

In this article...

- Different routes used to administer medicines
- Benefits and limitations of the different administration routes
- Points to consider before administering medicines

Medicines administration 1: understanding routes of administration

Key points

Bioavailability is the proportion of a medicine that reaches the systemic circulation

The chosen route of administration will influence a medicine's effectiveness and the patient's experience

Care should be taken before crushing medicines, and advice should always be sought from the pharmacist or prescribing doctor

Crushing modified-release tablets can result in the full dose of medicine being released at once rather than gradually

Administering medicines directly into the systemic circulation by injection or infusion means the medicine is rapidly distributed to its sites of action

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Abstract Medicines administration is a core responsibility of registered nurses in healthcare settings and is increasingly being undertaken by nursing associates. Before administering any medicine, the person carrying out the procedure must be familiar with the advantages and limitations of the prescribed route and know the indications, contraindications and side-effects of the medicine they intend to give. This article, the first in a two-part series, provides an update on the routes of administration. Part 2 will outline the procedure for administering medicines to patients.

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Medicine administration is a core responsibility of registered nurses in healthcare settings; increasingly, the task is also being carried out by nursing associates. To ensure patient safety, it is essential the correct procedure is implemented so the correct medicine is given in the prescribed amount using the most appropriate route. Before administering any medicine, the person carrying out the procedure must be familiar with the advantages and limitations of the prescribed route, and know the indications, contraindications and side-effects of the medicine they intend to give.

Medicine use and safety

A drug is defined as any chemical that can affect living processes (Burchum and Rosenthal, 2016); this article focuses on those that are administered for therapeutic effect. To make it suitable for administration to a patient, a drug has to be formulated into a preparation that enables it to be taken or given – such as a tablet or injection. Once formulated, the drug becomes a medicine; however, the two

terms tend to be used interchangeably. Ideally, any medicine should be effective, safe and selective in its mode of action.

Effectiveness refers to how the body responds to a medicine; if a medicine fails to lead to its intended result, there is no benefit to prescribing it (Burcham and Rosenthal, 2016). In the UK, the National Institute for Health and Care Excellence carries out technology appraisals on the use of new and existing medicines and treatments in the NHS ([Bit.ly/NICE TechAppraisal](https://bit.ly/NICE_TechAppraisal)); these use clinical evidence on effectiveness and economic evidence on whether the medicine/treatment represents value for money.

All medicines are evaluated to assess their safety, but no medicine is entirely risk free. Nurses should:

- Be aware of any potential problems that patients may experience when taking any medication;
- Know how and when to report these.

In the UK, the Yellow Card scheme ([Bit.ly/MHRAYellowCard](https://bit.ly/MHRAYellowCard)) collects and monitors information on suspected safety concerns or incidents involving medicines



Clinical Practice Review

and medical devices. The scheme is run by the Medicines and Healthcare products Regulatory Authority and relies on health professionals and patients voluntarily reporting suspected adverse drug reactions; it aims to provide an early warning that the safety of a product may require further investigation.

Ideally, a medicine should be selective in its action on the body. However, most medicines have side-effects and it is important to inform patients about these risks – as an example, antihistamines can cause drowsiness. Sometimes a decision has to be made by the patient and prescriber as to whether symptom relief is balanced against potential side-effects; in some situations, the side-effects may outweigh the benefits of the medicine.

Administration

The way in which medicines are administered will, to some extent, influence their clinical benefit and whether patients experience any adverse effects. For example, if intravenous (IV) furosemide is administered too quickly, it can cause deafness, while oral penicillin V will not be well absorbed if given with food (bnf.org). Two main factors determine whether a medicine will reach its intended site of action in the body:

- Its bioavailability;
- How it is given (route of administration).

Bioavailability

Bioavailability is the proportion of a medicine that reaches the systemic circulation and is therefore available for distribution to the intended site of action (Burchum and Rosenthal, 2016). The route of administration and formulation – tablet, capsule, liquid – can influence its bioavailability.

