Administration of medicines

After completing this tutorial, you will be able to:

- Outline the types of clinical problem that hospital pharmacists must solve concerning the safe administration of medicines.
- Describe the different methods by which injectable medicines are given.
- Define extravasation and list the medicine-related risk factors that may lead to tissue damage if it occurs.
- Support patients who may not be able to take their oral medicines safely such as those with dysphagia and/or an enteral feeding tube.

Why this subject matters...

Pharmacists are expected to know about *how* medicines are given in practice, and the limitations and problems caused by different routes of administration. It's a very practical, but fundamental, side of the pharmacist's role: how to get medicines into every patient in a safe and convenient way.

This tutorial covers concepts that you may not have come across if you haven't worked in a hospital before. It describes common clinical problems and gives you troubleshooting tips for resolving administration issues, but it does not give an in-depth description of each method of giving medicines.

Routes available

Most clinical problems that you'll encounter will relate to administration of medicines into the gut ('enteral'), or by injection, but remember that there are other routes which you should not overlook. For example, the **transdermal** route can be a useful alternative if you are running out of suitable methods to give certain medicines (e.g. fentanyl patches for pain in a patient with dysphagia).

Similarly, the **inhaled** route can be used to administer selected drugs other than bronchodilators and corticosteroids (e.g. antibiotics for cystic fibrosis, pentamidine for *Pneumocystis jirovecii* pneumonia).

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Note that in many clinical situations in hospitals, the administration of medicines can involve **unlicensed use**. Although medicines cannot be promoted outside the limits of their marketing authorisation, the Human Medicines Regulations 2012 do not prohibit the use of unlicensed medicines. It is recognised that informed use of unlicensed medicines or of licensed medicines for unlicensed purposes (‘off-label’ use) is often necessary – particularly in paediatric patients.

For example, crushing tablets and opening capsules for administration through enteral feeding tubes is unlicensed but common practice. However, make sure you have investigated all the appropriate licensed options first (e.g. oral liquids). The MHRA has provided guidance on the use of unlicensed medicines.

Intravenous medicines

The intravenous (IV) route provides a rapid way of administering drugs, fluids, blood products and parenteral nutrition. There are two basic methods:

1. Direct intravenous injection is the administration of a small volume of drug solution into an entry port sited in a vein. Injections can also be given via existing IV infusion administration lines (or 'giving sets'). The technique of direct injection is sometimes called an 'IV push'. The term 'IV bolus' is widely used as well but is potentially misleading because it implies that the injection can be given instantly over a few seconds whereas most direct injections should normally be administered over 2 to 5 minutes.

Administration of a direct intravenous injection

Direct injection gives therapeutic levels of a drug quickly, but there can be problems with this technique. For example, injections may damage a vein, particularly if the drug is irritant (e.g. phenytoin). In addition it is impractical if a drug needs to be given slowly or in a large volume.

2. Intravenous infusion involves IV administration over a longer time period often using larger volumes. An administration set ('IV line' or 'giving set') connects the bag or syringe of drug solution to an entry point in a patient's vein as in the image below. The infusion may be *intermittent* (e.g. metronidazole 500mg in 100mL saline over 20 minutes every eight hours) or *continuous* over 24 hours. Continuous infusion is indicated for drugs with a short half-life (e.g. glyceryl trinitrate) and/or when a constant therapeutic drug level is required (e.g. insulin). Infusions require a drug to be stable in the specified diluent for the duration of administration. They also require the drug to be compatible with the plastic used to make the IV line and infusion bag.

A **'Y-site'** is the point where two IV lines containing different solutions join to run down the same line into a patient forming a 'Y' shape. One infusion may be described as being 'piggybacked' onto the other.

The choice of intravenous administration method depends on the drug (e.g. indication, volume of infusion fluid, rate of administration, degree of irritancy, pharmacokinetics) and patient factors (e.g. age, availability of IV access, concurrent disease such as presence of heart failure).

An administration set connects a bag of infusion fluid to a patient

Intravenous injections and infusions may be given via peripheral or central veins. Peripheral lines are usually inserted in the hand or arm. They can become blocked or dislodged easily and, because the veins are quite narrow, they are not usually used for irritant drugs (e.g. amiodarone), concentrated solutions in fluid restricted patients (e.g. potassium) and vasoconstricting drugs (e.g. adrenaline). **Central lines** are preferred for these situations and are inserted into larger veins such as the superior vena cava. Central lines can be used to administer any intravenous medicine.

