Management of Medical Emergencies
FOR THE DENTAL TEAM
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Preface to 2nd Edition

In the five years since the first edition of this book, ideas and guidelines have changed regarding the most appropriate management of medical emergencies in dental practice. Several important publications have been produced which have necessitated a second edition. In November 2005, the International Liaison Committee on Resuscitation issued new international guidelines for managing cardiopulmonary arrest. These new guidelines were immediately adopted by the Resuscitation Council (UK). In July 2006, the Resuscitation Council (UK) published a document entitled ‘Medical emergencies and training – standards for clinical practice and training for dental practitioners and dental care professionals in general dental practice’. It has a foreword written by the president of the General Dental Council and its recommendations may form the basis against which a general dental practitioner’s actions in the United Kingdom could be judged. The recommendations in the British National Formulary have also continued to evolve and this new edition of our book incorporates the changes in thinking that have emerged from these publications.

Dentists and dental care professionals (DCPs) are now required to undertake continuing professional development (CPD) to maintain their registration with the GDC, which is a prerequisite for practising in the UK. The management of medical emergencies is one of the core subjects of CPD which must be covered by every dentist and DCP. To support this we have developed a CPD module to accompany this containing 3 hours of verifiable CPD (details on next page). We hope that this book remains a practical and helpful guide for all members of the dental team.

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INTRODUCTION

All members of the dental team need to be prepared to manage an emergency. As healthcare workers, we have a responsibility to manage any medical problem arising in the dental surgery. The public might also reasonably expect a dentist to be able to offer first line treatment for a medical emergency arising in a public place until more expert medical assistance arrives. There is therefore an onus on us to be prepared to deal with any such event.

The first aim should be to prevent emergencies from occurring. A full understanding of the patient's medical history is of paramount importance in this regard. Careful treatment planning and patient management in the full knowledge of the medical history will prevent the majority of untoward events taking place. Should an emergency occur however, the main aim must be to keep the patient alive until they can be transferred to more expert medical care for definitive treatment - usually in the accident and emergency department of the nearest hospital. Since the speed with which a patient receives expert care can be critical in determining the chances of survival, the first priority must be to alert the emergency services. The next priority is to prevent, as far as possible, any deterioration in the patient's condition before assistance arrives. Bearing this in mind, it seems reasonable to expect a dentist to diagnose the main acute life threatening events such as myocardial infarction, cardiac arrest and anaphylaxis. They and their team should also have the skills to assess the patient, maintain the patency of the airway, carry out basic life support, including administration of positive pressure air or oxygen and, if trained, carry out defibrillation and deliver emergency drugs. Preparation to deal with such events effectively and with a minimum of stress requires regular training and the availability of appropriate emergency equipment and drugs. It is essential that all members of the dental team, including nurses and reception staff, are involved in medical emergency training.

Fainting occurs quite often in dental practice but fortunately other medical emergencies are uncommon. A survey found that, apart from faints, the average dentist would have to deal with a medical emergency once every 3½ to 4½ years of practice in Great Britain and an event in which cardiopulmonary resuscitation (CPR) was required occurred once every 200 to 250 years. However, the stress felt by many patients when attending the dental surgery, and the nature of dental treatment mean that the risk of an emergency occurring in a dental surgery is higher than in most other settings. If a medical emergency occurs it is likely to be unexpected and alarming, not just for the patient but for all members of the team and other patients, and may even be life threatening to the patient.

Medical emergencies in children are extremely rare. Because of their rarity, the guidelines for management of medical emergencies given here apply only to adults and would need to be modified for use in young children. In general the principles for treating children are the same as for adults. However, drug dosages need to be adjusted and anatomical and physiological differences may necessitate modification of management procedures.

Even though we have provided guidelines for the use of emergency drugs and equipment in the dental surgery, emergency management protocols are under constant review and it is important to keep abreast of any changes that occur.
PREVENTION AND PREPARATION

Many factors contribute to preventing medical emergencies from occurring and many are common sense. They include the ambience of the practice, the training and attitude of staff and your knowledge of the patient’s medical history.