Medicines given by IV injection are said to have 100% bioavailability. Some medicines that are particularly well absorbed by the gastrointestinal mucosa, for example the antibiotic ciprofloxacin, may have bioavailability close to that of an IV dose (bnf.org). However, most medicines do not have this level of availability by the oral route so the dose given orally is usually higher than that given parenterally. For example, the beta-blocker propranolol, when given orally, is administered in doses of 40mg and above; the equivalent IV dose is 1mg.

Routes of administration

There are various routes of administration (Box 1), each of which has advantages and disadvantages. These routes need to be

Box 1. Administration routes

Enteral: oral, via enteral feeding tubes
Topical: via skin, eyes, ears, nose, vagina, rectum, lungs (inhaled)
Parenteral: intravenous, intramuscular, subcutaneous

understood in terms of their implications for the effectiveness of the drug therapy and the patient's experience.

Oral route

The oral route is the most frequently used route of medicines administration and is the most convenient and cost-effective (Dougherty and Lister, 2015).

Although solid-dose forms such as tablets and capsules have a high degree of drug stability and provide accurate dosage, the oral route is problematic because of the unpredictable nature of gastrointestinal absorption. For example, food in the gastrointestinal tract may alter the gut pH, gastric motility and emptying time, as well as the rate and extent of drug absorption.

Patients' tolerance of solid-dose forms also varies, particularly in very young and older patients, for whom liquids or solutions may be preferable. However, many medicines are not stable in solution; in such cases, an alternative should be considered. Key points are outlined in Box 2.

Modified-release preparations

Modified-release formulations can delay, prolong or target drug delivery. The aim is to maintain plasma drug concentrations for extended periods above the minimum effective concentration. Their main advantage for patients is that doses usually only need to be taken once or twice daily.

Crushing tablets

The process of crushing tablets is usually outside of the product licence and nurses should seek advice from a pharmacist or the prescribing doctor if they are uncertain about a tablet and whether it is suitable for crushing or the process will affect its efficacy (Dougherty and Lister, 2015).

Modified-release tablets must not be crushed or broken. Damage to the release-controlling mechanism can result in the full dose of medicine being released at once rather than over a number of hours. The entire dose of the medicine may then be absorbed too quickly, leading to toxicity, or not absorbed at all, leading to sub-optimal treatment.

Non-oral routes

While the oral route is most frequently used for medicine administration, it is not always appropriate. In such situations a range of alternatives is available to treat the patient effectively.

Sublingual administration

The sublingual mucosa offers a rich supply of blood vessels through which medicines can be absorbed. This is not a common route of administration but it offers rapid absorption into the systemic circulation. The most common medicine given via sublingual administration is glyceryl trinitrate in the treatment of acute angina.

The pharmaceutical industry has formulated 'wafer-based' versions of medicines, which dissolve rapidly under the tongue. These are aimed at particular groups of patients who have difficulty taking tablets, such as rizatriptan for people with migraines that are sometimes accompanied by nausea as this may prevent them from taking oral treatments. Wafers are also used to treat conditions in which adherence is an issue; for example, olanzapine can be administered by the sublingual route when used to treat schizophrenia (Montgomery et al, 2012).

Rectal administration

The rectal route has considerable disadvantages in terms of patient acceptability due to cultural issues and the potential for discomfort, leakage and unpredictable absorption; however, it does offer a number of benefits (Hua, 2019). Drug delivery can be localised into the large bowel – for example, the use of rectal steroids in the form of enemas or suppositories in the treatment of inflammatory bowel disease. Antiemetics can be administered rectally to treat nausea and vomiting, and paracetamol can be given to treat patients with a pyrexia who are unable to swallow.

Box 2. Key points on oral route for administration

- The oral route is convenient and cost-effective
- Some patients, particularly children and older people may have problems swallowing tablets and capsules
- Modified-release formulations can delay, prolong or target drug delivery
- Nurses should seek advice from a pharmacist or the prescribing doctor before crushing any tablets
- Modified-release tablets must not be crushed or broken

Topical administration

The topical application of medicines has obvious advantages in the management of localised disease. The medicine is available almost directly at the intended site of action, and because the systemic circulation is not reached in great concentration, the risk of systemic side-effects is reduced. Examples of topical medicines include:

- Eye drops containing beta blockers to treat glaucoma;
- Topical steroids to manage dermatitis;
- Inhaled bronchodilators to treat asthma;
- Pessaries containing clotrimazole to treat vaginal candidiasis.