Some drugs may cause pain on injection because of their tonicity, pH, or irritancy (e.g. erythromycin). The vein may become red and inflamed; this is called **phlebitis**. If a medicine liable to cause phlebitis must be given peripherally, then the peripheral line should go into as large a vein as possible.

Common clinical problems

- Calculating the rate of administration of a drug (e.g. phenytoin).
- Advising on the volume and type of infusion fluid suitable for diluting a drug (e.g. vancomycin).
- Determining how best to administer an IV drug in fluid restricted patients (e.g. potassium).
- Choosing between a peripheral or central intravenous line (e.g. dopamine, amiodarone).
- Advising on the safety of mixing drugs in the same syringe, IV bag or line (e.g. cefuroxime and metronidazole).

Intravenous access devices

We discussed intravenous access techniques briefly on the previous page, but we'd now like to look at this in more detail. One of the potentially confusing things that you need to understand as a hospital pharmacist, is the various devices used to deliver intravenous medicines into the body.

People will talk to you about Venflons, Hickman lines, triple-lumen catheters and many others. What do they all mean? On this page we hope to explain for you, using example pictures.

Peripheral intravenous access

1. Cannula

This is commonly called a 'Venflon' but that is actually a brand name. The cannula is inserted into a vein in the hand or arm and is for short-term use (days). Here is a close-up image:

A peripheral intravenous cannula
Courtesy of Fifo, Wikimedia Commons

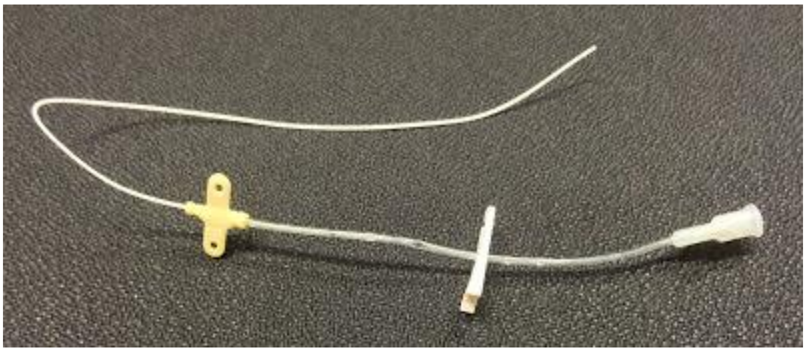
The needle helps to introduce a small plastic tube through the skin and into a vein; the needle is then removed. The little plastic 'wings' enable the whole device to be securely taped to the skin. The pink plastic tap is a valve that can be turned open and the hole in the top allows a syringe to be connected to e.g. take a blood sample or administer an injection. The white 'luer lock' plug at the end enables intravenous infusion lines to be connected. It's easier to appreciate the job that the peripheral cannula does when you see a picture of the device *in situ* as shown on the next page.

Notice that the short line connected to the luer lock branches into two so that two separate intravenous infusions can be connected. This is an example of a **Y-site**. Any medicines in the two infusions will be kept entirely separate until they reach the Y-site, after which they will mix before entering the patient.

A peripheral cannula in situ

In addition to a cannula, or sometimes instead, a patient may be fitted with one or more long lines at a different site. These are lengthy plastic catheters inserted into a vein so that the tip is positioned some way away from the insertion point. Some common examples are described below, with pictures. Note that 'long line' is a fairly imprecise phrase describing a variety of potential set ups. If you are ever unsure what someone means by the term, ask for clarification. It's often especially important for pharmacists to ask if a 'long line' is a peripheral line or a central line.

2. Midline intravenous catheter

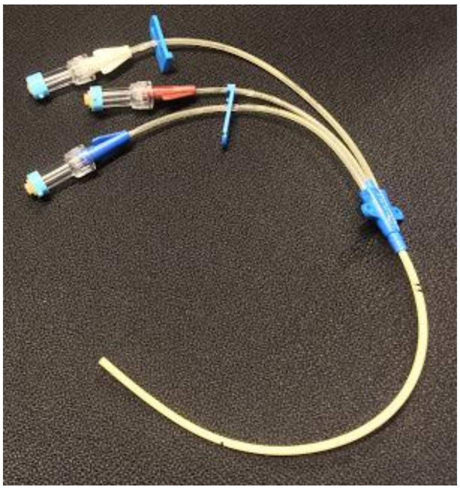


This is a long peripheral intravenous line or 'catheter' generally inserted into an arm vein, but the tip of the catheter sits some distance away from where it enters the patient (e.g. in a larger vein near the shoulder). In the picture shown here the thin white catheter is inserted fully into the vein until the yellow butterfly on the left-hand side is reached, and this is then secured to the skin with tape. A midline catheter requires less frequent site change than a peripheral cannula and is less prone to causing phlebitis. However, it is still for short-term use (but often weeks rather than days).

