When deciding which medication formulation is appropriate for administration via an enteral feeding tube, many factors need to be taken into consideration. It is not necessarily correct to assume that a liquid is preferable to a tablet; unwanted side-effects of the excipients of a liquid formulation must be borne in mind. The needs of the patient or carers must also be considered; it may not be practical for the patient to carry several bottles of liquid medication with them on a daily basis.

In this chapter each of the formulations available will be reviewed. Guidance on how to administer the formulation will be given and advantages and disadvantages listed. See chapter 9 for further information on appropriate choice of syringe.

**Liquid formulations**

**Solutions**

A solution is a homogenous one-phase system consisting of two or more components. The solute is dispersed in the solvent. The solvent is usually present in the greater amount. Syrup is a notable exception with 66.7% w/w sucrose as the solute in 33.3% w/w of water as the solvent.
Because a solution is a homogenous system, the drug will be distributed evenly throughout the system. This is in contrast to a suspension, where inadequate mixing or settling may lead to variable dosing.

Water is the most widely used solvent for pharmaceutical products. Some other solvents can be used in combination with water to act as co-solvents and thereby increase the solubility of the drug in the formulation. Examples of excipients used in solutions are ethanol, sorbitol, glycerol and propylene glycol. Inclusion of these excipients can determine the suitability of a solution for administration via an enteral feeding tube; for example, sorbitol can cause diarrhoea (see disadvantages below).

Administration of solutions

1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?
4. Draw the drug solution into an appropriate size and type of syringe.
5. Flush the drug dose down the enteral feeding tube.
6. Finally, flush the enteral feeding tube with the recommended volume of water (see p. 11).
7. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

Alternatively, at step (4) measure the drug solution in a suitable container and then draw into an appropriate size and type of syringe. Avoid syringes that are compatible with parenteral devices. Ensure that the measure is rinsed and that this rinsing water is administered via the enteral feeding tube to ensure the total dose is given. Do not measure liquid medicines using a catheter-tipped syringe, as this results in excessive dosing owing to the volume of the tip.

Advantages

- Even drug distribution in the formulation allows accurate dosing.
- Ready to use.
- Easily measured.
- Accurate dosing.
- Suitable for administration via an enteral feeding tube without further manipulation.

Disadvantages

- Co-solvents may be present in sufficient quantities to have a pharmacological effect, especially if present in all drug formulations being used; for example, sorbitol (≥15 g day) will have a laxative effect.
- May not be considered practical for carrying around.
- Cost.
- Stability and a short shelf-life may be impractical.
Suspensions

A suspension formulation is usually developed when the drug is insoluble or if, for reasons of palatability, the drug is formulated into coated microgranules.

Nongranular suspensions can be administered via enteral feeding tubes but may require further dilution owing to the viscosity and osmolarity.

For granular suspensions, granule size and the viscosity of the formulation must be taken into account when assessing the suitability of the formulation for administration via an enteral feeding tube. Examples of granular suspensions are ciprofloxacin, clarithromycin and lansoprazole. Some granular suspensions contain enteric coated granules (e.g. Zoton suspension) or modified-release granules (e.g. MST-continus suspension); caution should be exercised with such formulations to avoid changing the absorption characteristics (see individual monographs).

Administration of a suspension (see notes above)

1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?
4. Shake the medication bottle thoroughly to ensure adequate mixing.
5. Draw the medication suspension into the appropriate size and type of syringe.
6. Flush the medication dose down the enteral feeding tube.
7. Finally, flush the enteral feeding tube with the recommended volume of water (see p. 11).
8. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

Alternatively, at step (5) measure the drug suspension in a suitable container and then add an equal volume of water and mix thoroughly. Draw this into an appropriate size and type of syringe. Avoid syringes that are compatible with parenteral devices. Ensure that the measure is rinsed and that this rinsing water is administered via the enteral feeding tube to ensure that the total dose is given. Do not measure liquid medicines using a catheter tipped syringe as this results in excessive dosing owing to the volume of the tip.