THE PRACTICE

Comfortable practice surroundings and a friendly atmosphere are of benefit not only in promoting the good reputation of the practice but also help allay the fears of more anxious patients and generate a feeling of confidence and well being. On a more practical level, it is important that you have easy access to all parts of the surgery premises used by patients, including the lavatory, which it should be possible to unlock from the outside. Getting an acutely ill patient lying flat is a major priority and it should be possible to do this with relative ease in all parts of the surgery.

THE TEAM

The professionalism and attitude of the dental team play an important part in allaying patients’ fears and preventing stressful situations from arising that could potentially result in a medical emergency. Informed and observant staff may also identify emergency situations at an early stage so that preventive action can be taken.

It is essential that all team members know where the emergency drugs and equipment are kept and are properly trained and prepared to deal with an emergency, including a collapsed patient. Resuscitation skills should be practised regularly as a team in simulated emergencies. Training should take place in the dental surgery and in the waiting area to familiarise all team members with dealing with emergencies in different locations and ensure there is space to deploy equipment properly. Ideally, an accredited instructor should give training and each person who undergoes training should have his or her proficiency tested and certified.

In many areas there are schemes in operation, often run by the local postgraduate dean’s office, which provide ‘hands on’ CPR training for the dental team in their own dental practice; some areas also provide training in the management of other types of medical emergency. In rehearsing staff for dealing with an emergency, it is important to ensure that each member of staff knows what is expected of them, who will telephone for assistance and what they should say, who will get the emergency equipment and who will take charge. A notice next to the telephone with concise instructions, including the address details of the surgery, can be helpful in ensuring the right details are given, particularly when new or temporary staff may be managing the reception.

MEDICAL HISTORY

Obtaining a medical history is an essential step in evaluating a patient and how their dental treatment should be managed. A substantial and increasing number of patients attending the dental surgery have medical conditions or are taking medication which may influence their dental management. In view of this, the medical history should be obtained from every patient and updated at every recall. It should include enquiries about:

• current medication
• current treatment by doctor or hospital specialist or clinic
• allergies to medicines, substances (e.g. metals or latex) or foods
• cardiovascular disease or increased blood pressure
• a history of rheumatic fever, heart murmur, heart surgery or infective endocarditis.
• respiratory disease (including asthma or bronchitis)
• endocrine disorders (e.g. diabetes)
• epilepsy
• excessive bleeding, especially after extractions
• any other serious illnesses
• if the patient may be pregnant.

The patient’s medical history will often suggest the type of medical problem to be anticipated; diabetics who use insulin are at most risk of hypoglycaemia, especially if treated just before they are due to eat a meal. Patients with angina have ischaemic heart disease and will be more likely to suffer a myocardial infarct. Forewarned with such knowledge, it may be possible to take steps to reduce the likelihood of any problems arising during treatment.

Printed medical history forms can be used but it is advisable to seek verbal confirmation from the patient of what has been written. A suggested medical history form is shown in Figure 1.1; other designs of medical history form are available from various sources including the British Dental Association (BDA)\(^1\) and Admor Ltd\(^2\). Any points arising from enquiries about the medical history should be investigated further. Look up any drugs you are not familiar with in the British National Formulary, Merck Manual or other such source. If there is anything about which you or the patient are not clear, it is worth looking it up in a medical textbook such as Scully’s *Medical Problems in Dentistry*\(^3\); where you feel additional clarification would be useful, you should contact the patient’s medical practitioner or hospital specialist.

