Chapter 8

The Right Dosage Form and the Right Route of Administration: Working With Accuracy

**KEY TERMS**
- alcoholic solution
- angina
- anhydrous absorption bases
- aseptic technique
- binders
- bioavailability
- bolus dose
- buccal tablets
- compressed tablets
- continuous infusion
- controlled-release tablets
- diluents
- disintegrates
- effervescent tablets
- elixirs
- enteric-coated tablets

**OBJECTIVES**
After completing this chapter, the student will be able to:
- Describe the various dosage forms available for medications.
- Define the routes of administration for medications.
- Correlate the dosage forms with the appropriate route of administration.
- Apply the dosage form and administration route to prescription evaluation.
- Utilize appropriate reference books to verify prescription information.
- Adapt the dosage form and administration route for special-needs patients.
Medication can be administered in a variety of forms to accommodate the special needs of the patient, to facilitate delivery to the indicated site, or to control the rate of absorption. The available dosage form will determine the route of administration, although some dosage forms can be administered by more than one route. An important aspect of the prescription evaluation process performed by the technician involves matching the dosage form ordered with the route of administration prescribed in the directions to the patient. Any discrepancy should be verified before the prescription is entered into the patient profile.

**Solid Oral Dosage Forms**

**Tablets**

One of the oldest and most common dosage forms is the oral tablet. The tablet is a solid dosage form that contains an active ingredient (the drug) and may or may not have additional **diluents**, **binders**, **lubricants**, colorings, flavorings, and/or **disintegrates**. Most commercial tablets on the market today are **compressed tablets** formed by using pressure and some type of punch machine to create the desired size and shape. Compressed tablets may be sugar-coated and the coatings may be flavored and colored (see Fig. 8.1). This coating process has little therapeutic effect but increases patient acceptance and creates a pharmaceutically elegant tablet. Film-coated tablets are similar in appearance to sugar-coated tablets but the film is a thin layer of water-soluble material. See Figure 8.2 for an example of a film-coated tablet. Enteric-coated tablets are useful for drugs that may be irritating to the mucosa of the stomach or will be inactivated by the gastric fluid in the stomach. The coating is formulated to resist dissolving in the stomach but will disintegrate in

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**diluents** Usually inert powders added to a drug to increase the volume. **binders** Materials added to a tablet formulation to hold the powders together. **lubricants** Topical compounds that are intended to soothe and moisturize dry irritated skin. **disintegrates** Compounds added to a tablet formulation to ensure that the tablet will break apart and be available for absorption into the system. **compressed tablets** Tablets that are produced by a tablet press exerting great pressure on powders, and shaped by punches and dies of various sizes. **film-coated tablets** Tablets covered with a thin layer of polymer designed to dissolve at the desired place in the gastrointestinal tract. **enteric-coated tablets** Tablets formulated to pass through the stomach unchanged and dissolve in the intestine.
the intestine. Figure 8.3 shows an example of an enteric-coated tablet. Controlled-release tablets are formulated to release the drug over a predetermined period of time to provide more constant levels of the drug in the bloodstream (see Fig. 8.4 for a controlled-release tablet). This may be accomplished in several ways. The drug may be encapsulated into beads or granules of various sizes and thicknesses to dissolve at different times. The tablet may have two or more layers formulated to release the drug at different times. The drug may be embedded in an inert wax matrix that allows the drug to leach out through a small hole. With this type of tablet the wax coating may be eliminated in the feces of the patient, causing him or her to think the drug did not have any effect. The patient may need reassurance that the drug was released and exerted the proper therapeutic effect. Effervescent tablets combine the drug with sodium bicarbonate and an acid so that when water is added the tablet will disintegrate, releasing bubbles of carbon dioxide and forming an effervescent solution. An effervescent tablet is pictured in Figure 8.5. Buccal tablets are small, flat tablets that are placed between the lip or cheek and gum, and dissolve slowly into the oral mucosa. Sublingual tablets are similarly formulated to dissolve and be rapidly absorbed through the oral mucosa, but are placed under the tongue. Orally disintegrating tablets are manufactured by means of numerous technologies to formulate a powder into a tablet that will quickly dissolve when placed in the mouth. This dosage form originated to prevent psychiatric patients from storing tablets in a pouch in the cheek (a process known as “cheeking”) and removing them after the nurse leaves the room. This would interfere with their medication therapy. A number of products have emerged from the use of this technology to create a convenient tablet that does not require water to facilitate swallowing. Figure 8.6 shows an orally disintegrating tablet.

**Tablet Ingredients**

Because most tablets on the market today are compressed tablets produced by compression with a punch and die machine, the ingredients added to the drug are important for producing a uniform tablet that has the correct amount of hardness, will not stick to the machine, and will disintegrate and dissolve in the correct amount of time to release the drug for absorption into the system. These added ingredients are called excipients; they are considered to be inert, but research has shown that they do affect the stability and bioavailability of the dosage form. It is important for the technician to be aware of the excipients used because they may vary when a brand-name drug is manufactured.

**Controlled-release tablets**

Tablets that have been formulated to release a drug slowly over a predetermined period of time.

**Granules** Powders that have been wetted and broken into coarse particles to increase stability.

**Effervescent tablets**

Tablets that are compounded with an effervescent salt that releases a gas when placed in water, causing the medication to dissolve rapidly.

