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Volume 3. Medication Administration and Pharmacology



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THIS VOLUME of CDC B4N051, *Aerospace Medical Service Journeyman*, addresses the principles of medication administration and introduces you to pharmacology. You will use the knowledge you gain from within this text as a 5-level and throughout the rest of your career as a 4N0X1. This volume serves as a building block for you to refresh the knowledge you gained from technical school and takes you through the information of how to properly prepare and administer medication and understand principles of pharmacology.

Unit 1 starts with basic facts and safety factors in medication administration. You will also learn about medication orders, proper documentation, and legal aspect of administering medication. Next, you will begin to look at how the body responds to medications, as well as some sources you can use to learn about specific aspects of medications.

Unit 2 discusses information you need to know prior to administering medication. Included in this unit are tables that will assist you in converting weights and measures and properly setting up formulas for medication calculation. You will then move on to the different routes medication can be administered.

Unit 3 is devoted to pharmacology. Medication actions, side effects, and special guidelines for administering medication are covered in this unit. This will build the basic foundation in understanding different medication types and classes. You will need to continue to study and learn about medications as this is an ever-changing field.

A glossary of abbreviations and acronyms is included at the end of this volume.

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NOTE:

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

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Unit 1. Medication Administration Procedures

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AS AN AEROSPACE medical service technician, you administer medications every day to patients in the hospital. This task carries enormous responsibility. Be sure to follow proper and safe guidelines whenever you perform this important duty.

1–1. General Information

This section focuses on general information pertaining to medication administration. Important safety considerations are also addressed here.

401. Basic facts about medication administration

Medications are used to treat, cure, prevent disease, or provide relief. A basic working knowledge of medications is essential to providing proper care. In this lesson, we will consider key terms, general medication names, drug standards, as well as responsibilities.

Key terms

The following table lists key terms associated with medications.

Term	Definition
Absorption	The process of moving a medication into or across body tissues or into the bloodstream.
Adverse reaction	An undesirable side effect from a medication.
Agonist	A drug capable of and drawn to receptors to cause a cellular response.
Antagonist	A drug that blocks the response of another drug.
Bioavailability	The ability and degree a drug or other substance is available to reach target tissues or cells and produce its effects.
Clinical pharmacist	A specialist who can guide a provider in prescribing drugs.
Combination drug	A drug product that contains more than one active ingredient.
Contraindication	An improper or undesirable medication or treatment.
Controlled drug	A drug that has restricted use by the Comprehensive Drug Abuse Prevention and Control Act (in the United States).
Distribution	The action of transmitting medication to body tissues and the cellular site.

Term	Definition
Drug	Term used interchangeably with the term "medication."
Drug allergy	An adverse side effect caused by a medication. Symptoms may range from mild to severe allergic reactions.
Drug dependence	Exists when an individual relies on or needs a drug. The need may be physical, psychological, or a combination of both.
Drug interaction	Occurs when one drug modifies the action of another drug. It may result in an increase, decrease, or alter the action of the drug.
Drug tolerance	A low physical response to a drug, requiring greater dosages for the desired effect.
Drug toxicity	Harmful effects from a drug level above the therapeutic level or administered by the wrong route.
Formulary	A reference book or pamphlet that lists medications available at a specific healthcare facility. Also lists recommended dosages and special considerations.
Efficacy	The ability of a drug to produce a more intense response as its concentration is increased.
Excretion	The process of removing substances from the body.
Half-life	The length of time it takes for a drug to decrease its concentration in the plasma by one half of the original amount.
Pharmacist	A person licensed to prepare and dispense drugs.
Pharmacology	The study of the effect of drugs on living organisms.
Pharmacopoeia	A book containing the names, descriptions, and chemical factors of various products used in medications.
Pharmacy	The art of preparing, compounding, and dispensing drugs. Also used in reference to the place where drugs are prepared, compounded, and dispensed.
Potency	The strength of a drug at specified dose or concentration.
Precautions	Alert medical personnel to physiological and psychological conditions that may make a patient susceptible to negative or undesirable drug effects.
Prescription	The written direction for the preparation and administration of a medication.
Provider	A person licensed to prescribe medications (such as a physician, physician assistant, or nurse practitioner).
Scheduled drugs	The category (I thru V) a drug is placed into based on its potential for misuse or abuse (in the United States).
Therapeutic effect	A desired effect or level of drug in the body to produce desired action.

General medication names

Various terms are used when referring to individual medications. The following table describes each of the four major drug names.

Term	Definition	Example
Generic name	Assigned by the US Adopted Name Council. They are usually easier to remember than chemical names. There is only one generic name for each drug and it is assigned by the government. Providers will often order medications using this form of the drug.	Aspirin, acetaminophen, diphenhydramine, and Ibuprofen.

Term	Definition	Example
Chemical name	A term used primarily by chemists. Each drug only has one chemical name and it is a description of the chemical composition of the drug. They are often complicated and difficult to pronounce or remember.	Calcium gluconate, sodium chloride and 7-chloro-1, 3-ciphydro-1-methyl-5 phenyl-2H-1, 4-benzodiazepin-2-one (Generic name, Diazepam, or trade name, Valium).
Trade name	The name a manufacturer gives to a drug. May also be referred to as the brand name or product name. The same generic or chemical drug may have several different trade names depending on what company manufactures it.	Ecotrin, Motrin, Benadryl, and Advil.
Combination drugs	These drugs contain more than one active ingredient. It can be difficult to match a generic name to one brand name. When reading the label, the active ingredient is normally described by the generic name (written in lowercase letters) and the Trade name is normally capitalized.	Tylenol Cold, Excedrin, and Midrin.

Drug standards

In 1988, the US Food and Drug Administration (FDA) was officially established as a part of the US Department of Health and Human Services. The FDA is responsible for providing public health protection by ensuring the safety, efficacy, and security of human and animal drugs, medical devices, US food supplies, biological products, cosmetics, and radiation-emitting products. A branch of the FDA, called the Center for Drug Evaluation and Research (CDER), was developed to control what prescription and over-the-counter (OTC) drugs would be used for therapy. The FDA and CDER oversee drug standards to ensure medications are of uniform product quality. Some of the product standards monitored are:

- Purity.
- Quality.
- Packaging.
- Safety labeling.

Drugs also vary in strength and in the activity they will perform. For the desired effect of a drug to be predictable, the substance must be pure and of uniform strength. In addition, most drugs lose their potency after a period of time. Because of this, ensuring expiration dates on medication containers have not expired is an important responsibility each time a drug is dispensed or administered.

Drugs are derived from two general sources: natural and synthetic. Natural sources include plants, minerals, or animals. Synthetic sources are man-made products developed in a laboratory. The FDA oversees administration of dietary supplements and herbal products; however, the Center for Food Safety and Applied Nutrition (CFSAN) is the regulator of these products. Although these products are regulated by the Dietary Supplement Health and Education Act of 1994, herbal and diet supplements can be marked without prior approval from the FDA.

Responsibilities

Do you know who is responsible for ensuring the proper medication is administered? Many healthcare personnel are involved. They include *providers, pharmacists, nurses, medical service technicians*, and even the *patients* themselves.

Providers

Providers are responsible for diagnosing a patient's condition and prescribing medications to treat that condition. They also are responsible for monitoring a patient's response to a medication and altering the drug order, if necessary.

In addition, providers have an ethical and legal responsibility to use good judgment in prescribing a potentially harmful or addictive medication. They should consult with other professionals if unsure about a medication, and they should avoid prescribing medications for experimental purposes or in doses that may either cause or further a potential addiction to a drug. Providers are responsible for educating their patients and also act as sources of information and education for other members of the healthcare team.

Pharmacists

Pharmacists are professionals with extensive training in the areas of drug chemistry, classification, action, and administration. They are involved in selecting, obtaining, and storing different medications, as well as accounting for the safe dispensation of medications. As part of the medication administration team, pharmacists are responsible for interpreting orders from the physician, dispensing medications, monitoring medication usage, and educating the public on medication and health issues. Pharmacists also act as sources of information and advice for other members of the healthcare team regarding correct administration of different medications.

In a hospital setting, it is the pharmacist's responsibility to manage different systems of supplying medications to units within the facility. The pharmacist also stocks the pharmacy, checks for outdated medications, and ensures unused medications are returned to the pharmacy.

Pharmacists are ethically and legally responsible for preventing illegal and harmful dispensation of medications. They have direct access to potentially addictive drugs that also have a high street value. Although there are numerous laws prohibiting the sale of medication to individuals who do not have a prescription, such a sale is somewhat difficult to trace. So, the ethics of pharmacists play a major role in preventing them from engaging in such activities and should cause them to question or even refuse a physician's order they know to be harmful.

Nurses

Nurses are personally responsible—morally, ethically, and legally—for accurate medication administration. They are responsible for safely preparing and administering medications to patients, according to the doctor's orders. Their responsibility includes monitoring and reporting a patient's response to a medication and documenting the administration and results in the patient's record. Nursing personnel also are responsible for maintaining current knowledge about the pharmacology of medication and developing the skills needed to prepare and administer medications safely. They must be familiar with the condition and history of patients who receive medications and be able to interpret that information to know when *not* to give medications. Nursing personnel are responsible for safeguarding and storing the medications under their care, educating others on the safe uses of medications, and protecting the rights and ensuring the comfort and safety of patients receiving medication. Nurses must question medication orders they believe a contraindication exists or an error in the order was made. They should respectfully refuse to give medications they feel are unsafe.

Legally, professionals are held responsible for safe and therapeutic drug administration. Nurses are held liable for their actions or omissions. Each healthcare team member delegated the responsibility to administer drugs can be held liable for his or her actions. The law requires everyone to be safe and competent.

Aerospace medical service technicians

As a medic, you are trained to prepare and administer certain medications as part of your legal scope of practice. You share the same moral, ethical, and legal responsibilities that apply to other members

of the healthcare team. It is important all members of the healthcare team understand that as a properly trained medical technician, you are able to prepare and administer certain medications under the supervision of a physician or nurse. This does not mean you must be directly observed performing these duties. It means that a physician or nurse must have delegated a specific medication administration procedure to you to perform. In other words, you cannot decide on your own to administer a medication. Additionally, physicians and nurses are only permitted to delegate such duties to those medics who have attained the proper skill level and whose training is properly documented in their training record. Within these guidelines, you become personally liable to ensure you perform your duties appropriately. You are not operating under a nurse or physician's license when you follow these rules. On the other hand, any physician or nurse who directs you to perform a task that is not part of your scope of practice—as defined and documented in the Specialty Training Standard (STS)—is placing his or her license in jeopardy. If you are asked to perform a task or give a medication you are not trained to give, you should respectfully decline to perform the task or administer the medication. If it is covered in your career field's STS, you can ask the nurse, doctor, or supervisor to train you on the task (don't forget to document the training). If you are not familiar with a medication that was ordered, you should state that you are not familiar with the medication but that you will research the material, discuss any questions you may have, and review all aspects of administration prior to giving the drug.

The bottom line on these guidelines is that medical service technicians can assist greatly in the important duties associated with medication administration when physicians and nurses understand the training and capabilities of each medic. Professionals who refuse to permit a properly trained medic to perform duties within the scope of practice are not using the entire healthcare team appropriately. There are some medications that require individuals to be a specific skill level and be fully trained before being allowed to administer the drugs. Ensure you follow the rules of local policy! Even if the task is listed in your STS, if local policy states technicians will not give certain medications, then do NOT administer the medication. The local policies are created with patient and staff safety in mind. If you have a question or concern about what you are allowed to do, see your supervisor. He or she can explain the reason for the policy or will elevate it to your 4N0X1 Functional Manager for discussion.

Patients

Along with a set of rights, patients have certain responsibilities. They must realize the purpose of their medications and question anything they do not understand. They also must understand their role in the therapy and comply with the schedules and doses that are prescribed. They must report any adverse effects or changes in their condition that result from taking a medication. Finally, they must avoid misuse or abuse of medications and properly safeguard and store medications in their possession. Ensure you explain these responsibilities to the patient so he or she can be fully involved in his or her own medical care.

402. Safety considerations for medication administration

Safety and accuracy are primary medication administration responsibilities. An important first rule to remember is to ask for clarification when in doubt on any part of a medication order. Anyone who dispenses or administers medication must always remember that he or she is solely responsible for his or her own actions.

Patient history

You must obtain an accurate history pertaining to a patient's medication background before you administer or dispense any medication. Two essential considerations you must obtain and document are the patient's current medications and allergies. You must know what medications a patient is currently taking because of the possibility of an adverse reaction that could occur when two or more medications are introduced into the body. You must know a patient's allergies to avoid giving a drug

that previously caused an adverse reaction in the patient. Some allergic reactions are mild, while others cause serious problems.

Patient rights

When medications are dispensed or administered, patients or legal guardians have the following rights:

- To be informed of the drug's name, purpose, and side effects.
- To refuse any medication.
- To have a qualified person assess their medical history before being given any medication.
- To receive clearly labeled medication containers and instructions.
- Not to be given any medication unnecessarily.

The “Six Rights” of medication administration

Whenever you administer medications, be sure to observe and verify the “Six Rights.” These include ensuring:

1. The right **patient** is receiving the medication.
2. The right **medication** is being administered.
3. The right **dose** of the medication is being given.
4. The right **route** of administration is being used.
5. The medication is being given at the right **time**.
6. The right **documentation** is recorded.

- **Remember!**

The Six Rights for safe medication administration:

Right PATIENT

Right MEDICATION

Right DOSE

Right ROUTE

Right TIME

Right DOCUMENTATION

Principles of administration

With all aspects of patient care there are principles that must be followed. Medication administration is a procedure that is considered high risk. With any medication administration, the intent is to produce a particular reaction in the body. The thought is that once a medication has been given to a patient, you are not able to retrieve the medication. You may be thinking, “When medication is given by mouth, it is not absorbed immediately.” This is true, but the intention is not to induce vomiting to retrieve the medication that was given. As a medical technician, it is your responsibility to be knowledgeable, skilled, and have good judgment when administering any medication to a patient:

- Knowledgeable—Keeping up to date with the medications you administer is important. Learn the purpose of the medications, the potential side effects, cautions, contraindications, and possible interactions with other medications.
- Judgment—The wisdom to assess the patient's need accurately for the medication, to evaluate the response to the medication, and to plan appropriate interventions as indicated.

- Skill in delivery—Training is initiated at the apprentice level when you delivered your first subcutaneous injection to your classmate. You are now ready to progress and be capable of giving medications in a variety of routes, and know which route is suited for the medication ordered. Medication administration requires continuous training to ensure skill maintenance and is required to be documented.
- Patient education—This is an extension of being knowledgeable. You must be able to impart the information of the medication in lay terms to the patient receiving the treatment.

Most often, reading the information inserts found with the medication supply fulfills these principles. If you are unable to locate the insert, there are a number of sources to educate yourself on the medications beginning with the *Physician's Desk Reference* (PDR). Each military treatment facility (MTF) has a list of approved references that are available to all healthcare providers. With the responsibility of medication administration carries moral, ethical, and legal responsibilities. Most MTFs require Aerospace Medical Service technicians to take and pass their local pharmacology course or test. This ensures training is accomplished and documented before any administration.

When preparing to administer medication, basic principles should always be kept. Always wash your hands before handling medications and ensure the area you are preparing the medication in is clean. Be sure medications are rotated and never used past their expiration dates. When you have the order calculated and the medication prepared, you are ready to apply the Six Rights of medications.

1. Right medication.
2. Right amount.
3. Right time.
4. Right route.
5. Right patient.
6. Right documentation.

Right medication

Start by verifying the order with the provider who wrote the order, not the nurse or another provider, unless the order is going to be rewritten by the new provider. Confirm the right medication by carefully comparing the name of the drug ordered with the label on the package, bottle, or unit dose packet. Never give a medication when the name on the label is not clear or obscured in any way. If there is any question about the drug order because of handwriting, misspelling, inappropriateness, allergies, or interactions, you have the right and the responsibility to question the order. Never give medications that someone else has prepared, and never leave medications at the bedside unless specifically ordered by the provider and verified in the written order.

Right amount

Administering the right amount of the drug is extremely important. This is why medication calculations were reinforced previously. Verifying the right medication and calculating the dosage using the ten basic calculation steps are vital to your patient's health. Anyone who administers medications has the right and responsibility to question any dosage that is unusual or seems inappropriate for the individual patient. Seemingly inappropriate orders must be verified with the ordering provider.

Right time

The time of administration is an important part of drug dosage. Many medications are prescribed on a schedule (i.e., q4h, bid, or qd). This is to ensure the maximum effectiveness of the medication. When medications are not given at the correct time, it will render the *dosage* ineffective. The *dosage* is defined as the amount of the drug given for a particular therapeutic or desired effect.

There are seven *dosage* levels that are considered when an order for medications is made.

1. Minimum dose—Smallest amount of a drug that will produce a therapeutic effect.
2. Maximum dose—Largest amount of the drug that will produce a therapeutic effect without producing symptoms of toxicity.
3. Loading dose—Initial high dose used to elevate the level of the drug in the blood quickly. It is then often followed by a series of lower maintenance doses.
4. Maintenance dose—Dose required to keep the level of the drug in the blood at a steady state in order to maintain the desired effect.
5. Toxic dose—Amount of a drug that will produce harmful side effects or symptoms of poisoning.
6. Lethal dose—Dose that causes death.
7. Therapeutic dose—Dose required to produce a desired effect.

Right route

Route of administration is important because of its effect on degree of absorption, speed of drug action, and the side effects of the drugs. Many drugs are supplied in a variety of ways, such as acetaminophen. This medication is supplied in tablet form, suppository, and liquid. You have the right and responsibility to question the appropriateness of the route based on your assessment and observation of the patient's condition before administering the medication. A change in route may be indicated by the patient's condition change from the time the medication was initially ordered.

Right patient

The patient who is to receive the medication must be identified using certain techniques to reduce the chance of error. The patient's wristband (inpatient) or identification (ID) card (outpatient) is always first. You may then ask the patient to state his or her name if he or she is coherent and conscious. If the patient is not coherent or conscious, check the chart or ID tag on the end of the patient bed. If at any time your patient questions the medication or the dosage, recheck the order and the medication before giving it.

Right documentation

The last essential duty to all medical care provided is documentation. Follow the rule: if it was not documented, it was not done. Every medication administration must be recorded in the patient's record. There are certain items that must be documented: the medication, dosage, time, route, the location if an injection, any adverse signs or reaction, and the patient's response to the medication administered. Any patient's record has the potential to be examined in court; the accuracy of the documentation can be the critical factor in some legal judgments. At all times make sure your documentation follows your local MTF policies and guidelines, The Joint Commission (TJC), and any other agency directing the patient care for your facility.

A patient's SAFETY must be an overriding concern throughout the entire process of preparing and administering medications. Even the most "harmless" medication can cause illness or even death if prepared or administered in an unsafe manner.

Some of the more common mistakes that occur when personnel prepare and administer medications are contamination of equipment or of the medication and medication errors. Contamination occurs because the preparer is not using a sterile technique or because someone else is interfering with the process. Medication errors (wrong patient, wrong dose, etc.) occur because the preparer is not thinking and not following facility guidelines that ensure safety and accuracy.

Safety guidelines

All medical facilities have established routines and rules for providing a safe, orderly, and economical method of preparing and administering medications. These guidelines provide information on the following:

- Safeguarding the medication.
- Preparing the medication.
- Identifying the patient.
- Administering the medication.
- Documenting the administration.
- Disposing of unused medication.
- Reporting a medication error.

Safeguarding the medication

Drug security is only part of the safeguarding process. Access to medication and administration equipment also must be controlled when preparing, transporting, or administering medications. Under normal circumstances, both the medication cabinets and the preparation supplies and equipment (needles, syringes, etc.) are kept either within the nurses' station or in a locked supply room nearby. Access to these areas is controlled. Unauthorized personnel, patients, and visitors should never be allowed access to either the medications, equipment, or supplies used to prepare medications.

Preparing the medication

The first step in preparing a medication is to verify the medication order. Once the provider orders the medication, the nurses and medical technicians then carry out the order as written and document fulfillment of the procedure in the record. If any part of the order is illegible or raises a doubt as to its accuracy, either you or the nurse should contact the prescriber for verification.

Medications should be prepared in a controlled environment. The area should be well lit and out of the line of traffic for other nursing personnel and patients. This allows the individual who is preparing the medications to work alone without distractions or interruptions. Once the medications are prepared, the preparer must remain with them. If you are the preparer and an emergency forces you to leave, you must lock the medications in the cabinet before leaving.

Use aseptic techniques when preparing a medication. Certain parts of needles and syringes must be kept sterile before, during, and after preparation of a medication. Even when putting pills in a cup, you should wash your hands before beginning in order to avoid contaminating the medication, equipment, or supplies.

When preparing a medication, check the label on the container to ensure safety and accuracy. If the label is difficult to read or has come off the container, return the medication to the pharmacy and obtain another container of the medication. Follow the same precaution if the medication appears contaminated (looks cloudy or has sediment in it).

Drug information is frequently updated in reference books that should be readily available in each clinic or unit. Two of the most commonly used references are the PDR and the *Nurse's Drug Handbook*. All healthcare personnel involved in medication administration duties should be familiar with references such as these. Be sure to use these references regularly, rather than relying on your memory, to stay informed of medication precautions and guidelines.