Figure 1.1. A medical history form

![CONFIDENTIAL MEDICAL HISTORY FORM](image-url)
EMERGENCY EQUIPMENT

Various authorities give guidelines on the emergency equipment that should be available in a dental surgery. Our list is similar to that recommended by the Resuscitation Council.4

SUGGESTED EMERGENCY EQUIPMENT FOR THE DENTAL SURGERY

- Efficient, portable aspirator (to clear the airway)
- Oxygen supply and mask, capable of delivering 10L/min;
- Airway adjuncts
  - ventilation mask (e.g. Laerdal Pocket Mask)
  - selection of oropharyngeal (Guedal) airways (sizes 2, 3 and 4 for respectively small, medium and large adults)
  - bag and valve manual ventilator (e.g. AMBU bag) - the best device for delivering positive pressure air or oxygen
  - Selection of disposable syringes (1, 2, 5 and 10 mL*) and needles (19 gauge (white hub), 21 gauge (green), 23 gauge (blue) and 25 gauge (orange))
  - Butterfly needles or intravenous (i/v) cannulae (19 or 21 gauge)
  - Tourniquet
  - Automatic external defibrillator (AED)
  - A ‘spacer’ device for inhaled bronchodilators

Optional:

- If available, an RA machine (for analgesia in the management of myocardial infarction)
- Automated blood glucose measurement device

*50ml syringe may be needed if you keep 50ml ampoules of 20% glucose solution for injection in your emergency drug kit.

PORTABLE ASPIRATOR

Even if your surgery uses portable aspirators, which can be wheeled around the surgery and to all parts of the practice premises, a small, portable, hand-held aspirator, powered by a hand or foot pump is advisable in addition. If you have no other form of portable suction, one of these is essential. It is vital, in management of a collapsed patient, that the airway is cleared of blood and vomit and maintained at all times. Hand or foot-pump powered aspirators are available from various sources (e.g. Vitalograph5; Repro-Med Systems’ Res-Q-Vac6; Laerdal V-Vac7 or Ambu Res-Cue Pump8).

AIRWAY ADJUNCTS

VENTILATION MASK

These masks7,9,10 are designed to avoid the necessity of actual mouth-to-mouth contact during expired air ventilation. You can attach a one-way valve, which directs the patient’s exhaled air away from you. The mask is made of clear plastic so that you can see if the patient has vomited or is bleeding. In addition, there is a nozzle that allows a source of oxygen to be attached to supplement your expired air and enrich it with oxygen. These ventilation masks can also be used, without the one-way valve, in conjunction with a bag and valve manual ventilator, such as an Ambu Bag, which has its own one-way valve.

The mask is used by pressing it tightly against the skin of the face around the mouth and nose while at the same time pulling the mandible forward to maintain patency of the airway. If there is difficulty in maintaining the patency of the airway, then an oropharyngeal (Guedel) airway may help.
OROPHARYNGEAL (GUEDEL) AIRWAYS
Oropharyngeal airways are adjuncts which can be used to improve the patency of the airway and allow more efficient artificial ventilation to be carried out if, for example, the patient’s lips are closed; they are also helpful in overcoming the backward displacement of the tongue in an unconscious individual. They do not protrude from the face and so can be used with a ventilation mask.

They consist of a curved plastic tube with a flange at the oral end and have a flattened shape to ensure they fit neatly between the tongue and the hard palate. If the airway used is too long, it may induce laryngospasm or vomiting in a patient who is not deeply unconscious. They are available in various sizes; sizes 2, 3 and 4 are suitable for adults. To estimate the correct size of airway for a particular patient select an airway with a length corresponding to the distance from the angle of the patient’s mouth to the tragus at the front of the ear.

