Medication Safety: The Five “R’s” Revisited

A Knowledge Based Course

By

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Completion Requirements: Answer 70% of questions correctly, Evaluation
STATEMENT OF NEED

A recurring theme in this course is the importance of developing your knowledge and skills as a technician as you build trust with the pharmacists and other health professionals you encounter at work. When you see an error or something that seems questionable and may cause harm to a patient, you must speak up! Even if the pharmacist or physician is the most outstanding person in his field, even if you will be severely chastised for questioning him or her, even if you may be wrong, you must question him or her! Many patients are dead because technicians did not feel that it was “their place” to question a pharmacist or a physician. The best pharmacists and the best physicians are still human and human error is always a possibility, especially in the busy world of healthcare.

OBJECTIVES

1. Define the “5 R’s” of medication administration.

2. Discuss the different types of medication orders, including inpatient and outpatient.

3. List the patient’s rights and the application to medication administration.

4. Discuss medication administration accuracy; dosage forms and routes of administration.

5. Define the technician’s role in “the right price,” handling payment.
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INTRODUCTION

This course on medication safety focuses on the five “R’s” of medication administration: (1) The right drug; (2) the right dose; (3) the right route/dosage form; (4) the right time; (5) the right patient. While this alliteration is a great way to simplify the concept of medication administration, the clinical, professional, and technical aspects are actually quite complex. For that reason, we will attempt to break down the concepts into manageable “bites.”

While the policies and procedures vary from institution to institution (and the institution’s policy takes precedence over what is written here), the person who administers medications must always respect the dignity, privacy, safety, and autonomy of the patient. Patient cooperation is essential to the administration of most forms of medications. Even those patients who appear comatose, confused, or otherwise compromised should have the proposed procedure explained to them.

While much of this information will be review for you as a practicing technician, each healthcare professional who accepts the responsibility for the administration of medications must become familiar with the patient population, the institution’s policies concerning medications, the approved methods of medication administration, the formulary and other resources that are available for reference and information, and the institution’s expectations of the person who administers medications. All are very serious responsibilities and part of the purpose of continuing education is to “remind” us of things we already know.

One of the most important roles of a pharmacy technician is to ensure effective communication with patients and other healthcare professionals. The medical field has a language all its own that is familiar to healthcare professionals but is often very confusing to the patient. An experienced technician with a background in medical terminology can help to bridge the communication gap and provide a comfort zone for the patients, allowing for more effective communication with the pharmacist. Although it is important for the technician to speak in understandable terms to the patient, it is equally important to utilize the language of medicine when speaking with other health professionals. For that reason, part of this course will review medical terminology. The initial encounter with a patient often involves accepting a prescription and evaluating it for completeness and accuracy. Therefore, we will begin this course by examining the medication order.
MEDICATION ORDERS

Inpatient Prescriptions

An inpatient prescription is written in a different format compared with an outpatient prescription (discussed next) and some of the required information is different. These orders are written for a patient in a hospital, nursing home, or some other institutional setting where the medication will be administered by a healthcare professional.

Many hospitals have pharmacists on the floors to verify medication orders and enter them into the computer for the pharmacy to fill. Some medication orders may be entered into an automated dispensing system, so the nurse can retrieve the medication and administer it to the patient. The institution may use a medication cart system that can be filled by a robotic system. These automated systems will be discussed in a later chapter. Some smaller hospitals may use a manual fill cart system whereby the pharmacy fills the medications for a predetermined day’s supply and exchanges the drawers when empty. Learning to work with each of the different systems will be a continuing part of a technician’s education and orientation in different practice settings because reading and evaluating the medication order is an important responsibility of technicians in many institutional settings.

