Resuscitation Council (UK)

Emergency treatment of anaphylactic reactions

Guidelines for healthcare providers

Working Group of the Resuscitation Council (UK)

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Executive summary

- The UK incidence of anaphylactic reactions is increasing.
- Patients who have an anaphylactic reaction have life-threatening airway and/or breathing and/or circulation problems usually associated with skin and mucosal changes.
- Patients having an anaphylactic reaction should be recognised and treated using the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach.
- Anaphylactic reactions are not easy to study with randomised controlled trials. There are, however, systematic reviews of the available evidence and a wealth of clinical experience to help formulate guidelines.
- The exact treatment will depend on the patient's location, the equipment and drugs available, and the skills of those treating the anaphylactic reaction.
- Early treatment with intramuscular adrenaline is the treatment of choice for patients having an anaphylactic reaction.
- Despite previous guidelines, there is still confusion about the indications, dose and route of adrenaline.
- Intravenous adrenaline must only be used in certain specialist settings and only by those skilled and experienced in its use.
- All those who are suspected of having had an anaphylactic reaction should be referred to a specialist in allergy.
- Individuals who are at high risk of an anaphylactic reaction should carry an adrenaline auto-injector and receive training and support in its use.
- There is a need for further research about the diagnosis, treatment and prevention of anaphylactic reactions.

Summary of changes from previous guideline

This guideline replaces the previous guideline from the Resuscitation Council (UK): *The emergency medical treatment of anaphylactic reactions for first medical responders and for community nurses (originally published July 1999, revised January 2002, May 2005).*[1]

- The recognition and treatment of an anaphylactic reaction has been simplified.
- The use of an Airway, Breathing, Circulation, Disability, Exposure (ABCDE)* approach to recognise and treat an anaphylactic reaction has been introduced.
- The early use of intramuscular adrenaline by most rescuers to treat an anaphylactic reaction is emphasized.
- The use of intravenous adrenaline to treat an anaphylactic reaction is clarified. It must only be used by those skilled and experienced in its use in certain specialist settings.
- The age ranges and doses for adrenaline, hydrocortisone and chlorphenamine have been simplified.

*See Appendix 1 for more information about the ABCDE approach.

1. Introduction

1.1 Purpose of this guideline

The UK incidence of anaphylactic reactions is rising.[2] Despite previous guidelines, there is confusion about the diagnosis, treatment, investigation and follow-up of patients who have an anaphylactic reaction.[3-5]

This guideline replaces the previous guidance from the Resuscitation Council UK: *The emergency medical treatment of anaphylactic reactions for first medical responders and for community nurses (originally published July 1999, revised January 2002, May 2005).*[1]

This guideline gives:

- An updated consensus about the recognition and treatment of anaphylactic reactions.
- A greater focus on the treatments that a patient having an anaphylactic reaction should receive. There is less emphasis on specifying treatments according to which specific groups of healthcare providers should give them.
- Recommendations for treatment that are simple to learn and easy to implement, and that will be appropriate for most anaphylactic reactions.

There are no randomised controlled clinical trials in humans providing unequivocal evidence for the treatment of anaphylactic reactions; moreover, such evidence is unlikely to be forthcoming in the near future. Nonetheless, there is a wealth of experience and systematic reviews of the limited evidence that can be used as a resource.[6]

This guideline will not cover every possible scenario involving an anaphylactic reaction; the guidance has been written to be as simple as possible to enable improved teaching, learning and implementation. Improved implementation should benefit more patients who have an anaphylactic reaction.

1.2 Scope of this guideline

This guideline is for healthcare providers who are expected to deal with an anaphylactic reaction during their usual clinical role (e.g., doctors, nurses, paramedics) working in the hospital or out-of-hospital setting. There is considerable variation and overlap between the skills and knowledge of different healthcare providers who are expected to treat an anaphylactic reaction. We have therefore deliberately not developed guidelines for specific groups of healthcare provider.

Individuals who are involved in resuscitation regularly are more likely to have advanced resuscitation skills than those who are not. This guideline does not expect individuals to obtain intravenous access in an emergency if this is not part of their usual role. Rather, individuals should use skills that they know and use regularly. This will make it more likely that these skills are used effectively on the rare occasions when they are needed to treat an anaphylactic reaction. Any extra skills specifically for the treatment of a patient with an anaphylactic reaction should be reasonably easy to learn, remember and implement (e.g., intramuscular (IM) injection of adrenaline).

The Association of Anaesthetists of Great Britain & Ireland and the British Society for Allergy and Clinical Immunology have published specific guidance for the treatment of anaphylactic reactions associated with anaesthesia (www.aagbi.org and www.bsaci.org).

There is also specific guidance for managing medicines in schools, nurseries and similar settings (www.medicalconditionsatschool.org.uk (www.allergyinschools.org.uk no longer available)).[7 8]

The treatment of a patient having an anaphylactic reaction in any setting is the same for children and adults.[9] Any differences will be highlighted.

1.3 Key points

Treatment of an anaphylactic reaction should be based on general life support principles:

- Use the Airway, Breathing, Circulation, Disability, Exposure (ABCDE*) approach to recognise and treat problems.
- Call for help early.
- Treat the greatest threat to life first.
- Initial treatments should not be delayed by the lack of a complete history or definite diagnosis.

Patients having an anaphylactic reaction in any setting should expect the following as a minimum:

- Recognition that they are seriously unwell.
- An early call for help.
- Initial assessment and treatments based on an ABCDE* approach.
- Adrenaline therapy if indicated.
- Investigation and follow-up by an allergy specialist.

*See Appendix 1 for more information about the ABCDE approach.

1.4 Methods

Organisations involved in the previous guidelines nominated individuals for the Working Group. The co-chairs (appointed by the Executive Committee of the Resuscitation Council UK) identified the key issues that needed to be addressed based on review of the previous guidelines and a database of frequently asked questions and comments.[10] The group met in January and November 2007. Draft versions of the document were discussed within the group by email. Experts from outside the group were consulted for specific issues.

A draft version of the guideline was made available for comment on the Resuscitation Council (UK) website (www.resus.org.uk) between 25th September and 4th November 2007. The document was accessed 15,432 times in this period. The feedback was reviewed at the November working group meeting and the document updated. This guideline was made available on the Resuscitation Council (UK) website in January 2008.

2. Anaphylaxis

2.1 Definition of anaphylaxis

A precise definition of anaphylaxis is not important for the emergency treatment of an anaphylactic reaction. There is no universally agreed definition. The European Academy of Allergology and Clinical Immunology Nomenclature Committee proposed the following broad definition: [11]

Anaphylaxis is a severe, life-threatening, generalised or systemic hypersensitivity reaction.

This is characterised by rapidly developing life-threatening airway and/or breathing and/or circulation problems usually associated with skin and mucosal changes.

2.2 Epidemiology

One of the problems is that anaphylaxis is not always recognised, so certain UK studies may underestimate the incidence. Also, as the criteria for inclusion vary in different studies and countries, a picture has to be built up from different sources.

Incidence rate

The American College of Allergy, Asthma and Immunology Epidemiology of Anaphylaxis Working group summarised the findings from a number of important international epidemiological studies and concluded that the overall frequency of episodes of anaphylaxis using current data lies between 30 and 950 cases per 100,000 persons per year.[12]

Lifetime prevalence

The same group provided data indicating a lifetime prevalence of between 50 and 2000 episodes per 100,000 persons or 0.05-2.0%.[12] More recent UK primary care data concur, indicating a lifetime age-standardised prevalence of a recorded diagnosis of anaphylaxis of 75.5 per 100,000 in 2005.[13] Calculations based on these data indicate that approximately 1 in 1,333 of the English population have experienced anaphylaxis at some point in their lives.

Other data

A retrospective study of Emergency department attendances, identifying only the most severe cases, and relating this number to the population served, estimated that approximately 1 in 3,500 patients had an episode of anaphylaxis during the study period 1993-4.[14] Taking specific causes of anaphylaxis where prevalence and

severity data are available, there are 1 million cases of venom anaphylaxis and 0.4 million cases of nut anaphylaxis up to age 44 years worldwide.

Triggers

Anaphylaxis can be triggered by any of a very broad range of triggers, but those most commonly identified include food, drugs and venom.[15] The relative importance of these varies very considerably with age, with food being particularly important in children and medicinal products being much more common triggers in older people.[16] Virtually any food or class of drug can be implicated, although the classes of foods and drugs responsible for the majority of reactions are well described.[17] Of foods, nuts are the most common cause; muscle relaxants, antibiotics, NSAIDs and aspirin are the most commonly implicated drugs (Table 1). It is important to note that, in many cases, no cause can be identified. A significant number of cases of anaphylaxis are idiopathic (non-IgE mediated).

