalent to their routine symptoms. Patients and their families "need to be provided with more constructive strategies and support, than merely being told to 'use your pen" [44].

The BSACI management plans are available for download at http://www.bsaci.org/about/pag-allergy-action-plans-for-children, and were recently updated to take into account changes in UK-wide legislation allowing the use of "spare" adrenaline auto-injectors in schools. The BSACI plans, correctly completed, meet the requirements of the legislation and UK healthcare professionals are encouraged to use these plans where possible. Further information is available at www.sparepensinschools.uk.

Correct positioning of the patient is important in anaphylaxis,[8,26] something highlighted in MHRA guidance. Case series have highlighted the potential for a change in posture (e.g. from sitting or lying to standing) to trigger decompensation and fatal event in some patients. Lying the patient supine with the lower limbs elevated will increase venous return and cardiac output. Patients with respiratory symptoms can be allowed to sit if this improves comfort, with their lower limbs elevated where possible. Sudden standing must be avoided, and patients with anaphylaxis must not be instructed to walk to a first aid room to use their auto-injector, as this may increase the risk of death.[8,26,37]

Myth 10: 'MMR and influenza vaccination are contraindicated in patients with previous anaphylaxis to egg'

A common misconception is that the influenza and MMR vaccines cannot be given to egg-allergic children, in particular those with previous anaphylaxis. The MMR vaccine is grown in chick fibroblast cell lines and does not contain detectable egg protein. Egg allergy, however severe, is not a contraindication [45]. Influenza vaccines are prepared from viruses grown in embryonated hen's eggs, and can contain very low levels of ovalbumin. However, recent data has confirmed that both injected and intranasal forms of the vaccine are safe in egg-allergic children, including those with previous anaphylaxis [46 47]. The 'Green Book' [48] and US guidelines [46] now advise that these vaccines can be administered in primary care (or, in the case of the intranasal vaccine, schools), with the usual precautions taken for any vaccination. The only exception is those with previous life-threatening reactions to egg requiring intensive care, in whom there is little safety data (such reactions to egg are vanishingly rare); in any event, these patients (and their carers) may be better reassured if the vaccine is administered in hospital.

In contrast, yellow fever vaccine does contain small amounts of egg protein and has been reported to trigger anaphylaxis in some egg-allergic individuals. Desensitisation protocols for use in specialist centres are available [49], but administration is complicated by the need for such centres to be authorised to provide WHO certification. Currently the authors are aware of only one UK paediatric centre (Evelina Hospital, London) where WHO certification can be issued following successful administration.

Conclusions

Anaphylaxis is a severe, potentially life-threatening systemic allergic reaction, which constitutes a clinical emergency. Common misconceptions regarding anaphylaxis are summarised in Table 3. Prompt assessment and management are essential, as delays in treatment are associated with fatal outcomes. Anaphylaxis is primarily a clinical diagnosis: patients/carers and health professionals must be appropriately trained to recognize and institute appropriate treatment with intramuscular adrenaline, as part of a comprehensive management plan. Adrenaline is the first line treatment for anaphylaxis, but is underused. Changes in posture have been documented as a trigger for decompensation and fatal anaphylaxis. New management plans incorporating this advice, and which allow the use of "spare" auto-injectors in schools, are available from the BSACI and via www.sparepensinschools.uk.

Abbreviations

IM: intramuscular

MMR: Measles/Mumps/Rubella vaccine

NIAID: National Institute of Allergy and Infectious Diseases

Contributors

KA and PJT jointly wrote the manuscript and approved the final version.

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Competing interests

PJT co-led a taskforce of healthcare professionals (including the RCPCH) and representatives of patient support organisations which worked with the UK Departments of Health to introduce legislation allowing the provision of "spare" emergency adrenaline auto-injectors in schools, and helped develop guidance around this including the www.sparepensinschools.uk website.

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Table 3: Common misconceptions in anaphylaxis and what current evidence reveals.