**Buccal tablets** Tablets designed to be placed in the cheek so that the drug can be absorbed through the oral mucosa.

**Sublingual tablets** Small, fast-dissolving tablets that are administered under the tongue and absorbed through the oral mucosa.

**Excipients** Ingredients added to a drug in a solid dosage form to create an acceptable tablet or capsule.

**Stability** The amount of time a drug or compound retains its stated potency.

**Bioavailability** The ability of a drug to exert its therapeutic effect on the body.
is reformulated as a generic. The generic version of the drug is required to have the same amount of active ingredient as the brand-name product and demonstrate equal bioavailability, but a change in one or more excipients could cause an allergic reaction in a patient or cause the drug to act differently in a given individual.

When the single dose of an active ingredient is small, such as 1 mg, a diluent must be added to improve accuracy in the dose and to make a tablet of a reasonable size. Sometimes the diluent can impart other properties to the tablet, such as increasing the rate of disintegration to make the tablet acceptable for a chewable dosage form. Binders are used to increase the cohesiveness of the powders so that the tablet will not crumble during or after compression. Care must be taken to use the proper amount of binder so that the finished tablet will not be so hard that dissolution will be affected.

Lubricants are added to prevent the tablet from sticking to the machine and affecting the appearance and strength of the dosage form. Disintegrants are added to the tablet formulation to ensure that the tablet will break up and release the active ingredient in a reasonable amount of time so that it may be absorbed into the system. Coloring agents serve several purposes. They add pharmaceutical elegance to the finished product, can serve as a quality control factor during product manufacture, and aid the patient in product identification. Flavoring agents are especially important in the formulation of chewable tablets to improve palatability.

Advantages of Tablets

- formulated to give an exact dose
- convenient to carry
- long shelf life
- usually tasteless
- can be formulated for controlled release

Disadvantages of Tablets

- may need a liquid to take dose
- difficult to adjust dose
- may be hard to swallow
- impossible for unconscious patients
- time delay for dissolution and absorption into the bloodstream

Capsules

Another common solid oral dosage form is the capsule, which consists of either a hard or soft gelatin container with the drug and any excipients enclosed inside. A hard-shell gelatin capsule consists of the body, which contains the drug and any additives, and the cap that slips over the body to form an oblong shape. See Figure 8.7 for a picture of a hard-shell gelatin capsule. Some manufacturers have patented capsule shapes, such as Lilly’s pulvules, which have a tapered end similar to a bullet. Parke-Davis has trademarked its Kapseals, which have a

**Figure 8.7** Hard gelatin capsules have a cap that slips over the body of the capsule to enclose the drug.
colored gelatin band around the center to secure the capsule. Manufacturers have had to utilize many creative sealing methods for capsules and locking devices for bottles to provide tamper-resistant packages because there have been a number of tampering incidents involving capsules. Also available are capsules containing small pellets of medication. These capsules can be opened and the medication pellets sprinkled on applesauce for children or other patients who are unable to swallow the capsule. It is important to ensure that the child does not chew the pellets because this will adversely affect the release of the medication. Some capsules are formulated to release a drug over a controlled period of time. This may be accomplished by enclosing the active ingredient in various coatings that will release small amounts of the drug at different times to maintain a more constant blood level. These coated pellets are then enclosed in the capsule. See Figure 8.8 for a picture of a controlled-release capsule.

Soft gelatin capsules may contain liquid, paste, or powder, and have a seam at the middle that opens to release medication in the stomach within 5 minutes of ingestion. They are available in a wide variety of shapes, sizes, and colors. Soft gelatin capsules are often used for oils, such as vitamin E, and for cough preparations containing a liquid cough suppressant. Figure 8.9 shows an example of a soft-shell capsule.

Lozenges, Troches, and Lollipops

Lozenges and troches are oral medication dosage forms. They are usually round in shape and contain a drug in a hard candy or suitably flavored base designed to dissolve slowly in the mouth. They release the drug as they dissolve. They are commonly used as an oral anesthetic, antiseptic, antibiotic, antitussive, analgesic, or decongestant. Many are available commercially, but they are often compounded extemporaneously by the pharmacy using either a hard candy base or an acacia and powdered sugar compound that can be molded or kneaded into a pipe form and cut into equal-sized lozenges. Lozenges have the advantages of being easily transported, requiring no liquid to consume, being premeasured, and providing a topical therapy in addition to the systemic action of the drug. Several drugs are formulated as lollipops to facilitate administration to children and elderly patients who have difficulty swallowing traditional tablets. Figure 8.10 shows an example of a lozenge, and Figure 8.11 shows a lollipop that contains a drug.
Medicated Chewing Gum

Recently the use of chewing gum as a delivery system for medications has increased. For many years aspirin has been available as a gum, offering the advantage of a topical effect—especially for throat and mouth discomfort. Nicotine gum has been utilized as an aid in smoking cessation. The gum is easily portable and aids in the oral fixation of smoking as well as nicotine withdrawal. Chewing gums are being evaluated for other uses as topical medication delivery systems. Figure 8.12 shows an example of a medicated chewing gum.