BAG AND VALVE MANUAL VENTILATORS
The use of a bag and valve manual ventilator in conjunction with the ventilation mask obviates any risk to the rescuer from contact with the victim and allows greater volumes of air to be delivered with a greater oxygen concentration than expired air. However it is difficult for one person to squeeze the bag at the same time as maintaining the mask seal and airway, therefore ideally two rescuers are required to use this equipment effectively. One person can maintain the mask seal and keep the airway patent, while the other pumps the bag to give positive pressure ventilation. Connecting an oxygen supply to the bag increases the concentration of oxygen delivered still further. The use of oxygen with flow rates of 8-12L/min will allow air with an 80-95% concentration of oxygen to be delivered.
OXYGEN SUPPLY
A supply of oxygen is essential for increasing the oxygen concentration being delivered to the patient’s lungs in cases of hypoxia (respiratory impairment) or anoxia (respiratory arrest). Both ventilation masks and manual ventilators have nozzles that allow oxygen to be attached. An oxygen cylinder that can deliver up to 10 litres per minute should be used. The size of oxygen cylinder you need is determined by how long you might need to use oxygen before assistance arrives. You may consider having a larger cylinder if you work in a rural area or where traffic congestion may result in a longer journey time for an ambulance. A ‘D’ size cylinder holds 340 litres and will give 10L/min for 34
minutes whereas an ‘E’ size cylinder holds 680 litres and will give 10L/min for twice as long. In the UK, oxygen cylinders can be obtained from BOC Gases or Air Liquide UK Ltd.

TOURNIQUET
This is used to engorge the veins with blood to make them easier to identify for venepuncture. They can be obtained from many sources (e.g. General Medical), however, if nothing else is available, a rubber examination glove can be stretched and tied round the arm.
SYRINGES, NEEDLES, BUTTERFLIES, INTRAVENOUS CANNULAE
Use a syringe appropriate to the volume of the drug you are going to give: a 1mL syringe is far more appropriate for giving 1mL of a drug than would be a 20mL syringe. Generally 25 gauge needles, usually with an orange hub, are used for subcutaneous injections, 23 gauge (blue hub) needles for intramuscular injections and 21 gauge (green) needles for intravenous (i/v) injections. For more viscous solutions (e.g. 20% glucose solution), a wider, 19 gauge (white) needle will be necessary. If i/v drugs need to be given repeatedly, in a large volume or the patient is hard to keep still during injection, a butterfly or i/v cannula will make administration easier. However, this is only the case if you are trained and confident in their use.

RELATIVE ANALGESIA EQUIPMENT
Nitrous oxide is an effective means of reducing pain and anxiety in a patient suffering from myocardial infarction. Relative analgesia equipment is usually capable of delivering an appropriate mix of 50% nitrous oxide and 50% oxygen for this purpose.

AUTOMATED BLOOD GLUCOSE MEASUREMENT DEVICE
These devices measure the concentration of glucose in the blood and have developed greatly since they were first introduced in the 1980s. They are widely used by people with diabetes mellitus for home blood glucose monitoring. Original devices relied on visual colour comparison, but modern ones use a digital meter to indicate the exact blood glucose concentration. They can be bought for less than £20, with a pack of 50 test strips costing a similar amount. They can be obtained from large community pharmacies and are also available via the internet from sites such as www.chemistdirect.co.uk. They work by measuring the concentration of glucose in a fresh capillary whole blood sample. This is obtained by using a lancet to take a ‘finger prick’ blood sample from a puncture site on the side of the finger tip. The blood sample is placed on a test strip and inserted into the measuring device. To maintain accuracy, the measuring device requires regular calibration by the use of a spot of fluid of known glucose concentration (control solution) being placed on a test strip and measured by the measuring device. In the dental surgery, these devices can be used as an aid to management in the monitoring of blood glucose levels in hypoglycaemia.
AUTOMATED EXTERNAL DEFIBRILLATOR