Identifying the patient

Identifying the patient is an essential part of medication administration. Like some of the other precautions, the guidelines for identifying the patient may seem a little excessive, but they are intended to ensure safety and accuracy. Initially, always compare the patient's name band or ID card

with the chart. Ask the patient to state his or her full name and date of birth if the patient is capable of doing so.

Administering the medication

Use aseptic techniques when administering a medication. Use a sterile technique when giving an injection or starting an intravenous (IV). In all cases, follow the principles of asepsis. Remain with the patient until he or she has taken the medication. Observe the patient for any adverse reaction. If a reaction does occur, immediately notify the nurse or provider.

If a patient tells you that the medication you are about to administer made him or her feel bad the last time or if the patient states that he or she has an allergy to that medication, do not give the drug without checking with the nurse or doctor. Allergic reactions can be fatal. Also, check the medication if the patient states that it appears different. You may have made a mistake, and withholding the medication could prevent a medication error. Remember, the patient has the RIGHT to refuse any medication, so do not attempt to force it if the patient is hesitant for any reason. However, it is important to try to find out why the patient is refusing the medication, report the situation promptly to the nurse or provider, and document the situation.

Do not administer any medication you have not personally prepared. The person who administers the medication is responsible for his or her actions. A person who is responsible enough to administer a medication is responsible enough to prepare it.

Documenting the administration

It is very important that you document the procedure immediately after administration. Do not delay this step. Promptly documenting the completion of a procedure significantly reduces the danger of another individual duplicating the administration. Further information on documentation is addressed in the next lesson.

Disposing of unused medication

Except for emergency situations, patients must not be forced to take medication against their will. Under normal circumstances, when a patient refuses a medication, you should try to find out why and report the situation promptly to the nurse or provider. Then document the situation in the patient's record. Do not put unused medication back in its original container. Even if unused, it is considered contaminated. This does not apply to individually packaged tablets still in their original package. Document the manner of disposal in the nurse's notes or other appropriate form.

Reporting a medication error

In spite of all established guidelines, healthcare personnel are human and mistakes will occur. If you make a mistake, don't try to hide it! The first thing you should do is assess the patient's condition and notify the nurse or provider. Check the patient's vital signs and observe for any unusual reactions (pallor, sweating, etc.). Make an entry in the nurse's notes describing the situation and any remedial action taken. You also need to complete Air Force (AF) Form 765, Medical Treatment Facility Incident Statement. The information on the form should include a factual statement of what happened without any opinions or conclusions regarding the incident.

Special safety considerations

Remember these important rules when dispensing or administering medications:

- Question any order you think might be incorrect.
- Be knowledgeable about the desired effect and potential adverse reactions associated with any medication being dispensed or administered.
- Never use a medication that has not been obtained from a container that is clearly labeled.
- Never leave medications unattended at a patient's bedside unless ordered to do so by the provider.

- If a medication is not properly administered at the appropriate time, record that fact along with the reason for the omission in the patient's record.
- Report any medication administration error immediately to the nurse or provider.
- Report adverse reactions immediately to the nurse or provider.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

401. Basic facts about medication administration

1. What six things are medications used for?
2. What is a formulary?
3. What drug name is assigned by the US Adopted Name Council?
4. Why were drug standards developed?
5. Who is involved in selecting, obtaining, and storing different medications, as well as accounting for the safe dispensation of medications?

402. Safety considerations for medication administration

1. What two essential patient history considerations must be obtained and documented before administering a medication?
2. What are the "Six Rights" of medication administration?
3. List the four basic principles of medication administration.
4. What medication references are available to the technician, if needed?
5. When should you document the medication you have given?

6. What is the first step in preparing a medication?
7. What is the largest amount of the drug that will produce a therapeutic effect without symptoms of toxicity?
8. Define loading dose.
9. List the elements of proper medication documentation.
10. If a patient refuses to take a medication, what should you do?
11. What form do you use to report a medication error?

1-2. Medication Orders, Documentation, and Legal Aspects

This section contains information relating to medication orders, documenting medication administration procedures, and important legal considerations pertaining to medication administration.

403. Medication orders and documentation

A drug order consists of many essential parts. Besides the type (“It’s needed stat!”), an order must contain information about the patient, dosage, and so forth. Whether a medication order is given verbally or in writing, you must document the order and your actions in writing.

Types of medication orders

There are four types of medication orders. Each type is described in the following table:

Type of order	Description
Stat order	Medication is to be administered immediately and only once.
Single order	Medication is to be administered only once at a specified time.
Standing order	Multiple doses of a medication may be administered either indefinitely at a specified time each day or for a specified number of days.
PRN (<i>pro re nata</i> or “as needed”) order	Medication may be given whenever, in the nurse’s opinion, the patient requires it, providing the maximum dose prescribed by the provider is not exceeded.

Essential parts of a drug order

A drug order should not be confused with a prescription. Drug orders are instructions from the provider to members of the healthcare team, whereas a prescription is a specific instruction from the provider to the pharmacist.

The following is a list of the seven essential parts that must be included with each drug order:

1. Patient's name.
2. Date the order was written.
3. Drug name.
4. Drug dosage.
5. Method of administering the drug.
6. Time and frequency medication is to be given.
7. Signature of the provider.

Communicating the drug order

There are two ways to initiate an order. The first is when a provider writes an order in the patient's electronic health record or chart on AF Form 3066, Doctor's Orders (fig. 1-1). A second is when the provider verbally gives an order to a nurse. The nurse must write the order in the chart and the provider must co-sign the order as soon as possible. Medical technicians are generally not allowed to take verbal orders for medications.

Documenting medication administration

Once an order is given, it is followed directly and is documented. Remember these seven important rules for documenting an order:

1. The individual who administers the medication is responsible for the documentation.
2. Document promptly to reduce the risk of another individual duplicating the administration.
3. Make all documentations in ink.
4. Use dictionaries as needed to ensure correct spelling.
5. Line out any written mistakes, initial the error, and write the correct statement.
6. Ensure a provider or nurse co-signs any entries you make.
7. Include in the documentation the time of release for outpatients who are required to wait in the clinic area for a specified time after the administration of certain medications. This waiting period is used to observe for any adverse reactions.

Required items to document

You must include at least these eight items in the documentation:

1. Name of medication.
2. Dosage administered.
3. Route of administration.
4. Site of administration, if injected (to avoid duplicate injections at the same site).
5. Time of administration.
6. Any adverse reactions observed.
7. Signature of the person who administered the medication.
8. Co-signature of the nurse or provider, when applicable.

Occasionally, a medication is omitted through oversight or because the patient is unavailable, allergic, or does not need the medication. Sleeping pills are a good example of this last category. If a sleeping pill has been ordered for a patient, but you find the patient already asleep when the medication is due, there isn't much point in waking up the patient just to take the pill. Whatever the reason, notify the nurse or provider promptly of the omission, and they can decide if the patient should still receive the medication. If they decide not to give the drug to the patient, make a note of that fact and the reason for it in the patient's chart.

DOCTOR'S ORDERS - (SIGN ALL ORDERS)			
For Each Set of Orders, Record the Date and Time, Sign, and Cross Out the Unused Lines			
PATIENT IDENTIFICATION		DATE OF ORDER	NURSE'S SIGNATURE
Blanks, Phil N. 212860 Keesler Med Center 10 Jan 09 20/123-45-6789 21y/o Male Single Cau 81 SFS		10 Jan 09	
		TIME 0645	
		1.) Admit to 3 West	
		2.) Urinalysis, CBC - Labs	AS
		3.) PA & Lateral Chest x-rays	KS
		4.) Clear to full liquid diet as tolerated	
		5.) Mylanta 30ml every 4 hrs.	
		B. Happy, MD	Noted 0650 MDK
NURSING UNIT	ROOM NO.	BED NO.	
3 West	16	1	
PATIENT IDENTIFICATION		DATE OF ORDER	NURSE'S SIGNATURE
Blanks, Phil N. 212860 Keesler Med Center 10 Jan 09 20/123-45-6789 21y/o Male Single Cau 81 SFS		11 Jan 09	
		TIME 0630	
		1.) Tylenol 500mg, $\dot{\bar{\imath}}$ - $\bar{\imath}\bar{\imath}$ tabs every 6 hrs as needed.	
		2.) Prep for Colonoscopy - per protocols	
		3.) NPO after midnight	
		B. Happy, MD	Noted 0645 CLG
NURSING UNIT	ROOM NO.	BED NO.	
3 West	16	1	
PATIENT IDENTIFICATION		DATE OF ORDER	NURSE'S SIGNATURE
Blanks, Phil N. 212860 Keesler Med Center 10 Jan 09 20/123-45-6789 21y/o Male Single Cau 81 SFS			
NURSING UNIT	ROOM NO.	BED NO.	
PATIENT IDENTIFICATION		DATE OF ORDER	NURSE'S SIGNATURE
NURSING UNIT	ROOM NO.	BED NO.	

AF IMT 3066-1, 19870401, V2

INPATIENT RECORD
SI085182122

Figure 1-1. Air Force Form 3066, Doctor's Orders.

Figure 1–3. Air Force Form 3069, Medication Administration Record (back of form).

REVERSE OF AF FORM 3068, JUL 86

Figure 1–5. Air Force Form 3068, PRN Medication Administration Record (back of form).

404. Legal aspects of administering medications

There are laws, as well as security and accountability issues, that pertain to proper medication administration. You are responsible for learning and following these laws and regulations.

Laws

For the most part, federal law controls drug administration. There are two main laws that apply to the administration of drugs. One is the Food, Drug, and Cosmetic Act. It was implemented by the FDA and requires (among other things) all labels to be accurate and all drugs to be tested for harmful effects before permitting release to the market. The other federal law is the Comprehensive Drug Abuse Prevention and Control Act (also referred to as the Controlled Substances Act). It categorizes controlled substances and places limits on how often a prescription can be filled for an individual. In addition, the Air Force has specific guidelines in place to ensure that healthcare members adhere to these laws and follow proper procedure for drug administration.

Drug security and accountability

Here are four guidelines to remember regarding drug security and accountability:

1. Store narcotics under double-locked cabinets in the MTF.
2. Store all other medications in single-locked cabinets.
3. Account for all double-locked drugs at the end of each shift and properly document the action.
4. Allow provider-approved bedside medications for inpatients if so documented in the patient's chart.

As mentioned previously, the Controlled Substances Act pertains to narcotics and other drugs with abuse potential. This law is enforced by the Drug Enforcement Administration (DEA) of the US Department of Justice. The US Attorney General is responsible for designating drugs as "controlled substances." These drugs are further classified into schedules according to their potential for abuse.

Classification	Description	Examples
Schedule I	Drugs in this schedule have a high potential for abuse and are currently not acceptable for medical use. There is some controversy over the use of marijuana in treating glaucoma and cancer; however, it is currently classified as a schedule I drug.	Lysergic acid diethylamide (LSD), heroin, and marijuana.
Schedule II	Drugs in this schedule have a high potential for abuse but also have acceptable medical uses. This schedule includes narcotics, as well as certain stimulant and depressant drugs.	Opium, morphine, meperidine, codeine, cocaine, amphetamines, and secobarbital.
Schedule III	Drugs in this schedule have less potential for abuse than those in schedules II and I. Schedule III includes paregoric and barbiturates combined with one or more other medicinal ingredients.	Aspirin with codeine.
Schedule IV	Drugs in schedule IV have a lower potential for abuse than the drugs in schedule III.	Phenobarbital, diazepam, meprobamate, and propoxyphene.
Schedule V	Drugs in this schedule have a lower potential for abuse than the drugs in schedule IV. Medications in this schedule are used for relief of coughs or diarrhea, containing limited quantities of certain opioid-controlled substances.	Cough medicine with Elixir terpin hydrate and codeine and diphenoxylate with atropine.

Inventory procedures

In addition to classifying controlled substances, the Controlled Substances Act established a requirement for a periodic inventory of all controlled substances. Maintain inventories of schedule II drugs separately from the inventories of schedules III, IV, and V drugs. Each inventory should contain the name of the substance, finished form of the substance (e.g., 250 milligram (mg) tablet or 20 mg per milliliter [mL]), number of units or the volume of the finished form in each commercial container (e.g., 50 tablets), and number of commercial containers of each finished form (e.g., twenty 2 mL ampules). Each inventory also should show the location of the drugs and the time, date, and signature of the individual performing the inventory.

Special inventory procedures are required for schedule II drugs. These drugs are inventoried monthly by a disinterested officer, warrant officer, a senior noncommissioned officer (master sergeant [MSgt]—chief master sergeant [CMSgt]), or a civilian of comparable grade as appointed by the facility commander. In addition, regular inventories of stocked medications occur during shift changes in clinics and units.

By following established federal laws and local facility policies, each member of the healthcare team will be contributing to the safest possible medication administration program.

Medication Reconciliation

As defined by TJC, medication reconciliation is "the process of comparing a patient's medication orders to all of the medications that the patient has been taking. This reconciliation is done to avoid medication errors, such as omissions, duplications, dosing errors, or drug interactions. It should be done at every transition of care in which new medications are ordered or existing orders are rewritten. Transitions in care include changes in setting, service, practitioner, or level of care.

Medication Reconciliation Process

The medication reconciliation process comprises five steps:

1. Develop a list of current medications.
2. Develop a list of medications to be prescribed.
3. Compare the medications on the two lists.
4. Make clinical decisions based on the comparison.
5. Communicate the new list to appropriate caregivers and to the patient.

This means that there are two parts to address medication reconciliation:

1. Part A—Clinician/pharmacist reviews medication profile with the patient to assure it is correct and up-to-date.
 - a. Discontinue all nonactive medications.
 - b. Renew all expired medications. If the patient already has these medications, the pharmacist places them on hold.
 - c. Prescribe new medications not on the medication profile including OTC, herbal, and traditional medications. All prescriptions will contain the indication for prescribing (to address health literacy).
2. Part B—Patients will receive a copy of their medication profile using the Patient Wellness Handout or other printed report.
 - a. The medication profile will contain medications with the status of active, hold, or returned to stock.
 - i. Medications that are expired and not current therapy and discontinued should not appear on the profile.

- ## Standards

- ## Approved Drug List

Expired or unserviceable medications

Controlled temperature storage

Self-Test Questions

403. Medication orders and documentation

1. What are the four types of medication orders?
2. What are the seven essential parts of a drug order?

3. Who is responsible for documenting the administration of a medication?
4. Why does the site of administration need to be documented when an injection is given?
5. In order to avoid errors, what do many facilities use to copy a medication order?

404. Legal aspects of administering medications

1. What are the two main federal laws that apply to the administration of drugs?
2. When do double-locked drugs need to be accounted for?
3. In which schedule are drugs not acceptable for medical use and have a high potential for abuse?
4. Aspirin with codeine falls under what schedule of drugs?
5. Special inventory procedures are required for what schedule of drugs?
6. What are the five steps that make up the medication reconciliation process?
7. How often should controlled temperature drug storage areas be monitored, and why is this done?

1-3. The Body's Response to Medications

Performing medication administration procedures properly requires an understanding of how drugs work. This unit contains information about the body's response to medications, drug references, and the various types of medications used in treating disease. This section contains lessons addressing the actions and side effects of drugs, as well as information regarding factors that can influence drug action on the body.

405. Actions and side effects of medications

Drugs are administered for the purpose of achieving a desired effect on the body. This is known as the therapeutic effect. There are six therapeutic drug categories: palliative, supportive, curative, substitutive, restorative, and chemotherapeutic. Some drugs may need to be administered concurrently with other medications to reach the desired effect. Each drug category is specific in the effects of the body. The most common affect desired is the palliative effect.

Category	Purpose	Examples
Palliative	Relieves symptoms of a disease but does not affect the disease itself.	Aspirin given for pain.
Curative	Cures a disease or condition.	Penicillin given for an infection.
Supportive	Supports body function until further treatment or the body's response itself can take over.	Acetaminophen given for fever.
Substitutive	Replaces body fluids or substances.	Insulin administered for a diabetic condition.
Chemotherapeutic	Destroys malignant cells.	Busulfan administered for leukemia.
Restorative	Returns the body to normal health.	Vitamins and mineral supplements.

Drug action

A drug is administered to evoke a drug action. You administer some drugs in order to invoke a local action or effect on the immediate area of application, while others are absorbed into the circulation for systemic action. The chemical makeup of drugs determines the body's reaction, and the extent of systems affected.

Local action

A local action is the effect a drug or medication produces on the tissues at the point or area of application or introduction. Such effects, however, will be confined to the site or area of application only if the medication is applied in reasonable doses. If it is applied in heavy concentrations or large doses, some of the medication will be absorbed to have a systemic effect.

Systemic action

Systemic action is the effect of a drug on some tissue or organ remote from the site of introduction. Such action occurs only after the drug has been absorbed or injected into the circulatory system. Most drugs are administered for some sort of systemic action.

Stimulation is the action whereby the activity of a tissue or organ is increased; for example, it increases pulse and respiration. Prolonged stimulation of cells results in depression.

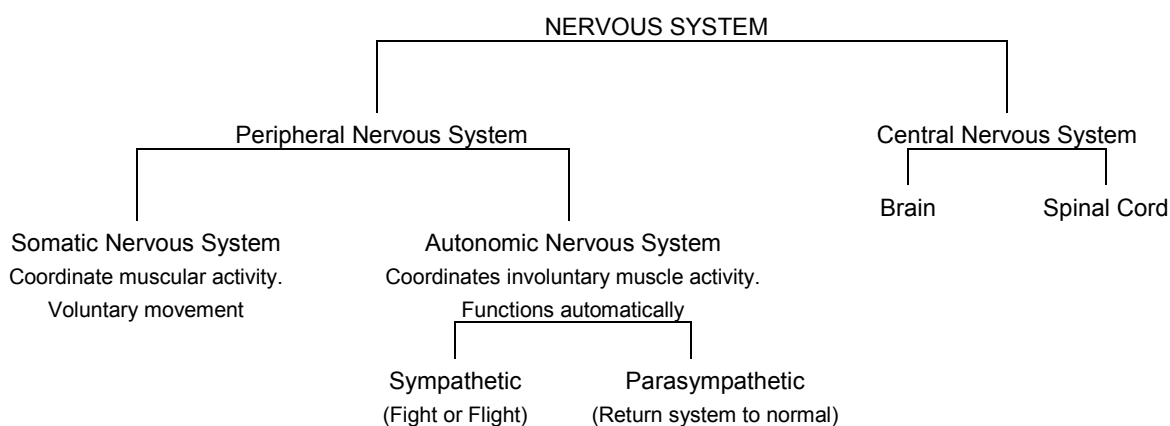
Depression is the action of a drug that results in decreased power of the cells to function. A drug that decreases the ability of the respiratory center is called a respiratory center depressant. The barbiturates are examples of depressant drugs.

Irritation is a drug action that produces slight, temporary damage to tissue. Mild irritation usually results in stimulation of tissue. Prolonged or excessive irritation results in an inflammatory reaction and tissue damage. Various laxatives produce bowel movements by irritating the bowel tissues.

Nervous system actions

The nervous system is divided into two branches: the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS involves the brain and the spinal cord.

The PNS is divided into two more divisions, the somatic nervous system and the autonomic nervous system. Somatic nervous system controls the coordinated muscular activity in the body. The autonomic nervous system can be thought of as being *automatic* or involuntary. Chemical substances called neurotransmitters are released at the nerve endings to transmit impulses to the muscles in the body. The autonomic nervous system is then further divided into the sympathetic and parasympathetic divisions.



Drugs that affect the function of the autonomic nervous system are divided into four categories:

1. Adrenergics (sympathomimetics)
2. Adrenergic blockers (alpha and beta blockers)
3. Cholinergics (parasympathomimetics)
4. Cholinergic blockers (anticholinergics)

Each of these reactions affects either the sympathetic or the parasympathetic parts of the autonomic nervous system (fig. 1–6). Many medications fall into each of these action categories and will be discussed individually. This section is designed for you to gain an understanding of the overall systemic effects of these actions, beginning with the adrenergics.

Adrenergics

The sympathetic nervous system is commonly known as the fight-or-flight system, used to mobilize the body for quick response and action. When the body's system stimulates the fight-or-flight response, blood pressure, pulse, and respirations increase. The peripheral blood vessels constrict to send more blood inward to the vital organs and the skeletal muscles and speeding up the heart action. The bronchioles dilate to allow for a greater oxygen supply and the pupils dilate.

The chemical substance (neurotransmitters) released at the sympathetic nerve endings are called catecholamine and include epinephrine (adrenaline), norepinephrine, dopamine, and isoproterenol. Drugs that mimic the action of the sympathetic nervous system are called sympathomimetic or adrenergic.

Actions of the adrenergics include the stimulation of the cardiac muscles, increased blood flow to the skeletal muscles, and peripheral vasoconstriction. Adrenergics cause bronchodilation and the pupils to dilate (mydriatic action).

The uses of adrenergics can be to restore rhythm in cardiac arrest and elevating blood pressure for all kinds of shock. Capillary constriction is accomplished by applying adrenergic topically to relieve nosebleeds or when combined with local anesthetics for minor surgery. Because of the bronchodilation actions, adrenergic agents are widely used in the treatment of acute asthmatic attacks, bronchospasm, or anaphylactic reactions. Adrenergics are also used for ophthalmic procedures as a mydriatic agent.

As a technician, you must warn the patient of the potential side effects of the adrenergics, which may include palpitations, nervousness or tremors, tachycardia, cardiac arrhythmias, or anginal pain. Adrenergics are known to cause hypertension, hyperglycemia, headache, and insomnia. When adrenergic agents are applied to a laceration of the periphery, such as nose, finger and toes, it can cause tissue necrosis.