Common 'myths'	What evidence tells us
Myth 1: Anaphylaxis often results in death.	Anaphylaxis can be life-threatening, but the majority of reactions do not result in severe outcomes.
Myth 2: There are no hives so it can't be anaphylaxis.	Cutaneous symptoms (most commonly urticaria or 'hives') are absent in around 10% of anaphylaxis reactions.
Myth 3: No trigger for the reaction is identified, therefore it is not anaphylaxis.	In around 20% of cases, no trigger is identified; this is known as idiopathic anaphylaxis.
Myth 4: Adrenaline is dangerous.	Adrenaline given by intramuscular injection into the outer mid-thigh is very safe.
Myth 5: Antihistamines can be used to treat anaphylaxis initially; adrenaline is only needed if symptoms worsen.	Adrenaline, not antihistamines, is the first line treatment for anaphylaxis.
Myth 6: Corticosteroids prevent delayed or biphasic reactions in anaphylaxis.	There is insufficient evidence to support the use of corticosteroids prevent delayed or biphasic reactions in anaphylaxis.
Myth 7: Only children who have had	It is very difficult – if not impossible –

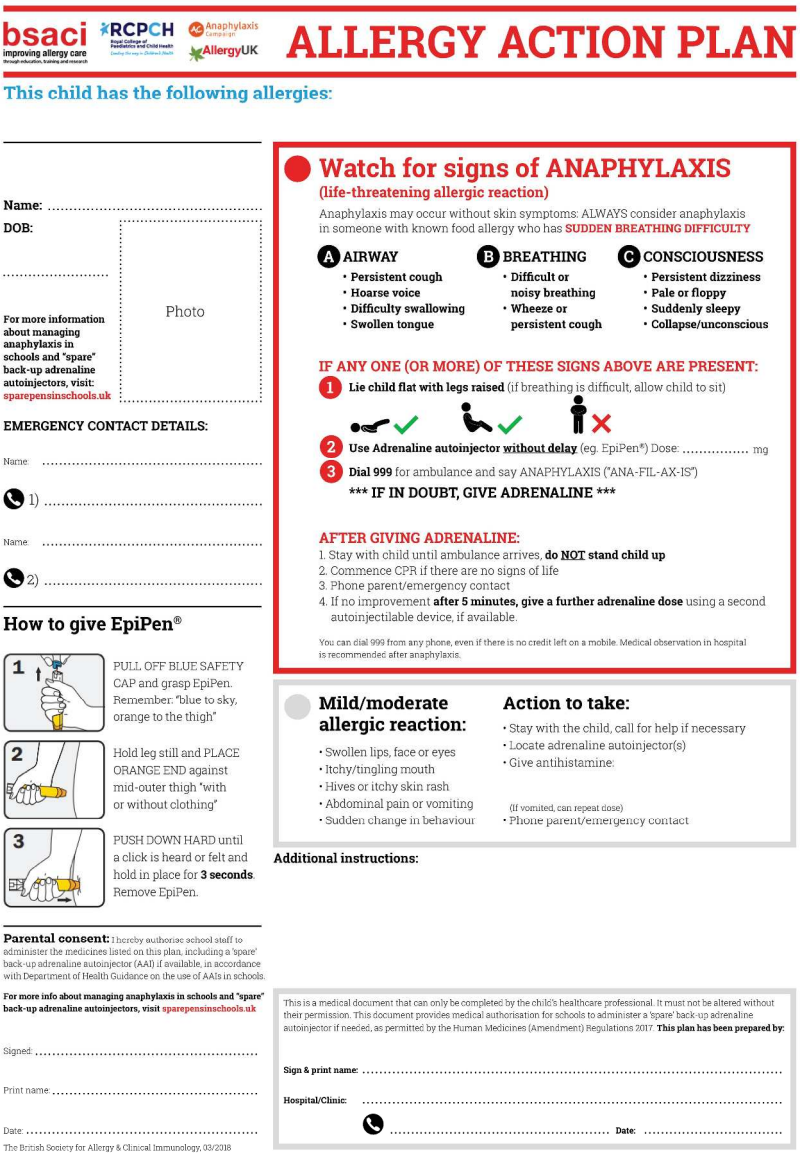
anaphylaxis need an adrenaline auto-injector.	to accurately predict who is at risk of severe anaphylaxis.
Myth 8: Adrenaline auto-injectors are overprescribed and overused in anaphylaxis.	Auto-injectors are under-used to treat anaphylaxis in the community.
Myth 9: Prescription of an adrenaline auto-injector in isolation is life-saving.	Optimal management of food allergic patients and treatment of anaphylaxis has many facets and is not limited to a prescription for an adrenaline auto-injector.
Myth 10: MMR and influenza vaccination are contraindicated in patients with previous anaphylaxis to egg.	Both vaccines are safe to administer in egg-allergic children, including those with previous anaphylaxis.