In management of cardiac arrest the sooner the patient is defibrillated the better the prognosis for survival. In view of this, automated external defibrillators (AEDs) have been developed and are widely available on aircraft, in public buildings and on public service vehicles such as police cars and fire engines. They are simple to use and can be successfully operated by non-medical personnel after minimal training. After placing the chest pads, the AED will lead you through the entire process of defibrillation using voice prompts and visual messages on a screen. They analyse the heart’s rhythm and determine whether a shock is required or not and provide the correct sequence of shocks with minimal input from you. Many existing AEDs are monophasic defibrillators and provide a sequence of shocks at 200, 200 and 360 joules. However, most of the newer devices are biphasic and deliver lower energy shocks. The cost of AEDs has reduced significantly and a growing number of dental practices have these devices. Currently an AED costs in the region of £1,000. However, prices are falling and the case for dental surgeries to have one is increasingly being made. Indeed the Resuscitation Council’s guidance for dental practices¹ now recommends that all clinical areas should have access to an AED, and this recommendation is likely to increase their uptake in general dental practice. Dentists who purchase one should ensure that they and their staff are fully trained in their use and that the equipment is fully serviced and maintained. They are available from a number of companies including Laerdal⁷, Life Tec Medical Ltd¹⁴, Medtronic¹⁵, and Philips Healthcare UK¹⁶. They are also available through www.aed4u.com.
EMERGENCY DRUGS

The Poswillo Report, published in 1990, made recommendations about the emergency drugs and equipment that should be available in a dental practice in the UK. Some felt these recommendations were excessive for the majority of practices that did not carry out general anaesthesia (GA). Now that GA is no longer carried out in general dental practice, the current consensus is to stock fewer drugs. The emergency drugs listed in the introductory section of the British National Formulary (BNF), entitled Medical Emergencies in Dental Practice are suitable. This currently lists 8 emergency drugs, outlined in Table 1, that should be available to assist with first line treatment of a medical emergency arising in a dental surgery. It does not include drugs for advanced cardiac life support. The BNF is updated every six months and its recommendations do change from time to time.

Other authorities and organisations have made recommendations for emergency drugs and equipment which should be available in a dental practice. Previous editions of the BNF have also recommended additional drugs such as chlorphenamine injection for use in acute allergic reactions and hydrocortisone sodium succinate for use in anaphylaxis and acute steroid insufficiency. Some dentists may still wish to stock them in their emergency drug box if they feel confident to administer these drugs and hence we have discussed their use in the text. These additional drugs are supplemental however and the current BNF's list provides a good basis for dealing with most emergencies that are likely to arise in the dental surgery.

In addition to the 8 emergency drugs currently recommended in the BNF, we also describe the use of:

- Hydrocortisone sodium succinate 100 mg (with 2mL ampoule of water) for injection

Table 1. Emergency drugs

<table>
<thead>
<tr>
<th>Emergency Drugs Recommended by the British National Formulary.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The suggested numbers to be kept in the emergency drug kit are given in brackets.</td>
</tr>
<tr>
<td>- Adrenaline (epinephrine) injection 1:1000, 1mg/mL, 1mL ampoules (3-4)</td>
</tr>
<tr>
<td>- Aspirin dispersible tablets 300mg</td>
</tr>
<tr>
<td>- Glucagon injection, 1 unit (1mg) vials (with solvent) (2)</td>
</tr>
<tr>
<td>- Glucose powder or syrup (e.g. GlucoGel®)</td>
</tr>
<tr>
<td>- Glyceryl trinitrate spray or tablets (1 spray)</td>
</tr>
<tr>
<td>- Midazolam buccal liquid, midazolam 10mg/ml (1 bottle) OR midazolam injection 2mg/ml, 5-ml ampoules (3-4), or 5mg/ml, 2-ml ampoules (3-4)</td>
</tr>
<tr>
<td>- Oxygen (1 x ‘E’ size cylinder)</td>
</tr>
<tr>
<td>- Salbutamol aerosol inhaler, 100 micrograms/metered dose (1)</td>
</tr>
<tr>
<td>- Salbutamol nebuliser solution 1mg/mL, 2.5mL (2.5mg) or 2mg/mL, 2.5mL (5mg)</td>
</tr>
<tr>
<td>- Chlorphenamine (chlorpheniramine) injection 10mg/mL, 1mL ampoules</td>
</tr>
<tr>
<td>- Glucose 20% intravenous infusion, 200mg/mL, 50mL ampoules. or 50% intravenous infusion, 500mg/mL, 25mL ampoules</td>
</tr>
</tbody>
</table>