Stings	**47**	29 wasp, 4 bee, 14 unknown
Nuts	**32**	10 peanut, 6 walnut, 2 almond, 2 brazil, 1 hazel, 11 mixed or unknown
Food	**13**	5 milk, 2 fish, 2 chickpea, 2 crustacean, 1 banana, 1 snail
Food possible cause	**17**	5 during meal, 3 milk, 3 nut, 1 each - fish, yeast, sherbet, nectarine, grape, strawberry
Antibiotics	**27**	11 penicillin, 12 cephalosporin, 2 amphotericin, 1 ciprofloxacin, 1 vancomycin
Anaesthetic drugs	**39**	19 suxamethonium, 7 vecuronium, 6 atracurium, 7 at induction
Other drugs	**24**	6 NSAID, 3 ACEI, 5 gelatins, 2 protamine, 2 vitamin K, 1 each - etoposide, acetazolamide, pethidine, local anaesthetic, diamorphine, streptokinase
Contrast media	**11**	9 iodinated, 1 technetium, 1 fluorescein
Other	**3**	1 latex, 1 hair dye, 1 hydatid

Table 1. Suspected triggers for fatal anaphylactic reactions in the UK between 1992-2001[15]

NSAID – Non steroidal anti-inflammatory drug
ACEI – Angiotensin Converting Enzyme Inhibitor

Mortality

The overall prognosis of anaphylaxis is good, with a case fatality ratio of less than 1% reported in most population-based studies.[18-20] Risk of death is, however, increased in those with pre-existing asthma, particularly if the asthma is poorly controlled or in those asthmatics who fail to use, or delay treatment with, adrenaline.[21] There are approximately 20 anaphylaxis deaths reported each year in the UK, although this may be a substantial under-estimate.

Risk of recurrence

The risk of an individual suffering recurrent anaphylactic reaction appears to be quite substantial, being estimated at approximately 1 in 12 per year.[22]

Trends over time

There are very limited data on trends in anaphylaxis internationally, but data indicate a dramatic increase in the rate of hospital admissions for anaphylaxis, this increasing from 0.5 to 3.6 admissions per 100,000 between 1990 and 2004: an increase of 700% (Figure 1).[23 24]

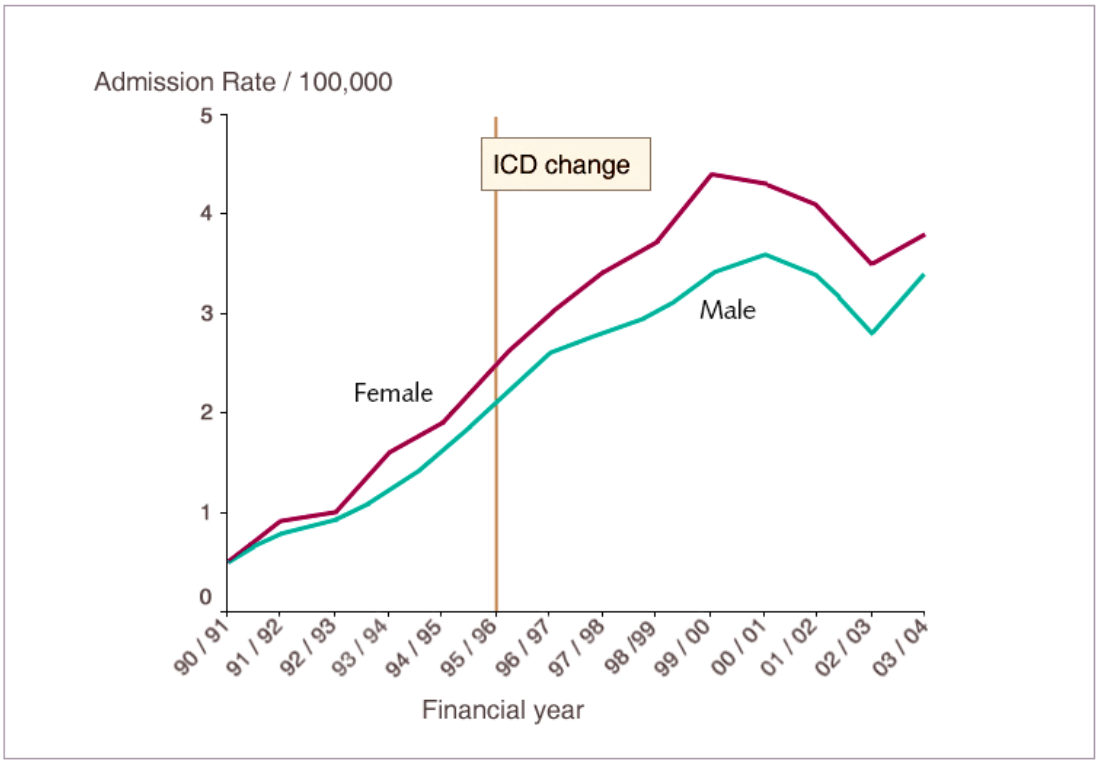


Figure 1. Hospital admission rates for anaphylaxis, 1990 to 2004, England

ICD – International Classification of Diseases (www.who.int/classifications/icd/en)

Time course for fatal anaphylactic reactions

When anaphylaxis is fatal, death usually occurs very soon after contact with the trigger. From a case-series, fatal food reactions cause respiratory arrest typically after 30–35 minutes; insect stings cause collapse from shock after 10–15 minutes; and deaths caused by intravenous medication occur most commonly within five minutes. Death never occurred more than six hours after contact with the trigger (Figure 2).[25]

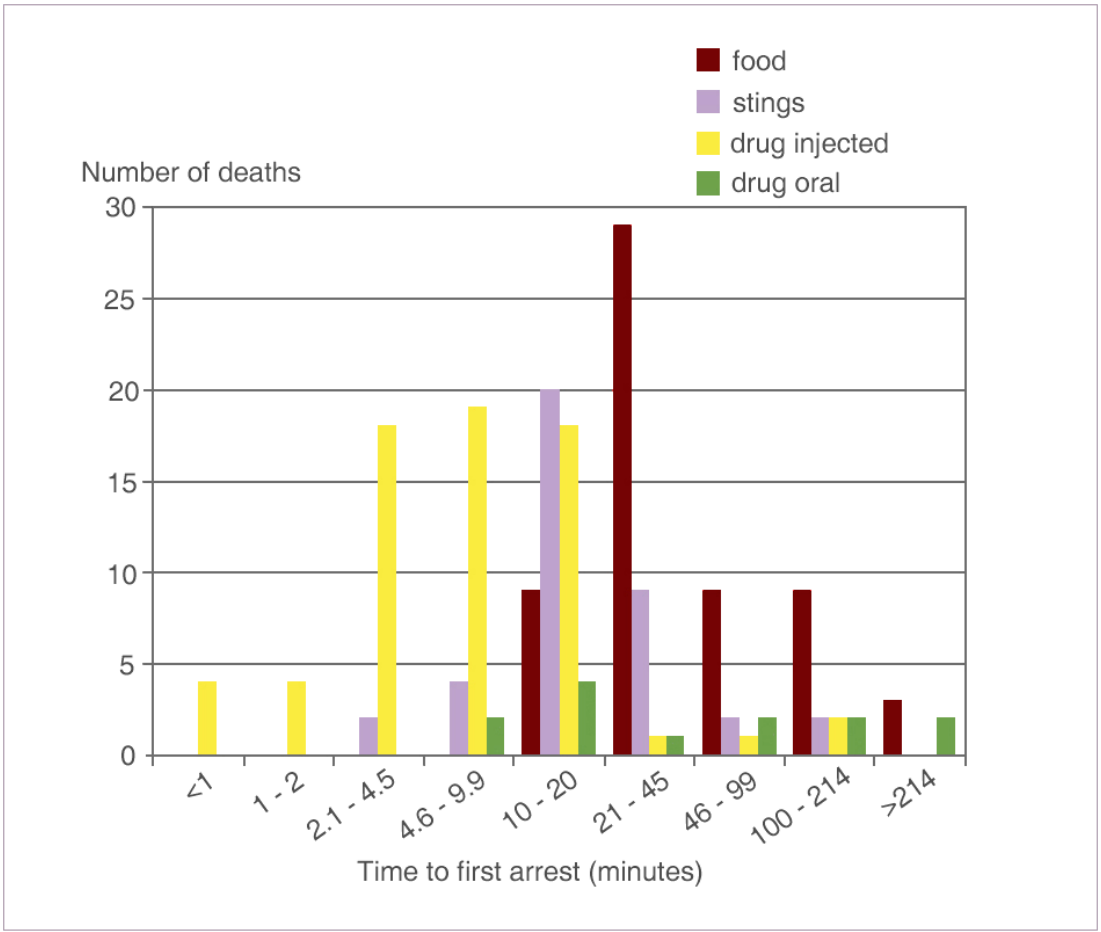


Figure 2. Time to cardiac arrest following exposure to triggering agent [25]

3. Recognition of an anaphylactic reaction

A diagnosis of anaphylactic reaction is likely if a patient who is exposed to a trigger (allergen) develops a sudden illness (usually within minutes of exposure) with rapidly progressing skin changes and life-threatening airway and/or breathing and/or circulation problems. The reaction is usually unexpected.