Drug administration is initiated with the physician’s medication order. No drug is given to a patient without physician authorization. Numerous kinds of medication orders exist. Orders written in the chart at the time of admission, which may be subsequently increased, decreased, or deleted, are the most common type of medication orders. Another type of drug order is a verbal order that may be given by the physician to a nurse or pharmacist, usually via the phone, when an emergency or unusual circumstance arises. Prior to initiation, verbal orders should be repeated to the prescriber. Verbal orders are always transcribed in the patient’s chart, signed by the order taker, and cosigned by the physician within 24 hours or as specified by hospital policy. Medication orders are also written upon transfer and discharge of patients and upon changes in the patient’s condition or required medical therapy.

Orders for drugs that should be immediately administered are called STAT orders\(^1\). The immediacy relates to the patient’s condition, such as the need for pain relief, when the patient is experiencing clinical distress, or when the patient has a drug or allergic reaction. The person administering drugs always gives top priority to making sure the patient receives a STAT drug in timely fashion. Orders written by the physician (to be given to the patient only if required by the patient’s condition) are prn (pro re nata) orders. One-time orders are written for specific circumstances, such as patient sedation for a test or procedure. Standing orders sometimes accompany a patient on admission to the hospital, or may be the printed drug regimens

\(^1\) In many hospitals, policy dictates that this type of order be delivered within 15 minutes.
prescribed by the physician or a physician group to treat a particular condition. These orders may be prewritten and signed by the physician or stamped on the chart with the physician’s signature. Medication orders may also be included in physician, unit, or patient-specific protocols, pathways, and standards of care.

Institutional policy may permit drug orders to be written by persons other than physicians, including doctors of osteopathic medicine, physician assistants, clinical nurse practitioners, dentists, podiatrists, and in some states, pharmacists. These policies must be known and observed.

**Types of Medication Orders**

Three types of medication orders are usually seen in an institutional setting:

- **Admissions orders**: medication orders and nursing instructions written by a physician when a patient is first admitted to a facility.
- **Routine medication orders**: written after a routine physician’s visit with the patient, indicating a change or addition to the medication regimen.
- **Discharge orders**: orders written by the physician when the patient leaves the facility and returns home.

**Information Needed on Drug Orders**

To properly administer a drug, the following information is needed for each drug order:

- Patient’s full name
- Room number, bed number, and other identifiers required by hospital policy (e.g., medical record numbers, ID bar codes).
- Name of drug (clearly written).
- Dosage strength (e.g., 10mg).
- Dosage schedule (e.g., STAT, t.i.d.).
- Route of administration (e.g., sublingual, subcutaneous, instill in left eye).
- Length of time drug is to be given (e.g., for 24 hours, one week, length of hospital stay, as needed).
- Prescriber’s signature.

The drug order is entered into the patient’s medication order forms (this can be done by hand or as part of a computerized physician order entry [CPOE] system) and transmitted to the pharmacy to be filled. Illegibility of handwritten physician orders has been identified as a key contributor to medication errors, which is leading to the development and implementation of CPOE systems. The person who administers the drug verifies the label on the drug by comparing it with the
order on the patient’s medication record. Computerized medication systems are being used more and more and provide additional levels of automated checking – from the time of drug order, to delivery to the patient, to the drug being administered. A rule of thumb – never administer a medication without checking it three times against the order or medication administration record (MAR). Leave all medications fully labeled in their unit-dose packages until they are at the bedside. The last check just prior to administration is the most important, because it is the last chance to pick up an error.

Outpatient Prescription

An outpatient prescription is a written or oral medication order from an authorized prescriber for a specific medication to be dispensed to a specific patient pursuant to the diagnosis of a condition or a risk factor. It is generally intended to provide a cure, slow the progression of disease, treat the symptoms, or prevent a risk factor from developing into a health problem. There are several ways in which an outpatient prescription can reach the pharmacy. When the patient arrives at the pharmacy counter with a new prescription, the technician greets the patient and begins the very important task of evaluating the prescription for completeness and accuracy. As the patient is greeted, the technician should carefully observe the patient for any concerns that might create a communication or special-needs challenge. The following information should be on every outpatient prescription:

- Name, address, and phone number of the prescriber or the hospital or clinic where the prescriber practices.
- Full name and address of the patient (verify the spelling).
- Date written, if known. The date written is especially important for controlled substances because, they can only be filled within 6 months after the prescription was written. For a non-controlled substance, unless there is serious concern about the length of time elapsed, the date the prescription if filled can be used if there is no date entered.
- Rx symbol (also called the superscription) preceding the drug name.
- Drug name or inscription – includes the medication, strength, and dosage form. Be certain to check each of these for legibility and accuracy. As you grow in knowledge, unusual doses will prompt you to check the literature for acceptable dose ranges.
- Dispensing directions, including the quantity to dispense (also called the subscription). The quantity should be reasonable for the course of therapy. For example, a prescription written for 60 capsules with directions to take one capsule four times a day for 10 days with no refills should prompt a phone call to the prescriber’s office.
- Signa or Sig: directions to a patient, often using abbreviations that must be clearly typed on the label in fully understandable text. The directions should coincide with the drug name, dose range, and route of administration.
- Any special instructions from the prescriber concerning refill authorization or expiration date of prescription. A prescriber may give a patient a prescription for pain in case he or
she needs it immediately after a procedure, and put a 7-day expiration date on the prescription so the patient does not hold the prescription and try to fill it later for another problem.

- Prescriber signature line: may contain two lines labeled “Dispense as Written” or “May Substitute” to indicate the prescriber’s authorization for generic substitution.

Prescription blanks for controlled substances require the physician’s DEA number, and some states require a special prescription blank written on security paper that will print “void” across the blank, if it is reproduced by a copy machine. Any missing patient information can be obtained from the patient. The patient should be asked as each new prescription is presented if he or she has any drug allergies, and the response(s) should be noted on the prescription. If the patient gives a positive response, the question should be repeated (any others?) until a negative response is received. If the patient indicates no allergies, the letters “NKA” (no known allergies) should be documented on the prescription and in the patient profile.

**E-prescriptions** are computer-generated prescriptions created by the provider and sent directly to the pharmacy. Instead of writing out the prescription on a piece of paper, the doctor or other healthcare provider enters it directly into his or her computer. The prescriptions travels from the doctor or healthcare provider’s computer to the pharmacy’s computer. E-prescriptions are sent electronically through a private, secure, and closed-network (i.e., Surescripts) so the prescription information is not sent over the open internet or as email. Some of the advantages of e-prescriptions are: fast – prescriptions arrive at the pharmacy before or shortly after the patient leaves the provider’s office; convenient – the patient does not have to make an extra trip to drop off the prescription at the pharmacy; legible – there is not handwriting for the pharmacist or technician to interpret (it is estimated that around 30% of prescriptions require pharmacists to call physicians for clarification due to poor handwriting. This is significant. According to the Institute of Medicine, medication errors are the most frequently occurring error in healthcare and cause several thousand deaths annually. A study conducted by Visante for the Pharmaceutical Care Management Association (PCMA) found that electronic prescribing will help prevent some 3.5 million serious medication errors that otherwise would have sickened, hospitalized, or killed patients over the next ten years. Currently more than 75% of the community pharmacies in the U.S accept e-prescriptions.

There are also some potential hazards associated with e-prescriptions. The computer may give the pharmacy (and provider) personnel a false sense of security; it is still possible to make errors. The technician must be aware of the integrity of the data input. Accidental data entry errors such as selecting the wrong patient or clicking on the wrong choice in a menu of dosages may occur. Some ill-defined software will frequently give erroneous pop-up alerts. Under such circumstances, many opt to turn the notifications off (or ignore them), disabling one of the systems great beneficial aspects.