Central intravenous access

1. Short-term access

This is often achieved by a **multi-lumen central line** with separate tubes ('lumens') running the length of the catheter. It is inserted into a large vein such as the internal jugular vein and the tip ends up in the distal superior vena cava just outside the heart. As you can see from the photo and diagram of a **triple lumen catheter** below, the lumens are effectively separate catheters bound together.



Cross section showing the three separate lumens running inside a triple lumen catheter

Medicines that enter via one lumen **do not mix in the catheter** with medicines administered via one of the other lumens. The lumens exit the catheter at different points along its length and any medicines administered down them are rapidly diluted by the fast-flowing bloodstream. **This allows incompatible medicines to be given simultaneously.** Double lumen catheters that only have two lumens are also available, as are quadruple lumen catheters with four lumens and quin lumen lines with five lumens. These lines are commonly needed by intensive care and high dependency patients.

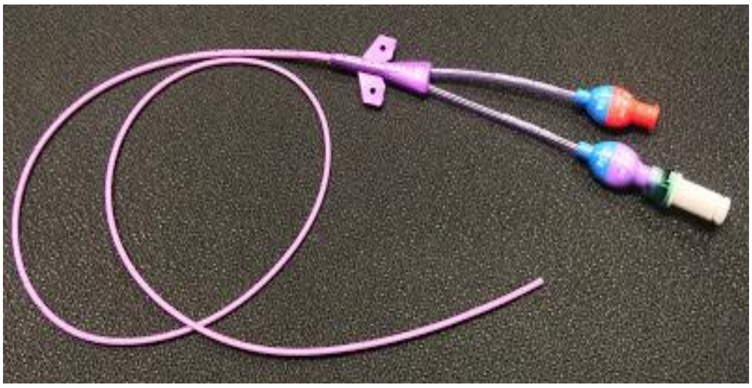
One advantage of central administration is that irritant or vasoconstrictive drugs can be given more safely because of the wide diameter of the vein and the faster blood flow.

2. Longer-term central venous access

There are a number of ways to achieve this, using an intravenous device that can stay in place for months or more, and three examples are given below.

a) PICC line

This stands for **P**eripherally **I**nserted **C**entral **C**atheter, and although it's inserted at a peripheral location the tip of the catheter resides centrally (e.g. in the superior vena cava). A PICC line is intended to stay in place for long periods (months) and is used, for example, for administering prolonged chemotherapy regimens or TPN. These lines are relatively straightforward to insert compared to some of the alternatives below, and can be single, double or triple lumen.



b) Totally implantable devices (TIDs)

These devices are implanted beneath the skin somewhere on the chest wall in a pocket of skin (e.g. near the collar bone) or on/under the upper arm, depending on patient choice. The catheter is fed into a central vein, and the port allowing access to the catheter is positioned just below the skin. When an injection is required a special 'non-coring' needle is inserted through the skin and then through a self-sealing rubbery membrane in the port (called a septum).

The photographs below show an example known as a **portacath** with the port at its head. The second photo is an X-ray showing the portacath in position in a patient. Patients who require long-term repeat injections may have a portacath e.g. people with cystic fibrosis or on chemotherapy. These types of device can be left in place for a long time but are more cosmetically acceptable and pose a lower infection risk.

X-ray courtesy of Pixman, Wikimedia Commons

c) Tunnelled and cuffed central catheter

Courtesy of General Ludd, Wikimedia Commons

One of the most well-known examples of this type of central venous catheter is a Hickman line. It is inserted into the body at a site on the chest wall and is tunnelled under the skin until it reaches the neck. Then it enters a large vein such as the jugular vein and runs down into the superior vena cava. In our photograph you can just see the line running under the skin from its insertion point up towards the incision at the neck where the line will have been pushed into the jugular vein. Macmillan Cancer Support has produced a helpful video for patients about having a tunnelled line inserted which you might like to watch.

Hickman lines are used for long-term intravenous administration of medicines such as chemotherapy.

Hickman lines, PICC lines, and portacaths might all be used by patients receiving long-term intravenous therapy at home.