The lack of any consistent clinical manifestation and a range of possible presentations cause diagnostic difficulty. Many patients with a genuine anaphylactic reaction are not given the correct treatment.[26] Patients have been given injections of adrenaline inappropriately for allergic reactions just involving the skin, or for vasovagal reactions or panic attacks.[4] Diagnostic problems have arisen particularly in children. Guidelines for the treatment of an anaphylactic reaction must therefore take into account some inevitable diagnostic errors, with an emphasis on the need for safety.

A single set of criteria will not identify all anaphylactic reactions. There is a range of signs and symptoms, none of which are entirely specific for an anaphylactic reaction; however, certain combinations of signs make the diagnosis of an anaphylactic reaction more likely.[27] When recognising and treating any acutely ill patient, a rational ABCDE approach must be followed and life-threatening problems treated as they are recognised (see Appendix 1 for more information about the ABCDE approach).

3.1 Anaphylaxis is likely when all of the following 3 criteria are met:

- Sudden onset and rapid progression of symptoms
- Life-threatening Airway and/or Breathing and/or Circulation problems
- Skin and/or mucosal changes (flushing, urticaria, angioedema)

The following supports the diagnosis:

- Exposure to a known allergen for the patient

Remember:

- Skin or mucosal changes alone are not a sign of an anaphylactic reaction
- Skin and mucosal changes can be subtle or absent in up to 20% of reactions (some patients can have only a decrease in blood pressure, i.e., a Circulation problem)
- There can also be gastrointestinal symptoms (e.g. vomiting, abdominal pain, incontinence)

Confusion arises because some patients have systemic allergic reactions that are less severe. For example, generalised urticaria, angioedema, and rhinitis would not be described as an anaphylactic reaction, because the life-threatening features –- an airway problem, respiratory difficulty (breathing problem) and hypotension (circulation problem) –- are not present.

3.2 Sudden onset and rapid progression of symptoms

- The patient will feel and look unwell.
- Most reactions occur over several minutes. Rarely, reactions may be slower in onset.
- The time of onset of an anaphylactic reaction depends on the type of trigger. An intravenous trigger will cause a more rapid onset of reaction than stings which, in turn, tend to cause a more rapid onset than orally ingested triggers (Figure 2).[25]
- The patient is usually anxious and can experience a "sense of impending doom".[28]

3.3 Life-threatening Airway and/or Breathing and/or Circulation problems

Patients can have either an A or B or C problem or any combination. Use the ABCDE approach to recognise these.

Airway problems:

- Airway swelling, e.g., throat and tongue swelling (pharyngeal/laryngeal oedema). The patient has difficulty in breathing and swallowing and feels that the throat is closing up.
- Hoarse voice.
- Stridor – this is a high-pitched inspiratory noise caused by upper airway obstruction.

Breathing problems:

- Shortness of breath – increased respiratory rate.
- Wheeze.
- Patient becoming tired.
- Confusion caused by hypoxia.
- Cyanosis (appears blue) – this is usually a late sign.
- Respiratory arrest.

There is a range of presentation from anaphylaxis, through anaphylaxis with predominantly asthmatic features, to a pure acute asthma attack with no other features of anaphylaxis. Life-threatening asthma with no features of anaphylaxis can be triggered by food allergy.[29] Anaphylaxis can present as a primary respiratory arrest.[15 25]

Circulation problems:

- Signs of shock – pale, clammy.
- Increased pulse rate (tachycardia).
- Low blood pressure (hypotension) – feeling faint (dizziness), collapse.
- Decreased conscious level or loss of consciousness.
- Anaphylaxis can cause myocardial ischaemia and electrocardiograph (ECG) changes even in individuals with normal coronary arteries.[30]
- Cardiac arrest.

Circulation problems (often referred to as anaphylactic shock) can be caused by direct myocardial depression, vasodilation and capillary leak, and loss of fluid from the circulation. Bradycardia (a slow pulse) is usually a late feature, often preceding cardiac arrest.[31]

The circulatory effects do not respond, or respond only transiently, to simple measures such as lying the patient down and raising the legs. Patients with anaphylaxis can deteriorate if made to sit up or stand up.[32]

The above Airway, Breathing and Circulation problems can all alter the patient's neurological status (**Disability problems**) because of decreased brain perfusion. There may be confusion, agitation and loss of consciousness.

Patients can also have gastro-intestinal symptoms (abdominal pain, incontinence, vomiting).

3.4 Skin and/or mucosal changes

These should be assessed as part of the **Exposure** when using the ABCDE approach.

- They are often the first feature and present in over 80% of anaphylactic reactions.[33]
- They can be subtle or dramatic.
- There may be just skin, just mucosal, or both skin and mucosal changes.
- There may be erythema – a patchy, or generalised, red rash.
- There may be urticaria (also called hives, nettle rash, weals or welts), which can appear anywhere on the body. The weals may be pale, pink or red, and may look like nettle stings. They can be different shapes and sizes, and are often surrounded by a red flare. They are usually itchy.

- Angioedema is similar to urticaria but involves swelling of deeper tissues, most commonly in the eyelids and lips, and sometimes in the mouth and throat.

Although skin changes can be worrying or distressing for patients and those treating them, skin changes without life-threatening airway, breathing or circulation problems do not signify an anaphylactic reaction. Reassuringly, most patients who have skin changes caused by allergy do not go on to develop an anaphylactic reaction.

3.5 Differential diagnosis

Life-threatening conditions:

- Sometimes an anaphylactic reaction can present with symptoms and signs that are very similar to life-threatening asthma – this is commonest in children.
- A low blood pressure (or normal in children) with a petechial or purpuric rash can be a sign of septic shock.
- Seek help early if there are any doubts about the diagnosis and treatment.
- Following an ABCDE approach will help with treating the differential diagnoses.

Non life-threatening conditions (these usually respond to simple measures):

- Faint (vasovagal episode).
- Panic attack.
- Breath-holding episode in child.
- Idiopathic (non-allergic) urticaria or angioedema.

There can be confusion between an anaphylactic reaction and a panic attack. Victims of previous anaphylaxis may be particularly prone to panic attacks if they think they have been re-exposed to the allergen that caused a previous problem. The sense of impending doom and breathlessness leading to hyperventilation are symptoms that resemble anaphylaxis in some ways. While there is no hypotension, pallor, wheeze, or urticarial rash or swelling, there may sometimes be flushing or blotchy skin associated with anxiety adding to the diagnostic difficulty. Diagnostic difficulty may also occur with vasovagal attacks after immunisation procedures, but the absence of rash, breathing difficulties, and swelling are useful distinguishing features, as is the slow pulse of a vasovagal attack compared with the rapid pulse of a severe anaphylactic episode. Fainting will usually respond to lying the patient down and raising the legs.

4. Treatment of an anaphylactic reaction

As the diagnosis of anaphylaxis is not always obvious, all those who treat anaphylaxis must have a systematic approach to the sick patient. In general, the clinical signs of critical illness are similar whatever the underlying process because they reflect failing respiratory, cardiovascular, and neurological systems, i.e., ABCDE problems. Use an ABCDE approach to recognise and treat an anaphylactic reaction. Treat life-threatening problems as you find them. The basic principles of treatment are the same for all age groups.

4.1 The specific treatment of an anaphylactic reaction depends on:

1. Location.
2. Training and skills of rescuers.
3. Number of responders.
4. Equipment and drugs available.

Location

Treating a patient with anaphylaxis in the community will not be the same as in an acute hospital. Out of hospital, an ambulance must be called early and the patient transported to an emergency department.

Training of rescuers

All clinical staff should be able to call for help and initiate treatment in a patient with an anaphylactic reaction. Rescuers must use the skills for which they are trained. Clinical staff who give parenteral medications should have initial training and regular updates in dealing with anaphylactic reactions. The Health Protection Agency recommends that staff who give immunisations should have annual updates.[34]

Number of responders

The single responder must always ensure that help is coming. If there are several rescuers, several actions can be undertaken simultaneously.