It is important for the technician to remember the privacy of personal health information
contained in all prescriptions, whether written or electronic, is protected by a federal law and state laws. The federal law is the Health Insurance Portability and Accountability Act (HIPPA). HIPPA requires that the personal information be shared only for the purpose of providing the patient clinical care. E-prescriptions meet this requirement. As with many eHealth solutions, privacy of patient information stored in electronic format may lead to the possibility of novel errors, such as inadvertently divulging protected health information on the internet through inadequate security practices. Instances of negligence may also arise where employees may forward prescriptions to organizations outside its intended use. Another security issue that needs to be addressed upfront is the verification of electronic signatures, in ensuring the medical integrity of the prescriptions received by the pharmacy. Therefore, hospitals, clinics and pharmacies should be protected with firewalls, use strict computer permission settings, and remain vigilant toward signs of an intrusion.

Less widely discussed but equally valuable is e-prescribing of controlled substances, or EPCS. With a regulatory go-ahead courtesy of a 2010 decision to lift the ban on EPCS – technology developers are racing to merge the practical functionality offered by traditional e-prescribing with a sophisticated set of security measures that allow physicians to electronically order these tightly regulated substances. In order to provide ECPS, there is an extremely complicated auditing/certification process. While many providers are keeping the technology at arm’s length – largely due to concerns that such prescriptions cannot be adequately secured or that costs required to receive the appropriate certifications are prohibitive – the reality is that e-prescribing of controlled substances is a highly efficient and cost effective process, and can easily be managed with the right protocols in place at the provider and pharmacy. Most of the burden for those steps will fall on the e-prescribing software vendors and some on the providers; however, it is important for the technician to be aware that the next generation of tools is emerging to enable caregivers to have the same e-prescribing of controlled substances, which promises to create a safer medical environment by reducing errors and promoting medication compliance, a win-win.

Most pharmacies have a patient profile\(^3\) form for new patients to document and update information for the patient profile. If there is no written form, use the computer software to request and document patient information. Each new medication dispensed to the patient then becomes a part of the patient profile to assist the pharmacist in the drug utilization review (DUR) to assess the appropriateness of the new medication for the patient. It is extremely important for the patient profile to be accurate and current because the computerized drug interaction alerts that warn of medication concerns during data entry are based on the drugs, allergies, and diagnoses listed in the patient profile. Another important factor to consider when receiving a new prescription is the patient’s method of payment. Third-party insurance information must be


\(^3\)Computer file that lists a patient’s medication history, including allergies, diagnoses, age, weight, and all medications ordered.
entered into the patient profile before the prescription is entered. Computer software programs can ask for all types of information for the patient profile, but some of the information is not legally required and some patients may refuse to give additional information. The technician must be sensitive to the patient’s reluctance to provide more information than is legally required. If the prescription is written for a brand name drug and the physician has authorized a generic substitution, the patient should be asked if he or she prefers brand-name or generic drugs, keeping in mind the cost difference if he or she prefers brand-name or generic drugs, keeping in mind the cost difference and the fact that a third-party insurance plan may mandate the use of a generic drug. Remember: a drug will have three different names; the brand name which is a trade name assigned by the manufacturer for marketing; a generic name given to the drug by The United States Adopted Names; and a chemical name derived from the exact chemical formula of the drug.

The prescription evaluation process may take only a few minutes or it may be much more complicated, but the time spent communicating with the patient during this initial process begins the establishment of a trust relationship between the patient and the pharmacy professionals. On the most difficult day, when every patient has presented challenges and it’s almost closing time, as the last patient of the day walks up to the pharmacy counter with six new prescriptions and an insurance card you have never seen before, take a deep breath and put that friendly smile on your face and greet the patient.

Evaluating the Prescription

After the initial communication with the patient and gathering of the profile information, the prescription can be evaluated, entered into the computer, and prepared for the pharmacist to check. The required information discussed earlier should be committed to memory. That way any missing information will be easier to identify. Keep in mind that prescribers may use different formats, but as long as all of the required information is present, the prescription is valid. First examine the drug name line to be certain that all of the required information is listed to ensure that the exact drug, strength, and dosage form will be dispensed to the patient. If the medication prescribed is available in only one strength, the prescriber may not include the strength. If the strength is missing and more than one strength is commercially available, a call to the prescriber’s office is required to verify the correct strength. Check the entire body of the prescription for any information that needs to verified before the call is placed. Check the quantity and the directions to be sure they are legible and coincide with the drug and dosage form in the medication line. The route of administration may or may not be indicated in either the medication line or the Signa line, but in many cases the dosage form and route of administration can be deduced by analyzing the whole prescription.