The contraindication for adrenergic administration applies to patients with known coronary insufficiency, hypertension, cardiac arrhythmias, organic brain damage, or hyperthyroidism. The interactions may occur with CNS drugs (alcohol or antidepressants) and alpha- or beta-adrenergic blockers.

When administering adrenergic medications, carefully check the dosage. They are administered in small doses with the routes of subcutaneous, intramuscular (IM) (deltoid), or IV.

Adrenergic blockers

These drugs block the action of the sympathetic nervous system by slowing blood pressure and pulse. The most commonly used drugs in this category are beta-adrenergic blockers or simply beta-blockers.

Actions of the adrenergic blocker are primarily to decrease the pulse and blood pressure. The uses of beta-blockers include the treatment of hypertension, cardiac arrhythmias, angina pectoris, and migraine headache. Side effects commonly seen with the use of beta-blockers may include hypotension, bradycardia, fatigue or lethargy, nausea and vomiting, hypoglycemia, and confusion.

Contraindications or extreme caution applies when beta-blockers are used with patients having congestive heart failure (CHF) or atrioventricular block, hypotension, asthma, and diabetes. Interactions may occur with digitalis, insulin, or oral antidiabetic agents. Theophylline, tricyclic antidepressants, and alcohol may interact with the action of beta-blockers.

Patients should be informed that they may need to rise slowly from a reclining position to avoid postural hypotension and avoid alcohol, antihistamines, muscle relaxants, and sedatives because they potentiate CNS depression and sedation.

Cholinergics

The parasympathetic nerve fibers synthesize and liberate acetylcholine as the mediatory. Remember the parasympathetic nervous system enables the body system to return to normal. Drugs that mimic the action of the parasympathetic nervous system are called parasympathomimetic or cholinergic drugs.

The use of the cholinergics result in increased gastrointestinal (GI) peristalsis, contraction of the urinary bladder, secretions (sweat, saliva, and gastric juices), and skeletal muscle strength. Cholinergics will also lower intraocular pressure, constrict pupils, and slow the heart rate. Not all of these actions may occur every time, but the actions that do occur will occur simultaneously.

Cholinergics are used in the treatment of nonobstructive urinary retention, abdominal distention, myasthenia gravis, and open-angle glaucoma. The side effects of cholinergics may include nausea, vomiting and diarrhea, muscle cramps, and weakness. Others include slowing of the heart, hypotension, bronchospasm, and respiratory depression. Cholinergics cause excessive salivation,

increased sweating, lacrimation, and flushing (excessive tearing). Acute toxicity or cholinergic crisis is treated with IV atropine sulfate.

Since cholinergics can produce a crisis, there are contraindications or extreme caution that applies to patients with obstructive GI disorders, asthma, cardiac disorders, and hyperthyroidism. Interactions of cholinergics occur with quinidine, a myocardial depressant, and procainamide, a local anesthetic used to treat arrhythmias. Patients should avoid combining cholinergic drugs with heart medications or antibiotics.

Cholinergic blockers

Cholinergic blockers or anticholinergics are drugs that block the action of the parasympathetic nervous system. Therefore, they are also called parasympatholytic. Atropine is the classic example of a cholinergic blocker.

The actions include drying (all secretions decreased), decreased GI and genitourinary (GU) motility, and the dilation of pupils. Anticholinergics are used in the treatment of antispasmodic and antisecretory for GI or GU hypermotility, for preoperative and preanesthetic uses, or as an antidote for insecticide poisoning, cholinergic crisis, or mushroom poisoning. Emergency uses of anticholinergics include the treatment of bradycardia and atrioventricular heartblock with hypotension. Preventative treatment by using a bronchodilator is seen in the treatment of bronchospasms.

With anticholinergic treatment, side effects may include fever or flushing, blurred vision, dry mouth, constipation, and urinary retention. Other effects are confusion and headache, along with palpitations and tachycardia. Contraindications or extreme caution applies to the use of atropine with the following disease processes: asthma and other chronic, obstructive pulmonary diseases, GI or GU obstruction, cardiac arrhythmias, hypertension, hypothyroidism, and hepatic or renal diseases. Interactions with potentiation of sedation and drying occur with antihistamines.

Patients should be informed that treatment with anticholinergics could produce possible blurring of vision and the drying of secretions and to avoid over the counter inhalers or antihistamines. Their provider should prescribe these additional medications. Patients should notify provider of fast heartbeat or when palpitations occur.

Medication interactions

Whenever more than one drug is taken at the same time, it is possible that the *combination* may alter the normal expected response of each of the drugs individually. One drug may interact with another to increase, decrease, or cancel out the effect of the other. The combination of medications we will be discussing should not be confused when medications are manufactured in a particular combination such as Tylenol with Codeine. They are two separate medications given at the same time or at close intervals.

There are three drug interactions you need to be aware of:

- Synergism—The action of two drugs working together in which one helps the other simultaneously for an effect that neither could produce alone. Drugs that work together are said to be synergistic.
- Potentiation—The action of two drugs in which one prolongs or multiplies the effect of the other drug. It may also be looked at as enhancing the effect; drug A may be said to potentiate/enhance the effect of drug B.
- Antagonism—The opposing action of two drugs in which one decreases or cancels out the effect of the other drug. Drug A may be referred to as an antagonist of drug B.

It is extremely important for the provider to know of all medications that a patient is currently taking, to include over the counter medications, in order to prevent undesirable drug interactions. On the other hand, the provider may intentionally order two different drugs to be taken together because the

drug interactions are desirable and beneficial. Compare the following situations; they describe both desirable and undesirable drug interactions.

- Desirable synergism—The combining of Phenergan (a non-narcotic sedative) and Demerol (a narcotic analgesic) is very effective in relieving pain. By giving small amounts of each together, pain can be relieved more safely than by giving a large amount of Demerol (which is addictive) by itself.
- Undesirable synergism—Sedatives and barbiturates given in combination can depress the CNS to dangerous levels, depending on the strengths of each.
- Desirable potentiation—To build up a high level of some forms of penicillin in the blood, the drug Benemid (antigout medication) can be given simultaneously. Benemid potentiates the effect of penicillin by slowing the excretion rate of the antibiotic.
- Undesirable potentiation—Toxic effect may result when Tagamet (a gastric antisecretory) is given simultaneously with Tofranil (an antidepressant). Tagamet potentiates the level of antidepressant concentrations in the blood.
- Desirable antagonism—A narcotic antagonist (Narcan) saves lives from drug overdoses by canceling out the effect of the narcotic already in the system.
- Undesirable antagonism—Antacids taken at the same time as tetracycline alter the percentage of hydrogen ions (pH) and prevent absorption of the tetracycline.

Drug absorption

Drugs are prepared from plant, animal, mineral, or synthetic sources. They are prepared in solid, semisolid, or liquid form and given externally, internally, and, in some cases, both ways. External medications are applied to the skin or mucous membranes, either for local effect or for absorption into the body for a systemic effect. Drugs are usually taken internally for absorption and systemic effects, but they also may be taken internally for local effects on the alimentary canal (e.g., mineral oil).

Absorption is the process by which a medication or drug is transported from the site of entry to the circulatory system. It can occur in the alimentary canal, subcutaneous tissue, muscle tissue, or skin. Some medications are injected directly into the circulatory system (IV injections and solutions). Medications are absorbed at different rates and different ways. The solubility and concentration of the medication, site of drug entry, and circulation to the entry site affect the rate of absorption.

Drugs must be in liquid form to be absorbed through body membranes and tissues. Drugs ingested in a solid form (tablets) must be dissolved before they can be absorbed. Medications in high concentrations are also absorbed more quickly than low-concentration solutions.

Obviously, the rate of absorption will be affected by the location of where the medication enters the body. Some body areas have a higher level of circulation than others do. For example, muscle tissue has better circulation and absorption than subcutaneous tissue. Also, if circulation is increased to an area (local applications of heat), absorption will be improved. Finally, areas like the lungs and intestinal tract are lined with mucous membranes that have high levels of circulation. These areas also have large surface areas for absorption.

Drug distribution

Once absorbed, the medication is distributed throughout the body to the various cells and tissues. Tissues with a high blood flow (kidneys, heart, lungs, etc.) receive the medication first. Depending on their circulation, other areas receive the medication more slowly.

In the tissues, the medication combines with cellular components to alter cellular functions. Some drugs inhibit cellular activities; others enhance activities, increase membrane permeability, interact with hormones, and so forth. These actions produce numerous effects on the body; some of which are desirable, some are not.

Drug excretion

Drugs follow one of three paths in the body. They are either (1) metabolized, deactivated, and excreted, (2) simply excreted (the cells are not capable of metabolizing all drugs), or (3) they accumulate in the body until they have some sort of toxic (poisonous) effect. Drugs are excreted in the same manner as other waste products, primarily through the kidneys and GI tract (by way of the liver). Some drugs also are excreted through the exchange of gases in the lungs. Nursing mothers excrete drugs with their breast milk; because of this, they must be extremely careful about the medications they take to prevent dangerous substances from reaching their babies.

Adverse effects of drugs

Though medications are given to help the body, various undesirable effects are possible. These include drug side effects, toxicity, allergy, tolerance, interaction, and dependence.

Side effects

Drug side effects are also referred to as secondary effects. These are usually unintended effects that a drug has on the body. The effects are usually predictable and can range from harmless to harmful. Some side effects are considered acceptable to permit the drug's therapeutic effect to work (for example, drowsiness is often an acceptable effect of some medications). Medications should be discontinued whenever hazardous side effects occur.

Drug toxicity

Toxicity results from an overdose of a drug. It results in the body's inability to metabolize and excrete the drug in a timely manner. The effects of drug toxicity may be noticed immediately or may take months to become evident.

Drug allergy

Allergic reactions to medications can range from mild to severe. These reactions can take anywhere from a few hours to a few days after administration to become evident. A severe reaction is known as an anaphylactic reaction. An anaphylactic reaction can be quickly fatal if not recognized and treated promptly.

Drug tolerance

Drug tolerance exists when a patient has an unusually low physical response to a drug. In these cases, increased dosages are often ordered to achieve the desired therapeutic effect of the drug.

Drug interaction

This occurs when one drug alters the effect of another drug that was administered. The effect of one or both drugs can be increased or decreased as a result. This effect can be beneficial or harmful and is normally not an acceptable practice except in extremely unusual situations.

Drug dependence

Dependence exists when a person either relies upon or needs a drug. There are two types of drug dependence: physical and psychological. Physical dependence is the body's requirement for the drug. Withdrawal signs become evident if the drug is not obtained. Psychological dependence is simply an emotional or mental need for the drug.

406. Factors that influence drug action

The purpose of most drug therapy is to maintain a constant level of a drug in the body to permit the therapeutic action to be achieved. Since drug concentration in the body is reduced through time by the process of elimination, repeated doses are usually given. If repeated doses are not given on a regular basis, the desired level of the drug cannot be maintained.

Various factors can influence the action that drugs have on the body. These include age, weight and sex, genetic factors, psychological factors, illness and disease, the time of administration, and the external environment.

Age

With regard to drug action on the body, special consideration must be given to two groups of patients: small children and the elderly. Small children and infants are highly affected by drugs due to immature liver and kidney function that result in slower excretion of a drug. Elderly patients also are highly affected due to a diminished renal function.

Weight and sex

A patient's weight is also a factor in the action drugs have on the body. Due to body fat absorption, the greater the weight, the greater the dosage required. Accordingly, males often require a higher dose of a drug since they generally weigh more than females.

Genetic factors

Some patients may be more sensitive to a drug than other patients. In addition, some patients metabolize a drug slower or faster than other patients do.

Psychological factors

A drug's ability to work effectively is often influenced by the patients' beliefs of what a drug can or cannot do for them personally. This is often due to past experience in taking the medication.

Illness and disease

Depending on the problem, drugs can either be more or less effective on any given patient.

Time of administration

Oral medications taken before meals act faster due to low digestive system content. Medications given at bedtime can take longer to act since the circulatory system has usually slowed down.

Environment

Ambient temperature affects a drug's action on the body. Warmer temperatures cause blood vessels to dilate, thereby increasing circulation. This results in a more rapid action of a drug. Colder temperatures result in blood vessel constriction, causing a patient's circulation to slow down and will make drug action slower.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

405. Actions and side effects of medications

1. What is the purpose of a palliative drug action?
2. What category of therapeutic drug has the purpose of replacing body fluids or substances?
3. This term is applied when drugs are used to return the body to health but not cure the disease.

4. What signs and symptoms must the technician warn patients they may experience after taking an adrenergic medication?
5. Explain the function of the sympathetic nervous system. Which category of drugs is used to prevent its action in the body?
6. A patient you are caring for has CHF and is taking oral digitalis. What category of medications is contraindicated for use with the patient?
7. Once cholinergic medications have been introduced into the body, what are the actions of this type of drug?
8. List the three drug interactions with a brief description of each that the technician needs to be aware of.
9. During her medical history screening at the Family Practice Clinic, Mrs. Jones admitted to taking OTC Tagamet for her heartburn at home and that her doctor had previously prescribed Tofranil for her current depression. For what type of drug interaction do you need to be alerted, and is it desirable or undesirable?
10. What is the process called in which a medication is transported from the site of entry to the circulatory system?
11. How long does it take for the effects of drug toxicity to be noticed?
12. What is the term used for severe drug allergic reaction?
13. When an overdose of a drug occurs, what normally results?
14. Name the two types of drug dependence.

406. Factors that influence drug action

1. What is the purpose of most drug therapy?
2. What factors influence the action that drugs have on the body?
3. Why are infants highly affected by drugs?
4. When patients do not believe a certain medication will help them, what factors are influencing them?
5. Why do oral medications taken before meals usually act faster in the body?

1-4. Drug Information

All healthcare workers should have a basic knowledge of the medications they administer or dispense to patients. This section describes commonly used drug information references and specific types of drugs.

407. Drug references

There are a wide variety of excellent pharmacological references available for use in healthcare facilities. Some of the more commonly used references include the PDR, the *Nurses' Drug Reference*, *American Hospital Formulary Service*, the *US Pharmacopoeia—National Formulary*, and the formulary developed by your facility's pharmacy and therapeutics committee.

Physician's Desk Reference

You can usually find a PDR at any inpatient unit or clinic where drugs are dispensed. A PDR includes the latest product information prepared by the manufacturers. This information includes indications, dosage, description, contraindications, and adverse reactions. If you know either the generic or the trade name of a medication, this reference will provide the other information you need.

Nurses' Drug Reference

This book also is an excellent source of information when working with medications. It contains an alphabetical listing of many drugs and includes information pertaining to each drug's category, manufacturer, legal status, available dosages, dose ranges for various patients by weight and age, dispensing instructions, and storage requirements. In addition, this reference explains the therapeutic uses for each drug.

American Hospital Formulary Service

This publication is a collection of drug monographs kept current by periodic supplements prepared by pharmacists for the purpose of disseminating drug information to the entire medical community. It is a tested and proven source of comparative, unbiased, and evaluative drug information and contains a monograph on virtually every drug entity available in the United States.

United States Pharmacopoeia—National Formulary

This is a unification of two official publications. The United States Pharmacopoeia (USP) section contains a compilation of a select list of medicines, including the most efficient forms for their application. Drugs are admitted to the USP based on their established merit. A convention is held every five years to add and delete medications based on new information. The National Formulary (NF) section contains supplements and interim revision announcements. It consists of standards designed to ensure the safety, effectiveness, quality, and purity of drugs. The NF is also revised every five years.

Local facility formulary

As explained earlier in this volume, each facility develops a local formulary. The local formulary is simply a list of medications available from the facility's pharmacy with recommended dispensing and administration guidelines included. The local formulary is updated as needed by the pharmacy to keep all personnel advised of the available medications.

In addition to the pharmacological references, various nursing and medical textbooks contain information on drugs and drug interactions. Providers and nurses also are good sources of information about drugs. If none of these sources are able to answer your questions, you can always check with your pharmacist who is a highly trained expert on drug matters.

You should become familiar with the proper use of each reference available in the work center. Do not rely on your memory when it comes to medication administration, as that can be dangerous. Safety must always come first.

408. Types of medications

The specific action of a drug determines the category it is placed in. This lesson addresses types of medication preparations, general categories of drugs, and the common actions and side effects associated with each.

Preparations

The following table describes the various forms of medication preparations:

Type	Description
Aqueous solution	One or more drugs dissolved in water.
Aerosol spray or foam	A liquid, powder, or foam deposited in a thin layer on the skin by air pressure.
Aqueous suspension	One or more drugs finely divided in a liquid, such as water.
Capsule	A gelatinous container to hold a drug in powder, liquid, or oil form.
Cream	A non-greasy, semisolid preparation used on the skin.
Elixir	A sweetened and aromatic solution of alcohol used as a vehicle for medicinal agents.
Extract	A concentrated form of a drug made from vegetables or animals.
Fluid extract	An alcoholic solution of a drug from a vegetable source. The most concentrated of all fluid preparations.
Gel or jelly	A clear or translucent semisolid that liquefies when applied to the skin.
Liniment	An oily liquid used on the skin.
Lotion	An emollient liquid that may be a clear solution, suspension, or emulsion used on the skin.
Lozenge (troche)	A flat, round, or oval preparation that dissolves and releases a drug when held in the mouth.

Type	Description
Ointment	A semisolid preparation of one or more drugs used for application to the skin and mucous membrane.
Paste	An ointment-like preparation, but thicker and stiffer, that penetrates the skin less than an ointment.
Pill	One or more drugs mixed with a cohesive material in oval, round, or flattened shapes.
Powder	A finely ground drug or drugs; some are used internally, others externally.
Spirit	A concentrated alcohol solution of a volatile substance.
Suppository	One or several drugs mixed with a firm base, such as gelatin, and shaped for insertion into the body. The base dissolves gradually at body temperature, releasing the drug.
Syrup	An aqueous solution of sugar often used to disguise unpleasant tasting drugs.
Tablet	A powdered drug compressed into a hard small disc. Some are readily broken along a scored line. Others are enteric-coated to prevent them from dissolving in the stomach.
Tincture	An alcoholic or water-and-alcohol solution prepared from drugs derived from plants.

Actions, side effects, and guidelines for administration of various types of medications

You need to have a general understanding of various medication types and the common actions, side effects, and administration guidelines. It is important to remember this information is continually being updated and revised. This is especially true of any side effects that have been reported as having occurred in patients who have been administered a particular medication. Because of this, it is very important to use the references described in the previous lesson whenever you administer medications. The following table contains general information on each medication type.

NOTE: Only the most common actions, side effects, and administration methods are listed here.

Medication Type	Common Actions	Common Side Effects	Guidelines for Administration
Mild analgesics (non-narcotic)	Mild to moderate pain relief Fever reduction Some act as anti-inflammatories	GI upset Tinnitus	Oral: tablets, elixir Rectal: suppositories
Strong analgesics (narcotics)	Moderate to severe pain relief Sedation	GI upset Heart palpitations Hypotension	Oral: tablets, elixir Rectal: suppositories. Parenteral: IM, IV
Sedatives	Produces a tranquilizing or soothing effect	Nausea Vomiting Delirium Dependency after repeated doses	Oral: tablets, elixir

Medication Type	Common Actions	Common Side Effects	Guidelines for Administration
Hypnotics	Induces sleep Dulls the senses	Disorientation Hallucinations Dependency after repeated doses	Oral: tablets, elixir Rectal: suppositories
Immunological preparations	Disease prevention	Local tenderness at site of administration Fever	Oral: drops (polio) Parenteral: IM
Antiarrhythmics	Prevention or correction of irregular heart action	Fever Blurred vision Confusion	Oral: tablets Parenteral: IM, IV
Anti-infectives	Fight infection	Mild to severe allergic reactions Urine discoloration	Oral: tablets, suspension Topical: ointments
Antibiotics	Inhibits growth of or destroys microorganisms	Mild to severe allergic reactions Nausea Vomiting Diarrhea	Oral: tablets, suspension Topical: ointments Parenteral: IM
Cathartics	Purgative (cleansing) action that produces watery evacuation of intestinal content	Nausea Vomiting GI upset Diarrhea	Oral: oil Rectal: suppositories, enemas
Stool softeners	Wetting agent that produces soft bowel movements	Nausea Vomiting Diaphoresis Hypotension	Oral: tablets, elixir, syrup Rectal: suppositories
Local anesthetic agents	Produces numbness in a restricted body area	Local irritation Possibility of systemic effects	Topical: sprays, lozenges Parenteral: subcutaneous (SC), intradermal (ID)
Psychotherapeutic agents	Improves or moderates mental symptoms, such as depression, anxiety, and psychosis	Confusion Drowsiness Hallucinations	Oral: tablets, syrup Parenteral: IM
Insulin	Hormone used in the treatment of diabetes that regulates blood glucose metabolism	Hypoglycemia Urticaria Anaphylaxis	Parenteral: SC, IV

Medication Type	Common Actions	Common Side Effects	Guidelines for Administration
Oral hypoglycemics	Medications used to regulate the amount of glucose in the blood Regularly taken by patients with a high blood glucose level	Nausea Urticaria Indigestion	Oral: tablets Parenteral: SC
Anticoagulants	Prevent rapid clotting of the blood	Nausea Vomiting Diarrhea Fever	Oral: tablets Parenteral: IM, IV
Antacids	Used to neutralize digestive system acid content	Possible systemic effects due to interaction with other medications	Oral: tablets, suspension
Antihypertensives	Control of high blood pressure	Dizziness Drowsiness Constipation	Oral: tablets Topical: patches Parenteral: IM, IV
Emetics	Used to induce vomiting	Nausea Vomiting Diarrhea	Oral: syrup
Antiemetics	Prevention or relief of nausea	Drowsiness Weakness Constipation	Oral: tablets, elixir, syrup Rectal: suppositories Parenteral: IM
Antidiarrheal	Control of diarrhea	Constipation Blurred vision	Oral: tablets, suspension, syrup Parenteral: IM
Anti-inflammatory	Reduces body tissue inflammation	Drowsiness Fluid retention	Oral: tablets, suspension Rectal: suppositories

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

407. Drug references

1. What is a PDR?
2. What reference source is a collection of drug monographs kept current by periodic supplements prepared by pharmacists?