FIGURE LEGENDS

Figure 1: Allergy Action Plan from the British Society for Allergy and Clinical Immunology / Royal College of Paediatrics and Child Health. Available at www.sparepensinschools.uk or http://www.bsaci.org/about/pag-allergy-action-plans-for-children

Figure 2: Acute management of anaphylaxis. Panel A: current UK Resuscitation Council algorithm. Panel B: suggested amended algorithm by the authors which emphasises the need for further doses of intramuscular adrenaline in the event of ongoing anaphylaxis symptoms and incorporates a low dose adrenaline infusion protocol used widely in Australia and Spain (with permission, from Brown SG, Emerg Med Australas. 2006;18:155-69).

Figure 3: Risk factors for severe reactions. Reproduced with permission from reference 35.



bsaci improving allergy care · RCPCH Royal College of Paediatrics and Child Health · Anaphylaxis Campaign · AllergyUK

ALLERGY ACTION PLAN

This child has the following allergies:

Name: .....

DOB: .....

Photo

For more information about managing anaphylaxis in schools and "spare" back-up adrenaline autoinjectors, visit: sparepensinschools.uk

EMERGENCY CONTACT DETAILS:

Name: .....

1) .....

Name: .....

2) .....

How to give EpiPen®

1. PULL OFF BLUE SAFETY CAP and grasp EpiPen. Remember: "blue to sky, orange to the thigh"
2. Hold leg still and PLACE ORANGE END against mid-outer thigh "with or without clothing"
3. PUSH DOWN HARD until a click is heard or felt and hold in place for **3 seconds**. Remove EpiPen.

Parental consent: I hereby authorise school staff to administer the medicines listed on this plan, including a 'spare' back-up adrenaline autoinjector (AAI) if available, in accordance with Department of Health Guidance on the use of AAIs in schools.

For more info about managing anaphylaxis in schools and "spare" back-up adrenaline autoinjectors, visit sparepensinschools.uk

Signed: .....

Print name: .....

Date: .....

The British Society for Allergy & Clinical Immunology, 03/2018

Watch for signs of ANAPHYLAXIS

(life-threatening allergic reaction)

Anaphylaxis may occur without skin symptoms: ALWAYS consider anaphylaxis in someone with known food allergy who has **SUDDEN BREATHING DIFFICULTY**

A AIRWAY	B BREATHING	C CONSCIOUSNESS
• Persistent cough	• Difficult or noisy breathing	• Persistent dizziness
• Hoarse voice	• Wheeze or persistent cough	• Pale or floppy
• Difficulty swallowing		• Suddenly sleepy
• Swollen tongue		• Collapse/unconscious

IF ANY ONE (OR MORE) OF THESE SIGNS ABOVE ARE PRESENT:

1. **Lie child flat with legs raised** (if breathing is difficult, allow child to sit)
2. **Use Adrenaline autoinjector without delay** (eg. EpiPen®) Dose: ..... mg
3. **Dial 999** for ambulance and say ANAPHYLAXIS ("ANA-FIL-AX-IS")

***** IF IN DOUBT, GIVE ADRENALINE *****

AFTER GIVING ADRENALINE:

1. Stay with child until ambulance arrives, **do NOT stand child up**
2. Commence CPR if there are no signs of life
3. Phone parent/emergency contact
4. If no improvement **after 5 minutes, give a further adrenaline dose** using a second autoinjectilable device, if available.

You can dial 999 from any phone, even if there is no credit left on a mobile. Medical observation in hospital is recommended after anaphylaxis.

Mild/moderate allergic reaction:	Action to take:
• Swollen lips, face or eyes	• Stay with the child, call for help if necessary
• Itchy/tingling mouth	• Locate adrenaline autoinjector(s)
• Hives or itchy skin rash	• Give antihistamine:
• Abdominal pain or vomiting	(If vomited, can repeat dose)
• Sudden change in behaviour	• Phone parent/emergency contact

Additional instructions:

This is a medical document that can only be completed by the child's healthcare professional. It must not be altered without their permission. This document provides medical authorisation for schools to administer a 'spare' back-up adrenaline autoinjector if needed, as permitted by the Human Medicines (Amendment) Regulations 2017. **This plan has been prepared by:**

Sign & print name: .....