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4 The trade name given to a drug by the manufacturer for marketing purposes.
PATIENT RIGHTS

Each patient is entitled to the “five rights” for safe, appropriate drug administration. Drug rights of the patient include the right drug, right dose, right route (or dosage form), right time, and right patient. These rights should be memorized and checked prior to each drug administration.

The Right Drug

The right drug is verified by checking the physician’s (prescriber’s) order or the nurse’s (or pharmacist’s) drug administration form, drug Kardex\textsuperscript{5}, or drug summary on the patient’s computer profile. Thousands of drugs are available and many sound alike, are spelled alike, and look alike. Abbreviation of drug names has become a risky practice, and many hospitals are limiting or eliminating the use of medication abbreviations entirely as a risk reduction strategy. One or two letters in a name can mean an entirely different drug (e.g., Zantac or Zyrtec, Lasix or Luvox). Capital letters are now used to differentiate between like-sounding drugs (e.g., vinCRISTINE, vinBLASTINE). The prescriber must be contacted if there are any questions or doubts concerning the order. Most drugs used in hospitals today are in unit-dose packages. The name is clearly visible on each drug dosage form.

Labels should be checked \textit{three} times before the drug is administered. The expiration date should also be checked. The Institute for Safe Medication Practices (ISMP)\textsuperscript{6} has identified top high-risk drugs. These are medications that have been involved frequently in serious errors. Examples include insulin and chemotherapy drugs. It is important to follow special safety precautions when administering these high-alert drugs.

The Right Dose

Accurate dosage strength is critical to beneficial drug administration. Giving the wrong strength, particularly to children or infants, can be and has been fatal. The right dose is further checked with special care given to decimal points. A zero before the decimal, called a \textit{leading decimal} (e.g., 0.1mg) should be noted. Care should be taken if there is a zero after the decimal, called a \textit{trailing decimal}, which can be misleading and can be misread, leading to a 10 times greater dosage error (e.g. 1.0 is one, not ten). Orders for units must always be written out. The abbreviation µ for units can be misread as a 0, or 10, 4 and lead to a 10 times greater dosage error.

Proper dosage strength should never be presumed by anyone in the prescribing, dispensing, or administering process. Physicians must clearly indicate the desired strength on the medication

\textsuperscript{5} Trademark for a card-filing system that allows quick reference to the particular needs of each patient for certain aspects of healthcare.
\textsuperscript{6} www.ismp.org
orders, pharmacists are expected to further verify dosage to be sure it is within appropriate therapeutic limits, and nurses are expected to further check that the dosage strength ordered by the physician was accurately dispensed by the pharmacist. After the drug and dosage strength has gone through these three checkpoints, the last checkpoint resides with the person who administers the drug to the patient. If any dosage changes have been made along the way, the change should be clearly indicated on the patient’s chart and other medication records. Children, the elderly, and patients with impaired liver and kidney functions are at the greatest risk of adverse drug events related to medication dosage.

The Right Route/Dosage Form

In addition to ensuring that the right strength has been selected, it is important to check and be sure that the drug is given by the right route in the right dosage form. Drugs come in many different forms. Liquids come as solutions, tinctures, suspensions, syrups, and elixirs. Oral solid dosage forms come as tablet, gelatin, capsules, caplets, enteric-coated tablets, extended-release capsules, sublingual tablets, and buccal tablets. External preparations include creams, ointments, and lotions. Some medications in ointment form contain potent active ingredients. The length of the ointment strip must be carefully measured by the drug administrator. Injectable medications must be carefully checked to be sure whether the injection should be administered by an intramuscular route intravenous route, subcutaneous route, or other route of administration. Drop-type drugs must be checked and used only as indicated for the eye, ear, or nose. There are many suppository dosage forms, such as rectal, vaginal, and urethral. Dosage forms are not interchangeable, so it is important that it is the right drug, administered in the right dosage form. It is also important to note when a drug dosage form has been changed by the prescriber (e.g., an injectable drug [IM] is changed to an oral dosage [po]). Every drug order should include the route of administration. If a question arises, the proper dosage form should be confirmed before the drug is administered.