On the Medicines Learning Portal site you can see a diagram that illustrates a method by which IV access devices can be selected in practice; it is included courtesy of the originator, Katie Scales, and the Injectable Medicine Guide.

Flushing intravenous lines

Intravenous lines must be **flushed** before and after the administration of medicines to prevent potentially incompatible drugs from mixing. Flushing should also occur at the end of surgical procedures to ensure that peri-operative medicines such as anaesthetics are not left in the line when the patient returns to the ward. In patients who have long-term intravenous lines inserted, flushing helps to prevent the line from blocking, maintaining their 'patency'.

Flushes should be compatible with the medicine being administered; the most commonly used in practice are water for injection and sodium chloride 0.9%.

Listen to Kathryn's experience of suffering paralysis and respiratory arrest after her intravenous line was not flushed in theatre.

Infusion devices

Some drugs may be given as direct injections over several minutes (e.g. cyclizine), but others must be given as infusions over longer time periods (e.g. vancomycin). An 'infusion device' is used to propel the drug from its container (i.e. infusion bag, syringe or bottle) to the patient. There are many different types of infusion device available, but they essentially fall into 2 groups; those that use gravity and those that use an electromechanical pump**.** In an acute hospital setting you are most likely to encounter the latter.

The choice of device depends upon many factors including the administration route, volume to be infused, required rate, half-life of the drug and whether it has a narrow therapeutic index, and the age of the patient. Practice does vary between hospitals, so ensure that you are familiar with your local protocols.

Attaching an administration set to an infusion container

Using gravity

Using gravity is the simplest method of infusing drugs and fluids. The infusion container (usually a bag or bottle) is hung above the patient at a specific height to create the desired flow pressure and flow rate.

A drip chamber (on the left) and roller clamp (on the right)

A clear administration set is attached to the infusion container. This consists of tubing which attaches to the patient's vascular access device (e.g. peripheral intravenous cannula), a 'roller clamp' and a 'drip chamber'. The drip chamber enables the number of drops falling per minute to be counted and the roller clamp is used to ‘pinch’ the tubing partially or fully closed, thereby controlling the flow of the infusion fluid into the patient.

Gravity infusion can be used to administer fluids without additives (e.g. sodium chloride 0.9%) and drugs **where the rate is not critical** and **serious adverse effects are not anticipated** (e.g. metronidazole). Care is required if the height between the infusion container and the patient changes (such as if the patient sits up in bed) as this may change the flow pressure, and in turn the rate at which the infusion is delivered.

Gravity calculations

The **rate of administration** is calculated taking into account the infusion volume, the desired infusion time and the number of drops per millilitre of fluid. For crystalloid fluids (e.g. sodium chloride 0.9%) given through a standard administration set there are approximately 20 drops per millilitre. For more viscous fluids such as blood there are approximately 15 drops per millilitre.

$$\text{Drops per minute} = \frac{\text{Number of drops per mL x volume to be infused (in mLs)}}{\text{60 x desired infusion time (in hours)}}$$

For example, a patient is prescribed metronidazole 500mg in 100mL intravenous infusion to be given over 1 hour. The drop rate is calculated as shown;

$$\text{Drops per minute} = \frac{\text{20 drops per mL x 100mL}}{\text{60 x 1 hour}} = \text{33 drops per minute}$$

Therefore the person administering this metronidazole infusion will need to use the roller clamp to adjust the rate so that one drop is falling through the drip chamber approximately every 2 seconds.

Electromechanical pumps

Compared to gravity infusion, electromechanical pumps enable drugs and fluids to be administered with more **precise control.** They are required in a range of scenarios such as when using drugs with a **short half-life** (e.g. noradrenaline, heparin), a **narrow therapeutic margin** (e.g. phenytoin) and those where a **variable infusion rate** may be required (e.g. insulin). Some are intended to be used at the bedside, whilst others are designed to be worn on the patient enabling them to move around.

Safety features of electromechanical pumps include alarms to detect resistance to flow (e.g. if the intravenous administration line becomes blocked) and to alert the user when the infusion has finished. Some may also be pre-programmed with the usual administration rate for a range of drugs (a 'drug library') to try to avoid errors arising from manual entry; you may hear these called 'SMART' pumps.

In practice you are most likely to encounter **syringe pumps, volumetric pumps** and **elastomeric pumps.**

Syringe pumps

These are used in a range of patients such as those requiring critical care in hospital to those with a palliative illness living at home. They are intended to deliver **small infusion volumes at low rates**, typically from around 5mL up to 60mL at less than 10mL/hour.