Advantages
- Ready to use (few exceptions).
- Easy to measure.
- Accurate dosing.

Disadvantages
- Granules in suspension may be too large or the suspension may be too viscous to pass through the enteral feeding tube.
- Settling or inadequate shaking may affect the accuracy of dosing.
- May not be practical to carry around.
- Cost.
Stability and shelf-life may be impractical

**Solid dosage formulations**

**Soluble tablets**

A soluble tablet dissolves completely when placed in water to give a solution of the drug; this is usually achieved by using an alternative salt form, e.g. prednisolone sodium phosphate.

**Administration of soluble tablets**

1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?
4. Select an appropriate size and type of syringe for administration.
5. Remove the plunger and place the tablet into the barrel of the syringe.
6. Replace the plunger.
7. Draw 10 mL of water into syringe and allow the tablet to dissolve, shaking as necessary.
8. Inspect the solution to ensure that there are no visible particles.
9. Flush the medication dose down the enteral feeding tube.
10. Draw an equal volume of water into the syringe and also flush this via the enteral feeding tube (this will rinse the syringe and ensure that the total dose is administered).
11. Finally, flush with the recommended volume of water (see p. 11).
12. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

Alternatively, at step (4) place the tablet into medicine pot, add 10 mL of water and allow tablet to dissolve. Draw this into an appropriate size and type of syringe. Ensure that the measure is rinsed and that this rinsing water is administered via the enteral feeding tube to ensure that the total dose is given.

**Advantages**

- Drug is in solution.
- Long expiry date of original packaged drug.
- Usually less expensive than alternative liquid formulation.
- Easy to carry around.
- Accurate dosing.

**Disadvantages**

- One must allow complete dissolution before administration.
**Effervescent tablets**

Effervescent tablets are defined as tablets in which more than 75% of the bulk of the tablet is composed of inert agents intended to make the tablet effervesce. These tablets are created by incorporating sodium or potassium carbonates or bicarbonates with tartaric or citric acid; this produces carbon dioxide when placed in water and rapidly breaks the tablets apart. Owing to the nature of the formulation, these preparations tend to have a high sodium content.

These tablets will effervesce and dissolve or disintegrate when placed in water. The volume suggested is usually 1/3 to 1/2 a tumblerful of water; however, for the purposes of administering these formulations via an enteral feeding tube it may be possible to dis- solve them in a smaller volume.1 (See individual monographs for details.)

**Administration of effervescent tablets**

1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?
4. Measure a suitable quantity of water into a container of appropriate size to allow effervescence without spillage.
5. Add the effervescent tablet and allow it to disperse.
6. Draw the contents of the measuring pot into an appropriate size and type of syringe.
7. Inspect the syringe contents to ensure that there are no visible particles that might block the tube.
8. Flush the medication dose down the enteral feeding tube.
9. Rinse the measure and administer this water via the enteral feeding tube to ensure that the total dose is given.
10. Finally, flush with the recommended volume of water (see p. 11).
11. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

**Advantages**

- Low osmolarity – will not cause diarrhoea.
- Long shelf-life of original packaged drug.
- Easy to carry around convenient.
- Generally less expensive than liquids.
- Accurate dosing.

**Disadvantages**

- May require a large volume to be fully dispersed.
- Must be fully dispersed before administration to avoid gas production in the enteral feeding tube.
- Sodium content can be high.
- Excipients may not dissolve and may sediment out.
- Cannot be dispersed in syringe owing to the production of gas.
Dispersible tablets

Although designed to be given orally, dispersible tablets disintegrate in water to give particles that may or may not suspend in water.

These tablets will usually disperse when placed in a small amount of water, e.g. 10–15 mL; however not all are suitable for administration via an enteral feeding tube as the resultant particles or granules may be too large for administration via fine-bore tubes, e.g. Pentasa dispersible tablets.