3. What reference is a combination of two official publications?
4. Who ensures the local formulary is updated as needed?
5. When administering medication, what dangerous practice should you avoid?

408. Types of medications

1. What determines which category a drug is placed in?
2. What type of preparation is described as one or more drugs dissolved in water?
3. Describe a capsule.
4. What type of medication is used to induce sleep or dull the senses?
5. What is an antiemetic used for?

Answers to Self-Test Questions**401**

1. To treat, cure, diagnose, or prevent disease, or to provide relief.
2. A reference book or pamphlet that lists medications available at a specific healthcare facility. In addition, a formulary lists recommended dosages and special considerations.
3. Generic name.
4. To ensure uniform product quality.
5. Pharmacists.

402

1. Current medications and allergies.
2. Right patient, right medication, right dose, right route, right time, and right documentation.
3. (1) Be knowledgeable.
(2) Use judgment.
(3) Have skill in delivery.
(4) Patient education.
4. Medication package insert, PDR, MTF approved medication list.

5. Immediately after administration.
6. Verify the medication order.
7. Maximum dose.
8. Initial high dose used to elevate the level of the drug in the blood quickly.
9. The medication, dosage, time, route, location if an injection, adverse signs or reactions, and the patient's response.
10. Try to find out why the patient is refusing the medication, report the situation promptly to the nurse or provider, and document the situation.
11. AF Form 765, Medical Treatment Facility Incident Statement.

403

1. Stat, single, standing, and PRN.
2. Patient's name, date order was written, drug name, drug dosage, method of administering the drug, and signature of the provider.
3. The individual who administers the medication.
4. To avoid duplicate injections at the same site.
5. A computer-generated product that lists all the medication orders that apply to a particular patient.

404

1. Food, Drug, and Cosmetic Act and the Comprehensive Drug Abuse Prevention and Control Act.
2. At the end of each shift.
3. Schedule I.
4. Schedule III.
5. Schedule II.
6. (1) Develop a list of current medications.
(2) Develop a list of medications to be prescribed.
(3) Compare the medications on the two lists.
(4) Make clinical decisions based on the comparison.
(5) Communicate the new list to appropriate caregivers and to the patient.
6. At least once daily. Medications may become unstable or deteriorate if not stored properly.

405

1. Relieve symptoms of a disease without affecting the disease itself.
2. Substitutive.
3. Restorative.
4. May include palpitations, nervousness or tremors, tachycardia, cardiac arrhythmias, or anginal pain.
5. Sympathetic nervous system is used to mobilize the body for quick response and action. Adrenergic Blockers.
6. Adrenergic Blockers.
7. Increased GI peristalsis, contraction of the urinary bladder, increased secretions and skeletal muscle strength, lower intraocular pressure, constrict pupils, and slow heart rate.
8. (1) Synergism—Action of two drugs working together, for a more effective result.
(2) Potentiation—Two drugs, one prolongs or multiplies the effect of another.
(3) Antagonism—Opposing action of two drugs, one decreases or cancels the action of another.
9. Potentiation; undesirable.
10. Absorption.
11. Immediately or may take months
12. Anaphylactic reaction.
13. Drug toxicity.

14. Physical and psychological.

406

1. To maintain a constant level of a drug in the body to permit the therapeutic action to be achieved.
2. Age, weight and sex, genetic factors, psychological factors, illness and disease, time of administration, and external environment.
3. Infants have immature liver and kidney functions that result in a slower excretion of a drug.
4. Psychological factors.
5. Due to a low digestive system content.

407

1. *Physician's Desk Reference* is a reference source containing the latest drug product information prepared by manufacturers.
2. *American Hospital Formulary Service*.
3. *US Pharmacopoeia—National Formulary*.
4. Local facility pharmacy.
5. Relying on your memory for drug information.

408

1. The specific action of a drug.
2. An aqueous solution.
3. A gelatinous container that holds a drug in powder, liquid, or oil form.
4. A hypnotic.
5. Prevention or relief of nausea.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

1. (401) A specialist who can guide a provider in prescribing drugs is *best* defined as a
 - a. pharmacist.
 - b. clinical provider.
 - c. clinical pharmacist.
 - d. pharmaceutical technician.
2. (401) Out of the several names given each medication, which of these drug names is given by the manufacturer?
 - a. Trade name.
 - b. Official name.
 - c. Generic name.
 - d. Chemical name.
3. (401) Which statement is *true* regarding the role of a medical service technician in medication administration?
 - a. Technicians are not trained to prepare medications for administration.
 - b. A nurse or physician must directly observe technicians when they are administering medication.
 - c. Technicians are permitted to administer medications under the supervision of a nurse or physician.
 - d. Nurses can always allow technicians to decide on their own to administer a medication if the decision is in the patient's best interest.
4. (402) Which statement is *not* considered one of the patients' legal and ethical rights?
 - a. Be informed of a drug's name.
 - b. Be informed of a drug's purpose.
 - c. Choose the method of administration.
 - d. Receive clearly labeled medication containers.
5. (402) What form should be filled out when reporting a medication error?
 - a. AF Form 765.
 - b. AF Form 786.
 - c. AF Form 3066.
 - d. AF Form 3069.
6. (403) How many ways can a provider initiate a drug order?
 - a. One.
 - b. Two.
 - c. Four.
 - d. Five.
7. (403) What do many medical treatment facilities use to avoid errors when copying a drug order?
 - a. Kardex.
 - b. Medication card.
 - c. Telephone consults.
 - d. Computer-generated product.

8. (404) Drug administration is controlled *primarily* by
 - a. state amendments.
 - b. facility mandate.
 - c. federal law.
 - d. state law.
9. (404) Narcotics, such as codeine, cocaine, and amphetamines, which have a high potential for abuse, but have acceptable medical uses are classified as
 - a. Schedule I.
 - b. Schedule II.
 - c. Schedule III.
 - d. Schedule IV.
10. (404) What law requires a periodic inventory of all controlled substances?
 - a. Drug Regulatory Act.
 - b. Drug Control Regulation.
 - c. Controlled Substances Act.
 - d. Attorney General Mandate of 1974.
11. (404) As a minimum, how often should controlled temperature drug storage areas be monitored?
 - a. Beginning of each shift.
 - b. Once per day.
 - c. Once per week.
 - d. Once a month.
12. (405) Penicillin administered to treat an infection is an example of what category of drugs?
 - a. Chemotherapeutic.
 - b. Substitutive.
 - c. Supportive.
 - d. Curative.
13. (405) The process by which a drug is transported from the site of entry to the circulatory system is known as
 - a. osmosis.
 - b. solubility.
 - c. absorption.
 - d. stimulation.
14. (406) A patient's weight is a factor in drug action due to
 - a. acid content.
 - b. water content.
 - c. enzyme production.
 - d. body fat absorption.
15. (406) Why are oral medications that are taken *before* meals generally faster acting?
 - a. Slower circulation level.
 - b. Higher body metabolism.
 - c. Lower body metabolism.
 - d. Lower digestive system content.
16. (406) Which statement is *true* regarding how ambient temperature can affect drug action?
 - a. Warmer temperatures increase circulation and cause rapid drug action.
 - b. Warmer temperatures decrease circulation and cause slow drug action.
 - c. Colder temperatures cause blood vessels to dilate cause slow drug action.
 - d. Colder temperatures cause blood vessels to constrict cause rapid drug action.

17. (407) Which of these is a common reference source for drugs?
- a. Internet search.
 - b. *Physician Desk Reference*.
 - c. *Nurse's Pharmacy Handbook*.
 - d. *Technicians Pharmacy Handbook*.
18. (408) A finely ground drug that can be used internally or used externally describes a type of medication preparation called a
- a. pill.
 - b. paste.
 - c. powder.
 - d. tincture.
19. (408) What type of medication has a cleansing action that produces watery evacuation of intestinal content?
- a. Antiarrhythmics.
 - b. Antiemetics.
 - c. Cathartics.
 - d. Antacids.

Student Notes

Unit 2. Medication Administration Techniques and Procedures

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YOU MUST KNOW how to prepare medications to be administered to patients, a task that involves administration techniques and procedures. All personnel involved in medication administration should be prepared to perform these administration procedures to ensure safe patient care. In this unit we start by addressing pre-administration considerations. Then we guide you through the appropriate preparation and techniques to administer the various forms of medications.

2–1. Medication Administration Preparation

In this unit, you will be introduced to the steps required before administering any medication, such as performing metric conversions and calculating weights and measures. You must be proficient with these tasks to accurately administer medication.

409. Pre-administration considerations and procedures

Preparing medications for administration is a common task. Properly carrying out the provider’s order often involves calculating dosages and performing mathematic conversions.

General information

There are five general methods, or *routes*, in which technicians may administer medication. These routes are *parenteral*, *oral*, *sublingual (SL)*, *buccal*, and *topical*. Though many medications are supplied ready to administer, some require pre-administration preparation.

Medications are available in various forms to permit administration by more than one route. The advantage of this is permitting the most advisable route to be used. For example, a patient who is unconscious can be given a parenteral injection instead of an oral dose of the same medication if the drug is available in more than one form.

Preparation procedures

The first step in preparing a medication for administration is to verify the order. This means you must ensure and document the patient’s name, date, name of the medication, dosage, specified time, route to be used, and the provider’s signature. Many of these items are abbreviated on the order.

Patient’s full name and date of birth

Ensure the patient’s full name and date of birth (DOB) are legible and clearly indicated on the chart (e.g., **Doe, John Robert, DOB: 14 Oct 1972**).

Date

Document the date an order is written. If the medication is to be administered on a date other than the current date, ensure this fact is also noted (e.g., **25 Feb 08**).

Name of the medication

Legibly write the name of the medication to be given. Some medications have more than one common name (e.g., Septra and Bactrim are the same medication). Some may also be abbreviated (e.g., Penicillin is often written “PCN”).

Dosage

Document the ordered dosage of the medication (e.g., **25 mg**).

Specified time

Document the time the medication is to be given. In most cases, you give the medication immediately unless another time is indicated on the order (e.g., **0600**).

Route to be used

As mentioned previously, some medications are available in more than one form. This is one reason you must specify the route. You also must know the correct method of administering a parenteral medication. You may abbreviate the route (e.g., **IM**).

Provider's signature

The provider ordering the medication must sign the order. Some forms permit the provider to initial such orders, if the signature of the responsible provider is on the form in an appropriate location. Include the provider's printed stamp.

Understanding the metric system

When administering medications, there is no margin of error. It is possible for a small error in calculation to harm a patient seriously. A misplaced decimal point could cause a fatality. When preparing medications for administration, there are three principles to keep in mind:

1. Check to ensure all measurements are the same. Convert any measurements, if necessary.
2. Write the problem in equation form using the appropriate formula, and complete the necessary calculations.
3. Check the accuracy of your answers and have another individual verify your calculations.

The most common method used to calculate medication dosages is by using the basic calculation dosage of ordered dose divided by the supplied dose. Begin with step one, conversion.

Depending on the route of administration and the strength of the medication supplied, the dosage may be ordered in different measurements. An example is when you are ordered to administer 250 mg of Rocephin, and it is supplied in 1 gram (g) vials. The conversion from milligrams to grams must be accomplished before calculating the amount of the dose. Basic conversions do not change and are readily referenced in most nursing manuals. As with basic mathematics, the base number is always one. Base weight is denoted in grams, length in meters, and volume in liters. As you see in the chart below, when the decimal point is moved either to the right or left, the value of the number changes.

Grams Meters Liters								
mega	kilo	hecto	deka	Base value	deci	centi	milli	micro (μ)
10^6	10^3	10^2				10^{-2}	10^{-3}	10^{-6}
1,000,000	1000	100	10	1.0	0.1	0.01	0.001	0.000001

Conversions must be made before inputting the information into the medication calculation formula. When you use the above scale, you can figure out the conversions for these base values in grams, meters, and liters. Other measurements and values may need to be converted as well. See the measurement conversion chart below for some common measurement equivalencies.

Abbreviations		Measurement Conversions		
Kilograms	kg	1 kg	=	2.2 lb
Gallons	gal	1 gal	=	8 pts
Yards	yd	1 gal	=	3.8 l
Inch	in	1 yd	=	3 ft
Ounces	oz	1 in	=	2.5 cm
Liter	L	1 oz	=	30 cc
Gram	g/gr	1 L	=	1.06 qts
Millimeter	mm	1 qt	=	4 C
Cubic centimeter	cc	1 qt	=	32 oz
Tablespoon	Tb	1 tsp	=	5 mL
Teaspoon	tsp	1 Tb	=	15 mL
Quart	qt	1 pt	=	2 l
Pint	pt	1 pt	=	16 oz
REMEMBER: 1 medicine cup is equal to 1 oz/ 30 cc/ 2 Tb/ 8 grams.				

410. Medication calculation

Healthcare personnel who perform medication administration must be able to handle the basic mathematics needed to convert a written order to the medication units available. In most cases, this is simply a matter of multiplying or dividing. Here are some examples of how appropriate dosage calculations are calculated.

Calculation formula

There are two methods that can be used to calculate the dosage needed for medication administration. They are basic calculation or ratio and proportion. Basic calculation requires only simple arithmetic, while ratio and proportion requires the ability to determine an unknown, X. For this lesson we will focus on the basic calculation formula, which is the most common way to calculate dosages. As with any math problem, there are rules that must be followed. The basic calculation formula has ten.

1. Label all parts of the formula.
2. Use the same measurement for ordered and supplied doses.
3. Use the same level for the quantity and the amount given.
4. Reduce fractions to the lowest terms before dividing.
5. Multiply by the quantity after dividing.
6. Take extra care with decimals.
7. Convert fractions to decimals.
8. Round off decimals to one decimal place after computation is complete.
9. Verify the accuracy of the calculations with another healthcare provider.
10. Question the answer if not within normal limits.

Basic calculation method:

$$\frac{\text{Ordered}}{\text{supplied}} \times \text{quantity} = \text{The amount needed for the dosage required}$$

Sample order 1: Administer acetaminophen elixir 650 mg

The acetaminophen is supplied as 325 mg/5ml.

The answer you need to determine is how many teaspoons is equal to 650 mg. Use the steps below for the calculation.

Steps 1–3:

$$\frac{\text{ordered}}{\text{supplied}} \quad \frac{650 \text{ mg}}{325 \text{ mg}} \quad \times \quad 5 \text{ ml} \quad = \quad \text{Total mls to be given to the patient}$$

Step 4—reduce the fraction:

When reducing, remember that like values cancel each other out leaving you with the whole numbers.

$$\frac{650 \text{ mg}}{325 \text{ mg}}$$

$$\frac{650}{325} \div \frac{325}{325} = 2$$

The factor of 2 is carried to the next step.

Step 5—multiply the result by the quantity:

The supplied quantity is 5 ml per teaspoon.

$$5 \text{ ml} \times 2 = 10 \text{ ml}$$

The converted order is 10 ml is equal to 650 mg.

5 mls is equal to 1 tsp, you administer 2 tsp to equal 10 ml.

Complete steps 6–10: Before administering the dose of 10 mls of acetaminophen elixir to the patient.

Sample order 2: Administer 2 tsp Robitussin q4h

The Robitussin is supplied as 10 mg/5 ml.

You know 2 tsp are equal to 10 mls. You will need to determine how many mgs of Robitussin the patient will be receiving with each administration. Use the steps above for the calculation.

Step 1—label all the parts:

$$\frac{\text{ordered}}{\text{supplied}} \quad \frac{2 \text{ tsp}}{5 \text{ ml}} \quad \times \quad 10 \text{ mg} \quad = \quad \text{Total mgs to be given to the patient}$$

Steps 2–5—Use the same label for the orders and supplied doses.

$$\frac{\text{ordered}}{\text{supplied}} \quad \frac{10 \text{ ml}}{5 \text{ ml}} \div \frac{5}{5} = 2 \div 1 \quad \times \quad 10 \text{ mg} \quad = \quad 20 \text{ mg/2 tsp q4 hours (hr)}$$

Complete steps 6–10: Before administering the dose of 10 mls of acetaminophen elixir to the patient.

Sample order 3: Administer 25 mg/kg. The patient weighs 165 lb

The medication is supplied 250 mg/ml.

Step 1—label all the parts:

$$\frac{\text{ordered}}{\text{supplied}} \quad \frac{25 \text{ mg/kg}}{250 \text{ mg/ml}}$$

The **total** amount ordered is based on the patient's weight. For every kg the patient weighs, you will administer 25 mgs of the medication. This weight must first be converted from lbs to kgs. You know there are 2.2 lbs for every kilogram. You will divide 165 by 2.2 to convert the lbs to kgs and then multiply by 25.

- $165 \div 2.2 = 75 \text{ (kg)} \times 25 \text{ (mg)} = \text{total mg ordered } 1,875 \text{ mg}$

The **total** order is: Administer 1,875 mg:

$$\frac{\text{ordered}}{\text{supplied}} = \frac{1875 \text{ mg}}{250 \text{ mg}} \div \frac{250}{250} = \frac{7.5}{1} \quad 7.5 \text{ mls}$$

Complete steps 6–10: Before administering the dose of 10 mls of acetaminophen elixir to the patient.

The steps incorporate very basic math steps, and when followed with the rules above, your calculations are assured to bring you to the correct answer.

Example #1

A provider has ordered 10 mg of Dilantin to be given IM. The medication is available in a 30 mg per 3 ml vial.

Dosage calculation:

$$\begin{array}{rcl} 30 \text{ mg} & = & 10 \text{ mg} \\ 3 \text{ ml} & = & \times \text{ ml} \\ 30 \times & = & 30 \\ \times & = & 1 \end{array}$$

Solution: 1 ml to be administered.

Example #2

A provider has ordered 500 mg of Keflex to be given *per os* (by mouth) (po) QID for 10 days. The medication is available in a 10 gm per 200 mL suspension.

Dosage calculation:

$$\begin{array}{rcl} 10 \text{ gm} & = & .5 \text{ gm} \\ 200 \text{ mL} & = & \times \text{ mL} \\ 10 \times & = & 200 \times .5 \\ 10 \times & = & 100 \\ \times & = & 10 \end{array}$$

Solution: 10 mL to be administered 4 times per day for 10 days.

Nurses and technicians at your facility will assist you in becoming proficient in dosage calculating. Learning this part of your job takes time. Practical experience and mentoring are the key factors in mastering the skill of drug dose calculations.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

409. Pre-administration considerations and procedures

1. What are the five general routes of medication administration?
2. What is the first step to take when preparing a medication for administration?
3. What should be done if a medication is to be administered on a date other than when it was ordered?

410. Medication calculation

1. What is the most common method of calculating drug dosages?

Use the following scenario for questions 2 and 3.

Mr. Adams has an order to receive 5 mg/kg of medicine each day. Mr. Adams weighs 220 lbs. The medicine is supplied in 50 mg/ml.

2. How much does Mr. Adams weigh in kgs?
3. How many mls does the patient receive?

Use the following scenario for questions 4 and 5.

The doctor ordered Mrs. Smith to receive a medication of 1 g of Flexeril q4h. The medication from pharmacy is supplied in 2000 mg/tab.

4. How many tablets will the patient receive?
5. How many tablets will the patient receive in one 12 hr shift?

2-2. Routes of Administration

Throughout this volume, you will discover there are many ways to give medications. It is crucial that you are familiar with the different routes of medication administration to ensure the medication is given in the prescribed method and one that is most beneficial and not harmful to the patient.

411. Administering parenteral medications

Parenteral medications involve injecting a drug into the body. We discuss four types of injection techniques—SC, ID, IM, and IV administrations.

SC injections

You administer a subcutaneous injection (abbreviated “sc” or “sub Q”) by injecting a medication into the SC tissue of the skin. Drug action is faster using this method than it is with the oral route; however, there are disadvantages that must be considered. These include:

- Sterile technique is required due to penetration of the skin surface.
- It is usually more expensive than giving an oral medication.
- Only small amounts of a drug can be administered by this method.
- Drug action is slower than an IM injection.
- There is a possibility of local irritation.
- There is a potential for patient anxiety before the injection.
- The patient feels a certain degree of pain during administration of the drug.

ID injections

You administer an intradermal injection (abbreviated “ID”) to the dermis of the skin. A prime advantage of this method is the slow absorption rate of the drug, making it useful for allergy testing. Disadvantages of this administration method are relatively the same as those for SC injections.

IM injections

You administer an intramuscular injection (abbreviated “IM”) by injecting the medication into a muscle. Disadvantages of the IM method are relatively the same as those of the SC and ID methods. However, there are some advantages to this method, namely—

- The patient experiences minimal pain from an irritating drug.
- Larger volumes of a drug may be administered than is possible with the SC or ID methods.
- The rate of absorption is rapid.
- Many IM medications are supplied in prefilled syringes, making drug preparation easier.