Topical administration has also become a popular way of introducing medicines into the systemic circulation through the skin. The development of transdermal patches that contain drugs began with the introduction of a hyoscine-based product for the treatment of nausea in the early 1980s (Pastore et al, 2015). The market for such products has since grown to include a wide range of therapy areas including smoking cessation (nicotine replacement), chronic pain (fentanyl), Parkinson's disease (rotigotine).

The transdermal route is not without its problems – for example, some preparations can cause local skin reactions (Pastore et al, 2015), and the adhesiveness of some patches can be a limitation. However, many patients find it a welcome alternative to taking tablets.

Administration via enteral feeding tubes

Medicines should only be administered via fine-bore enteral feeding tubes after other routes have been considered (Bit.ly/BAPE-NEnteralDrugAdmin). Most medicines are not licensed for enteral administration and this route is complex from a medico-legal perspective.

Interactions that may compromise the effectiveness of a medicine can occur between the medicine and the enteral feed and clinically significant interactions

Box 3. Parenteral administration

Advantages

- Can be used for medicines that are poorly absorbed, inactive or ineffective if given orally
- The intravenous route provides immediate onset of action
- The intramuscular and subcutaneous routes can be used to achieve slow or delayed onset of action
- Patient adherence problems can be avoided

Disadvantages

- Staff need additional training and assessment
- Can be costly
- Can be painful
- Aseptic technique is required
- May require additional equipment, for example programmable infusion devices

include phenytoin, warfarin and flucloxacillin (Bit.ly/BAPENEnteralDrugAdmin).

Medicines that have to be specially prepared as liquids to enable administration via enteral tube incur significant additional costs, and consideration should be given to alternatives before these are requested. A pharmacist should, therefore, be involved in any decision to administer medicines via this route.

BAPEN (British Association for Parenteral and Enteral Nutrition) has produced information about administration of medicines via enteral feeding tubes as well as useful information leaflets for patients (Bit.ly/BAPENEnteralDrugAdmin).

Parenteral route

Parenteral administration refers to any non-oral means of medicine administration, but is generally interpreted as relating to injecting directly into the body, bypassing the skin and mucous membranes. The common parenteral routes are intramuscular (IM), subcutaneous (SC) and IV. Box 3 outlines the advantages and disadvantages of parenteral routes.

Parenteral administration requires an appropriate injection technique. If performed incorrectly – for example using the wrong size needle or cannula – it can cause damage to nerves, muscle and vasculature and may adversely affect drug absorption. For example, inadvertent administration of subcutaneous insulin into muscle can result in rapid absorption and

hypoglycaemic episodes (Dougherty and Lister, 2015).

Intramuscular and subcutaneous

In general, the IM and SC injection of medicines establishes a deposit or 'depot' that will be released gradually into the systemic circulation. The medicine's formulation will influence the period over which it is released. For example, the formulation of antipsychotic agents, such as flupentixol in oil, allows them to be administered once a month or every three months.

IV route

The IV route carries the greatest risk of any route of medicine administration. By administering directly into the systemic circulation, either by direct injection or infusion, the medicine is instantaneously distributed to its sites of action. This route of administration can be complex and it is now an integral part of the nurse's role. Those administering IV medicines must have appropriate training and be deemed competent to undertake the procedure (Dougherty and Lister, 2015).

Conclusion

It is important that any nurse administering medicines or delegating this procedure to another member of their team understands the different routes of medicines administration and their limitations. This will enable them to assess the effectiveness of the medicine being administered and to identify any potential problems the patient may be experiencing with the treatment. Part 2 of this series outlines the procedure for the safe administration of medicines. **NT**

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Useful resources

- British National Formulary bnf.nice.org.uk
- Royal Pharmaceutical Society, Royal College of Nursing (2019) *Professional Guidance on the Administration of Medicines in Healthcare Settings*. RPS/RCN. Bit.ly/RPSAdministration

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Part 1: Understanding administration routes June

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