Commercial emergency ‘kits’, which contain all the necessary drugs and equipment are available from large dental supply companies. Whether you choose a commercial emergency drug kit or create your own, it is essential to be familiar with all the emergency drugs and equipment you possess, know how to use them and replace the drugs before they pass their ‘use by’ date. The commercial kits often provide a notification system to replace drugs that are soon to go out of date; if you have created your own drug kit, you should devise a system to ensure that they are replaced before this happens. A good method is to make a note in the practice appointment.
book when a drug needs to be replaced. Computer practice management systems have the facility to provide reminders.

In the United Kingdom, the Misuse of Drugs Act, 1971, prohibits certain activities in relation to ‘controlled drugs’. These drugs are graded broadly according to the harmfulness attributable to a drug when it is misused and subsequent legislation has defined the conditions under which persons acting in their professional capacity can possess, store and use the drug. In January 2008, the legal status of midazolam changed from a schedule 4 controlled drug to a schedule 3 controlled drug. This means that:

- prescriptions or requisitions for midazolam must comply with the full controlled drug regulations;
- invoices for midazolam must be retained for 2 years;
- midazolam (as with other schedule 3 drugs) should be denatured before being placed in waste containers;

However, records of midazolam usage do not need to be kept in a controlled drug register. Also, midazolam is exempt from the safe custody requirements and does not legally require storage in a controlled drug cabinet.

Practitioners who carry out intravenous sedation should do so only after appropriate training and must ensure that they have the equipment necessary to deal with any emergency situation arising from its use and carry appropriate additional drugs, such as flumazenil, the benzodiazepine antagonist. We have not specifically discussed problems arising from the use of intravenous sedation or general anaesthesia as these lie beyond the scope of this book.

ADMINISTERING EMERGENCY DRUGS

For a drug to be effective in an emergency, it must be got into the patient by a means that will ensure rapid absorption and therapeutic effect. The main routes of drug administration are:

**By mouth**

- **topically across the oral mucosa.** Glyceryl trinitrate placed under the tongue is absorbed rapidly across the mucosa of the floor of the mouth and is used in the treatment of angina. Midazolam liquid placed between the teeth and buccal mucosa is rapidly absorbed across the oral mucosa in the treatment of status epilepticus.
- **systemically via the gut.** If a hypoglycaemic diabetic patient is conscious, a glucose preparation, such as glucose powder dissolved in water or Gluco-Gel®, a glucose rich syrup designed to be absorbed across the mucosa, can be administered. For other emergency drugs the rate of absorption of the drug is usually too slow by the oral route.

**By inhalation** - this affords rapid absorption of some drugs. It is especially effective if the target organ is the lungs, hence an inhaler or nebuliser is the best way of administering salbutamol in the treatment of asthma. This route is rapid and minimises systemic side effects.

**By injection.** There are three routes:

- intravenous (i/v)
- intramuscular (i/m)
- subcutaneous (s/c).

**DRUG DELIVERY TECHNIQUES**

**ADMINISTERING DRUGS BY INJECTION**

**INTRAVENOUS INJECTION**

Intravenous (i/v) injection affords the most rapid distribution of a drug. Most dentists have had some experience in gaining i/v access but this will usually have been on fit young patients with good veins and may have been some time ago. In a medical emergency, it is unlikely to be as straightforward; first, because you will be under pressure and second, as the patient is likely to
be shocked, the peripheral vasculature may be shut down. The difficulty of gaining i/v access in emergencies is now widely recognised and guidelines for emergency drug use by dentists predominantly recommend administration by other routes. Our advice is that if you feel competent to get i/v access then do so but don’t waste valuable time on repeated attempts. If you are not successful at first, try other routes for administering emergency drugs.