Medicated Thin Strips

A novel dosage form has emerged to provide a convenient dosing mechanism for the mobile world in which we live. The medication is formulated in a thin flavored strip that dissolves when placed in the mouth. Cough suppressants and analgesics for children, and breath fresheners and anti-gas medications for adults are available in this palatable and portable dosage form. It is important to store these strips in a cool place or they may melt and stick together or to the packaging. Figure 8.13 shows an example of a medicated thin strip.

CAUTION Keep out of the reach of children because they may consider them a treat.

Other Solid Dosage Forms

Suppositories—Rectal, Vaginal, and Urethral

Suppositories are solid dosage forms that are commonly made with a cocoa butter base that allows for the inclusion of a medication and the molding of the suppository into a product tapered at one end for easy insertion into the designated body cavity. The most common type is a rectal suppository that is designed for insertion into the rectum and is often used as a topical remedy for hemorrhoids. The heat of the body will cause the suppository to melt, releasing the drug. An adult rectal suppository should weigh about 2 grams, and an infant suppository about 1 gram. Suppositories may contain sedatives, analgesics, tranquilizers, or other medications administered for their systemic effects. The medication is quickly absorbed into the rectal mucosa and delivered to the bloodstream. See Figure 8.14 for a picture of a rectal suppository.

In vaginal suppositories the medication may be encapsulated in a soft gelatin base or it may be in the form of a tablet. Such tablets are often ovoid in shape and may weigh 2 to 5 grams. After the tablet is inserted into the vaginal canal, the
medication is released and absorbed into the vaginal mucosa for either a topical or systemic effect.

A urethral insert used for erectile dysfunction in a male weighs 4 grams and is in the form of a micropellet that is designed to be inserted with an applicator. A urethral suppository for a female weighs only about 2 grams and can be used to treat urethritis or inflammation of the urethra.

**Powders, Granules, and Aerosols**

Powders are mixtures of drugs and inactive ingredients that can be either sprinkled on an external area for a topical effect or dissolved in liquid prior to ingestion for a systemic effect. External powders should be finely ground into a smooth, homogeneous mixture to prevent irritation at the site of application. If an active ingredient is present, the smaller the particle size of the drug the greater the effect, because there will be more surface area of the drug to contact the affected area. See Figures 8.15 and 8.16 for the different textures of a powder and a granule.

Granules are powders that have been wetted and allowed to dry in coarse particles. Because the particle size is larger and they have been allowed to dry, they form a more stable product and have a longer shelf life. The most common products manufactured as granules are antibiotics for suspensions, which are packaged in dispensing bottles designed for the addition of a prescribed amount of water at the time of dispensing.

*Do not add the water to antibiotic granules for oral suspension until the day of dispensing because the formulation will expire 10–14 days after mixing.*

**Aerosols**

Solid particles that are finely ground and suspended in a gas that is packaged under pressure will form an aerosol. These dosage forms may be intended for internal use as an *inhalation* for conditions such as asthma. They have the advantage of being delivered directly to the lungs for quick action with minimal systemic side effects. External aerosols are advantageous for topical administration to places that are difficult to reach. They can also be applied to irritated areas with little further irritation. Figure 8.17 shows a typical aerosol used for inhalation to treat asthma.

**Ointments, Creams, Pastes, and Gels**

Ointments are dosage forms formulated to apply to the skin or mucous membranes. They utilize various bases depending on the purpose of the ointment. *Oleaginous* or *oleaginous* A base in which the oil is the external phase, usually greasy and non-washable.
hydrocarbon bases Oil-based bases used to soothe and protect the skin.
nocclusive Covered in a manner that does not allow penetration by air or moisture.
hydrophobic Bases that repel moisture.
anhydrous absorption bases Ointment bases that do not contain water but can absorb significant amounts of water and moderate amounts of alcoholic solutions.

hydrocarbon bases form emollients that soothe the area and are occlusive to protect the affected area from air. They also are hydrophobic, so they repel moisture, which is advantageous for diaper rash or other conditions in which moisture is a problem. An example of an oleaginous ointment base would be white petrolatum or Vaseline petroleum jelly. Anhydrous absorption bases are not water-washable but can absorb water. They also tend to be occlusive and greasy, so they make good emollients. Anhydrous lanolin is an example of this type of base. Absorption bases that contain water but can absorb only a limited amount of water and are not water-washable also have properties of being emollient, greasy, and occlusive. These are called water in oil (W/O) emulsions. Lanolin is an example of a W/O absorption base. In a W/O emulsion, the water is the internal phase and the oil is the external phase of the compound.

Creams are semisolid dosage forms that contain a drug dissolved or dispersed in a water-removable ointment base. A cream is insoluble in water, contains water, can absorb more water, and can be washed off the skin with water. These oil in water emulsions (O/W) are less protective, less emollient, and less occlusive than an ointment base. In an O/W emulsion the oil is the internal phase of the compound and the water is the external phase. The type of emulsion determines the properties of the compound.

Pastes are thicker and more absorptive than ointments because they contain higher amounts of dry ingredients. For example, in zinc oxide paste the amount of zinc oxide in the zinc oxide ointment is increased to form a thick paste that is more protective and stays on the skin longer.

Gels are semisolid preparations that are water-soluble and water-washable. They may be used topically or introduced into a body cavity (e.g., as nasal or vaginal gels) or they may be taken internally (e.g., as aluminum hydroxide gel).