The Right Time

Time of drug administration (i.e., dosage schedule or frequency) is an important factor in pharmacotherapy. Drugs should be given at the time ordered, allowing for an ordinary deviation of a half hour, unless timing is critical. Diabetic patients may receive their hypoglycemic drugs a half hour before meals, unless otherwise specified. Patients on therapeutic drug monitoring are involved in pharmacokinetic laboratory studies. Dosage time is related to drug half-life and the time the phlebotomist will draw blood for the serum analysis.

The duration of action of a drug is known as its half life. This is the period of time required for the concentration or amount of drug in the body to be reduced by one-half. We usually consider the half life of a drug in relation to the amount of drug in plasma. A drug’s plasma half life depends on how quickly the drug is eliminated from the plasma. A drug molecule that leaves
plasma may have any of several fates. It can be eliminated from the body, or it can be translocated to another body fluid compartment such as the intracellular fluid or it can be destroyed in the blood. The removal of a drug from the plasma is known as clearance and the distribution of the drug in the various body tissues is known as volume of distribution. Both of these pharmacokinetic parameters are important in determining the half life of a drug.

The symbol to represent the half life is: \( t_{1/2} \).

Time of drug administration can be of great concern to the patient who is waiting. A patient who has been ordered an analgesic for pain relief to be given every four hours for the first 24 hours after an operation should receive this drug on time. Delays for this patient increase the pain and anxiety and slow the recovery process. Many drugs are now administered per parameters. An example is a cardiac medication that is administered if the heart rate and blood pressure are within a certain range and held if outside the range. Knowledge of when the physician wants the medication administered, any hospital-, unit-, or physician-specific per parameters policy applicable, and the actual monitoring required prior to administration are required. It is less confusing for the patient if, when possible, drug administration times in the hospital are kept close to when the patient would normally take them at home, being considerate of the patient’s individual waking and sleeping times. This also facilitates an accurate assessment of therapeutic effects.

The Right Patient

The last requirement is to verify that the right patient is the one to receive the drug. The patient should be asked, “Please tell me your name and date of birth”; in an institutional setting, this is checked against the patient’s armband. Just addressing the person by name is not sufficient. People may respond positively even if they have not clearly heard their name, due to distractions, deafness, or language barriers. Beds are often shifted to different positions in the room, so identifying a person as the patient in Room 120, Bed 3 is insufficient information and may be misleading. Many hospitals are implementing computerized medication systems that utilize bar-coding or other methods of patient verification, and compare this information to the actual medication order or medication profile.
**MEDICATION ADMINISTRATION ACCURACY:**
**DOSAGE FORMS AND ROUTES OF ADMINISTRATION**

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 preformed 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 common 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. 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. **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 the intestine.

**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. 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 layer 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.

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7 Usually inert powders added to a drug to increase the volume.
8 Tablets covered with a thin layer of polymer designed to dissolve at the desired place in the gastrointestinal tract.
9 Tablets formulated to pass through the stomach unchanged and dissolved in the intestine.
10 Powders that have been wetted and broken into coarse particles to increase stability.
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. 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 disintegrated 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.

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 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\(^{11}\) 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 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 a single dose of an active ingredient is small, such as 1 mg, a diluent must be added to improve accuracy in the dose and 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

\(^{11}\) The ability of a drug to exert its therapeutic effect on the body.
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 in 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. 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 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 that the child does not chew the pellets because this will adversely affect the release of the medication. Some capsules are formulated to 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.

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.
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 design 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 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.

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.

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.

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.

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, homogenous 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.

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.

Caution: Do not add 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.
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 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 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 WO 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 a 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).