The antecubital fossa is usually the best site to gain i/v access. Secure a tourniquet above the patient’s elbow and make sure it is tight enough to inhibit venous return; if the patient is conscious, ask them to clench and unclench their fist repeatedly. Slapping the injection site with your forefinger and middle finger may also help engorge the veins. Approach the vein with the needle as near parallel with the vein as possible, with the bevel of the needle uppermost. Pierce the skin and enter the vein; entering at the junction of two veins is often easier. Once in the vein, the tourniquet should be released before injecting the drug slowly.

Many emergency drugs are supplied in clear glass vials. Simply break open the vial at the neck and draw the liquid into the syringe via a needle. Expel any air from the syringe before injecting.

As an aid to rapid administration, a number of emergency drugs are now available for immediate use. One such system is the Min-i-jet® system\(^2\) (Figure 1.17). This consists of a glass vial that forms the plunger of the syringe. To prepare the drug for injection, remove the yellow protective caps and insert the glass vial into the plastic syringe prior to injection. Another pre-loaded syringe system is produced by Aurum\(^2\); this requires only that a needle to be attached to the syringe to be ready for use.

**Drugs which can be administered by i/v injection:**
- hydrocortisone - in acute steroid insufficiency and as an adjunct in anaphylaxis
- chlorphenamine - in acute allergic reactions and as an adjunct in anaphylaxis
- glucagon in an unconscious hypoglycaemic patient.

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**Figure 1.15.** Inserting a needle into a vein in the ante-cubital fossa

**Figure 1.16.** Drawing up a drug from a vial; (a) break open vial, (b) draw up drug into syringe using a needle, (c) expel air from the syringe, (d) ready to inject

**Figure 1.17.** Min-i-jet pre-loaded adrenaline (epinephrine) syringe system
Hydrocortisone is not stable for any length of time in a liquid form and is supplied as a powder, which you dissolve in sterile water (supplied) to make the preparation for injection (Figure 1.19). In this case, break open the vial of sterile water (2mL) and draw it up into the syringe with a needle. Remove the metal cover from the vial of powder, insert the needle of the syringe containing the sterile water through the rubber bung and inject the water into the vial (Figure 1.20). Agitate until the powder is completely dissolved and draw the liquid back into the syringe. Expel any air before injecting.

INTRAMUSCULAR INJECTIONS
Many drugs can be given i/m; although they are not disseminated as rapidly as drugs given i/v, eventual blood levels can be comparable with those achieved by i/v bolus injection. I/m injections can be administered at four sites:

- the upper arm (deltoid muscle)
- the upper outer quadrant of the buttock (gluteus medius muscle)
- the thigh (vastus lateralis muscle)
- the muscle mass of the tongue – familiar territory for dentists.

The safest site is the thigh. Use a 23 gauge (blue) needle. This has a 25mm long needle ensuring that the drug is injected into the muscle in most individuals. In some obese adults a 21 gauge (green) needle, which is 38mm long, may be required. Even in the most wasted individual there is sufficient muscle bulk and absorption will be relatively rapid with minimal chance of damaging any other structure. In an emergency this site is also accessible through clothing. You should aim for the middle of the antero-lateral aspect of the thigh, midway between the top of the leg and the knee. The upper arm and upper outer quadrant of the buttock are less accessible and involve the risk of damage to the radial nerve in the arm and sciatic nerve in the buttock should the injections be misplaced.

Figure 1.18. Aurum pre-loaded adrenaline (epinephrine) syringe

Figure 1.19. Hydrocortisone comes as a vial of water and a vial of powder that need to be mixed together
Having loaded the syringe with the drug you wish to give, disinfect the skin with some form of alcohol wipe. Stretch the skin with one hand and insert the needle with a stabbing action through the skin at 90° to the surface into the muscle. Before injecting aspirate to check that you are not in a blood vessel. If you aspirate blood withdraw the needle slightly and try again. When you no longer aspirate blood, inject the solution slowly then withdraw the needle quickly, press on the injection site with a gauze swab and massage gently.