Equipment and drugs available

Resuscitation equipment and drugs to help with the rapid resuscitation of a patient with an anaphylactic reaction must be immediately available in all clinical settings. Clinical staff should be familiar with the equipment and drugs they have available and should check them regularly.

All patients who have had an anaphylactic reaction should be monitored (e.g., by ambulance crew, in the emergency department etc,) as soon as possible. Minimal monitoring includes pulse oximetry, non-invasive blood pressure and 3-lead ECG. Monitoring must be supervised by an individual who is skilled at interpreting and responding to any changes.

4.2 Patients having an anaphylactic reaction in any setting should expect the following as a minimum:

1. Recognition that they are seriously unwell.
2. An early call for help.
3. Initial assessment and treatments based on an ABCDE approach.
4. Adrenaline therapy if indicated.
5. Investigation and follow-up by an allergy specialist.

4.3 Patient positioning

All patients should be placed in a comfortable position. The following factors should be considered:

- Patients with Airway and Breathing problems may prefer to sit up as this will make breathing easier.
- Lying flat with or without leg elevation is helpful for patients with a low blood pressure (Circulation problem). If the patient feels faint, do not sit or stand them up - this can cause cardiac arrest.[32]
- Patients who are breathing and unconscious should be placed on their side (recovery position).
- Pregnant patients should lie on their left side to prevent caval compression.[35]

4.4 Remove the trigger if possible

Removing the trigger for an anaphylactic reaction is not always possible.

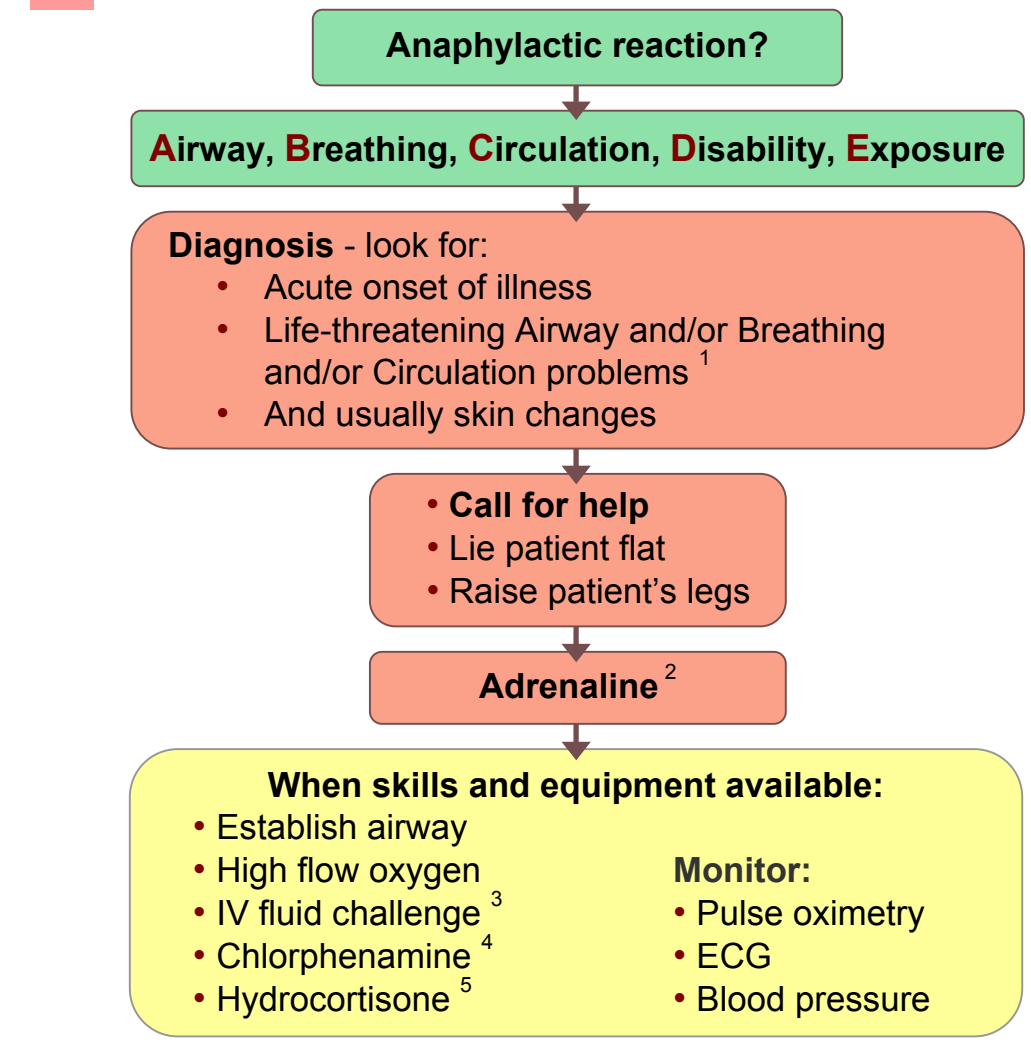
- Stop any drug suspected of causing an anaphylactic reaction (e.g., stop intravenous infusion of a gelatin solution or antibiotic).
- Remove the stinger after a bee sting. Early removal is more important than the method of removal.[36]
- After food-induced anaphylaxis, attempts to make the patient vomit are not recommended.
- Do not delay definitive treatment if removing the trigger is not feasible.

4.5 Cardiorespiratory arrest following an anaphylactic reaction

Start cardiopulmonary resuscitation (CPR) immediately and follow current guidelines.[35 37 38] Rescuers should ensure that help is on its way as early advanced life support (ALS) is essential. Use doses of adrenaline recommended in the ALS guidelines. The intramuscular route for adrenaline is not recommended after cardiac arrest has occurred.

4.6 Anaphylaxis algorithm

The key steps for the treatment of an anaphylactic reaction are shown in the algorithm (Figure 3) on the next page.



1 Life-threatening problems:

Airway:	swelling, hoarseness, stridor
Breathing:	rapid breathing, wheeze, fatigue, cyanosis, SpO_2 < 92%, confusion
Circulation:	pale, clammy, low blood pressure, faintness, drowsy/coma

2 Adrenaline *(give IM unless experienced with IV adrenaline)*

IM doses of 1:1000 adrenaline (repeat after 5 min if no better)

• Adult	500 micrograms IM (0.5 mL)
• Child more than 12 years:	500 micrograms IM (0.5 mL)
• Child 6 -12 years:	300 micrograms IM (0.3 mL)
• Child less than 6 years:	150 micrograms IM (0.15 mL)

Adrenaline IV to be given **only by experienced specialists**
Titrate: Adults 50 micrograms; Children 1 microgram/kg

3 IV fluid challenge:

Adult - 500 – 1000 mL
Child - crystalloid 20 mL/kg

Stop IV colloid
if this might be the cause
of anaphylaxis

	4 Chlorphenamine (IM or slow IV)	5 Hydrocortisone (IM or slow IV)
Adult or child more than 12 years	10 mg	200 mg
Child 6 - 12 years	5 mg	100 mg
Child 6 months to 6 years	2.5 mg	50 mg
Child less than 6 months	250 micrograms/kg	25 mg

Figure 3. Anaphylaxis algorithm

5. Drugs and their delivery

5.1 Adrenaline (Epinephrine)

Adrenaline is the most important drug for the treatment of an anaphylactic reaction.[39] Although there are no randomised controlled trials, adrenaline is a logical treatment[31] and there is consistent anecdotal evidence supporting its use to ease breathing difficulty and restore adequate cardiac output. As an alpha-receptor agonist, it reverses peripheral vasodilation and reduces oedema. Its beta-receptor activity dilates the bronchial airways, increases the force of myocardial contraction, and suppresses histamine and leukotriene release. There are also beta-2 adrenergic receptors on mast cells[40] that inhibit activation[41], and so early adrenaline attenuates the severity of IgE-mediated allergic reactions. Adrenaline seems to work best when given early after the onset of the reaction[42] but it is not without risk, particularly when given intravenously.[25] Adverse effects are extremely rare with correct doses injected intramuscularly (IM). Sometimes there has been uncertainty about whether complications (e.g., myocardial ischaemia) have been caused by the allergen itself or by the adrenaline given to treat it.

Difficulties can arise if the clinical picture is evolving when the patient is first assessed. Adrenaline should be given to all patients with life-threatening features. If these features are absent but there are other features of a systemic allergic reaction, the patient needs careful observation and symptomatic treatment using the ABCDE approach. Adrenaline must be readily available in clinical areas where an anaphylactic reaction could occur.