Administration of dispersible tablets

1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?
4. Select an appropriate size and type of syringe for administration.
5. Remove the plunger and place the tablet in the barrel of the syringe.
6. Replace the plunger.
7. Draw 10 mL of water into syringe and allow the tablet to disperse, shaking if necessary.
8. Inspect the syringe contents to ensure that there are no large particles that might block the tube.
9. Flush the medication dose down the enteral feeding tube.
10. Draw an equal volume of water into the syringe and flush this via the enteral feeding tube (this will rinse syringe and ensure that the total dose is administered).
11. Finally, flush with the recommended volume of water (see p. 11).
12. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

Alternatively, at step (4) place the tablet into medicine pot, add 10 mL of water and allow the tablet to disperse. Draw this into an appropriate size and type of syringe. Ensure that the measure is rinsed and that this rinsing water administered via the enteral feeding tube to ensure that the total dose is given.

Advantages

- Cost.
- Convenient to carry around.
- Lower electrolyte content than effervescent tablets.

Disadvantages

- Particles granules of dispersion may be too large for administration via fine-bore tubes.
- Sedimentation during administration may lead to tube blockage.

Orodispersible tablets

Orodispersible tablets are designed to disperse on the tongue. They are not necessarily absorbed sublingually, merely swallowed with the saliva; however, individual
monographs should be consulted. They are intended to be taken without water, examples are Feldene Melts or Zoton FasTab.

Administration of orodispersible tablets
The administration of these formulations via enteral feeding tubes varies depending on the medicine concerned. The formulations and dose equivalences vary depending on the intended site of absorption, for example, Zoton FasTabs are enteric coated micro-granules that, although they disintegrate easily in a small amount of water, may block a very fine-bore enteral feeding tubes. Also, the dose may be inappropriate; for example, Zelaper is a lower dose than the equivalent oral product of selegiline. Individual monographs should be consulted. If the formulation is suitable for administration via an enteral feeding tube, the same method as for dispersible tablets can be used; see individual drug monographs for more details.

Advantages
• Convenient to carry around.
• Cost.

Disadvantages
• Unsuitability of some formulations for fine-bore tubes owing to site of absorption or formulation characteristics.

Buccal/sublingual tablets
Medicines formulated into buccal or sublingual tablets are designed to be absorbed through the oral mucosa and therefore bypass the first-pass metabolism effects of the liver. These formulations are a useful alternative for patients who are ‘NBM’ or are unable to swallow, providing the patient is able to produce normal quantities of saliva (caution is needed in head and neck surgery patients). However, they are not suitable for administration via enteral feeding tubes as significantly reduced drug absorption will occur, owing to first-pass metabolism.

Compressed tablets
Ordinary-release tablets are usually made by one of two methods: either direct compression or wet granulation. Compression pressures are usually higher for tablets made directly from drug powder and bulking agent compared to those used in producing tablets formulated from granules. A variation in the excipients used in the tablet formulation will affect the disintegration time of the tablet when it is placed in water. (See individual monographs for information on disintegration times.)

When a tablet formulated by wet granulation is placed in water, it will usually disintegrate to give visible granules before deaggregating to give primary drug particles. A large proportion of ordinary-release tablets will disperse sufficiently in water to be suitable for administration via an enteral feeding tube, without the need for crushing.
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Advantages

- Cheap.
- Easily obtained.
- Most disintegrate easily when placed in water.
- No need to crush, therefore exposure risk is reduced.

Disadvantages

- Not all tablets will disintegrate easily.
- Variability in dispersion characteristics between generic brands of the same drug.
- Administration method can affect dosing accuracy.

Administration of compressed tablets

There are several methods of administering compressed tablets.