IV administration

You administer an intravenous drug (abbreviated “IV”) by introducing the medication into a vein through an established IV line. Two methods of IV drug administration are commonly used—IV drip and IV push.

An IV drip is achieved by allowing the drug to flow with the IV solution into the vein. This is accomplished by injecting the drug into the IV solution bag. Often, the solution is injected into a separate bag that flows into the same line. This is called “piggybacking” the IV.

An IV push is achieved by injecting the drug at the site of the IV catheter, ahead of the rest of the IV solution. You use an IV push when a faster administration of a drug is desired. This method also permits a greater drug concentration since the drug is not diluted in the IV bag as it is with the IV-drip method.

The advantage of an IV administration method is a rapid drug effect. Disadvantages are that IVs are limited to highly soluble drugs, and distribution of the drug may be inhibited if the patient has poor circulation.

Selection of route

The desired rate of absorption, along with the purpose and characteristics of the medication, usually determines the route of administration.

Of course, IV administration is the fastest parenteral route because the medication is injected directly into the bloodstream where it can be absorbed immediately. IM injections also produce a very rapid reaction because of the large number of blood vessels available. Of the different sites available for an IM injection, the deltoid muscle has the best blood supply and the most rapid response. Gluteal muscles are not so well-supplied and have slower response times. SC tissues have a poorer blood supply and response time than IM tissues but are generally faster than oral forms of administration. ID tissues are poorly supplied with blood vessels and have a slow rate of response to medications.

Although ID injections are generally unsatisfactory for therapeutic purposes, they are very useful for allergy testing. If you intradermally inject a small amount of a substance that an individual is allergic to, the substance will produce a mild allergic response at the injection site. This allows you to determine the status of the patient’s allergies without risking anaphylaxis.

You can increase the rate of absorption to an area by applying heat, massaging the site, or administering vasodilators. On the other hand, cold applications, tight clothing, tourniquets, and vasoconstrictors can retard absorption of a medication.

Potential problems

As you select a site for injection, you should assess the area for any problems that might interfere with circulation and absorption of the medication. These problems include existing tissue damage,

reduced muscle mass, and altered circulation. The tissue may be scarred or more sensitive as the result of skin infections and disorders, disease processes, burns, lacerations or other trauma, and frequent previous injections. In addition to having poor absorption, damaged tissue is more sensitive and more prone to developing infections. Reduced muscle mass may be the result of age (very old or very young), inactivity, malnutrition, or disease processes. Reduced muscle mass limits the available areas for IM injection. There also is a greater risk of nerve, tissue, and blood vessel damage when there is less protective muscle tissue. Avoid sites of extensive tissue damage or reduced muscle mass if possible. Circulatory alteration includes deficiencies in the clotting mechanism and impairment in the circulation itself. Deficiencies in the clotting mechanism may result in prolonged bleeding from the injection site or bleeding into the tissues. Circulatory impairment may be the result of a disease process (e.g., arteriosclerosis) or the tissue damage we mentioned earlier. In either case, absorption from the area is reduced and the onset of action is delayed.

If your patients have any of the problems described here, you may have to use an alternate means of medication administration. If you experience problems of this nature, notify the physician and he or she will determine how the medication should be administered.

In addition to these problems, you also should be aware of any renal or hepatic problems that might interfere with the metabolism or excretion of the medication. Although parenteral medications are not absorbed through the digestive system, they are processed and excreted by the liver and/or kidneys. If either of these systems is malfunctioning, the medication is not excreted normally and continues to accumulate in the system. Elderly patients are particularly prone to such problems and, as a result, suffer increased side effects and adverse reactions.

Relief of anxiety and pain

Parenteral injections are associated with a great deal of anxiety and pain. Anxiety usually results from a lack of knowledge about the therapy, previous unpleasant experiences, feelings that the injection is being used as a punishment (particularly in children), feelings of loss of control, or anxiety about the illness or hospitalization. You can relieve much of this anxiety by explaining the procedure and allowing the patient to verbalize fears and ask questions. You also can relieve some of the anxiety by pleasantly distracting the patient.

The pain felt during parenteral injections is caused by a combination of trauma to the pain receptors, distention of the tissues by the medication, and muscle tension caused by pain anticipation. The approaches you use to relieve patients' anxiety also help to relieve the tension they feel. In addition to this, you can position patients so they are unable to tense their muscles. For example, if you place patients in a prone position with toes facing inward, they cannot contract their gluteal muscles. Also, you can alleviate some of the pain by selecting sites with fewer pain receptors or tissue damage; by inserting the needle with a quick, smooth motion; by injecting the medication slowly; and by limiting the volume of the injection to the dosage actually required. As your skill and knowledge increases, you will develop your own approaches to relieve patient anxiety and pain.

Asepsis

Aseptic techniques are major factors in preparing and administering parenteral medications. Once you puncture the skin, you have broken one of the body's most important defensive mechanisms. The patient then becomes liable to all sorts of nosocomial infections and associated complications. The only way you can prevent these problems is to practice aseptic techniques (i.e., washing your hands, maintaining the sterility of equipment, and cleaning the injection site).

A thorough handwashing will eliminate a sufficient number of active pathogens. Maintaining the sterility of injection supplies and equipment is a fairly complex process. You can touch certain items anywhere with your bare hands. Other items can be touched in certain places only.

Your local operating instructions (OI) will describe specific procedures and cleaning agents to use when you prepare an injection site. Generally speaking, you should use soap and water to remove any gross contamination that may be present. Once the skin is dry, use an alcohol or antiseptic swab to

remove bacteria from the skin surface. Clean from the center of the site outward, using friction and a circular movement. Wait until the skin is dry before you actually inject the medication.

Supplies required for parenteral medications

The only supply items involved in parenteral injections are the syringes and needles used to make the actual injections.

Syringes

The basic components of a syringe are the barrel, plunger, and tip (fig. 2-1). The barrel is the round outer part, the plunger is the piston-like part that moves up and down inside the barrel, and the tip is the small projection that fits inside the hub of the needle. There are two types of tips—plain and locking. A plain tip is tapered to fit tightly inside the hub of the needle and holds the needle in place by friction. A locking tip has a threaded outer collar sized to accept the needle hub.

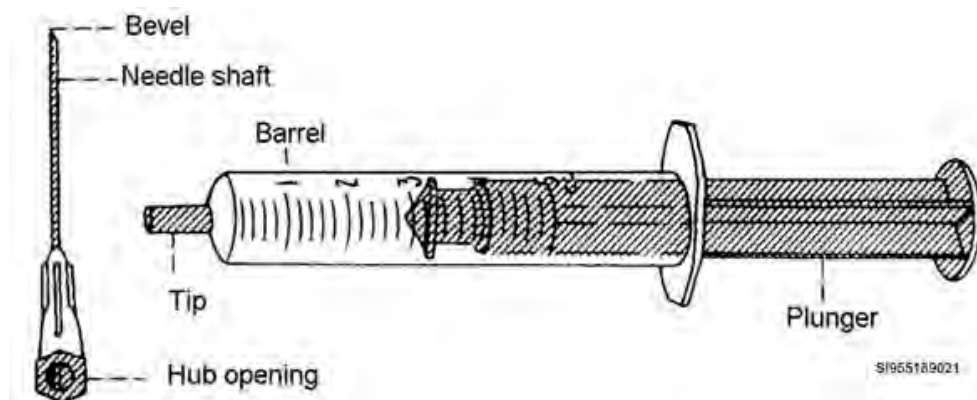


Figure 2-1. Parts of a syringe.

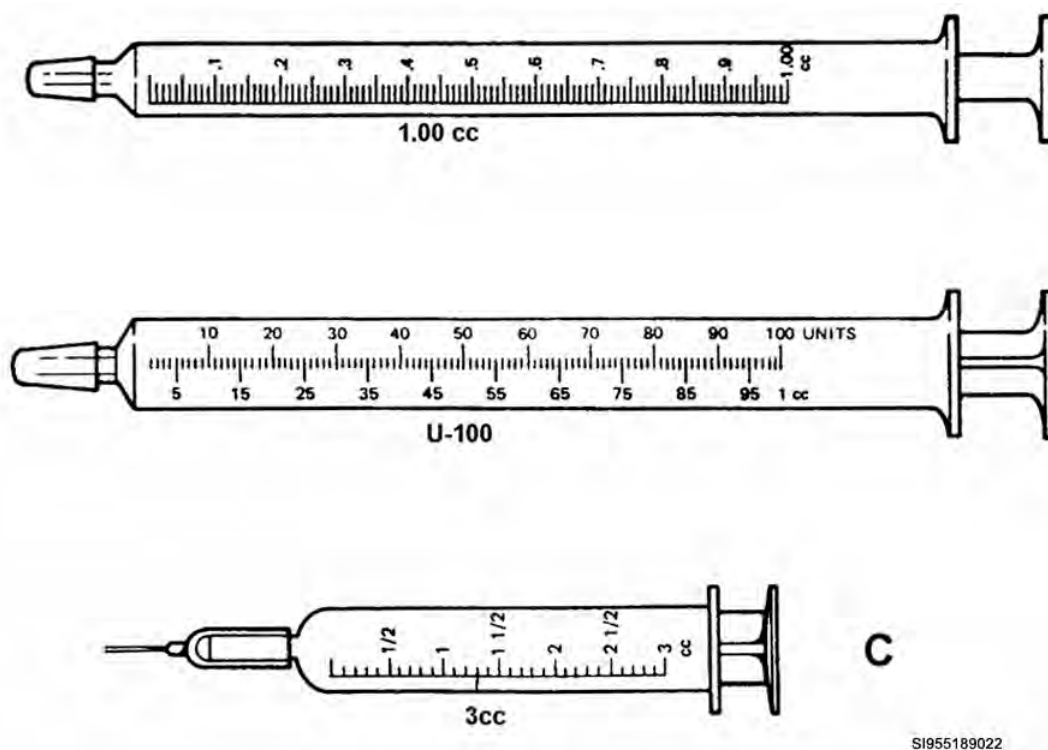


Figure 2-2. Syringes. (A) 1 cc tuberculin, (B) U-100, (C) 3 cc syringe.

When you pull back on the plunger, a vacuum is created inside the barrel. If the end of the needle is in a fluid, that fluid is pulled into the barrel. When you have enough fluid, stop pulling the plunger and take the needle out of the medication. As you do this, you should touch only the knob-like end of the plunger and the outside of the barrel.

The tip, the inside of the barrel, and the entire plunger below the knob are all considered sterile. There are a variety of different sizes and types of syringes including plastic, insulin, glass, and prepackaged inserts. Of these, plastic syringes are by far the most common. Plastic syringes range in size from the 1.0 cc tuberculin syringe to the much larger 50 cc irrigating syringe (fig. 2-2). Some of these syringes are prepackaged with needles already attached; others are not. Some syringes are designed for a specific purpose, as are the insulin syringes in figure 2-2. Syringe selection is based on the purpose of the injection, the volume of medication to be injected, and the need for accuracy in dosage. The advantages of plastic syringes include variety, disposability, and convenience. Disadvantages include expense and sometimes unclear calibrations.

The outside of the barrel is marked or calibrated to show how much fluid is in the syringe. These calibrations may be in cubic centimeters, milliliters, and/or minims (remember the apothecary system?). Milliliters and cubic centimeters are considered interchangeable, so the syringe will be marked with one or the other. The most common sizes are 1, 3, and 5 cc, but 10, 20, 30, and 50 cc syringes are also available. The most accurate is the 1 cc or tuberculin syringe. The tuberculin syringe is calibrated in both minims and cubic centimeters with a total capacity of 1.0 cc or 16 minims. On the cc scale, it is calibrated in increments of 0.1, 0.05, and 0.01 cc. On the minim scale, the syringe is calibrated in increments of 1.0 and 0.5 minims. We mention all this to illustrate just how precise the dosage can be. In contrast, the 20 and 30 cc syringes are calibrated in 1 and 5 cc increments. Obviously, if you want an exact measurement, you will use a smaller syringe.

Insulin syringes are calibrated to measure a specific volume of a specific type of insulin (U-40, U-100, or U-500). Of these, U-100 syringes are the most common. They hold 100 units of insulin per cc of medication and are calibrated in 2- and 10-unit increments. These units may be very close but are not interchangeable with syringes calibrated in the metric or apothecary systems. Some insulin syringes are also calibrated in the metric system. If you use one of these syringes, make sure you know which calibration you are using.

Glass syringes also are available in a variety of sizes. They generally have locking tips and easily read calibrations. The plunger in a glass syringe is somewhat different than the plunger found in a plastic syringe. The inside end of a plastic syringe plunger is attached to a rubber stopper that helps to ensure a tight seal with the barrel. Glass syringes do not have that rubber stopper. The plunger itself is constructed so that it fits tightly inside the barrel. Glass syringes are economical because they can be cleaned, sterilized, and reused. Unfortunately, this is a very time-consuming process. In addition to this, the syringes are easily broken, and the plunger eventually loosens in the barrel, resulting in medication leakage and inaccurate measurements.

A number of different manufacturers have developed needle-syringe units containing premeasured doses of certain medications. These units are marked clearly with the name, dosage, and strength of the medication. Some of these units are in the form of a cartridge, which is placed in a special holder for administration. Other units are in a syringe or injectable form and are ready for use when removed from the package. Prepackaged units guarantee accuracy, are convenient for normal use, and are especially convenient for emergency situations (fig. 2-3). However, they are more expensive and have limited capacity to add additional medications. Also, some of the cartridge types require a special type of holder that may not be available.

The volume within a syringe is measured at the point where the plunger is parallel with the calibration (glass syringes) or where the bottom edge of the rubber stopper is parallel to the desired calibration. This volume should be measured without air bubbles in the medication. Also, this volume does not take into account the negligible amount in the tip and shaft of the needle.

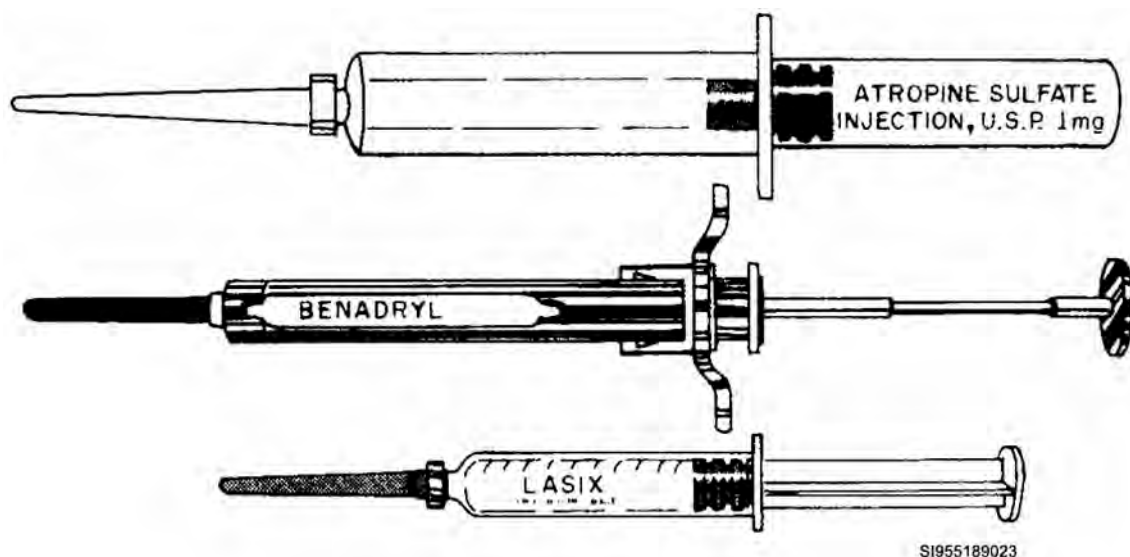


Figure 2-3. Prepackaged medications.

Some types of injection use an air bubble to ensure that the medication reaches its desired location. If you use this system, measure the medication volume first, and then pull back the plunger to introduce an air bubble.

Needles

The basic components of a needle are the hub, shaft, and bevel. The hub is the enlarged portion at the end of the needle that fits over the tip of the syringe. The shaft is the long, slender part. The bevel is actually just the angled tip of the needle rather than a separate part. Needles are available in a variety of lengths and external diameters (gauges). The gauge is an inverse measurement of the diameter. As the diameter increases, the gauge decreases. Thus, an 18-gauge needle is much larger than a 27-gauge needle. There are a wide variety of sizes available from the $\frac{1}{2}$ -inch, 27-gauge needle to the 2-inch, 18-gauge needle (fig. 2-4). There are larger needles, but they are not commonly used in patient care.

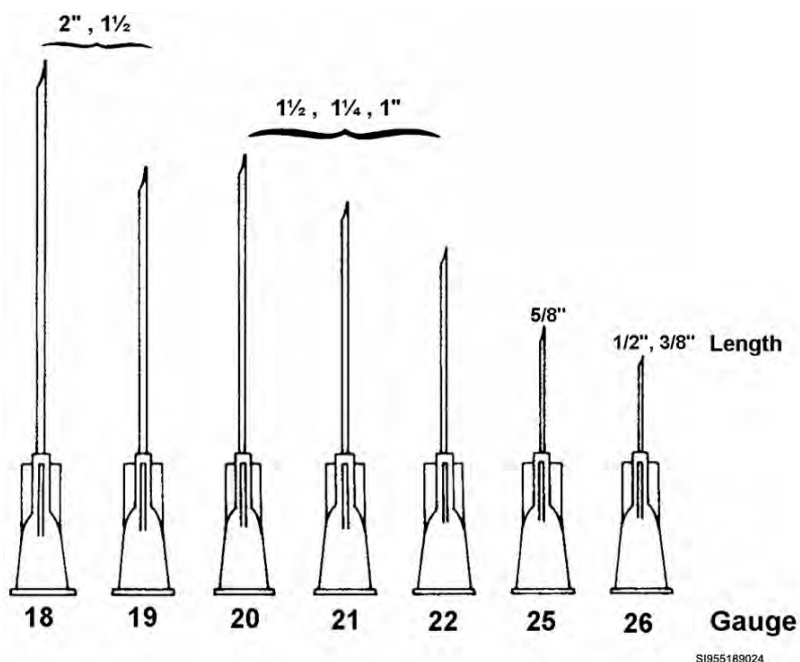


Figure 2-4. Needle lengths and gauges.

When you select a needle for an injection, you should consider a number of factors including the size of the individual, route and site of injection, and the viscosity and volume of the medication. You also should ensure the needle is sharp, without burrs, and is the smallest gauge and size appropriate for the medication. For example, do not use a big 18-gauge needle for IM injections if a 21-gauge needle will work. Using the largest size needle available causes unnecessary anxiety and suffering.

Although some syringes and needles are packaged as a unit, the needles are also available in individual sterile packages. This allows the administrator to select or change needles without discarding the entire preparation. As with the syringe, certain parts of the needle must be kept sterile during the preparation process. In the case of the needle, the outside of the hub is the only part you can touch safely. Fortunately, most needles are encased in a protective cap. This allows you to attach the needle to the syringe or to change needles without contaminating the setup.

Earlier in this section, we gave you some guidelines regarding the maximum volume to be administered by each route. Let's see how that information relates to the syringes and needles. We said an ID injection should not be more than 0.5 cc. Since this is a small volume and accuracy is important, you will use a 1 cc or tuberculin syringe. ID injections are given into the skin itself, so a short $\frac{3}{8}$ to $\frac{5}{8}$ inch, 26- to 27-gauge needle should suffice. SC injections are deeper with a larger volume (up to 1.5 cc), so you will need both a large syringe and needle. The 3 cc syringe is most commonly used; however, a tuberculin, 2, or 2.5 cc syringe may be used, depending on the actual dosage. The needle length for SC injections depends on the amount of SC tissue available. Individuals who are heavily "padded" require longer needles. The average length is between $\frac{1}{2}$ and $\frac{5}{8}$ inch, but longer needles may be used if necessary. The gauge size is usually 26- or 27-gauge. As we said, you can administer as much as 5 cc with an IM injection. Based on that, you can use anything from a tuberculin syringe to a 5 cc syringe, depending on the actual dosage and the need for accuracy. The needle size varies with the size of the individual and the amount of muscle available. These needles range from 1 inch, 22-gauge to 2 inch, 18-gauge. The gauge selected also depends on the viscosity or thickness of the medication.

Preparation of parenteral injections

When you were in the resident course, you learned the basic procedures for preparing a syringe and needle to draw up medications. We will refresh your memory with a brief review of the more important parts of those procedures.

The actual preparation is a two-step process. In the first step, you assemble the syringe and needle. When the unit is assembled, you draw up (aspirate) and adjust the medication in the syringe, which is the second step.

Begin by washing your hands and collecting your supplies. You will need an appropriately sized syringe and needle, as well as the medication ordered by the doctor. You should have already verified the medication order and checked the patient's condition prior to preparing your supplies. As we mentioned earlier, you should prepare the supplies and medication in a clean, well-lit area near where the syringes, needles, and medications are secured.

NOTE: TJC recommends that all syringes and needles be kept in a locked cabinet or storage area. This storage area does not have to be in the medication cabinet or even in the nurses' station, but it should be reasonably close to facilitate the preparation.