5.2 Intramuscular (IM) Adrenaline

The intramuscular (IM) route is the best for most individuals who have to give adrenaline to treat an anaphylactic reaction. Monitor the patient as soon as possible (pulse, blood pressure, ECG, pulse oximetry). This will help monitor the response to adrenaline. The IM route has several benefits:

- There is a greater margin of safety.
- It does not require intravenous access.
- The IM route is easier to learn.

The best site for IM injection is the anterolateral aspect of the middle third of the thigh.[43] The needle used for injection needs to be sufficiently long to ensure that the adrenaline is injected into muscle (See Appendix 2 for guidance regarding needle length and IM injection technique).[44]

The subcutaneous or inhaled routes for adrenaline are not recommended for the treatment of an anaphylactic reaction because they are less effective.[43 45 46]

Adrenaline IM dose – adults

0.5 mg IM (= 500 micrograms = 0.5 mL of 1:1000) adrenaline

Adrenaline IM dose – children

The scientific basis for the recommended doses is weak. The recommended doses are based on what is considered to be safe and practical to draw up and inject in an emergency.[47]

(The equivalent volume of 1:1000 adrenaline is shown in brackets)

> 12 years:	500 micrograms IM (0.5 mL) i.e. same as adult dose
	300 micrograms (0.3 mL) if child is small or prepubertal
> 6 – 12 years:	300 micrograms IM (0.3 mL)
> 6 months – 6 years:	150 micrograms IM (0.15 mL)
< 6 months:	150 micrograms IM (0.15 mL)

Repeat the IM adrenaline dose if there is no improvement in the patient's condition. Further doses can be given at about 5-minute intervals according to the patient's response.

5.3 Intravenous (IV) adrenaline (for specialist use only)

The intramuscular (IM) route for adrenaline is the route of choice for most healthcare providers (see section 5.2)

There is a much greater risk of causing harmful side effects by inappropriate dosage or misdiagnosis of anaphylaxis when using IV adrenaline.[4] This is why the IM route is recommended for most healthcare providers.

This section on IV adrenaline only applies to those experienced in the use and titration of vasopressors in their normal clinical practice (e.g., anaesthetists, emergency physicians, intensive care doctors).

Many healthcare providers will have given IV adrenaline as part of resuscitating a patient in cardiac arrest. This alone is insufficient experience to use IV adrenaline for the treatment of an anaphylactic reaction. In patients with a spontaneous circulation, intravenous adrenaline can cause life-threatening hypertension, tachycardia, arrhythmias, and myocardial ischaemia.

If IV access is not available or not achieved rapidly, use the IM route for adrenaline.

Patients who are given IV adrenaline must be monitored – continuous ECG and pulse oximetry and frequent non-invasive blood pressure measurements as a minimum.

Patients who require repeated IM doses of adrenaline may benefit from IV adrenaline. It is essential that these patients receive expert help early. If the patient requires repeated IV bolus doses of adrenaline, start an adrenaline infusion.

FOR SPECIALIST USE ONLY

Ensure patient is monitored

Adrenaline IV bolus dose – adult:

Titrate IV adrenaline using 50 microgram boluses according to response.
If repeated adrenaline doses are needed, start an IV adrenaline infusion.

The pre-filled 10 mL syringe of 1:10,000 adrenaline contains 100 micrograms/mL. A dose of 50 micrograms is 0.5 mL, which is the smallest dose that can be given accurately.

Do not give the undiluted 1:1000 adrenaline concentration IV.

Adrenaline IV bolus dose – children:

IM adrenaline is the preferred route for children having an anaphylactic reaction. The IV route is recommended only in specialist paediatric settings by those familiar with its use (e.g., paediatric anaesthetists, paediatric emergency physicians, paediatric intensivists) and if the patient is monitored and IV access is already available. There is no evidence on which to base a dose recommendation - the dose is titrated according to response. A child may respond to a dose as small as 1 microgram/kg. This requires very careful dilution and checking to prevent dose errors.

Adrenaline infusion

An infusion of adrenaline with the rate titrated according to response in the presence of continued haemodynamic monitoring is an effective way of giving adrenaline during anaphylaxis.[48] Use local guidelines for the preparation and infusion of adrenaline.

FOR SPECIALIST USE ONLY

5.4 Adrenaline in special populations

Previous guidelines recommended adrenaline dose adjustments in certain circumstances (e.g., in patients taking tricyclic antidepressants, the previous recommendation was to give half the dose). The Working Group considered it unhelpful to have caveats such as this in the setting of an acute anaphylactic reaction. There is large inter-individual variability in the response to adrenaline. In clinical practice, it is important to monitor the response; start with a safe dose and give further doses if a greater response is needed, i.e., titrate the dose according to effect.

Adrenaline can fail to reverse the clinical manifestation of an anaphylactic reaction, especially when its use is delayed or in patients treated with beta-blockers.[49] The decision to prescribe a beta-blocker to a patient at increased risk of an anaphylactic reaction should be made only after assessment by an allergist and cardiologist. [50 51]

5.5 Adrenaline auto-injectors

Auto-injectors are often given to patients at risk of anaphylaxis for their own use. At the time of writing, there are only two doses of adrenaline auto-injector commonly available: 0.15 and 0.3 mg. The more appropriate dose for an auto-injector should be prescribed for individual patients by allergy specialists. Healthcare professionals should be familiar with the use of the most commonly available auto-injector devices. The dose recommendations for adrenaline in this guideline are intended for healthcare providers treating an anaphylactic reaction.

If an adrenaline auto-injector is the only available adrenaline preparation when treating anaphylaxis, healthcare providers should use it.

5.6 Oxygen (give as soon as available)

Initially, give the highest concentration of oxygen possible using a mask with an oxygen reservoir. Ensure high flow oxygen (usually greater than 10 litres min^{-1}) to prevent collapse of the reservoir during inspiration. If the patient's trachea is intubated, ventilate the lungs with high concentration oxygen using a self-inflating bag.

5.7 Fluids (give as soon as available)

Large volumes of fluid may leak from the patient's circulation during an anaphylactic reaction. There will also be vasodilation, a low blood pressure and signs of shock. If there is intravenous access, infuse intravenous fluids immediately. Give a rapid IV fluid challenge (20 mL/kg in a child or 500-1000 mL in an adult) and monitor the response; give further doses as necessary. There is no evidence to support the use of colloids over crystalloids in this setting. Consider colloid infusion as a cause in a patient receiving a colloid at the time of onset of an anaphylactic reaction and stop

the infusion.[52 53] Hartmann's solution or 0.9% saline are suitable fluids for initial resuscitation. A large volume of fluid may be needed.

If intravenous access is delayed or impossible, the intra-osseous route can be used for fluids or drugs when resuscitating children or adults, but only by healthcare workers who are accustomed to do so.[54] Do not delay the administration of IM adrenaline attempting intra-osseous access.

5.8 Antihistamines (after initial resuscitation)

Antihistamines are a second line treatment for an anaphylactic reaction. The evidence to support their use is weak, but there are logical reasons for them.[55] Antihistamines (H_1-antihistamine) may help counter histamine-mediated vasodilation and bronchoconstriction. They may not help in reactions depending in part on other mediators but they have the virtue of safety. Used alone, they are unlikely to be life-saving in a true anaphylactic reaction. Inject chlorphenamine slowly intravenously or intramuscularly.

The dose of chlorphenamine depends on age:

>12 years and adults:	10 mg IM or IV slowly
>6 – 12 years:	5 mg IM or IV slowly
>6 months – 6 years:	2.5 mg IM or IV slowly
<6 months:	250 micrograms/kg IM or IV slowly

There is little evidence to support the routine use of an H_2-antihistamine (e.g., ranitidine, cimetidine) for the initial treatment of an anaphylactic reaction.[56]

5.9 Steroids (give after initial resuscitation)

Corticosteroids may help prevent or shorten protracted reactions. In asthma, early corticosteroid treatment is beneficial in adults and children.[57 58] There is little evidence on which to base the optimum dose of hydrocortisone in anaphylaxis. In hospital patients with asthma, higher doses of hydrocortisone do not seem to be better than smaller doses.[59]

Inject hydrocortisone slowly intravenously or intramuscularly, taking care to avoid inducing further hypotension.