The tongue has a smaller muscle bulk than muscles at other sites but is readily accessible to a dentist. In an emergency, if other sites are inaccessible, it may accommodate injection of a small amount of fluid up to 1mL.

*Drugs that can be given by i/m injection:*
- adrenaline (epinephrine) - in anaphylaxis
- glucagon - in an unconscious hypoglycaemic patient
- hydrocortisone - in acute steroid insufficiency and as an adjunct in anaphylaxis
- chlorphenamine (chlorpheniramine) - in acute allergic reactions and as an adjunct in anaphylaxis.
SUBCUTANEOUS INJECTIONS
In an emergency, subcutaneous injection is always a second choice. Absorption of a drug from this site is slower and less predictable than from muscle and is only suitable for small volumes (1mL or less). Nevertheless should you be unable to give a drug by any other means, then this route can be used. The aim is to deposit the drug in the loose connective tissue under the skin. The best sites for injection are where there is subcutaneous, fat such as:
• the outer upper arm
• the abdomen below the ribs
• anterior thighs.

The best site is the abdomen, as even the thinnest individual has some fat in this region. Use a 25 gauge orange needle to deliver a small volume (up to 1mL) of a drug. Load the syringe and have the needle in place. If a suitable disinfecting agent is at hand, wipe it over the skin, then pinch about two inches of flesh between your forefinger and thumb. Insert the needle through the skin at an angle of 45° with a short stabbing action. Aspirate to ensure that you are not in a blood vessel before injecting the drug slowly. Withdraw the needle quickly and place a disinfectant or gauze swab over the injection site and massage it lightly.

Drugs that can be given by s/c injection:
• adrenaline (epinephrine) in treatment of anaphylaxis (first choice route: i/m)
• glucagon, in hypoglycaemia (first choice route: i/m)

ADMINISTERING DRUGS BY INHALATION
Aerosol preparations, such as salbutamol inhalers, are usually carried by asthmatics and those with chronic obstructive pulmonary disease (COPD); these patients should be proficient in the use of them. They come in several forms: the most common are the pressurised (aerosol) inhalers which require the patient to activate the inhaler while breathing in and hold their breath for ten seconds afterwards. For those unable to use such inhalers, breath activated aerosol inhalers, dry powder inhalers and spacing devices are available – make sure that the patient has any specialised inhalers with them when they attend for treatment.
A patient having an acute asthmatic attack can find it difficult to coordinate a deep inspiration with triggering of the inhaler. Indeed, they may be unable to take a deep breath at all; as a result the jet from the inhaler may deposit at the back of the throat rather than entering the lungs. In these cases a large volume spacer device placed between the inhaler and the mouth may help.

The spacer reduces the velocity of the drug and mixes it more effectively with any inspired air. In an emergency, if a proper spacer is not available, one can be fashioned from a large disposable cup or 500ml soft drink bottle.

More effective still is to nebulise the drug and deliver it along with oxygen via a mask.

Oxygen delivery masks with an attached nebuliser chamber can be purchased very cheaply. They can be used as an oxygen delivery mask with or without using the nebuliser facility. When used as a nebuliser, empty the drug (e.g. a nebul of salbutamol (1mg/ml, 2.5mls i.e. 2.5mg)) into the nebuliser chamber and then turn on the oxygen. The oxygen and the nebulised drug are delivered very effectively into the patient's lungs via the mask even when their breaths are very shallow or laboured.
ADMINISTERING DRUGS VIA THE ORAL MUCOSA

Patients who require glyceryl trinitrate (GTN) for relief of angina usually carry a sublingual spray with them and should be practised in its use. If there is any doubt, ask the patient to open his or her mouth and lift the tongue to the roof of the mouth, then spray the floor of the mouth with two squirts of the GTN spray.

Midazolam can also be given by this route in the treatment of status epilepticus. During an attack, midazolam liquid can be deposited into the space between the teeth and the buccal mucosa from where the midazolam will be absorbed across the oral mucosa.