**TIP** It is important for the technician to understand the differences in these topical preparations because many active ingredients will be available in ointment, cream, or gel form, and dispensing an ointment instead of a gel or cream would be considered a medication error.

**Transdermal Patch**

Transdermal patches are delivery systems in which the medication is enclosed in an adhesive patch designed to deliver the drug over a set time period by absorption through the skin. Nitroglycerin was one of the original medications formulated for transdermal delivery. It should be applied to a hair-free or shaven area of the chest or back for best results. Figure 8.18 shows a transdermal patch.
The nitroglycerin patch should be removed at bedtime and a new patch applied in the morning to provide a drug-free period so that the patient does not build up a tolerance for the medication.

Scopolamine is available as a transdermal patch to be applied behind the ear for prevention of motion sickness. There are also transdermal forms of nicotine for smoking withdrawal, hormones for birth control, clonidine as an antihypertensive, and fentanyl as a narcotic painkiller. The technician should be familiar with the application methods and the duration of action of the various patches. Unless directed otherwise, the patient should always remove one patch before applying a new one.

### Liquid Dosage Forms

Liquid medication dosage forms use a fluid vehicle as a delivery system for the medication. The most common vehicles for liquid medications are water, alcohol, and mineral oil. Liquid dosage forms are advantageous because they are

- faster acting
- easier to swallow
- easier to adjust dose
- easier to administer to the eye or ear
- easier to administer to children or elderly patients

The disadvantages of liquid dosage forms are as follows:

- shorter expiration dates
- may need flavoring agents to mask bad taste
- inconvenient—may spill
- require a measuring device
- difficult to store—may require refrigeration

### Solutions

A solution is an evenly distributed homogenous mixture of one or more medications dissolved in a liquid vehicle. Solutions are classified according to the type of vehicle used. Non-aqueous solutions can be alcoholic, hydroalcoholic, or glycerite. An alcoholic solution uses alcohol as the vehicle, and a common example is spirits of peppermint. Tinctures contain vegetable material in an alcoholic base. A hydroalcoholic solution uses a combination of alcohol and water as a vehicle. Elixirs are examples of hydroalcoholic solutions that are usually sweetened and flavored. Glycerites are medications dissolved in glycerin.

Aqueous solutions are medications that are dissolved with the use of water as a vehicle. Examples of aqueous solutions are douches, irrigating solutions, enemas, vehicle A liquid, such as alcohol, mineral oil, or water, used to dissolve a drug for oral or topical administration.
glycerite A solution in which one of the vehicles is glycerin; such solutions are usually thick and oily in nature and sometimes used in the ear.
alcoholic solution A solution in which alcohol is used as the vehicle.
tincture An alcoholic solution of a drug that is much more potent than a fluid extract (do not substitute one for the other); alcoholic or hydroalcoholic solutions containing vegetable materials or chemicals made by percolation or maceration processes.
hydroalcoholic solution A solution in which both alcohol and water are used as vehicles; the ratio of alcohol to water may vary greatly.
elixirs Hydroalcoholic solutions that contain one or more dissolved drugs and are sweetened and flavored for oral use; liquids that are alcoholic or hydroalcoholic solutions.
gargles, washes, and sprays. **Viscous aqueous solutions** are usually thick and sticky. A syrup is a viscous aqueous solution that consists of a sugar and water mixture. Jellies are semisolid but have a high concentration of water. Mucilages are thick adhesive liquids.

### Routes of Administration

#### Oral

The most common route of administration for medications is the oral route, meaning that the drug is administered into the body through the mouth or through a G-tube. Dosage forms commonly administered orally are tablets, capsules, oral solutions, oral suspensions, and oral emulsions. The patient directions or Sigma written on the prescription by the prescriber may indicate to take “po” or by mouth. These instructions should be included on the prescription label and communicated to the patient. The oral route of administration is advantageous because it is

- safe and convenient
- usually less expensive than other forms
- can be modified for extended release
- noninvasive

The disadvantages of oral administration are as follows:

- not appropriate for unconscious patients
- patient may be unable to swallow
- requires time for absorption and distribution
- absorption time is affected by food, drugs, stomach acid, and condition of patient

#### Sublingual and Buccal Tablets

Although a sublingual tablet is placed in the mouth, this is not considered an oral administration route because the absorption process is very different. The tablet is placed under the tongue and the drug is absorbed through the oral mucosa under the tongue into the bloodstream. The drug does not pass through the intestinal tract. This provides a much faster effect of the drug and eliminates many of the factors that might affect absorption rates. The most common drug available in a sublingual tablet is nitroglycerin. A rapid effect is very important with this drug because it is used to treat an attack of angina.

A buccal tablet is placed inside the pouch of the cheek between the cheek and the gum. Similarly to a sublingual tablet, it is absorbed through the lining of the cheek and bypasses the intestinal tract. Metandren Linguets, a male sex hormone, is an example of a buccal tablet that is commercially available.