The plunger of the syringe is pushed forward by the pump at the programmed rate

The prescribed medicine(s) is drawn up into a syringe and this is placed in the pump. The pump then pushes the plunger of the syringe forward in tiny increments delivering the contents to the patient. At higher flow rates, the administration of the infusion appears to be continuous, maintaining steady plasma levels of the drug. At very low flow rates such as those used in neonates, these small incremental movements mean that the drug is not delivered smoothly and plasma levels of the drug may rise and fall. This matters for drugs with short half-lives such as inotropes where these fluctuations in plasma levels may be clinically significant.

In a critical care setting syringe pumps may be used to deliver a range of medicines including inotropes and anaesthetics. Care is required when syringes are replaced to ensure that adequate plasma levels of the drug are maintained. This is especially important for drugs with short half-lives, again such as inotropes. If you are not working in critical care, you may see syringe pumps being used to administer drugs such as insulin, heparin and furosemide.

You can read more about the use of syringe pumps ('syringe drivers') in a palliative setting in the Palliative care topic.

Volumetric pumps

There are several types of volumetric pump; the one used most is a peristaltic pump. They are designed to deliver **large infusion volumes** (e.g. 50 to 3000mLs) **at medium to high rates** (e.g. 5 to 50mL/hour). The infusion container is hung above the patient, and an administration set is attached. The administration line is then fed through the pump, and a series of rollers 'squeeze' the line to push the infusion fluid to the patient.

They are commonly used to administer infusion fluids with additives (e.g. potassium chloride) and drugs (e.g. vancomycin, amiodarone) in adults and older children. They are used in neonates, but syringe pumps should be used when strict control over administration rate is required.

A peristaltic pump delivering a large volume infusion

Elastomeric pumps

These are single use non-electronic pumps. They are generally designed for patients to use at home as they are small and portable. They are used to deliver medicines where accuracy of the administration rate is less critical such as with antibiotics and chemotherapy. They vary in size from around 100mL to 500mL. The pump contains an elastomeric balloon (surrounded by a protective cover) that is stretched when filled with the medicine. As the balloon deflates the drug is pushed out and into the patient. A 'flow restrictor' on the administration set controls the infusion flow rate.

Electromechanical pump calculations

With electromechanical pumps **the rate of administration** may be expressed in various formats including mL/hr, mg/kg/hr and micrograms/kg/min.

For example, a 70kg patient is prescribed **dopamine 10 micrograms/kg/min** through a central intravenous administration line. The concentration of the infusion to be given is **400mg in 100mL 5% glucose.**

Firstly calculate the **dose** of dopamine the patient requires per minute
70kg x 10 micrograms/kg/min = 700 micrograms per minute
Then convert the **concentration** of the dopamine infusion to micrograms per mL
400mg in 100mL = 4mg in 1mL = 4000 micrograms in 1mL
Finally calculate the **rate** of the infusion
700 micrograms per minute/4000 micrograms per 1mL = 0.18mL/min

The calculated administration rate is entered into the infusion pump.

Safety concerns with infusion devices

The MHRA receives many reports of incidents involving infusion pumps, with a significant amount resulting in patient harm or death. The majority of serious problems relate to over-infusion of drugs and user error is often a contributing factor. Training on infusion devices is essential, as well as rationalising the infusion devices used with an organisation and having a centralised equipment library.

Extravasation

Extravasation injury in a child

A complication of giving intravenous medicines is **extravasation**. Extravasation occurs when a medicine leaks from a blood vessel and causes injury to the surrounding tissue. The consequences of this leakage depends upon whether the medicine is classed as:

an **irritant**, meaning it can cause inflammation but not necrosis or

a **vesicant**, which means it can cause irritation, vascular ulceration, and necrosis

If a **non-irritant** medicine leaks from a blood vessel this is called **infiltration**.

In addition to patient harm, extravasation injury costs the NHS millions of pounds in legal costs and damages. Chemotherapy medicines are amongst the most commonly implicated agents.

There are a range of risk factors for extravasation including those related to the administration device (such as an inadequately secured cannula), those associated with the administrator (such as lack of familiarity with the device or medicine), and those related to the patient (such as extremes of age or small veins).