Hospital/Clinic: .....

..... **Date:** .....

Figure 1: Allergy Action Plan from the British Society for Allergy and Clinical Immunology / Royal College of Paediatrics and Child Health. Available at www.sparepensinschools.uk or http://www.bsaci.org/about/pag-allergy-action-plans-for-children

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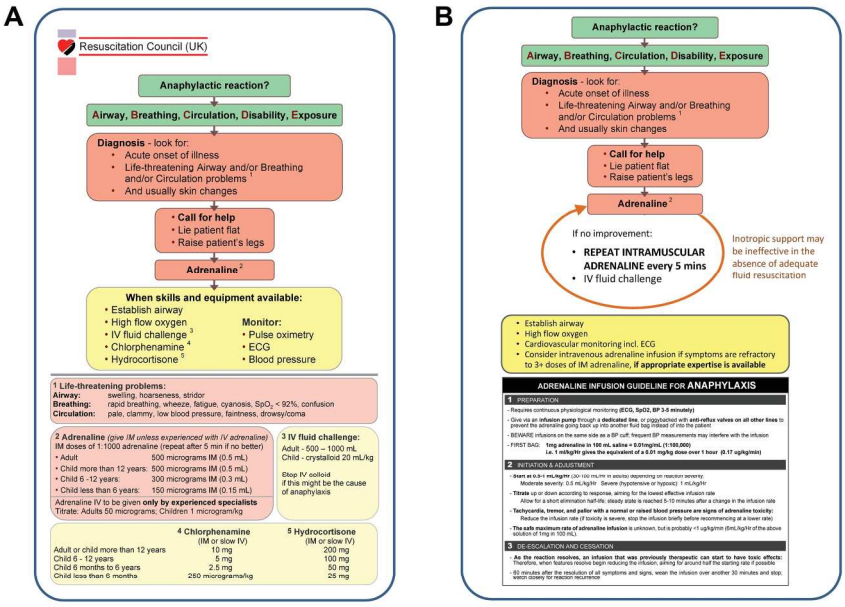

(A) UK Resuscitation Council Algorithm

(B) Modified algorithm proposed by the authors

Figure 2: Acute management of anaphylaxis. Panel A: current UK Resuscitation Council algorithm. Panel B: suggested amended algorithm by the authors which emphasises the need for further doses of intramuscular adrenaline in the event of ongoing anaphylaxis symptoms and incorporates a low dose adrenaline infusion protocol used widely in Australia and Spain (with permission, from Brown SG, Emerg Med Australas. 2006;18:155-69).

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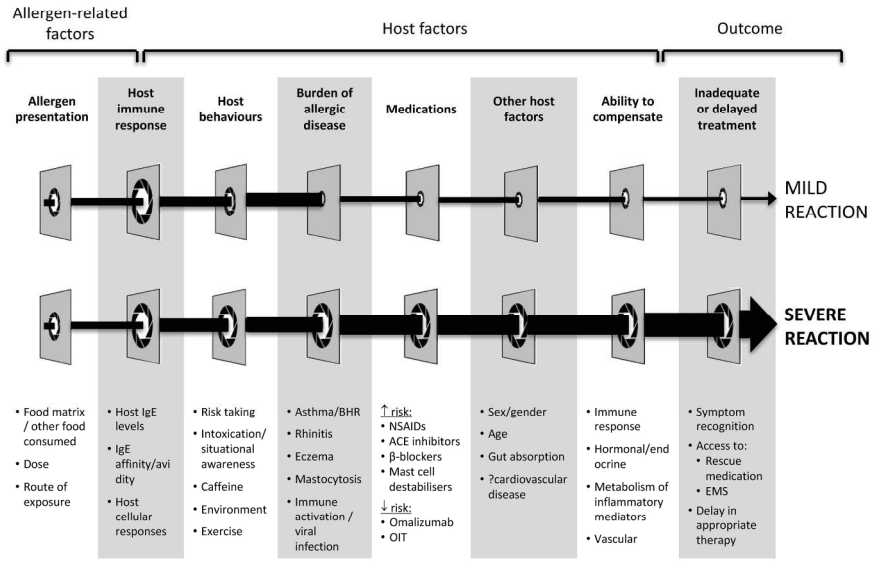

Figure 3: Risk factors for severe reactions. Reproduced with permission from reference 35.

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