Examine the syringe and needle packages to see if they have been opened or damaged in any way. If the seal on either package is broken, discard the item and obtain a new one. Take the syringe and needle out of the packages, taking care not to contaminate the sterile parts as you do so. Holding the syringe in one hand and the needle in the other, carefully insert the syringe tip into the hub of the needle and tighten with a twisting, clockwise motion. Loosen the protective cap on the needle, but do not remove it completely. Be extremely careful when you do this. Usually, the cap comes off suddenly, which could cause you to jerk back and stab yourself. Once you have assembled the syringe and needle, you are ready to draw up the medication.

If you use prefilled cartridges, simply insert the cartridge in the holder and screw the plunger onto the medication stopper. The unit is then ready for use.

Parenteral medications are available in ampules, vials, prepackaged cartridges, and syringe units. Other than inserting a cartridge into a holder as we just described and possibly changing the needle or adding medications (if possible), there is no preparation involved for prepackaged units. We will concentrate on the procedures for preparing injections from ampules and vials.

Ampules are glass containers consisting of two chambers separated by a narrow neck. To remove the medication, break off the top part and aspirate the medication from the lower chamber. The neck or stem of the ampule is usually scored or scratched so that it will break at a certain point. If the ampule is not scored, get a small file and score it before proceeding. Hold the ampule vertically and tap the side to bring the medication down into the lower chamber. Clean the neck with an alcohol swab and wrap a 2x2 sterile gauze pad around the neck to protect your fingers. Break off the top chamber with a quick snapping motion. Always point the ampule away from you and other people as you break off the top.

To prevent contamination of the medication, you should draw up the required dose as soon as the ampule is open. There are a variety of ways to hold the syringe and ampule as you draw up the medication. Use the method most comfortable for you, but take care not to contaminate the needle by touching the side or neck of the ampule during the process. Hold the inverted ampule in one hand and the syringe in the other. Carefully insert the needle through the neck into the fluid. Steady the syringe by resting the barrel on the heel of the hand holding the ampule. Hold the syringe between your thumb and first finger and use one of your other fingers to draw back the plunger (fig. 2-5). If your hands are not steady enough for this method, you can set the ampule on a flat surface and use one hand to manipulate the syringe and the other to hold the ampule. Again, carefully insert the needle into the medication and hold the syringe steady with one hand as you pull back the plunger with the other. When you have withdrawn the desired amount of medication, pull out the needle and dispose of the ampule according to local policy.

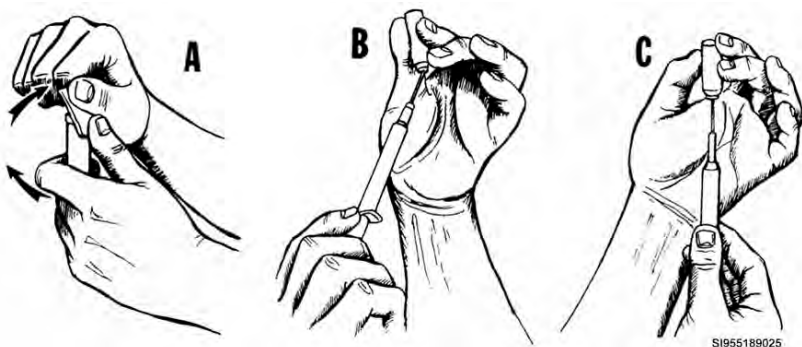


Figure 2-5. Aspirating medication from an ampule.

Once you have drawn up the medication, you need to get rid of air bubbles and any excess medication. You should always draw up a little more medication than you actually need to allow for these adjustments. Invert the syringe and pull back the plunger until there is a small air pocket between the medication and the top of the syringe. Tap the barrel with your fingernail until the bubbles rise to the surface and disperse into the air pocket. Continue to hold the syringe upright as you slowly depress the plunger to force out the air bubbles. Once all the air is gone, you can hold the syringe in the horizontal position over a sink to express the excess medication. Do this slowly to avoid dumping too much of the medication. As we mentioned earlier, measure the volume from the point where the bottom end of the plunger is parallel with the desired calibration. *Recap the needle* and prepare to inject the medication.

In some facilities, you will use a special needle called a filter needle to draw up the medication. The purpose of this needle is to keep glass fragments or contaminants out of the medication. Once you have aspirated the medication, replace the filter needle with the needle you will use for the injection. Discard the filter needle in a special sharps container according to local policy. Even if you do not have filter needles, it is good practice to switch needles before injecting the medication.

Vials are single or multidose glass containers that are sealed with a thick rubber stopper. The stopper or diaphragm is covered with a metal cap to ensure sterility. The medication in these vials is either in the form of a solution or dry sterile powder. If the medication is in a powder form, it will have to be reconstituted or mixed with fluid prior to administration.

Vials are vacuum packed. To withdraw fluid, first you have to inject an amount of air equal to the medication you want to withdraw. When you have assembled your syringe and needle, remove the protective metal cap on the vial and clean off the diaphragm with an alcohol swab. Pull back the plunger to aspirate the needed amount of air, and insert the needle in the center of the rubber diaphragm. Holding the syringe and vial, as shown in figure 2-6, inject the air and aspirate the medication. Keep the tip of the needle below the fluid level as you aspirate the medication or you will aspirate air instead of fluid. Change the needle, eliminate air bubbles, and get rid of the excess medication as discussed earlier.

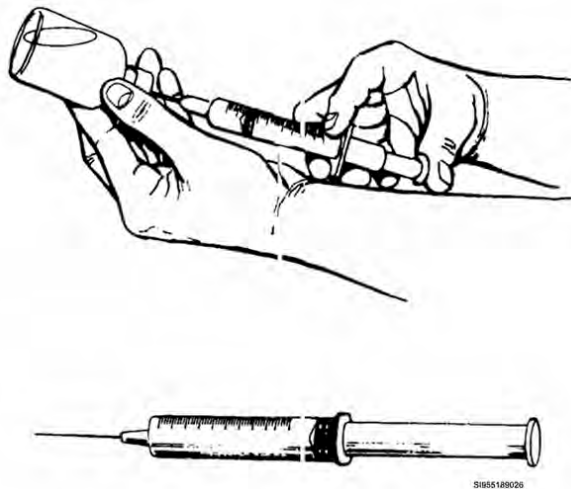


Figure 2-6. Aspirating medication from a vial.

If you are reconstituting a medication, draw up the necessary amount of diluent. Switch to a new needle and inject this fluid into the vial containing the powder. Mix the medication thoroughly and label the vial with the date and time of the reconstitution, volume and type of diluent, name and concentration of the reconstituted drug, expiration date and time, and your name. When the medication is mixed and labeled, inject the appropriate amount of air and withdraw the medication you need to administer. Change the needle and make final adjustments. If the vial contains only enough reconstituted medication for a single administration, you do not need to label it as described above. Simply dispose of it according to agency policy.

There is another type of vial that contains both the drug and diluent in the same bottle. This vial (mix-O-vial) has two compartments that are separated by a rubber stopper. The external opening is sealed with another rubber diaphragm positioned so that it can be pushed down like a plunger. When the top plunger is depressed, the pressure forces the second plunger into the lower chamber. This allows the diluent (upper chamber) to mix with the drug (lower chamber). Mix the medication thoroughly, clean the upper diaphragm, and withdraw the medication as you would with an ordinary vial. Change needles and adjust the medication as before.

Although we did not specifically mention it, you must remember to triple check the medication as we described at the beginning of this unit. Check it with the medication card when you first take it out of the cabinet. Check it again just before you draw up the medication, and check it a final time before you return the vial to the medication cabinet or dispose of the empty container. **DO NOT SKIP THESE STEPS!** In many cases, the patient's life and your career literally depend on how conscientious you are.

Administration of parenteral injections

The initial steps for parenteral injections are the same as for any other type of medication administration. Identify yourself, check the patient's ID band, verbally ask his or her name and DOB, and explain what you are going to do. As we said, parenteral injections cause feelings of anxiety in patients. Much of that anxiety is relieved if you approach the task in a calm, reassuring manner and give a good explanation of the procedure. You also should provide a little distraction (conversation, music, etc.) to relax the patient. Position the patient as required for the particular type of injection and administer the injection. Monitor the patient after the injection for therapeutic effects and adverse reactions.

SC injections

SC injections (fig. 2-7) are given into the loose connective/fatty tissue between the skin and muscle. As shown in the illustration, SC injections are commonly administered in the tissues of the upper outer arm. You also can use the tissues of the anterior thighs and abdomen or the buttocks or upper back areas. If you are giving frequent injections, rotate the sites.

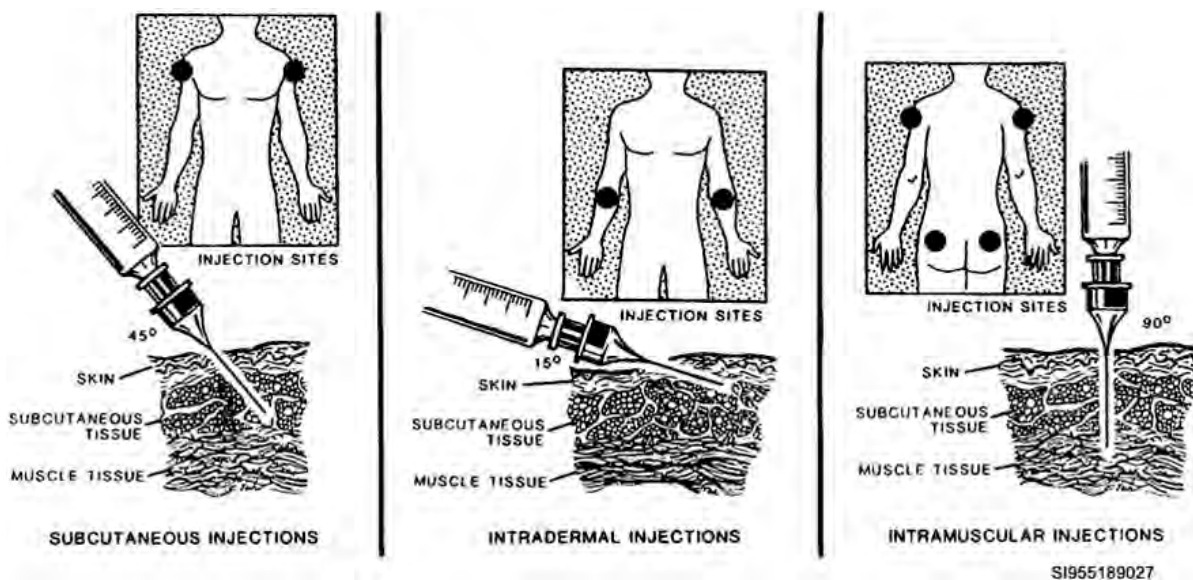


Figure 2-7. Injection sites.

When you have selected a site, clean the skin, as shown in figure 2-8, Part A. Pinch up the skin in your hand (Part B) to pull the SC tissue away from the skin and insert the needle at a 45-90° angle with the bevel up. The exact angle depends on the thickness of the skin and amount of SC tissue available. Aspirate or pull back on the plunger to determine if you are in a blood vessel. If you do get a blood return, withdraw the needle and re-prepare the injection. Do not aspirate if you are injecting heparin. If no blood appears, inject the medication slowly.

When you are finished, withdraw the needle at the same angle as injected (Part C) and massage the injection site with a gauze pad to speed up absorption. Monitor the patient for adverse reactions and document your activities.

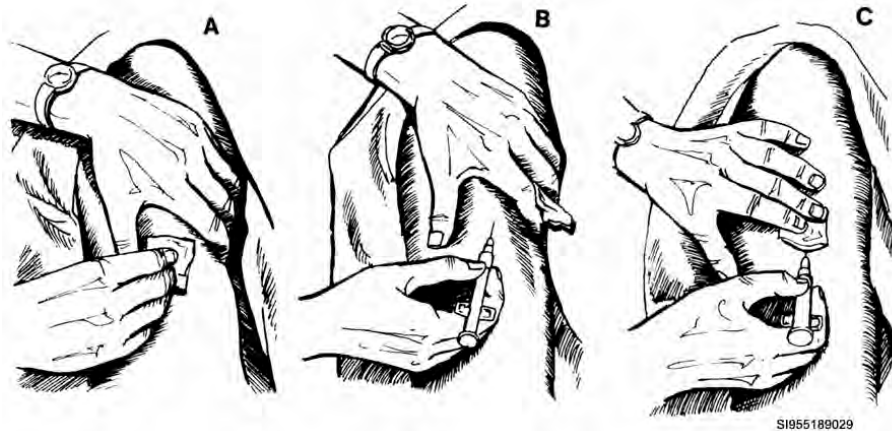


Figure 2-8. Subcutaneous injection.

ID injections

As you can see in figure 2-7, ID injections are injected directly into the skin or dermal tissue. They are used primarily for diagnostic testing to determine sensitivity to medications or other substances or to check for exposure to diseases, such as tuberculosis. The inner aspect of the forearms (fig. 2-9) and the scapular surfaces are the areas most commonly used. Other potential sites include the upper arms and upper chest areas. You should avoid any discolored (bruised), irritated, or swollen areas. Also avoid areas where the clothing brushes up against the skin, areas that are scarred or have been altered by skin disorders, and areas that are pigmented or hairy. Basically, just avoid any area that will either hide or give a false reaction to the medication.

Prepare the skin by pulling it taut and insert the needle at a very shallow angle (10–15°) just under the skin surface (fig. 2-9). The bevel should be facing up so that the medication will form a wheal just under the skin surface. Inject the medication slowly to avoid tissue damage. Withdraw the needle gently, and place a small gauze pad over the injection site to absorb any bleeding. Do not massage the site, as that will force the medication into the tissue. Mark the injection site with a permanent marker so you will know if there are any changes and annotate your actions (time, medication, site, etc.). Monitor the patient for any adverse reactions, such as a rash, itching, hives, swelling, or breathing difficulties. Notify the nurse and physician if the patient exhibits any of these signs.



Figure 2-9. Intradermal injection.

IM injections

IM injections are given into the deep tissue of large muscle groups (see fig. 2-7). Common sites include the ventrogluteal site (lateral hip area, fig. 2-10), dorsogluteal site (upper, outer buttocks area, fig. 2-11), quadriceps femoris sites (anterior thigh muscles, fig. 2-12 [A] adults and [B] infants), and mid-deltoid sites (lateral upper arm area, fig. 2-13). Of these, the dorsogluteal site presents the most risk because of the proximity of the large sciatic nerve and gluteal artery. The ventrogluteal site is not located near any major nerves or arteries, and it is preferred for large volume injections.

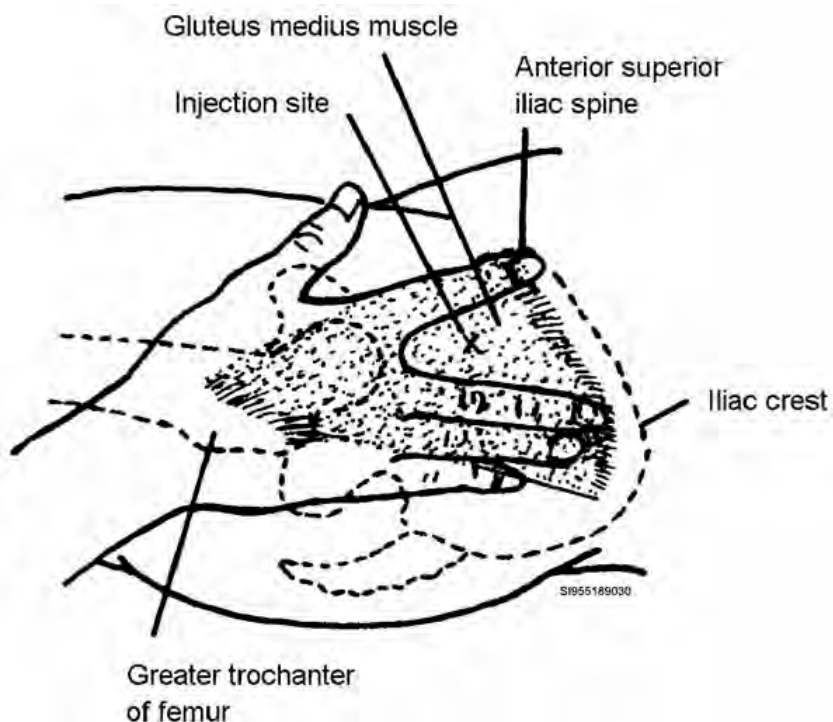


Figure 2-10. Ventrogluteal injection site.

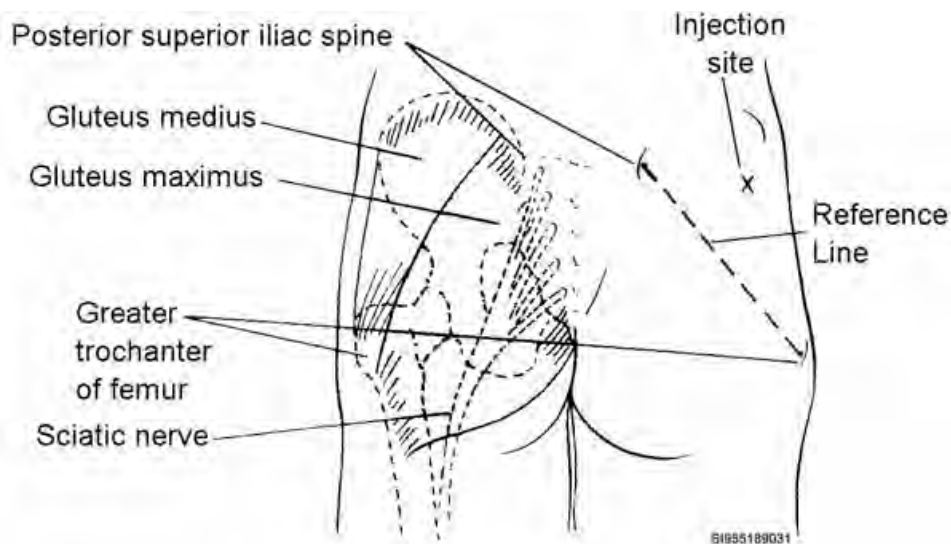


Figure 2-11. Dorsogluteal injection site.

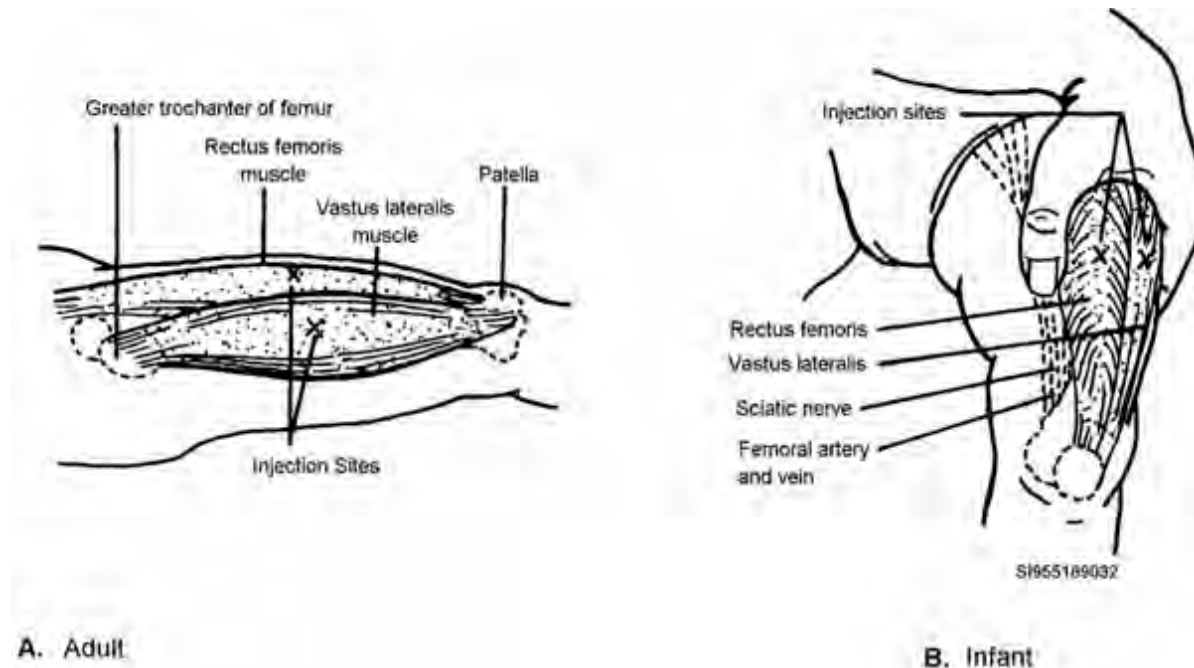


Figure 2-12. Quadriceps femoris injection sites (adults and infants).

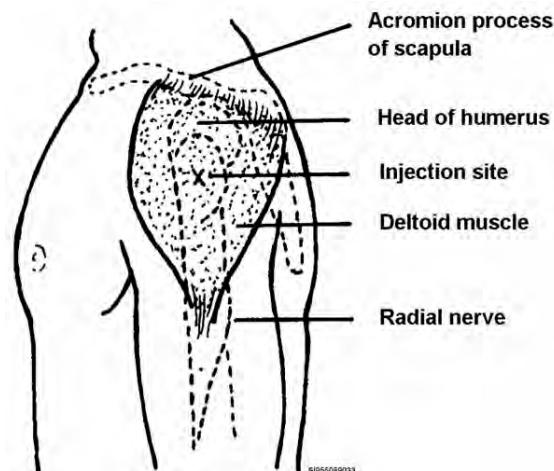


Figure 2-13. Deltoid injection site.