Medicine-related risk factors that increase the risk of inflammation and tissue damage include:

- pH of less than 5 or greater than 9.
- Osmolarity more or less than that of plasma (approximately 290 mOsmol/L). Most injections are formulated to have a similar osmolarity to plasma to reduce the risk of vein irritation but there are exceptions.
- Vasoconstrictive potential (extravasation of dopamine can cause ischaemic necrosis, for example).
- Presence of certain excipients (such as alcohol or polyethylene glycol).
- The volume of medicine or fluid that has entered the surrounding tissue.
- Concentration of the medicine or fluid.
- Potential of the medicine to precipitate (such as diazepam).
- Ability to bind to DNA and/or kill replicating cells.

The evidence base for managing extravasation is made up of small trials and case reports. Despite this, the BNF has some information on extravasation. In addition, your hospital is likely to have local guidelines if chemotherapy is given there, as these agents are commonly implicated in extravasation injury. Refer to the Information sources for more guidance on where to look, but the most important point to remember is that if you are asked about managing a case of extravasation, **act quickly and ask for help** – this is an urgent problem.

Subcutaneous and intramuscular medicines

1. Subcutaneous (SC)

Administration of drugs and fluids by the subcutaneous route may be by direct injection (e.g. insulin, enoxaparin), by intermittent or continuous infusion (e.g. diamorphine, terbutaline) or by implantation (e.g. etonogestrel). This route can be an option when intravenous access becomes difficult (e.g. elderly or restless patients) and is particularly useful in palliative care.

Administration of a subcutaneous injection

The subcutaneous compartment can accommodate large volumes of fluid. Subcutaneous administration of fluid ('hypodermoclysis') can be a useful method of hydration in patients with terminal illness or following a stroke. The rate of administration should not normally exceed 2 litres in 24 hours at a single site.

The subcutaneous route is normally well tolerated, but pain, oedema and bruising can occur. Irritant drugs should not be given subcutaneously (e.g. prochlorperazine).

Common clinical problems

- Being asked about mixing drugs in the same syringe, particularly in patients with terminal illness.
- Checking the suitability of infusion fluids administered subcutaneously.

2. Intramuscular (IM)

Intramuscular injections are used:

- To ensure compliance (e.g. depot antipsychotics).
- When other routes are less effective (e.g. hydroxocobalamin).
- When other routes may be dangerous (e.g. adrenaline for anaphylaxis).
- When a prolonged duration of action is desired (e.g. depot medroxyprogesterone).
- As a short-term alternative to intravenous administration (e.g. morphine).

The intramuscular route is not always suitable if a rapid onset of action is required. It is also more uncomfortable for the patient and only small volumes can be given (typically no more than 3mL although there is some variation in the literature). Intramuscular injection of certain drugs may cause pain, abscesses or bleeding (e.g. NSAIDs, iron) so consider whether alternative methods of administration may be used. The route is avoided in patients with increased bleeding risk (e.g. raised INR, low platelet count) to prevent injection site haemorrhage, and in those with decreased muscle mass.

Administration of an intramuscular injection

Common clinical problems

Clinicians may ask you about the intramuscular route as an alternative option to intravenous where the latter cannot be used. In practice you probably won't be asked many questions about intramuscular drug administration although this route is more common in some clinical areas than others (notably mental health).

Enteral administration

1. Oral administration

You will often be asked for help in managing oral administration problems. Think laterally and be inventive. For example, if a patient is going to be nil-by-mouth (NBM) prior to surgery but normally takes levothyroxine, it may not matter if they miss one or two doses, as the half-life is about 7 days. Similarly, if the patient takes simvastatin for hypercholesterolaemia missing several doses won't matter, since atherosclerosis is a chronic process.

However, if the same patient takes carbamazepine for epilepsy, they cannot miss any doses and you need to think about alternative routes, in this case rectal might be a suitable option.

For patients with dysphagia where no licensed liquid formulation exists think about alternative routes or drugs, using injections orally, specials manufacturers, crushing tablets or opening capsules. Some conventional tablets are soluble in water (e.g. ciprofloxacin). Note that certain tablets must not be crushed as they can pose dangers. These include: enteric-coated tablets (crushing destroys the protective coating), slow-release tablets (crushing stops the prolonged action), and chemotherapy drugs (crushing could release cytotoxic dust). Patients with part of their gut removed may still be able to take medicines orally. Establish exactly which section of gut has been removed and check the site of drug absorption.