Tablets that disintegrate

1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?
4. Select an appropriate size and type of syringe.
5. Remove the plunger and place the tablet into the barrel of the syringe.
6. Draw 10 mL of water into the syringe and allow the tablet to disintegrate, shaking as necessary (larger volumes may be necessary for some bulky tablets; see individual monographs).
7. Inspect the syringe contents to ensure that there are no large visible particles that might block the tube.
8. Flush the medication dose down the enteral feeding tube.
9. Draw an equal volume of water into the syringe and flush this via the enteral feeding tube; this will rinse the syringe and ensure that the total dose is administered.
10. Finally, flush with the recommended volume of water (see p. 11).
11. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

Alternatively, at step (4) place the tablet into a medicine pot and add 10 mL of water (larger volumes may be necessary for some tablets; see individual monographs) and allow the tablet to disintegrate. Draw this into the syringe. Ensure that the measure is rinsed and that this rinsing water is administered via the enteral feeding tube to ensure that the total dose is given.

Both of the above methods have advantages:

- Allowing the tablet to disintegrate in a small container allows the patient carer to inspect the dispersion and any particles will be visible when drawn into a syringe; however, there is a risk that some of the dose may be left in the container if it is not rinsed adequately.
- Allowing the tablet to disperse directly in the syringe ensures that the whole dose is given, within a closed system. Particles may not be visible owing to the cloudiness of
the dispersion, but using a larger volume for dispersal will usually overcome this problem.

**Tablets that do not disintegrate**
Several devices are available for crushing tablets. Crushing of tablets should always be considered a last resort because of its effect on dosing accuracy, plus the patient or carer is at risk of exposure to drug powder (see chapter 8 on health and safety and clinical risk management). There are also legal implications that must be considered (see chapter 7 on the unlicensed use of medications).

**Using a mortar and pestle**
N.b. This has been demonstrated to reduce dose delivered by 25% through loss of drug on transfer.

1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?
4. Ensure that suitable protective clothing is worn.
5. Place the tablet(s) in the mortar.
6. Crush the tablet(s) to a fine powder, making sure that the powder is contained in the mortar.
7. Add 5 mL of water and crush further to form a paste.
8. Add a further 5–10 mL of water and continue to crush and mix the paste; this should form a fine suspension. Ensure that there are no visible pieces of coating or large tablet particles.
9. Draw this suspension into an appropriate size and type of syringe and administer via the enteral feeding tube.
10. A further 10–20 mL of water should be added to the mortar and stirred with the pestle to ensure that any drug remaining in the mortar or on the pestle is mixed with the water.
11. Draw this water into the syringe and flush it down the enteral feeding tube. This can be repeated to ensure that all the powder is administered.
12. The tube should then be finally flushed with water to ensure that the whole dose is administered (see p. 11).
13. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

N.b. Care should be taken when using this method in fluid-restricted patients.

The pestle and mortar should be thoroughly cleaned with hot soapy water after each use to avoid cross-contamination.

**Using a crushing syringe**
1. Stop the enteral feed.
2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?

4. Place the tablet in the barrel of the crushing syringe and push the plunger down.

5. Put the cap on the crushing syringe and rotate the barrel of the syringe to crush the tablet.

6. Remove the cap and draw 10–15 mL of water into the crushing syringe.

7. Replace the cap and shake the syringe to ensure that the powder is mixed well.

8. Inspect the syringe contents to ensure that there are no large particles that might block the tube.

9. Flush this suspension down the enteral feeding tube.

10. Draw a further 10–30 mL of water into the crushing syringe and shake before flushing down the enteral feeding tube; this will ensure that the whole dose is given.

11. Finally, flush with the recommended volume of water (see p. 11).

12. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

This closed system is preferred for cytotoxics or hormones for which no liquid formulation is available, so as to avoid environmental contamination and exposure of a carer to the medicine.

**Modified-release tablets**

Modified-release tablets are formulated to release the drug slowly over time. As a rule these are not suitable for administration via enteral feeding tubes because altering the dosage form, for example by crushing, will affect the pharmacokinetic profile of the drug and may result in excessive peak plasma concentrations and side-effects.