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 result. Note: 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 the 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. Glycertites 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, 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 Signa written on the prescription by the prescriber may indicate a 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 or 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.\(^\text{12}\)

A buccal tablet is placed inside the pouch of the cheek between the cheek and the gum. Similarly

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\(^{12}\) Chest pain caused by reduced blood flow in the coronary arteries.
to a sublingual tablet, it is absorbed through the lining of the cheek and bypasses the intestinal tract. Metandren Linguits, a male sex hormone, is an example of a buccal tablet that is commercially available.

**Parenteral**

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 are beyond the scope of this course. 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 IV medications 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.

**Intramuscular Administration**

Intramuscular (IM) administration involves 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.

Subcutaneous Administration

Subcutaneous (SQ) administration involves injecting a small amount of 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 pre-marked areas on the back of the patient and checking for inflammation.

Intra-articular Administration

Intra-articular administration involves injecting a medication directly into a joint, such as a 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 in only extreme life-threatening emergencies. Only healthcare personnel 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 is also 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 bypassing the gastrointestinal tract. The drug is contained in an adhesive patch that slowly releases the medication at a predetermined rate. The skin assists in controlling the rate of absorption and delivery to the bloodstream. The patch may be applied to the skin every day, every 3 days, or every 7 days.

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

**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 anti-nausea 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 rectal 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.
CONCLUSION

A recurring theme in this course is the importance of developing your knowledge and skills as a technician as you build trust with the pharmacists and other health professionals you encounter at work. When you see an error or something that seems questionable and may cause harm to a patient, you must speak up! Even if the pharmacist or physician is the most outstanding person in his field, even if you will be severely chastised for questioning him or her, even if you may be wrong, you must question him or her! Many patients are dead because technicians did not feel that it was “their place” to question a pharmacist or a physician. The best pharmacists and the best physicians are still human and human error is always a possibility, especially in the busy world of healthcare.
FINAL EXAM

Exam Purpose: The purpose of this exam is to make sure that the reader has read the material. The questions are straightforward and not designed to be “tricky” in any way. If you find any of the questions to be unclear, please contact J&D Educational Services, so that they may make the author aware of any ambiguities.

Please choose the best answers based on the choices provided.

1. Which of the following is NOT considered one of the 5 “Rs”?
   a. The right drug
   b. The right time
   c. The right doctor
   d. The right patient

2. One of the most important roles of a pharmacy technician is to ensure effective communication with patients and other healthcare professionals.
   a. True
   b. False

3. Orders for drugs that should be immediately administered are called ______________.
   a. One-time orders
   b. PRN orders
   c. Medication orders
   d. STAT orders

4. ______________ are usually seen in an institutional setting.
   a. Admissions orders
   b. Routine medication orders
   c. Discharge orders
   d. All of the above.
FINAL EXAM

5. Which of the following is NOT required on a medication order?
   a. Patient’s social security number
   b. Name of drug
   c. Length of time drug is to be given
   d. Prescriber’s signature

6. ____________ are computer-generated prescriptions created by the provider and sent directly to the pharmacy.
   a. Emails
   b. Electronic medical records
   c. E-prescriptions
   d. Patient profiles

7. It is estimated that around ____ of prescriptions require pharmacists to call physicians for clarification due to poor handwriting.
   a. 10%
   b. 30%
   c. 50%
   d. 60%

8. If your pharmacy receives E-prescriptions, you can trust them for 100% accuracy.
   a. True
   b. False

9. The patient information contained in an E-prescription is covered under HIPPA.
   a. True
   b. False

10. In order to provide ECPS, there is an extremely complicated auditing/certification process.
    a. True
    b. False
FINAL EXAM

11. Leave all medications fully labeled in their unit-dose packages until they are at the bedside.
   a. True
   b. False

12. The _____________ is the name given to a drug by the manufacturer for marketing purposes.
   a. Generic name
   b. Trade name
   c. Chemical name
   d. None of the above