The quadriceps femoris sites, which include the *rectus femoris* (mid-anterior thigh) and *vastus lateralis* (mid-lateral thigh), are also free from nerves and blood vessels and are preferred for pediatric patients. The brachial sites are easily accessible but are close to the axillary nerves and blood vessels and can absorb only a small volume (around 2 cc).

There are several techniques you can use to administer an IM injection. Begin by positioning the patient so that he or she is in the most relaxed position possible. Placing the patient in the prone position with the toes turned inward relaxes the gluteal muscles. Assess the potential site to ensure that there is no tissue damage and that the muscle is large enough to absorb the medication and handle the needle you have chosen. Clean the area as described and stretch the skin tight between your thumb and first finger. Insert the needle at a 90° angle with a quick, smooth motion (refer back to fig. 2-11). Aspirate to determine if you are in a blood vessel. If not, inject the medication slowly and withdraw the needle. Massage the area to help with absorption, and encourage the patient to walk

about or engage in a similar form of mild activity. Monitor the patient for adverse reactions and report your activities.

In addition to this basic technique for IM injections, you also should be familiar with the air lock and the Z-track techniques. The air-lock technique is used to prevent medication leakage along the needle path, as well as the pain and tissue injury caused by that leakage. The air lock seals the medication in the muscle with a small air bubble. To perform this technique, aspirate a small air bubble (0.2 cc) into the syringe with the medication. Invert the syringe so that the bubble rises to the plunger end of the barrel. Insert the needle and inject the medication as you did with the basic technique. After you inject the air bubble, withdraw the needle and maintain pressure over the area for a few minutes.

The Z-track method can be combined with the air-lock technique or used separately to prevent medication leakage into the tissues. To perform the Z-track injection, pull the skin and underlying tissues approximately 1 inch to the side and downward (fig. 2-14). This retraction changes the relative positions of the skin, SC tissues, and underlying muscles. While maintaining the retraction, insert the needle deeply into the muscle tissues. Aspirate and inject the medication slowly if there is no blood return. Wait approximately 10 seconds before you withdraw the needle. Do not release the tissues until after you have withdrawn the needle, and do not massage the site.

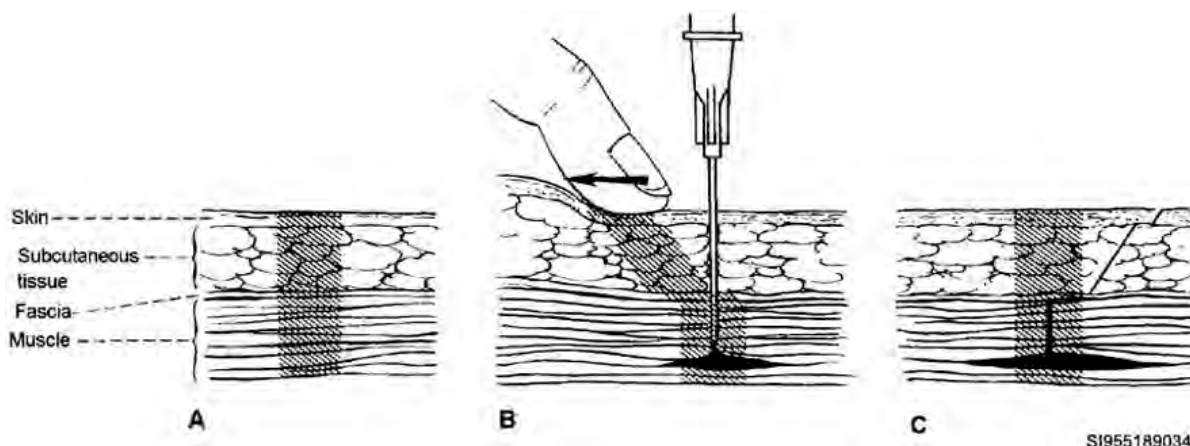


Figure 2-14. Z-track technique.

This completes our discussion of parenteral injections. For your own protection—and protection of the patient—dispose of used syringes and needles in the proper sharps container in accordance with (IAW) local policy.

412. Administering oral, sublingual, and buccal medications

Here we address the techniques to administer oral, sublingual (SL), buccal, and various topical medications.

Oral medications

Oral medications are administered by mouth (PO) directly into the digestive system. The advantages of oral medications are that they are convenient and easy to administer, less expensive than most other forms of medications, less stressful for the patient, and relatively safe in that the skin barrier is not broken during administration. Disadvantages include a possible unpleasant taste, potential for gastric irritation, and a slower rate of absorption.

Preparing oral medications

Once the order is verified as correct and the patient can handle the medication, collect the supplies and prepare the administration. Usually the only supply items needed for oral medications are a container to hold or dispense the medication and the medication itself. Adult liquid and solid medications are usually dispensed in paper or plastic medicine cups. Other items like syringes or

medicine droppers are used to give medications to pediatric patients. With the possible exception of a paper cup, these devices are calibrated to ensure the patient receives the right dose. Of course, these devices are not accurate for very small doses (less than a teaspoonful). When administering a very small dose, use a small syringe to dispense the medication. Some of these devices are calibrated in all three measurement systems for convenience.

If the patient is receiving prepackaged unit doses, no additional supplies are needed. The package should be properly labeled with the name of the medication, dosage, lot number, date of expiration, and, in some cases, name of the patient. Ensure this information is correct before taking the package to the patient.

Use good aseptic techniques when preparing the medication. Wash your hands before you start, and make sure you do not contaminate the medication as you pour it out and give it to the patient. **DO NOT** touch liquid or solid medications with your bare hands. Except for liquids, medications are usually prepared in a special area at a work station. Liquid medications are usually poured at the patient's bedside to prevent contamination and accidental spills.

Figure 2-15 illustrates the technique for preparing solid and liquid oral medications. In figure 2-15, Part A, the preparer checks the bulk medication with the information on the medication card. Part B shows the correct technique for pouring a liquid medication. The container should be at eye level. You should have your thumb at the desired level. Notice the technician is holding the bottle with the label uppermost. This prevents any spills on the label when holding the bottle upright. Wipe off the lip of the bottle with a clean paper towel before replacing the lid. When using a medicine dropper rather than a cup, hold the dropper upright as you draw up the medication. If you invert the dropper, the medication will run into the bulb and part of the dose will be lost.

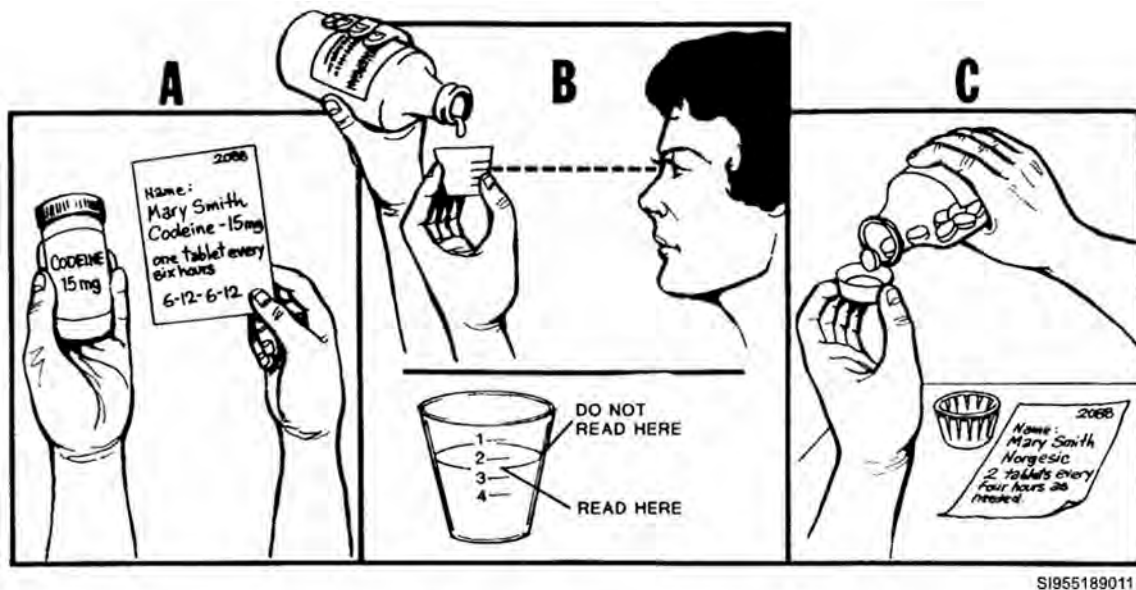


Figure 2-15. Preparing oral medications.

When pouring solid medications (fig. 2-15, Part C), pour the medication into the bottle cap and then drop it into the medicine cup. Do not use your fingers! Discard medication that falls on the table or floor.

Administering oral medications

After preparing the medication, take the medication to the patient. Check the patient's ID (ID band or ID card and verbal response). Assist the patient to a sitting position. Allow the patient to swallow the tablets or capsules at his or her own pace without rushing the procedure. Provide the patient with

water to lubricate the mouth and throat as needed to help wash down the medication. Do not give the patient water to wash down medications administered to coat the throat, such as cough syrup. Water washes away the medicine and defeats its purpose. Make sure the patient takes all of the medication. If the patient refuses, is asleep, or is out of the room, take the medication with you when you leave and document that you were unable to administer the medication and the reason. Do not leave the medication at the patient's bedside. Observe the patient for a few minutes after he or she has swallowed the medication and watch for adverse reactions and for the normal therapeutic effects of the medication. When finished with the administration, document the procedure.

SL and buccal medications

You administer certain medications orally, to be absorbed by the mucus membranes of the mouth. These membranes are highly vascular, so this is an effective and simple method of administration.

Preparing and administering SL and buccal medications

SL medications are placed under the tongue for absorption into the bloodstream (fig. 2-16).

Advantages of SL medications are convenience, safety (due to the skin barrier remaining intact), and rapid absorption into the bloodstream with a minimal loss of potency since the medication bypasses the

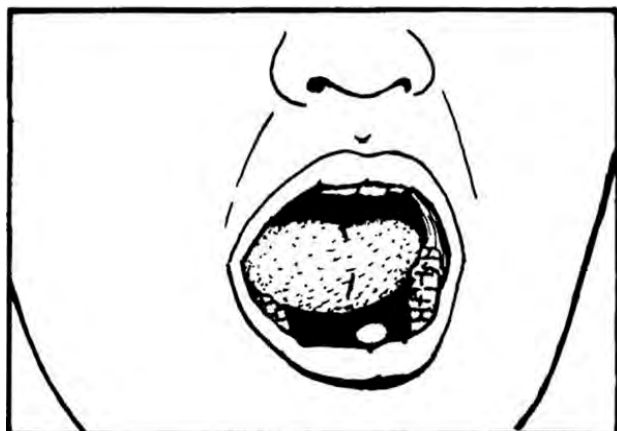


Figure 2-16. Oral administration: sublingual.

liver. However, there are disadvantages. You must ensure the drug remains under the patient's tongue until dissolved, and there is a diminished therapeutic effect if the patient accidentally or intentionally swallows the drug.

Buccal medications (no common abbreviation designated) are placed between the upper molars and the cheek. Like SL medications, buccal medications are absorbed into the bloodstream. The advantages and disadvantages are also the same. Tablets and lozenges are two forms of medication that are administered in this manner.

Procedures for preparing and administering buccal and SL medications are the same as those described for oral medications with one important exception—certain SL and buccal medications (primarily nitroglycerin) are often left at the bedside for self-administration by the patient. Nitroglycerin is used to relieve the pain of angina pectoris. When the patient needs this medication, he or she usually does not have the time or inclination to go looking for the nurse or technician. Make sure the patient understands how to take the medication and what to do if there is an adverse reaction. Also, encourage the patient to notify you if he or she does have to take a tablet so that vital signs can be assessed, so administration may be documented, and so the nurse or provider can be notified.

413. Other miscellaneous routes of medication administration

Topical medications are administered to the skin surface, body cavities, or body orifices. In most cases, topical medications affect only the area where they are applied. The types of medications we discuss in this lesson are dermatologic preparations, inhalations, ophthalmic ointments and drops, otic drops, nasal instillations, rectal suppositories, and vaginal suppositories and douches.

Dermatologic preparations

Dermatologic types of medications are applied to the skin surface. The main advantage of these preparations is that they provide a local effect with few side effects. Disadvantages include a possibility for systemic disturbances if the medication enters the body through a break in the skin surface, as well as the potential need for bandaging to confine the substance to a local area.

Preparing dermatologic medications

The supplies you need vary depending on the type of medication involved and the containers in which they are stored. Many ointments, creams, and lotions are packaged in tubes. To apply the medication, remove the cap and squeeze out the desired amount. Some creams and other agents are packaged in jars or similar containers. You need a tongue blade or similar device to dip the cream out of the jar. You cannot use your fingers as you would at home because you will contaminate the entire container. You also need gloves or an applicator to apply the medication. In most cases, it is probably safe to use your bare hands, but with the current infectious hazards, you cannot afford to take any chances. In addition to the infection control hazard, you also may be affected by the medication if you use your bare hands. The medications are absorbed as easily through your own skin as through the patient's skin. If the patient has an open wound, lesions, or an incision, use sterile techniques as well as sterile gloves to apply the medication.

Applying dermatologic agents

After you check the patient's ID, you are ready to apply the medication. If the patient hasn't had a bath recently, you should clean or rinse the skin or site of application thoroughly before applying the medication. Make sure the patient's skin is dry before you begin, unless moisture is required. If moisture is a crucial factor for the type of medication you are using, apply the medication while the skin is still damp. Depending on the type of container, either squeeze, pour, spray, or otherwise remove the medication from the container. The method of application varies depending on the type and purpose of the medication. Some ointments and lotions are administered to penetrate and relax the muscles. These agents are usually applied by massaging or rubbing the lotion into the patient's skin. Other agents are applied to protect or moisturize the skin, and these are applied as a thin layer. The doctor usually provides specific instructions when he or she writes the medication order, and there are additional instructions on the medication container.

Inhalations

Inhalations are administered into the respiratory tract through the use of an inhaler. Advantages of inhalers are that they provide rapid relief of respiratory distress, and they can be administered to an unconscious patient through a positive-pressure device. Disadvantages include the possibility for a systemic reaction and a somewhat difficult ability to monitor the precise amount of drug administration.

Pulmonary medications are administered as sprays or aerosols inhaled by the patient. This form of administration is unsafe for oil-based medications because of the high possibility of lipid pneumonia. Pulmonary administrations are an effective means of therapy because of the extensive surface and vascularity of the lung tissue. Depending on the supplies used to administer the medication, you may have to protect the patient from burns, scalds, chills, and/or excessive moisture. Some of the medications administered as pulmonary medications have potentially lethal, adverse effects. These include Epinephrine and Isoproterenol. Signs of adverse effects include dizziness, rapid pulse, nausea, and anxiety. If the patient exhibits these signs, stop the treatment, notify the doctor and document the procedure and your observations.

Pulmonary administrations are divided into volatile and nonvolatile substances. *Volatile* substances vaporize at room temperature. Some are also flammable, which creates an additional hazard. Examples include anesthetic gases and ammonia ampules. *Nonvolatile* substances do not evaporate easily and must be heated or vaporized for administration. The old-fashioned method of administering such medications was to place them in a tea kettle and have the patient breathe the steam. Now, electrically operated vaporizers and humidifiers are available for home and hospital use.

Preparing inhalations

A variety of respiratory equipment can be used to nebulize (break into small droplets) or atomize (break into large droplets) nonvolatile medications in the hospital. These include handheld nebulizers, metered dose inhalers, intermittent positive-pressure breathing (IPPB) machines, and complex pieces of equipment, such as ventilators (see figs. 2-17 and 2-18). Use this equipment with caution because

of the possibility of excessive ventilatory pressures and lung damage. Clean the equipment after each use to prevent contamination, and use new tubing for each patient.

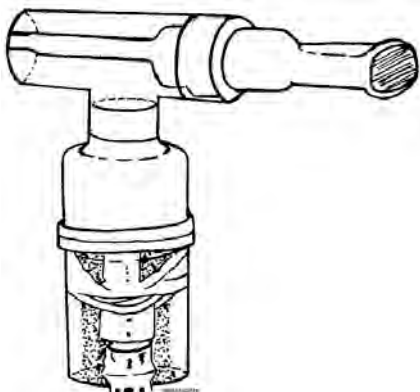


Figure 2-17. Handheld nebulizer.



Figure 2-18. Assisting patient with metered dose inhaler.

After you check the medication order, prepare the medication as directed. Some medications are diluted with sterile saline or other substances; others are administered as packaged. Place the medication in the nebulizer chamber and take it to the patient.

Administering inhalations

Check the patient ID and assist him or her to the sitting position. Instruct the patient on proper breathing techniques for the equipment you are using. Some types of equipment require a tight lip-lock on the nebulizer mouthpiece during both inhalation and exhalation; others (handheld nebulizers) do not. With all types, instruct the patient to inhale as deeply as possible while you are activating the nebulizer and exhale slowly through pursed lips. Administer the medication gradually, usually over a 15-minute time period. Assess the patient's vital signs before, during, and after the therapy. If there is an increase in pulse or blood pressure, stop the treatment, notify the doctor, and document the procedure in the patient's record. When you finish, make the patient comfortable, clean up your equipment, and report the results to the nurse.

Ophthalmic ointments and drops

Eye medications are applied into the lower conjunctival sac. Ophthalmic medications provide a fast and local effect for pain relief, the ability to furnish artificial lubrication for the eye, and the ability to directly combat infections when administering antibiotics.

One disadvantage of ophthalmic medications is the need to administer the medication very carefully due to the sensitive nature of the eye. Another is the periodic need to apply a patch to the eye to contain the medication. This results in a temporary physical limitation for the patient.

Preparing ophthalmic medications

Check the medication order and the patient and then collect your supplies. The type of supplies you need depends on the particular type of administration you are using. If you are going to irrigate the eye, you need a container of sterile solution (you can usually use an IV bag of sterile water or normal saline) and tubing or an irrigation syringe. To administer an instillation, you need an eye dropper, which is usually part of the medication container. Ophthalmic ointments are administered directly from the container. Be careful not to contaminate the dropper by touching the patient's conjunctival sac. In addition to these supplies, you will need towels or tissues to absorb the excess moisture.

Administering ophthalmic medications

Positioning and sterile technique are important factors when you administer ophthalmic medications. Although the external eye surface is not sterile, it is very susceptible to infection, so sterile techniques are necessary. For the same reason, the eyes should be treated separately with separate supplies and

solutions. When you administer instillations or ointments, the patient should be either in the sitting or lying position, with his or her head tilted slightly backward. Turn the patient's head slightly so that the treated eye is lower than the other. This stops the solution from running into the patient's unaffected eye. You can position yourself a number of different ways to instill medications, but the safest is probably standing behind and slightly toward the affected side of the patient. For stability, rest the heel of the hand holding the dropper on the patient's head. Rest your other hand on the patient's cheekbone, and gently pull back the lower eyelid to expose the lower conjunctival sac. Squeeze the eyedropper slowly and allow a few drops of medication to fill into the lower conjunctival sac (fig. 2-19).

Use the same general technique when you administer ophthalmic ointments. Expose the lower conjunctival sac, and squeeze a strip of ointment onto the conjunctival sac surface (fig. 2-20). Do not apply drops or ointment directly onto the eyeball. Ask the patient to close his or her eyes and move them back and forth to spread the medication. You need a basin or similar device to catch the excess fluid when you irrigate an eye. Although sterile normal saline (IV saline) is generally considered acceptable for eye irrigations, the physician may order a special solution you must obtain or prepare in advance. Position the patient as you did to administer eye drops, and place the basin so it catches the fluid as it runs out of the eye. Using either IV tubing or a bulb syringe, direct the fluid toward the inner canthus so the solution runs across the eye.



Figure 2-19. Eye drop administration.

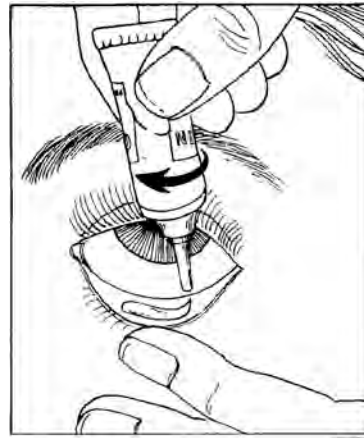


Figure 2-20. Eye ointment administration.

Otic drops

Ear medications are administered into the external auditory canal. The advantages of otic medications are their ability to cleanse the canal when necessary and their ability to combat infection when administering an antibiotic. The only notable disadvantage is the need to carefully position the patient to ensure proper administration.

Preparing otic administrations

Otic medications are administered into the ear canal. This may be in the form of either ear drops (instillation) or an irrigation. To prepare otic drops, check the medication (three times), collect the supplies, and warm the medication. An ear dropper is usually included with the medication container, so the only supplies you may need are some cotton balls to hold the medication in the patient's ears. To ensure patient comfort, warm the medication until it is approximately body temperature. The tympanic membrane is very sensitive. A solution that is too cold or too hot can cause excruciating pain. To irrigate an ear, you need some sort of irrigating solution (50/50 hydrogen peroxide and water, normal saline, antiseptic solutions, etc.) that has been warmed to body temperature. You also need a bulb syringe, Pomeroy syringe, or IV tubing to squirt the fluid into the ear.