**Hard gelatin capsules**

Some hard gelatin capsules can be opened and the powder mixed with water. There are a number of considerations, including the risk of inhaling powder.

Most capsules are too small to be manipulated and opened, and this should be taken into consideration with elderly or arthritic patients. Some capsules contain granules rather than powder.

**Administration of hard gelatin capsules**

1. Stop the enteral feed.

2. Flush the enteral feeding tube with the recommended volume of water (see p. 11).

3. Check the relevant monograph – can the drug be administered with feed, or should a specific time interval be allowed before administering the drug?

4. Open the capsule and pour the contents into a medicine pot.

5. Add 15 mL of water.

6. Stir to disperse the powder.

7. Draw into an appropriate size and type of syringe and administer via the enteral feeding tube.
8. Add a further 15 mL of water to the medicine pot; stir to ensure that any powder remaining in the pot is mixed with water.
9. Draw up this dispersion and flush it down the tube. This will ensure that the whole dose is given.
10. Flush the enteral feeding tube with the recommended volume of water (see p. 11).
11. Re-start the feed, unless a specific time interval is needed following the administration of the drug.

**Advantages**
- Cheap.
- Convenient.

**Disadvantages**
- Occupational exposure risk.
- Small capsules may be difficult to open.
- Not all capsules are suitable; the contents may not disperse in water owing to the hygroscopic or hydrostatic nature of the powder.

**Soft gelatin capsules**

Drugs that are presented in soft gelatin capsules are usually poorly soluble in water and are therefore contained in an oily solution within the capsule; an example is ciclosporin in Neoral. Therefore, it is unlikely that these will be suitable for administration via an enteral feeding tube.

In certain circumstances it may be possible to pierce the capsule shell using a pin and squeeze out the contents (for example the contents of a nifedipine capsule for sublingual use); however, accurate dosing cannot be guaranteed. The volume contained in the capsule can vary depending on the brand of capsule used, and the volume expelled will vary depending on the skill of the person expelling the contents; for these reasons this method is unreliable and is not recommended.

**Enteric coated tablets**

Tablets are given an enteric coating to protect the drug from degradation by the acidic conditions of the stomach or to reduce the incidence of gastric side-effects.

Crushing enteric coated tablets and administering them via feeding tubes is highly likely to cause tube blockage.

Administering enteric coated tablets via an enteral feeding tube with the tip placed in the stomach would necessitate crushing or removing the enteric coat prior to administration; therefore, the drug is likely to be degraded in the stomach. The extent of drug degradation is unpredictable and the practitioner should explore alternative therapies or routes before deciding to administer enteric coated tablets via an enteral feeding tube placed in the stomach. If it is decided to administer the drug by this method, the above techniques are applicable but will result in decreased amounts of drug available for absorption and the patient’s response to therapy should be monitored carefully. If the patient has a feeding tube with the end in the small intestine (duodenum or jejunum),
then crushing or removing the enteric coat prior to administration down the enteral feeding tube is not an issue.

**Injectable formulations**

Injections vary widely in their suitability for administration via enteral feeding tubes. The injectable formulation may be a different salt form from the oral formulation and therefore the oral bioavailability may be unknown. The pH of injections can also vary widely, making some unsuitable for enteral administration (see chapter 7). Refer to the individual monographs for information about the appropriateness of different injections for use via an enteral feeding tube.

**Advantages**
- The drug is in a soluble form.

**Disadvantages**
- Variable salts.
- Cost.
- Inherent risks of supplying injectable preparation intended for oral/enteral use.

**References**


**Suggested further reading**


Protocol produced by Dr David Wright, Senior Lecturer in Pharmacy Practice, University of East Anglia, Norwich; *Swallowing Difficulties Protocol: Achieving Best Practice in Medication Administration* (March 2005) distributed by Rosemont Pharmaceuticals.