Common clinical problems

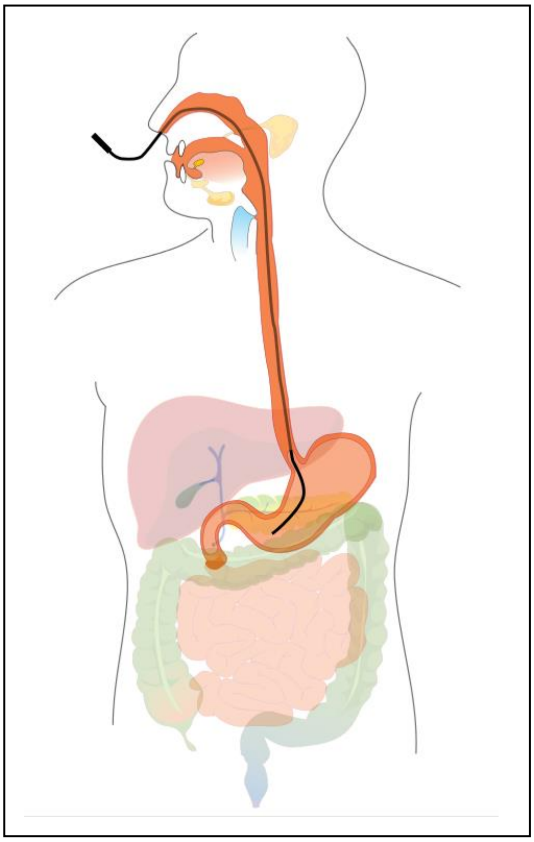
- Advising on the care of NBM patients (e.g. patients undergoing surgery).
- Finding appropriate medicines and/or formulations for patients with dysphagia (e.g. patients with stomatitis or after a stroke).

2. Administration through enteral feeding tubes

Enteral feeding is indicated in patients who cannot ingest food normally but whose gastrointestinal tract is able to digest and absorb sufficient nutrients (e.g. patients with head and neck cancer or following a stroke). A variety of methods are used to deliver enteral feeds:

- **Nasogastric (NG)** tubes are inserted through the nose into the stomach. They are used for short-term feeding only.
- **Percutaneous endoscopic gastrostomy (PEG)** tubes are inserted through the abdominal wall into the stomach via a stoma. They are used for long-term feeding.
- **Jejunostomy** tubes may be inserted through the nose **(NJ)** or through the abdominal wall **(PEJ)**.

Enteral feeding tubes can be used to administer drugs but care must be taken to check that the tube does not **bypass the site of absorption** (e.g. iron is mainly absorbed in the duodenum and jejunal administration will therefore reduce bioavailability).



A nasogastric tube in an adult, shown here in black
Courtesy of Nanoxyde, Wikimedia Commons

In addition, drugs can **interact with the feed** (e.g. phenytoin) or cause the tube to block (e.g. insufficiently crushed tablets). NG tubes are long, fine bore tubes which **block** easily. PEG and PEJ tubes are shorter with a wider bore.

Enteral feed may be administered as a bolus, intermittent or continuous infusion. Try to administer drugs in the gaps when the tube is not being used for feed, remembering to flush with sterile water before and after each drug.

If a liquid formulation is unavailable or unsuitable then consider using injections orally, changing the drug or route of administration, opening capsules or crushing tablets. However, enteric-coated tablets, modified-release tablets or cytotoxic drugs must not be crushed, as above.

Administration of most medicines through enteral feeding tubes is unlicensed practice.

Common clinical problems

- Advising how to administer drugs through enteral feeding tubes (e.g. crushing tablets, availability of liquids, giving injections orally).
- Managing interactions between drugs and enteral feeds (e.g. sucralfate).
- How to unblock enteral feeding tubes.

On the Medicines Learning Portal website, listen to Helen Jones interviewing Sue Green, a Community Nutrition Nurse in Hampshire. Sue talks about the practical problems faced by patients with a PEG tube and those who care for them, and the part a pharmacist can play in optimising their medicines.

3. Buccal/ sublingual administration

These routes of administration will not generate many clinical problems but they may occasionally be useful to consider in some situations where you've exhausted other potential routes or where alternatives are less convenient (e.g. sublingual buprenorphine for heroin withdrawal).

Suggested questions

The types of clinical problem you will encounter involving the administration of medicines are very diverse. So it's impossible to give you comprehensive guidance for every eventuality. However, the following examples may help you.

If asked about **administration of a drug intravenously** think about dose, type of infusion fluid, fluid volume, rate of administration, availability of IV access, and whether any other drugs are being given IV.