**Parenteral** administration is the term used for medications given by injection that also bypass the gastrointestinal tract. This route of administration is used when the patient is not able to take oral medications (for example, if he or she is unconscious or has a health condition that prevents swallowing). In addition, some drugs are only available in the injectable form and this route provides for fast drug action. The disadvantages are that it is invasive because it penetrates the skin and may introduce bacteria into the system, causing infection, and it may be painful or frightening to the patient.
Intravenous Administration

Intravenous (IV) administration involves administering the drug through a needle placed directly into a vein. IV preparations are usually solutions that must be sterile and free of particulate matter. Methods of preparing IV medications using aseptic technique to ensure sterility will be discussed in a later chapter. Drugs administered by this route are immediately available to the body because they are introduced directly into the bloodstream. They have the advantage of being faster acting, but recovery is much more difficult if a medication error or an adverse reaction occurs. There are several methods of administering an IV medication that the technician should understand. Using the wrong method may result in serious injury or death of the patient. A bolus dose is a large dose injected over a short period of time. This method is also called IV push and usually involves a healthcare provider using a syringe with the medication and slowly injecting the drug over a predetermined time period. An example is using lidocaine by IV push to treat an abnormal heart rhythm. Another common method is continuous infusion, in which the drug is added to an IV bag and allowed to drip or infuse over a number of hours to supply a constant blood level of the drug. These IV bags are often mixed by the technician and may involve one or more drugs in a given amount of fluid to be administered over a prescribed amount of time. Technician accuracy is extremely important in performing IV admixture and will be discussed in detail in another chapter. Figure 8.19 is an example of an IV bag used for infusion.

Intramuscular Administration

Intramuscular (IM) administration involves a direct injection into a large muscle mass. IM medications can be either solutions or suspensions, and some formulations can be given either IV or IM. It is important for the technician to be aware of the route of administration and the different reconstitution methods used for the different routes of administration. IM administration provides a faster rate of action than the oral route, but not as fast as an IV. IM suspensions can be formulated for extended release (sometimes lasting up to 3 months) by suspending the drug in a vegetable oil. The resulting preparation is called a “depot,” so when the name of an injectable drug is followed by the word “depo” that indicates it is a long-acting preparation. Drug volumes up to 5 mL can be administered IM. Volumes greater than 5 mL can be divided into two doses. Drug absorption may be erratic depending on the site used, the muscle mass of the patient, and the amount of exercise performed by the patient. This is not a preferred route of administration for a patient with decreased muscle mass or bleeding problems, and it may cause considerable bruising. Although the medication is not absorbed directly into the bloodstream, it is difficult to reverse the drug action once it has been injected.

bolus dose A large initial dose given to quickly bring the blood level of a drug up to a therapeutic level.

continuous infusion Administering a drug by placing it in solution in an IV bag and allowing the solution to slowly enter a vein over a prescribed period of time.
Subcutaneous Administration

Subcutaneous (SQ) administration involves injecting a small amount of a solution or suspension immediately under the skin. Patients can be taught to self-administer SQ injections. The most common SQ medication is insulin, which is usually self-administered by diabetic patients to control their blood sugar. SQ injections are also used for emergency doses of epinephrine to counteract an allergic reaction, and for some ready-to-use treatments for migraines. There is a limit to the volume of medication that can be injected under the skin (usually 1.5 mL), and it may be difficult for patients with thin or frail skin. The rate of absorption is slower than the IV or IM routes.

Intradermal Administration

An intradermal injection is inserted in the top layers of the skin and is not as deep as an SQ injection. The diagnostic test for tuberculosis involves placing the material in the tissue just beneath the epidermis. Allergen testing is also performed by injecting aliquots containing about 1 mL of various materials suspected of causing the allergic reaction intradermally in premarked areas on the back of the patient and checking for inflammation. See Figure 8.20 for an example of the above types of injections.

Intra-articular Administration

Intra-articular administration involves injecting a medication directly into a joint, such as the knee. This type of injection is often used to inject steroids into an inflamed joint to relieve pain and reduce inflammation.

Intra-arterial Administration

Intra-arterial administration involves injecting the drug directly into an artery. This method delivers the drug directly to the desired location, so it decreases the side effects to other parts of the body. Cancer chemotherapy drugs are sometimes administered by this method, but extreme caution should be used because these drugs are toxic.

Intracardiac Administration

Intracardiac administration involves injection directly into the heart muscle. This method is used only in extreme life-threatening emergencies. Only healthcare per-

Figure 8.20 Injections: a comparison of the angles of insertion for intramuscular, subcutaneous, and intradermal injections. (Reprinted with permission from Stedman’s Medical Dictionary for the Health Professions and Nursing. 5th ed. Baltimore, MD: Lippincott Williams & Wilkins, 2005.)
sonnel who are trained and experienced in performing this type of injection should attempt it because there is a risk of rupturing the heart.

**Intraperitoneal Administration**

Intraperitoneal administration involves injection into the peritoneal or abdominal cavity. This method of injection is often used to administer antibiotics needed to treat infections in the abdominal cavity, such as peritonitis resulting from a ruptured appendix. Peritoneal dialysis is sometimes used as a method to remove toxic substances that are normally excreted by the kidneys for patients suffering from end-stage renal disease.

**Intrapleural Administration**

Injection of a drug into the pleura or the sac surrounding the lungs is called intrapleural administration. This may be done to eliminate or prevent excessive amounts of fluid from building up in the pleural sac surrounding the lungs.