The dose of hydrocortisone for adults and children depends on age:

>12 years and adults:	200 mg IM or IV slowly
>6 – 12 years:	100 mg IM or IV slowly
>6 months – 6 years:	50 mg IM or IV slowly
<6 months:	25 mg IM or IV slowly

5.10 Other drugs

Bronchodilators

The presenting symptoms and signs of a severe anaphylactic reaction and life-threatening asthma can be the same. If the patient has asthma-like features alone, follow the British Thoracic Society – SIGN asthma guidelines (www.brit-thoracic.org.uk). As well as the drugs listed above, consider further bronchodilator therapy with salbutamol (inhaled or IV), ipratropium (inhaled), aminophylline (IV) or magnesium (IV). Remember that intravenous magnesium is a vasodilator and can cause hot flushes and make hypotension worse.

Cardiac drugs

Adrenaline remains the first line vasopressor for the treatment of anaphylactic reactions. There are animal studies and case reports describing the use of other vasopressors and inotropes (noradrenaline, vasopressin, metaraminol and glucagon) when initial resuscitation with adrenaline and fluids has not been successful.[60-64] Only use these drugs in specialist settings (e.g., intensive care units) where there is experience in their use. Glucagon can be useful to treat an anaphylactic reaction in a patient taking a beta-blocker.[65] Some patients develop severe bradycardia after an anaphylactic reaction. Consider IV atropine to treat this.[37 48]

6. Investigations

Undertake the usual investigations appropriate for a medical emergency, e.g., 12-lead ECG, chest X-ray, urea and electrolytes, arterial blood gases etc.

6.1 Mast cell tryptase

The specific test to help confirm a diagnosis of an anaphylactic reaction is measurement of mast cell tryptase. Tryptase is the major protein component of mast cell secretory granules. In anaphylaxis, mast cell degranulation leads to markedly increased blood tryptase concentrations (Figure 4). Tryptase levels are useful in the follow-up of suspected anaphylactic reactions, not in the initial recognition and treatment: measuring tryptase levels must not delay initial resuscitation. Tryptase concentrations in the blood may not increase significantly until 30 minutes or more after the onset of symptoms, and peak 1-2 hours after onset.[66] The half-life of tryptase is short (approximately 2 hours), and concentrations may be back to normal within 6-8 hours, so timing of any blood samples is very important.

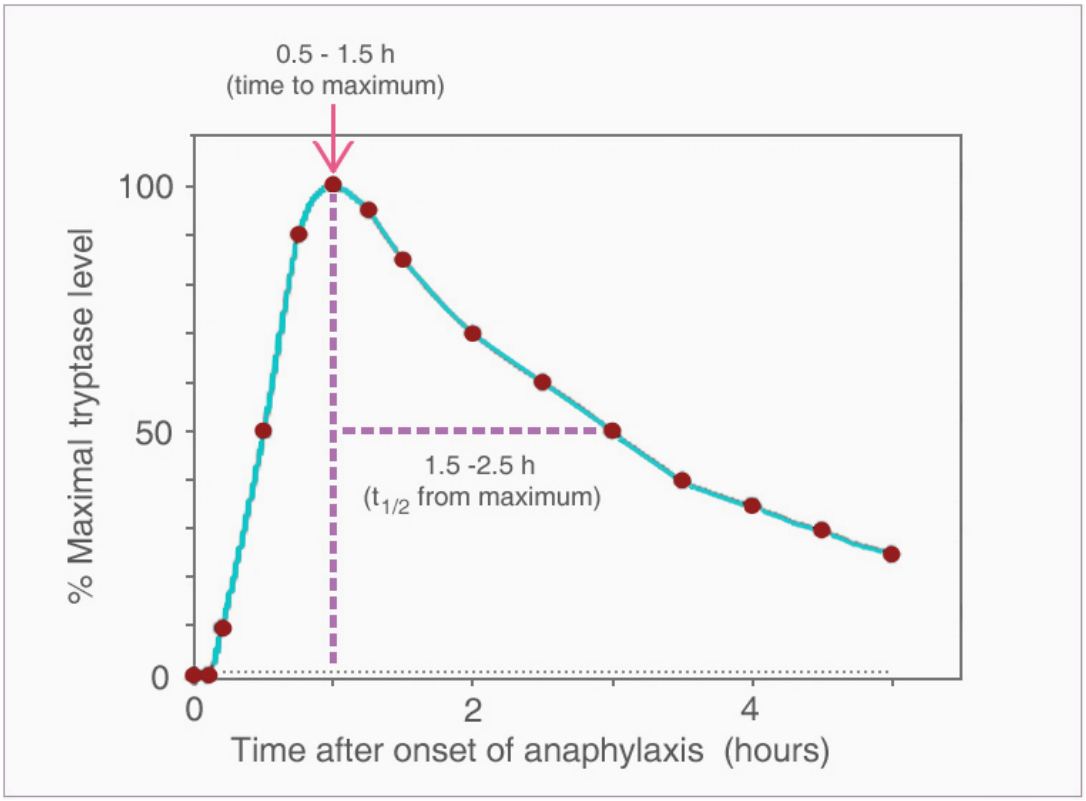


Figure 4. Suggested time course for the appearance of tryptase in serum or plasma during systemic anaphylaxis.[66] Reproduced and adapted with permission from Elsevier.

6.2 Sample timing

The time of onset of the anaphylactic reaction is the time when symptoms were first noticed. It is important that this time is accurately recorded.

a) Minimum: one sample at 1-2 hours after the start of symptoms.

b) Ideally: Three ***timed*** samples:

1) Initial sample as soon as feasible after resuscitation has started – do not delay resuscitation to take sample.
2) Second sample at 1-2 hours after the start of symptoms
3) Third sample either at 24 hours or in convalescence (for example in a follow-up allergy clinic). This provides baseline tryptase levels - some individuals have an elevated baseline level.

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Serial samples have better specificity and sensitivity than a single measurement in the confirmation of anaphylaxis.[67]

6.3 Sample requirements

1) Use a serum or clotted blood ('liver function test' bottle) sample. Some laboratories ask for a plasma sample – either plasma or serum samples can be tested.

2) ***Record the timing of each sample accurately*** on the sample bottle and request form. State on the request form the time of onset of the reaction (symptoms). Record on the sample bottle the number of minutes or hours after the onset of symptoms the sample was taken

3) As little as 0.5 mL of sample can be enough (children), but 5 mL (adults) is better.

4) Optimally, store the serum from spun samples frozen (-20^{o}C) in the local laboratory, before dispatch to a reference laboratory.

5) Tryptase is very stable (50% of tryptase is still detectable after 4 days at room temperature[66]), so even samples stored at room temperature over a weekend can give useful, though sub-optimal, information.

6) Consult your local laboratory if you have any queries.

7. Discharge and follow-up

7.1 Discharge from hospital

Patients who have had a suspected anaphylactic reaction (i.e. an airway, breathing or circulation (ABC) problem) should be treated and then observed for at least 6 hours in a clinical area with facilities for treating life-threatening ABC problems.[68] They should then be reviewed by a senior clinician and a decision made about the need for further treatment or a longer period of observation.

Patients with a good response to initial treatment should be warned of the possibility of an early recurrence of symptoms and in some circumstances should be kept under observation for up to 24 hours.[69] This caution is particularly applicable to:

- Severe reactions with slow onset caused by idiopathic anaphylaxis.
- Reactions in individuals with severe asthma or with a severe asthmatic component.
- Reactions with the possibility of continuing absorption of allergen.
- Patients with a previous history of biphasic reactions.
- Patients presenting in the evening or at night, or those who may not be able to respond to any deterioration.
- Patients in areas where access to emergency care is difficult.

The exact incidence of biphasic reactions is unknown. Although studies quote an incidence of 1-20%, it is not clear whether all the patients actually had an anaphylactic reaction and whether the initial treatment was appropriate.[70] There is no reliable way of predicting who will have a biphasic reaction. It is therefore important that decisions about discharge are made for each patient by an experienced clinician.

Before discharge from hospital all patients must be:

- Reviewed by a senior clinician.
- Given clear instructions to return to hospital if symptoms return.
- Considered for anti-histamines and oral steroid therapy for up to 3 days. This is helpful for treatment of urticaria[71] and may decrease the chance of further reaction.[68 72]

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- Considered for an adrenaline auto-injector (see below), or given a replacement.
- Have a plan for follow-up, including contact with the patient's general practitioner.

7.2 Record keeping

To help confirm the diagnosis of anaphylaxis and identify the most likely trigger, it is useful for the allergy clinic to have:

- A description of the reaction with circumstances and timings to help identify potential triggers.
- A list of administered treatments.
- Copies of relevant patient records, e.g., ambulance charts, emergency department records, observation charts, anaesthetic charts.
- Results of any investigations already completed, including the timings of mast cell tryptase samples.