13. Prescribers may have different formats, but as long as all of the required information is present, the prescription is valid.
   a. True
   b. False

14. Labels should be checked ______ times before the drug is administered.
   a. Once
   b. Twice
   c. Three
   d. Only by the pharmacist

15. Proper dosage strength should never be presumed by anyone in the ____________.
   a. Prescribing process
   b. Dispensing process
   c. Administering process
   d. All of the above

16. The duration of action of a drug is known as its ________________.
   a. Half-life
   b. Clearance
   c. Volume of distribution
17. The distribution of the drug in the various body tissues is known as ______________.

a. Half-life
b. Clearance
c. Volume of distribution
d. None of the above

18. The last requirement is to verify that the right patient is the one to receive the drug. Just addressing the patient by name is sufficient.

a. True
b. False

d. None of the above

19. ______________ tablets are useful for drugs that may be irritating to the mucosa of the stomach.

a. Enteric-coated
b. Controlled-release
c. Effervescent
d. semisolid

20. ______________ tablets are formulated to release the drug over a predetermined period of time to provide more constant levels of the drug in the bloodstream.

a. Enteric-coated
b. Controlled-release
c. Effervescent
d. Buccal

21. ____________ 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.

a. Enteric-coated
b. Controlled-release
c. Effervescent
d. Buccal
FINAL EXAM

22. The ability of a drug to exert its therapeutic effect on the body is referred as its _______.
   a. “cheeking”
   b. Excipient
   c. Bioavailability
   d. Lubricant

23. _______________ 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.
   a. Excipients
   b. Lubricants
   c. Binders
   d. Disintegrants

24. Soft gelatin capsules may contain
   a. Liquid
   b. Paste
   c. Powder
   d. All of the above

25. The use of chewing gum as a delivery system for medications has decreased.
   a. True
   b. False

26. An adult rectal suppository should weigh about ___ grams.
   a. .5
   b. 1
   c. 1.5
   d. 2
FINAL EXAM

27. ___________ are powders that have been wetted and allowed to dry in coarse particles.
   a. Aerosols
   b. Granules
   c. Pastes
   d. Inhalations

28. White petrolatum is an example of a __________________________.
   a. Oleaginous or hydrocarbon base
   b. Anhydrous absorption bases

29. Pastes are thicker and more absorptive than ointments because they contain higher amounts of dry ingredients.
   a. True
   b. False

30. The most common vehicles for liquid medications are ____________.
   a. Water
   b. Alcohol
   c. Mineral oil
   d. All of the above.

31. ________________ contain vegetable material in an alcoholic base.
   a. Glycerite
   b. Viscous aqueous solutions
   c. Elixrs
   d. Tinctures

32. ___________ are thick adhesive liquids.
   a. Glycerite
   b. Elixrs
   c. Mucilages
d. Tinctures

FINAL EXAM

33. Although a sublingual tablet is placed in the mouth, this is NOT considered an oral administration.
   a. True
   b. False

34. __________ is a large dose injected over a short period of time.
   a. Continuous infusion
   b. Bolus dose
   c. Subcutaneous
   d. Intramuscular

35. _______________ administration involves injecting a medication directly into a joint.
   a. Intradermal
   b. Intra-articular
   c. Intraperitoneal
   d. Intrapleural

36. _______________ administration involves injection into the peritoneal or abdominal cavity.
   a. Intradermal
   b. Intra-articular
   c. Intraperitoneal
   d. Intrapleural

37. Use of the ____________ route of administration continues to increase as more drugs become available.
   a. Implants
   b. Topical
   c. Aerosol
   d. Inhalation
38. Rectally administered liquids are often in the form of enemas for bowel cleansing prior to diagnostic testing.
   a. True
   b. False

39. Treating a sore throat with analgesics and anesthetics can cause a strep throat to be overlooked.
   a. True
   b. False

40. When you see an error or something that seems questionable and may cause harm to a patient, _____________!
   a. Write a report
   b. Talk to your friends and significant others
   c. Speak up