**Implants**

A medication pump, such as an insulin pump, or a medical device that is inserted into the body either permanently or for a prescribed amount of time and is designed to provide continuous administration of a drug over a predetermined amount of time is called an implant. Implants are used to treat long-term or chronic conditions, such as diabetes, or for cancer chemotherapy. There also is an implant system for long-term birth control lasting up to 5 years.

**Topical Application**

Dosage forms used for topical treatment of skin conditions include ointments, creams, gels, and pastes, as well as solutions, lotions, and sprays. The drug should penetrate the skin to provide the therapeutic effect. The skin acts as a natural barrier that will affect the rate and amount of penetration. Usually the concentration needed to provide a therapeutic effect is difficult to determine. The condition of the patient’s skin, the drug and delivery vehicle used, and whether an occlusive dressing is utilized all determine the final therapeutic effect of the product. Antibiotics, anesthetics, antiseptics, emollients, and corticosteroids are some of the medications delivered by topical application. In most cases, topical administration of a drug is intended for a local therapeutic effect where the product is applied. Some products are designed to produce a systemic effect by having the drug diffuse through the skin and into the bloodstream. Nitroglycerin ointment is an example of an ointment intended for its systemic effect. Topical corticosteroids should be applied sparingly and used for only the prescribed amount of time because they can be absorbed through the skin and produce unwanted side effects.

**Inhalation**

Use of the inhalation route of administration continues to increase as more drugs become available. Aerosol inhalers for the treatment of asthma are being replaced by dry-powder inhalers due to concerns about damage to the ozone layer. Asthma inhalation drugs include bronchodilators and corticosteroids. Other inhalation drugs for such things as nicotine replacement, insulin, and influenza vaccine are also being marketed.
Transdermal Route of Administration

The transdermal route of administration involves delivery of the drug across the
top of the skin for percutaneous absorption to facilitate a systemic effect while by-
passing the gastrointestinal tract. The drug is contained in an adhesive patch that
slowly releases the medication at a predetermined rate. The skin assists in control-
ling the rate of absorption and delivery to the bloodstream. The patch may be ap-
plied to the skin every day, every 3 days, or every 7 days.

CAUTION It is important for the technician to correlate the directions printed on the prescrip-
tion label with the manufacturer’s directions for use. Any discrepancy should be
checked with the pharmacist and/or the prescriber.

Professional Judgment Scenario 8.1

While preparing a fentanyl patch order for the medicine floor at the hospital, John
noticed that the medication administration record (MAR) stated that a new fen-
tanyl transdermal patch should be applied each morning. John felt sure that the
fentanyl patch should be changed only every 3 days, but the administration record
plainly stated “q am.” The pharmacist who had verified the physician’s orders was
very experienced and did not like to be questioned. John wasn’t 100% certain
about the dosing time and thought he should just send the order as it was. Using
your professional judgment, choose the course(s) of action you would take in this
situation:

1. The patient may be in a lot of pain, so just send the order as is.
2. Check the package insert in the fentanyl for the manufacturer’s dosing recom-
mendations.
3. Confront the pharmacist to let him know he’s made an error.
4. Approach the pharmacist as one professional to another and ask to discuss the
dose indicated in the MAR.

If you approach the pharmacist and do not feel comfortable that the correct de-
cision about the dose has been reached, what would be your next step?
Remember the welfare of the patient always comes first!

Rectal Administration

Rectal administration involves inserting a drug through the anus into the rectum.
Rectal suppositories are solid dosage forms formulated in a base that is intended to
dissolve and release the medication after it is inserted. The medication is absorbed
through the rectal mucosa to provide a systemic effect, as in the case of antinausea
and laxative drugs, or it may exert a topical effect, as in the case of hemorrhoid
preparations. Rectally administered liquids are often in the form of enemas for
bowel cleansing prior to diagnostic testing. Proctofoam is a foam packaged for rec-
tal application to soothe inflamed tissue.

Vaginal Administration

Vaginal suppositories or tablets are intended for insertion into the vaginal canal and
are designed to melt or dissolve and release the medication. Vaginal preparations
also include creams, ointments, gels, solutions, and foams. They may contain a
medication intended to be absorbed, or the effect may be topical and limited to the vaginal area. Preparations for treating vaginal yeast infections are available without a prescription and patients often need guidance in making this type of purchase. A vaginal infection should only be self-treated if the patient has previously experienced a yeast infection and is certain this is the problem, so that a more serious infection does not go untreated and cause complications.

**Ocular, Otic, and Nasal Routes of Administration**

Ophthalmic solutions, suspensions, and ointments must be sterile preparations free of any particulate matter that may irritate the eye. Solutions are instilled into the eye by tipping the head back and placing the required number of drops inside the lower lid of the eye while looking up. If several types of drops are being used, there should be a few minutes’ wait time between the application of different medications. Ophthalmic ointments are applied by pulling down the lower lid and applying a thin ribbon of the ointment along the inside of the lid. There should be a 10-minute wait time between applications of two different ophthalmic ointments. In both cases, care should be taken to avoid touching the eye with the tip of the dropper or ointment tube. Ocular inserts are solid devices that are placed in the eye and release a drug at a constant rate, minimizing side effects due to rapid absorption. The disadvantage is that they are cumbersome to insert properly and the insert must be removed from the eye after the drug is released.