7.3 Reporting of reaction

Adverse drug reactions that include an anaphylactic reaction should be reported to the Medicines and Healthcare products Regulatory Agency (MHRA) using the yellow card scheme (www.mhra.gov.uk). The British National Formulary (BNF) includes copies of the Yellow Card at the back of each edition.

Discuss all cases of fatal anaphylactic reaction with the coroner.

7.4 When to prescribe an adrenaline auto-injector

Emergency departments should liaise with their nearest specialist allergy service to devise a local guideline for which patients should be given an adrenaline auto-injector on discharge.

An auto-injector is an appropriate treatment for patients at increased risk of an idiopathic anaphylactic reaction, or for anyone at continued high risk of reaction e.g., to triggers such as venom stings and food-induced reactions (unless easy to avoid). An auto-injector is not usually necessary for patients who have suffered drug-induced anaphylaxis, unless it is difficult to avoid the drug.

Ideally, all patients should be assessed by an allergy specialist and have a treatment plan based on their individual risk.[73]

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Individuals provided with an auto-injector on discharge from hospital must be given instructions and training and have appropriate follow-up including contact with the patient's general practitioner.

7.5 Specialist referral

All patients presenting with anaphylaxis should be referred to an allergy clinic to identify the cause, and thereby reduce the risk of future reactions and prepare the patient to manage future episodes themselves. There is a list of specialist clinics on the British Society for Allergy and Clinical Immunology (BSACI) website. A list of clinics with a specific interest in anaphylactic reactions during anaesthesia is available at the BSACI and Association of Anaesthetists of Great Britain and Ireland websites (www.bsaci.org and www.aagbi.org).

7.6 Patient education

Refer patients at risk of an anaphylactic reaction to an appropriate allergy clinic. Patients need to know the allergen responsible and how to avoid it. If the allergen is a food, they need to know what products are likely to contain it, and all the names that can be used to describe it. Where possible they also need to know how to avoid situations that could expose them to the allergen.

Patients need to be able to recognise the early symptoms of anaphylaxis, so that they can summon help quickly and prepare to use their emergency medication. Patients at risk are usually advised to carry their adrenaline auto-injector with them at all times. Patients and those close to them (i.e., close family, friends, and carers) should receive training in using the auto-injector and should practise regularly using a suitable training device, so that they will know what to do in an emergency.[74]

Patients must always seek urgent medical assistance when experiencing anaphylaxis and after using an adrenaline auto-injector. Information about managing severe allergies can be obtained from their allergy specialist, general practitioner, other healthcare professional or the Anaphylaxis Campaign. Although there are no randomised clinical trials,[75] there is evidence that individualised action plans for self-management should decrease the risk of recurrence. [7 76]

Specific guidance and training is available for schools with children at risk of allergic reactions (www.allergyinschools.org.uk link no longer available).

All those at high risk of an anaphylactic reaction should consider wearing some device, such as a bracelet (e.g., Medic Alert), that provides information about their history of anaphylactic reaction.

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Appendices

Appendix 1. The ABCDE approach

Modified from Immediate Life Support manual 2005, European Paediatric Life Support manual 2006 and Paediatric Immediate Life Support manual 2007 (Resuscitation Council (UK)).

Underlying principles

The approach to all critically ill patients, including those who are having an anaphylactic reaction, is the same. The underlying principles are:

1. Use an Airway, Breathing, Circulation, Disability, and Exposure (the ABCDEs) approach to assess and treat the patient.
2. Do a complete initial assessment and re-assess regularly.
3. Treat life-threatening problems before moving to the next part of assessment.
4. Assess the effects of treatment.
5. Call for help early (e.g., calling for an ambulance or resuscitation team).
6. Use all members of the team or helpers. This will enable interventions, e.g., calling for help, assessment, attaching monitoring equipment, and intravenous access, to be undertaken simultaneously.
7. Communicate effectively.
8. The aim of the initial treatments is to keep the patient alive, and achieve some clinical improvement. This will buy time for further treatment and expert help.
9. Remember - it can take a few minutes for treatments to work.
10. The ABCDE approach can be used irrespective of your training and experience in clinical assessment or treatment. The detail of your assessment and what treatments you give will depend on your clinical knowledge and skills. If you recognise a problem or are unsure, call for help.

First steps

1. Ensure personal safety.
2. First look at the patient in general to see if the patient ‘looks unwell’.
3. If the patient is awake ask, “How are you?” If the patient appears unconscious, shake him and ask, “Are you all right?” If he responds normally, he has a patent airway, is breathing and has brain perfusion. If he speaks only in short sentences, he may have breathing problems. Failure of the patient to respond is a marker of critical illness.
4. Monitor the vital signs early. Attach a pulse oximeter, ECG monitor, and non-invasive blood pressure monitor to all critically ill patients, as soon as possible.

5. If trained to do so, insert an intravenous cannula as soon as possible. Take bloods for investigation.

Airway (A)

Airway obstruction is an emergency. Get expert help immediately.

1. Look for the signs of airway obstruction:
   - Complete or severe airway obstruction causes paradoxical chest and abdominal movements ('see-saw' respirations) and the use of the accessory muscles of respiration. Central cyanosis is a late sign of airway obstruction. In complete airway obstruction, there are no breath sounds at the mouth or nose. In partial obstruction, air entry is diminished and often noisy.
2. Treat airway obstruction as an emergency:
   - In most cases where airway obstruction is caused by lack of pharyngeal tone or the tongue falling to the back of the throat, e.g., loss of consciousness because of hypotension, only simple methods of airway clearance are needed (e.g., airway opening manoeuvres, suction, insertion of an oropharyngeal or nasopharyngeal airway).
   - Anaphylaxis can cause airway swelling (pharyngeal or laryngeal oedema). Overcoming this obstruction may be very difficult and early tracheal intubation is often required. This requires expert help.
3. Give oxygen at high concentration:
   - Give high concentration oxygen using a mask with an oxygen reservoir. Ensure high flow oxygen (usually greater than 10 litres min^{-1}) to prevent collapse of the reservoir during inspiration. If the patient's trachea is intubated, give high concentration oxygen with a self-inflating bag.
   - In acute respiratory failure, try to maintain the PaO_2 as close to normal as possible (approximately 13 kPa or 100 mm Hg). In the absence of arterial blood gas values, use pulse oximetry to guide oxygen therapy. Aim for an oxygen saturation of 94-98%. In the sickest patients this is not always possible, so you may have to accept lower values, i.e., above 8 kPa (60 mm Hg), or 90-92% oxygen saturation on a pulse oximeter.

Breathing (B)

1. During the immediate assessment of breathing, it is vital to diagnose and treat immediately life-threatening conditions, e.g., acute severe bronchospasm. Look, listen and feel for the general signs of respiratory distress: sweating, central cyanosis, use of the accessory muscles of respiration, subcostal and sternal recession in children, and abdominal breathing.
2. Count the respiratory rate. The normal adult rate is 12 - 20 breaths min^{-1}. A high, or increasing, respiratory rate is a marker of illness and a warning that the patient may deteriorate suddenly.

The normal respiratory rate varies by age (approximate):

<1 year	30-40 min^{-1}
>1 to 2 years	26-34 min^{-1}
>2 to 5 years	24-30 min^{-1}
>5 to 12 years	20-24 min^{-1}
>12 years	12-20 min^{-1}

Assess the depth of each breath, the pattern (rhythm) of respiration and whether chest expansion is equal and normal on both sides.

3. Record the inspired oxygen concentration (%) given to the patient and the SpO_2 reading of the pulse oximeter. A normal SpO_2 in a patient receiving oxygen does not necessarily indicate adequate ventilation: the pulse oximeter detects oxygenation and not hypercapnia. The patient may be breathing inadequately and have a high $PaCO_2$.

4. Listen to the patient's breath sounds a short distance from his face. Rattling airway noises indicate airway secretions, usually because the patient cannot cough or take a deep breath. Stridor or wheeze suggests partial, but important, airway obstruction. Listen to the chest with a stethoscope if you are trained to do so. The specific treatment of breathing disorders depends upon the cause. Bronchospasm causing wheeze is common in anaphylaxis. All critically ill patients should be given oxygen.

5. Initially give the highest possible concentration of inspired oxygen using a mask with an oxygen reservoir. Ensure high flow oxygen (usually greater than 10 litres min^{-1}) to prevent collapse of the reservoir during inspiration. If the patient's trachea is intubated, give high concentration oxygen with a self-inflating bag. As soon as a pulse oximeter is available, titrate the oxygen to maintain an oxygen saturation of 94-98%. In the sickest patients this is not always possible so you may have to accept a lower value, i.e., above 8 kPa (60 mm Hg), or 90-92% oxygen saturation on a pulse oximeter.