If you are advising about whether drugs may be put down **enteral feeding tubes**, ask about the type of tube, where the end of the tube is, and the feeding regimen. Think about alternative administration routes or drugs. Some patients who need a tube can still take medicines by mouth, so remember to check this.

If the enquiry is about a **patient who is NBM** prior to surgery establish the drugs and doses, and how long they are likely to be NBM. Again think about alternative administration routes or alternative drugs.

Similarly, if a patient becomes **dysphagic**, ask about the drugs and doses, and when/whether their swallow is expected to improve.

There are also some more general questions to ask when problem solving.

Information sources

The BNF and SmPCs are good places to start for most straightforward administration questions. The BNF will show you the range of dosage forms available, and the SmPC will give detailed advice about administration. For enquiries specific to children, start with the BNF for Children. Many SmPCs are on the electronic medicines compendium, but you may also have to use the MHRA website or that of the European Medicines Agency. If you're unfamiliar with all the features of the emc then we have a learning module about it here.

Your Trust or other employer will have local policies and procedures related to the administration of medicines, particularly injections. Be familiar with the basic content of these documents and know how to find them.

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Many healthcare organisations use the Injectable Medicines Guide to help ensure the safe administration of intravenous medicines. The tutorial on Injection compatibility will also assist you in managing enquiries on this topic. If you're asked specifically about administering medicines to patients who are fluid-restricted then the UKCPA Critical Care Group's guidance on Minimum Infusion Volumes is one of the first resources to check.

For questions about **extravasation**, evidence is often lacking but a good starting point is the Cardiff and Vale Treatment Summary. If you are asked about extravasation of chemotherapy, then consult your Trust's policy. Try to have familiarised yourself with these resources before you need them, as extravasation enquiries are always urgent.

For help with administering drugs through **enteral feeding tubes** try Drug Administration via Enteral Feeding Tubes (Pharmaceutical Press) and the NEWT Guidelines. These sources can differ in the advice they give, so ideally you should check both. You'll need a username and password to log into either site. Don't forget Stockley's Drug Interactions for interactions between enteral feeds and medicines.

For patients with **swallowing difficulties** who don't have an enteral feeding tube, SPS has a range of guidance.

The UKCPA's Handbook of Perioperative Medicines provides guidance on managing your patient's medicines around surgery. As above, use this with any local policies your Trust may have.

If you think you might need to recommend the use of a special medicine, then the RPS have produced guidance on the prescribing of specials which can help your decision-making. Trying to establish exactly where drugs are absorbed in the gastrointestinal tract is notoriously difficult. However, pharmacology textbooks can be a good starting point, as can SmPCs (look at section 5). Manufacturers medical information departments may be able to help with these questions, and others related to administration of medicines.

Be careful about conducting a general internet search on this subject. If you do, you may like to look at our brief guide to evaluating websites about medicines.

Presenting your answer

Once you've asked sufficient questions, gathered the information required and assessed it, you'll need to provide an **answer**. We can offer you some general guidance on answering clinical problems.

Next steps in learning...

The British Association for Parenteral and Enteral Nutrition (BAPEN) have a practical guide to administering medicines via enteral feeding tubes.

You may also like to read a detailed review of some of the factors that healthcare professionals need to think about in this area in an article from the American Journal of Hospital Pharmacy (you will need to register with the MedScape site first for access). Note that it is a US publication so some of the brand names etc. are different to the UK.

HEE's e-LfH platform has a helpful e-learning package for social care staff and other professional carers on how to safely manage medicines for patients with dysphagia.

An important aspect of drug administration that can lead to errors, is the **calculations** that are sometimes required. If you are uncertain about your competence in this area, then there is a tutorial on drug calculations on this site that offers various online resources to help you, as well as a quiz.

We haven't mentioned the inhaled route much during this topic but there are many different types of **inhaler** on the market, but pharmacists should be able to advise on their correct usage. The Asthma UK website has advice on correct usage, and also a series of videos showing how many of the devices should be used (see bottom of the webpage).

The **covert administration of medicines** is a topic that you may be asked about. CPPE has a Mental Capacity Act and covert administration of medicines workshop to help you to develop your knowledge and skills in this topic. CPPE also has a series of Mental health distance learning cards, focusing on different areas of support for people living with mental health conditions. Covert administration of medicines is covered in card 7.

SPS has guidance on the subject of covert administration as well.

There is a BMJ learning package on prescribing, preparing, and administering injectable medicines safely. You need to register with the site to gain access.

Packages on Infusion devices are available on the e-LfH site.

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