Otic preparations include solutions or suspensions that are administered into the ear canal and contain analgesics, antibiotics, and anti-inflammatory agents. The solvents traditionally used are glycerin or water. Glycerin helps the preparation remain in the ear for a longer period of time. Glycerin preparations are also used to soften earwax to facilitate removal of excess wax.

Nasal solutions are administered to the nasal passages in the form of drops or sprays and may be either suspensions or emulsions. Most nasal preparations are used to treat nasal congestion, but some products that use the nasal route for systemic effect are becoming available. Some asthma and allergy preparations are administered by nasal inhalation. A nasal spray to administer insulin for treatment of diabetes is in the testing phase.

**Throat Sprays and Gargles**

Throat sprays may contain antiseptics, anesthetics, deodorants, and flavorings. They are used to relieve minor sore throat pain or to improve bad breath. Chronic bad breath may be a sign of an underlying infection, so a trip to the dentist may solve the problem. Treating a sore throat with analgesics and anesthetics can cause a strep throat to be overlooked. An untreated strep throat can result in serious complications, including rheumatic fever. The technician should be alert for repeated purchases of sore-throat products and involve the pharmacist if patient counseling is indicated.

**Drug Information Resources**

Information about drugs, available strengths, dosage forms, and routes of administration is readily available in the manufacturer’s package insert and a variety of reference books that may be available in the pharmacy. The technician should become familiar with the contents and layouts of the different reference books. (See the “Suggested Readings” section at the end of this chapter for full source information for these resources.)
Drug Facts and Comparisons: Contains most comprehensive and current drug information, monthly updates, complete pharmacology, drug interactions, adverse effects, available doses, and administration; lists comparable brand and generic products together.

American Hospital Formulary Service Drug Information (AHFS): Comprehensive listing of available drugs, pharmacology, dosages, administration, and adverse effects; updated yearly with three supplements.

United States Pharmacopeia-National Formulary (USP-NF): Official compendium of all approved drugs and the required standards of purity and stability for each drug to be considered official.


Physician’s Desk Reference (PDR): Book of package insert information for drugs chosen by manufacturers to be included; not a comprehensive reference; very few generics, color pictures of tablets, capsules, or packaging of included products.

Drug Interaction Facts: Lists the drug interactions and ranks them according to severity of the interaction and the likelihood of its occurrence.

Redbook: Lists all drugs and devices and the wholesale prices of the items; also contains many frequently-used tables, such as pregnancy categories, tablets that are not to be crushed, and addresses of drug companies.

Orange Book: Lists generic drugs and rates their bioavailability in comparison with the brand-name product to determine whether they are legally substitutable.

American Drug Index: A concise listing of available drugs, dosage forms, drug classes, “look-alike-sound-alike” drugs, pregnancy categories, discontinued drugs, and laboratory values.

Handbook on Injectable Drugs: Complete information about injectable drugs, admixture procedures, compatibility, stability, and dilution.


Remington: The Science and Practice of Pharmacy: Comprehensive information about all aspects of the practice of pharmacy in various practice settings.

Material Safety Data Sheets (MSDS): Information about the safe handling of chemicals and hazardous drugs in the workplace, including handling chemical spills and treating exposure to hazardous materials.

Micromedex: A computerized reference system that contains comprehensive clinical information about drugs and toxicology, and a drug identification system.

Novel dosage forms and routes of administration are constantly being developed. Each dosage form has different advantages and disadvantages. As a professional technician, you should stay current with all new dosage forms released for sale so that you can provide up-to-date information to assist patients. Use your knowledge of available dosage forms and your ability to search available reference books for needed information as you perform prescription evaluations and choose the correct dosage form to enter into the computer. Be certain that the patient directions printed on the label are clear and accurate for the dosage form and route of administration of the product prescribed and dispensed.
Case Study 8.1

Jim was assigned to the IV room during the afternoon when the total parenteral nutrition (TPN) orders were to be mixed for distribution to the patient floors. As he gathered the additives for the first preparation, he noticed he needed the following ingredients: calcium gluconate, sodium chloride, magnesium sulfate, potassium acetate, and potassium phosphate. Jim wondered whether all these ingredients were compatible in the same IV bag. He had a number of bags to compound that day and was trying to save time. “Surely,” thought Jim, “if the doctor prescribed these ingredients to be added to the bag, they must be compatible.” Jim didn’t want to bother the pharmacist with a stupid question, so he asked another technician if the formula looked all right to her. She studied the formula for a few minutes and told Jim she thought she had read about a problem with one of the potassium additives but she couldn’t remember what it was. Using the reference books, help Jim decide what he needs to do.

1. What reference book would provide the best information about IV compatibility issues?
2. After checking the desk copy of the reference book, did you discover any compatibility issues?
3. What important information did you learn about the order in which these electrolytes should be added to the mixture?
4. Discuss the possible consequences that might have occurred if Jim had not checked the reference book.
Chapter Summary

• Tablets are a common oral dosage form that contain an active ingredient and a number of excipients, such as diluents, binders, lubricants, coloring, flavoring, and disintegrates.

• Different tablet formulations produce variations in the release, absorption, and action of the medication.