6. If the patient's depth or rate of breathing is inadequate or the patient has stopped breathing, use a pocket mask or two person bag-mask ventilation while calling urgently for expert help. In an anaphylactic reaction, upper airway obstruction or bronchospasm may make bag mask ventilation difficult or impossible. Early tracheal intubation should be considered by someone experienced in the technique.

Circulation (C)

In almost all medical emergencies, including an anaphylactic reaction, consider hypovolaemia as the likeliest cause of shock until proved otherwise. In anaphylaxis the shock is usually caused by vasodilation and fluid leaking from capillary blood vessels. Unless there are obvious signs of a cardiac cause (e.g., chest pain, heart failure), give intravenous fluid to any patient with low blood pressure and a high heart rate. Remember that breathing problems, which should have been treated earlier on in the breathing assessment, can also compromise a patient's circulatory state.

1. Look at the colour of the hands and digits: are they blue, pink, pale or mottled?

2. Assess the limb temperature by feeling the patient's hands: are they cool or warm?

3. Measure the capillary refill time. Apply cutaneous pressure for five seconds on a fingertip held at heart level with enough pressure to cause blanching. Time how long it takes for the skin to return to the colour of the surrounding skin after releasing the pressure. The normal refill time is less than two seconds. A prolonged time suggests poor peripheral perfusion. Other factors (e.g., cold surroundings, poor lighting, old age) can prolong the time.

4. Assess the state of the veins: they may be under-filled or collapsed when hypovolaemia is present.

5. Count the patient's pulse rate.

   Normal heart rate by age (approximate)

Newborn to 3 months	140 min^{-1}
>3 months to 2 years	130 min^{-1}
>2 to 10 years	80 min^{-1}
>10 years	75 min^{-1}
Adults	60-100 min^{-1}

6. Palpate peripheral and central pulses, assessing for presence, rate, quality, regularity and equality. Barely palpable central pulses suggest a poor cardiac output.

7. Measure the patient's blood pressure. Even in shock, the blood pressure may be normal, because compensatory mechanisms increase peripheral resistance in response to reduced cardiac output. In anaphylaxis, vasodilation is common and the blood pressure may fall precipitously very early on. A low diastolic blood pressure suggests arterial vasodilation (as in anaphylaxis or sepsis). A narrowed pulse pressure (difference between systolic and diastolic pressures) suggests arterial vasoconstriction (cardiogenic shock or hypovolaemia).

8. Listen to the heart with a stethoscope if you are trained to do so.

9. Look for other signs of a poor cardiac output, such as reduced conscious level.

10. The treatment of cardiovascular collapse depends on the cause, but should be directed at fluid replacement and restoration of tissue perfusion. Seek out signs of conditions that are immediately life-threatening, e.g., massive or continuing bleeding, or anaphylactic reaction, and treat them urgently.

11. A simple measure to improve the patient's circulation is to lie the person flat and raise the legs. This must be done with care as it may worsen any breathing problems.

12. In pregnant patients use a left lateral tilt of at least 15 degrees to avoid caval compression; after 20 weeks' gestation the pregnant woman's uterus can press down on the inferior vena cava and impede venous return to the heart.

13. Insert one or more large-bore intravenous cannulae if trained to do so. Use short, wide-bore cannulae, because they enable the highest flow. Use intraosseous access if you are trained to do so, especially in children when intravenous access is difficult.

14. Give a rapid fluid challenge: Adults - 500 mL of warmed crystalloid solution (e.g., Hartmann's or 0.9% saline) in 5-10 minutes if the patient is normotensive or one litre if the patient is hypotensive. Use smaller volumes (e.g., 250 mL) for adult patients with known cardiac failure and use closer monitoring (listen to the chest for crepitations after each bolus). The use of invasive monitoring, e.g., central venous pressure (CVP), can help to assess fluid resuscitation. For children give 20 mL/kg of warmed crystalloid.

15. Reassess the pulse rate and BP regularly (every 5 min), aiming for the patient's normal BP. If this is unknown, in adults aim for a systolic BP greater than 100 mmHg.

    Lower limit of blood pressure for children (approximate):

0 to1 month	50-60 mmHg
>1 to12 months	70 mmHg
>1 to 10 years	70 + (age in years x 2) mmHg
>10 years	90 mmHg

16. If the patient does not improve, repeat the fluid challenge.

17. If there are symptoms and signs of cardiac failure (shortness of breath, increased heart rate, raised JVP, a third heart sound, and inspiratory crackles in the lungs on auscultation), decrease or stop the fluid infusion. Seek expert help as other means of improving tissue perfusion (e.g., inotropes or vasopressors) may be needed.

Disability (D)

Common causes of unconsciousness include profound hypoxia, hypercapnia, cerebral hypoperfusion due to hypotension, or the recent administration of sedative or analgesic drugs.

1. Review and treat the ABCs: exclude hypoxia and hypotension.
2. Examine the pupils (size, equality, and reaction to light).
3. Assess the patient's conscious level rapidly using the **AVPU** method: **A**lert, responds to **V**ocal stimuli, responds to **P**ainful stimuli, or **U**nresponsive to all stimuli. Alternatively use the Glasgow Coma Scale.
4. Measure the blood glucose, using a glucose meter or stick method, to exclude hypoglycaemia. If below 3 mmol l^{-1}, give 50 mL of 10% glucose solution intravenously. In children, use 5 mL/kg of 10% glucose. Assess the response and give further doses as necessary.
5. Nurse unconscious patients in the lateral position if their airway is not protected.

Exposure (E)

To examine the patient properly, full exposure of the body is necessary. Skin and mucosal changes after anaphylaxis can be subtle. Minimise heat loss. Respect the patient's dignity.

Additional information

1. Take a full clinical history from the patient, relatives or friends, and other staff.
2. Review the patient's notes and charts
    a. Study both absolute and trended values of vital signs.
    b. Check that important routine medications are prescribed and being given.
3. Review the results of laboratory or radiological investigations.
4. Consider what level of care is required by the patient, e.g., transport to hospital if in the community.
5. Make complete entries in the patient's notes of your findings, assessment and treatment. Record the patient's response to therapy.
6. Consider definitive treatment of the patient's underlying condition.

Appendix 2. Choice of needle and technique for intramuscular (IM) injection

There is no specific evidence for any particular technique of intramuscular injection when treating an anaphylactic reaction. This guidance is based on the recommendations for intramuscular injections for vaccination (Immunisation against infectious disease. Department of Health UK, 2006). For IM injections, the needle needs to be long enough to ensure that the drug is injected into the muscle.
A 25mm needle is best and is suitable for all ages. In pre-term or very small infants, a 16mm needle is suitable for IM injection. In some adults, a longer length (38 mm) may be needed.

Standard UK needle gauges and lengths		
Brown	26G	10 mm
Orange	25G	16 mm or 25 mm
Blue	23G	25 mm
Green	21G	38 mm

Give IM injections with the needle at a 90º angle to the skin. The skin should be stretched, not bunched.

Appendix 3. Useful websites

www.resus.org.uk
Resuscitation Council UK

www.bsaci.org
British Society of Allergy & Clinical Immunology

www.anaphylaxis.org.uk
The Anaphylaxis Campaign

www.eaaci.net
The European Academy of Allergology and Clinical Immunology

www.erc.edu
European Resuscitation Council

www.aagbi.org
The Association of Anaesthetists of Great Britain and Ireland

www.cochrane.org
The Cochrane collaboration

www.bestbets.org
Best Evidence Topics in emergency medicine.

www.hpa.org.uk
Health protection agency

www.allergyinschools.org.uk
Website for school nurses – site no longer available

Appendix 4. Glossary of terms and abbreviations

- The masculine forms he, him, and his are used throughout the document.
- The term 'patient' is used to describe an individual suffering from an anaphylactic reaction in any setting instead of alternative terms e.g., victim or casualty.
- **ABCDE:** Airway, Breathing, Circulation, Disability, Exposure (see Appendix 1).
- **ALS:** Advanced Life Support.
- **Anaphylaxis:** the process which leads to an anaphylactic reaction.
- **Anaphylactic reaction:** the life-threatening signs and symptoms caused by anaphylaxis.
- **Anaphylactic shock:** poor perfusion of the body's vital organs caused by an anaphylactic reaction.
- **BLS:** Basic Life Support, i.e., CPR without the use of equipment except for airway protective devices.
- **CPR:** cardiopulmonary resuscitation, which refers to chest compressions and ventilations.
- **IM:** intramuscular.
- **IV:** intravenous.

Appendix 5. Conflict of interest declaration

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