• Capsules may contain drugs and diluents in the form of powders, liquids, or pellets that affect the rate of absorption of the drug.

• Lozenges, troches, and lollipops contain medication in a flavored base to provide a convenient dosage form for patients who are unable to swallow a tablet, and also produce a topical effect.

• Chewing gums are a portable and convenient dosage form.

• Medicated thin strips may contain analgesics, cough suppressants, anti-gas medications, or breath fresheners.

• Suppositories are formulated to be inserted into a body cavity and release the drug by melting. They may be rectal, vaginal, or urethral.

• Powders may be sprinkled on topically or dispensed in packets for solution to take internally. Granules contain larger particles that are more stable.

• Ointments, creams, and gels are formulated with different bases to produce the topical effect desired.

• Transdermal patches have medication in a reservoir enclosed in a patch that allows the medication to be diffused into the skin for absorption.

• A solution should be clear with no particles visible, although it may be colored and thickened.

• Oral medications are placed in the mouth and swallowed. Sublingual medications are placed under the tongue and absorbed through the mucosa. Buccal tablets are placed between the cheek and gum for absorption.

• Parenteral medications bypass the gastrointestinal tract and are usually IM, IV, or SQ, but there are several other types of injections.

• Ophthalmic preparations may be ointments or drops, but they must be sterile.

• Otic preparations are solutions or suspensions placed in the ear.

• Nasal solutions may be in the form of drops, sprays, or nasal inhalers.

• Throat sprays and gargles contain topical medications to treat conditions of the throat.

• Pharmacy reference books are a valuable resource to facilitate prescription evaluation.
Review Questions

Multiple Choice

Choose the best answer to the following questions:

1. When a rapid effect is needed to treat an asthma attack, the drug may be
   a. taken by mouth
   b. applied transdermally
   c. inhaled through the mouth
   d. sprayed on the chest

2. Ophthalmic drugs
   a. treat local conditions of the ear
   b. are delivered directly into the eye
   c. may be either an ointment or drops
   d. b and c

3. An elixir is an example of
   a. a hydroalcoholic solution
   b. an aqueous solution with no alcohol
   c. an emulsion
   d. none of the above

4. A semisolid medication dosage form that is applied to the skin or mucous membranes to lubricate and soften, or as a base for a drug, is a/an
   a. ointment
   b. cream
   c. gel
   d. all of the above

5. A parenteral route of administration is one that bypasses
   a. the kidneys
   b. the heart
   c. the stomach
   d. the lungs

Fill in the Blanks

Fill in the blank with the correct answer.

6. Powders that have been wetted, allowed to dry, and then ground into coarse pieces are called ____________________________.

7. The most common vehicles for liquid medications are ________________, ________________, and ________________.
8. An evenly distributed, homogenous mixture of dissolved medication in a liq-
uid vehicle is called a ____________________________.

9. __________________ tablets contain ingredients that bubble 
and release the active drug when placed in a liquid.

10. __________________ tablets have a coating that protects the 
tablet from stomach acid and protects the lining of the gastrointestinal tract 
from irritation by the drug.

**Matching**

Match the term with the route of administration.

11. ____ sublingual A. Injection into the eye

12. ____ intra-articular B. Injection into the sac surrounding the lungs

13. ____ intrapleural C. Injection beneath the skin

14. ____ intravenous D. Administration and absorption of a drug from 
under the tongue.

15. ____ intravitreous E. Injection of a drug into a joint (e.g., the knee)

16. ____ subcutaneous F. Injection directly into a vein

**True/False**

Mark the following statements True or False:

17. ____ Otic preparations are used to treat local conditions of the eye.

18. ____ Aerosols are suspensions of fine particles in a gas packaged under pres-
sure.

19. ____ In an O/W emulsion the water is the internal phase.

20. ____ W/O emulsions are water-washable.

**LEARNING ACTIVITY 8.1**

Use the most appropriate reference book to research the following problems:

Danny’s mother presents the following prescription to the pharmacy from his den-
tist. Danny is 10 years old and weighs 110 pounds. He is going to have a dental 
procedure that requires conscious sedation, and the dentist has chosen Valium as 
the drug.
1. Would you question the appropriateness of this dose for this patient?
2. What reference book would give the best information about this issue?
3. What information did you find?

LEARNING ACTIVITY 8.2
Mrs. Jones picked up her prescription for alprazolam today. After arriving home, she received a call from her gynecologist with the good news that her pregnancy test was positive. She called to share the good news with you. After congratulating her, you begin to think about the prescription she just picked up.
1. What reference book would you check to see if there is cause for concern?
2. What is the pregnancy category for alprazolam?
3. What action would you take after reading this information?

LEARNING ACTIVITY 8.3
Mrs. Sable brings in a prescription for her husband, who has just been diagnosed with terminal cancer. She tells you his liver is seriously impaired and he doesn’t have long to live. He’s been told not to take acetaminophen because of his hepatic impairment. She presents a prescription for Percocet.
1. Using an appropriate reference book, list the ingredients in Percocet.
2. Discuss any problem that might arise from Mr. Sable taking Percocet.
3. Would Roxicet or Percodan be a reasonable alternative for Mr. Sable?
4. List the strengths and ingredients of Roxicet, Percocet, and Percodan.
Suggested Readings