Administering otic drops and irrigations

Check the patient's ID and position him or her to receive the medication. The patient may be lying, sitting, or standing (preferably lying or sitting) to receive ear drops. Turn the patient's head to the side, with the unaffected ear down. If you are administering the drops to a patient under three years of age, gently pull the earlobe down to straighten the canal and instill the drops into the canal. For adults and older pediatric patients, pull the auricle up and back to straighten the canal. Rest the heel of your hand holding the dropper on the patient's head (fig. 2-21). Doing so will prevent injury if the patient accidentally jerks his or her head. The tympanic membrane is both sensitive and fragile. Direct the drops toward the canal and not toward the membrane itself. If the doctor wants the drops to remain in the ear, gently insert a cotton ball in the external opening of the ear canal. Otherwise, instruct the patient to remain on his/her side long enough for the medication to take effect and provide tissues to absorb the drainage when he or she sits up.



Figure 2-21. Administration of ear drops.

The patient should be sitting or lying for ear irrigation. The standing position is not recommended because the procedure may affect the patient's sense of balance. Place a towel under the patient's head (lying position), and cover him or her with waterproof drapes. Either have the patient hold the basin or position it so it will catch the solution as it drains from the ear. Straighten the ear canal as before. If you are using a syringe, expel the air before beginning the irrigation. As you squirt the solution into the canal, direct the flow toward the side of the canal rather than toward the eardrum, and use a slow, steady stream rather than excessive pressure. As we said, the tympanic membrane is fragile and easily ruptured. Use aseptic techniques during these procedures; sterile techniques are not necessary unless the patient has a ruptured eardrum.

Ear irrigations are ordered for a number of reasons, including the removal of impacted objects. Never use irrigation to remove vegetable particles, such as bean or corn kernels! Water causes these objects to swell, completely obstructing the ear canal.

Nasal instillations

Nasal instillations are supplied in the form of drops. These medications are useful for shrinking swollen membranes and for treating nasal cavity or sinus infections. A disadvantage with nasal drops is the uncomfortable nature of the procedure that is often experienced by the patient.

Nasal administrations

Nasal administrations (nose drops and sprays) are generally used to relieve congestion. The only preparation involved is checking the order and medication for accuracy and collecting the necessary supplies for the procedure. You need the medication itself, a dropper (usually included with the medication), and tissues for the patient to blow his or her nose. Check the patient's ID and position him or her either lying or sitting with the head tilted back. Clear the nostrils by instructing the patient to blow his or her nose before instilling the medication. Instill the medication into each nostril, but do not allow the dropper to touch the nasal mucosa during the process (fig. 2-22). Instruct the patient to keep his/her head tilted back for a few minutes to allow the medication to be absorbed.



Figure 2-22. Administration of nasal medications.

When you administer nasal sprays, place the patient in an upright position. Instruct him or her to hold one nostril closed and inhale as you spray the medication into the other nostril.

Nose drops and sprays are OTC medications, so you should teach the patient as you perform the procedure. Caution the patient about the possible adverse effects of nasal medications from overuse.

Rectal suppositories

This type of medication is administered directly into the rectum. It provides a local effect for constipation; a systemic effect for problems such as fever, nausea, and vomiting; and the ability to avoid irritating the GI tract with the medication. A disadvantage of this method is the uncomfortable and sometimes embarrassing nature of the procedure.

Two types of rectal administrations are suppositories and enemas (cleansing and retention). Rectal suppositories are given to reduce fever, relieve pain and constipation, and reduce nausea. They consist of medication in a solid lanolin, glycerin, or gelatin base. When a suppository is inserted into the rectum, the base melts and the medication is absorbed by the mucosal tissue.

Suppositories are an OTC medication.

As you instruct the patient on the proper application, caution him or her not to take this type of medication orally. Check the medication order and the medication itself as you prepare it. Take the medication, a pair of disposable gloves, and a tube of water-soluble lubricant when you go to the patient. Check the patient's ID and ask him or her to attempt to void before beginning the procedure. Settle the patient in a side-lying position with knees bent, and drape him or her to avoid unnecessary exposure. Don your gloves, open the suppository package, and lubricate the suppository. Insert the suppository with your forefinger, pushing it in the direction of the umbilicus (fig. 2-23). Use a firm, gentle pressure, but do not attempt to force the suppository if you meet strong resistance. Notify the doctor if you do meet this type of resistance. When you finish, remove your gloves and make the patient comfortable. Instruct him or her to remain on his or her side for 15–20 minutes so the medication will be absorbed fully.

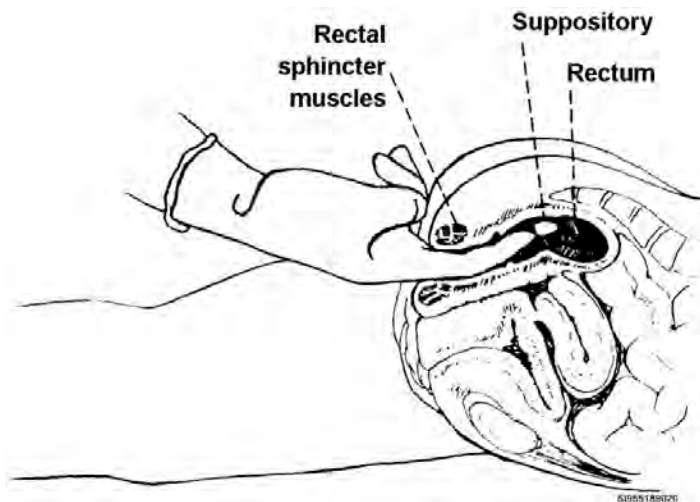


Figure 2-23. Insertion of rectal suppository.

Vaginal suppositories

Vaginal suppositories are administered along the posterior wall of the vagina. They provide relief from discomfort, such as pain and itching, and are able to directly administer medications used to combat infections. Disadvantages are the same as for rectal suppositories.

Check the patient's ID, explain the procedure, and provide privacy. Ask the patient to void before beginning the procedure to ensure the bladder is empty and to prevent accidental contamination. Position the patient in the supine position with the knees bent and feet flat on the bed. Place a pillow under the patient's hips, and drape the patient to avoid unnecessary exposure. Don your disposable gloves (sterile gloves are not necessary) and fill the applicator with the appropriate medication. Use

one hand to spread the labia and expose the patient's vagina. As you perform these procedures, observe the vaginal area for unusual drainage or odor. Insert the applicator as far as possible down and back into the vagina, and push the plunger to deposit the medication (fig. 2-24). A suppository can be applied with either an applicator or a gloved finger. Lubricate the applicator with a water-soluble lubricant, and insert the rounded end first. Remove the applicator and wrap it in a paper towel for disposal or cleaning (reusable types). Remove your gloves by turning them inside out and place them on another paper towel for disposal. Apply a perineal pad to prevent drainage on the bed or patient's clothing. Do not use a tampon because it will irritate the tissues and may absorb some of the medication. Instruct the patient to remain in the supine position for 10 minutes or so to allow the medication (suppositories) to melt and be absorbed.

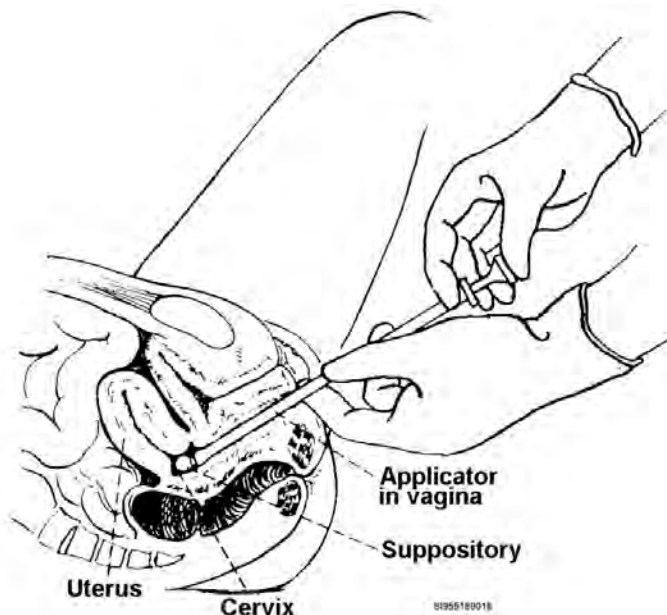


Figure 2-24. Vaginal suppository insertion.

Vaginal douche

Vaginal douches are applied both for cleaning and medication purposes. Be sure to warm the solution to body temperature before you administer the douche. Douches and other forms of vaginal medication administration can be self-administered, so instruct the patient on the proper procedures as you perform the administration.

A medicated vaginal douche is administered directly into the vagina. A vaginal douche has the ability to treat an infection by administering an antimicrobial solution, control an irritating discharge, or treat inflammatory conditions. Disadvantages are the same as for suppositories.

To administer a vaginal douche, position the patient in the supine position. Have her lie in a bathtub or on a bed pan in bed, as illustrated in figure 2-25. Warm the irrigation solution to 105–110°F. Put on gloves. Hang the irrigation bag 12–18 inches above the vagina, and begin by running a small amount of the solution over the vulva and external vaginal structures. Gently insert the nozzle 1½ to 2 inches down and back into the vagina. Release the clamp and allow the solution to flow into the vagina. Hold the labia together so the solution does not run back out, but periodically, release them to allow particles and drainage to be washed out. Rotate the nozzle slowly as the solution flows in so the solution reaches all parts of the vagina. When the douche bag is empty, remove the nozzle and assist the woman to the sitting position to allow the solution to flow out. Assist the patient in drying the external genitalia and moving into a comfortable position. Remove and clean your equipment, and document the procedure in the patient's record.

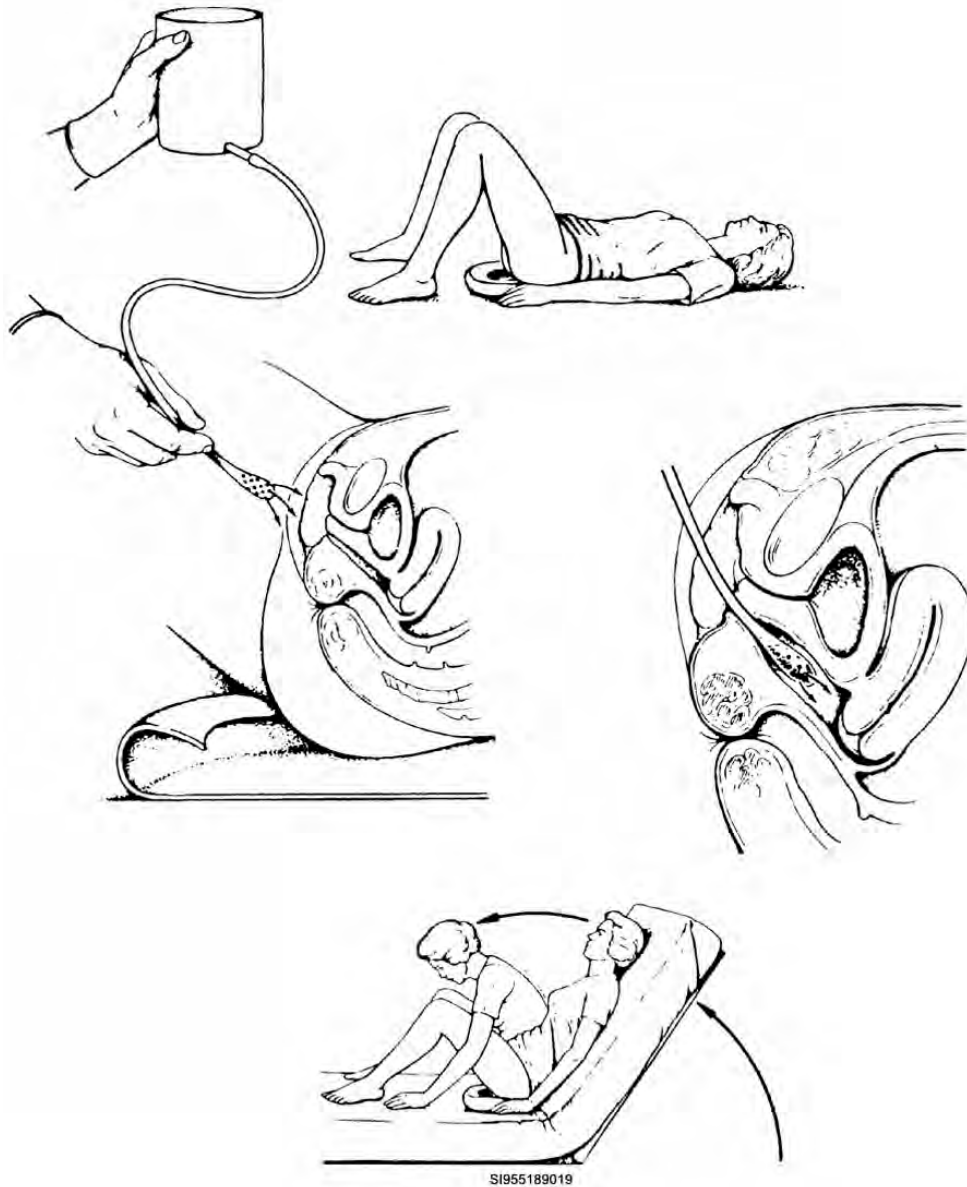


Figure 2-25. Vaginal douche.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

411. Administering parenteral medications

1. What are the four types of parenteral injection methods?
2. What type of parenteral injection technique is administered to the skin's dermis layer?
3. What are the two types of IV drug administration methods?

4. What factors may cause reduced muscle mass at a potential injection site?
5. When the plunger of a syringe is pulled back, what occurs within the barrel?
6. What are the basic components of the needle?
7. Where must all syringes and needles be stored?
8. Where are SC injections given?
9. Why are the quadriceps femoris sites preferred for pediatric patients?

412. Administering oral, sublingual, and buccal medications

1. What are the disadvantages of the oral method of administering medication?
2. Ideally, in what position should you place a patient to administer an oral medication?
3. Why is there a minimal loss of potency when administering an SL medication?

413. Other miscellaneous routes of medication administration

1. What three general areas of the body are topical medications administered to?
2. Why should you wear gloves when applying a dermatologic medication?
3. How often do you assess a patient's vital signs when administering an inhalation?
4. In what part of the eye do you administer ophthalmic medications?
5. How do you administer ear drops in a patient younger than three years of age? In an adult?

Answers to Self-Test Questions

409

1. Parenteral, oral, sublingual, buccal, and topical.
2. Verify the order.
3. Document the fact.

410

1. Basic calculation formula.
2. 100 kg.
3. 10 ml.
4. .5 tab.
5. 1.5 tabs.

411

1. SC, ID, IM, and IV.
2. ID.
3. IV drip and IV push.
4. Age, inactivity, malnutrition, or disease processes.
5. A vacuum is created and fluid is pulled into the barrel.
6. Hub, shaft, and bevel.
7. In a locked cabinet or storage area.
8. Into the loose connective and fatty tissue.
9. They do not contain nerves or blood vessels.

412

1. Possible unpleasant taste, potential for gastric irritation, and a slower rate of absorption.
2. Sitting.
3. The medication bypasses the liver.

413

1. Skin surface, body cavities, or body orifices.
2. For infection control and to avoid having the medications affect you in some way.
3. Before, during, and after the therapy.
4. Lower conjunctival sac.
5. For patients less than three years of age, gently pull the earlobe down to straighten the canal. For adults, pull the auricle up and back to straighten the canal.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

20. (409) Which element is *not* required on a medication order?
 - a. Patient's age.
 - b. Patient's name.
 - c. Specified time.
 - d. Provider's signature.
21. (409) Before administering any medication, you are responsible for all of the following *except*
 - a. for ensuring A1C Jones is available for work the next day.
 - b. performing all steps in the six medication rights.
 - c. being knowledgeable of the side effects of the medication.
 - d. verifying any possible interactions against current medications.
22. (409) How many pounds are equal to 65 kg?
 - a. 130.
 - b. 143.
 - c. 152.
 - d. 170.
23. (410) Dr. Young has ordered Mrs. Green to receive 5 mg/kg of Ancef twice a day. Mrs. Green weighs 65 kg. The medication Ancef is supplied in vials 50 mg/mL. How many mLs of the Ancef will be given for each dose?
 - a. 5.0.
 - b. 0.6.
 - c. 6.5.
 - d. 65.
24. (410) LtCol McNamara ordered a single dose Phenergan 12.5 mg, to be administered intramuscularly to A1C Jones for nausea and vomiting. The Phenergan is supplied in 50 mg/2mL pre-filled syringes. How many mLs would you administer?
 - a. 0.25.
 - b. 0.50.
 - c. 2.5.
 - d. 5.0
25. (411) The method of parenteral medication administration that involves injecting a drug into a muscle is
 - a. intravenous (IV) push.
 - b. intramuscular (IM).
 - c. subcutaneous (sc).
 - d. IV drip.
26. (411) Name the parts of a needle.
 - a. Hub, shaft, and bevel.
 - b. Cylinder, shank, and tip.
 - c. Barrel, bevel, and gauges.
 - d. Hub, tip, and calibrations.

27. (412) What administration method delivers medication directly into a patient's digestive system?
- Oral.
 - Buccal.
 - Inhalation.
 - Sublingual (SL).
28. (412) To prevent contamination and accidental spills, liquid medications being administered to inpatients are usually poured at what location?
- In the pharmacy.
 - At a work station.
 - At the nurses' station.
 - At the patient's bedside.
29. (413) Which statement is a *disadvantage* of inhalation medication?
- Unconscious patients cannot be treated.
 - Positive-pressure devices are sometimes used.
 - Monitoring the precise amount of drug administration is difficult.
 - Respiratory distress is not relieved through the use of an inhalation.
30. (413) When administering eye medications, ensure the patient's treated eye is lower than the other in order to
- maintain patient comfort.
 - keep the medication off the patient's face.
 - prevent the solution from running into the patient's unaffected eye.
 - allow the solution to pool in the affected eye, filling the conjunctival sac.
31. (413) Into what body cavity are otic medications administered?
- External auditory canal.
 - Internal auditory canal.
 - Lower conjunctival sac.
 - Upper conjunctival sac.
32. (413) To administer ear drops in a patient *under three years of age*, you gently pull the earlobe
- down to straighten the canal.
 - outward to expose the canal.
 - inward to confine the canal.
 - up to shorten the canal.
33. (413) Vaginal suppositories are
- cooled before administration.
 - useful for cleansing purposes.
 - administered to combat infection.
 - administered along the anterior wall of the vagina.
34. (413) When administering a vaginal douche, how high above the patient's vagina do you hang the bag?
- 4 to 8 inches.
 - 6 to 10 inches.
 - 12 to 18 inches.
 - 24 to 36 inches.

Unit 3. Pharmacology

3–1. Medications Used for Treatment of Illnesses	3–1
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MEDICATIONS ARE administered to produce a particular reaction in the body system. When administering medications, your responsibility includes understanding the information about them. This includes the actions, side effects, contraindications, and interactions. This information can be found in many different resources available to you as an Aerospace Medical Service Craftsman (AMSC). As a craftsman, you need to understand not just the basic information but also comprehend how and why these medications are given along with why the reactions happen. The medications listed are *not* all-inclusive but only a sampling of the more common medications used in each category.

3–1. Medications Used for Treatment of Illnesses

Anyone can develop an illness—you, a family member, a friend, or a neighbor. Some illnesses are mild; others are serious and long-lasting. These conditions can be treated with certain medicines, which are important elements in successful treatment. This section covers psychotropic, cardiac, GI, endocrine, and pain relief medications. The AMSC administers pain relief medications more frequently than most others do.

414. Pain relief

Pain relief can be obtained by using a variety of different medications, such as analgesics, sedatives, and hypnotics. All of these classifications depress the CNS to some degree. The primary action of an analgesic is to relieve pain, while sedatives are given to calm, soothe, or produce sedation, and hypnotics are given to produce sleep. The problem with administering these medications is that pain is subjective to the experience or the perception of the individual in pain. Healthcare workers can assess the pain by observing the patient's reaction to pain through vital signs, positions, and emotional responses by the patient. Pain has both psychological and physiological components. Some people will have a higher pain threshold because of conditioning, sensitivity, or physiological factors (i.e. endorphin release).

Endorphins are endogenous analgesics produced within the brain as a reaction to severe pain or intense exercise (aka runner's high), and these endorphins block the transmission of pain. Endorphin release may be responsible for a placebo effect: relief from pain because of suggestion without the administration of an analgesic.

Analgesics

Analgesics can be classified as opioid, nonopioid, and adjuvant. We will concentrate on the more common classifications, such as opioid and nonopioid analgesics.

Opioid analgesics

Opioids are classified as full or pure, partial or mixed agonists depending on the specific receptors they bind to and their activity at the receptor. Full agonists are commonly used because their action is similar to that of opium in altering the perception of pain, and they do not have a ceiling to analgesic effects. Opioids are listed under the controlled substance schedule and include both the natural opium alkaloids such as morphine, codeine and synthetics like Demerol and Darvon. Opioids tend to cause tolerance and physiological dependence with chronic use. Opioids are not used for extended periods except to relieve chronic pain for patients with terminal illnesses, cancer pain, and in selected patients with nonmalignant pain who do not benefit from other pain relief methods (i.e. neurofibromatosis). For the terminally ill patient, adequate pain control is more important than the risk of dependency of the drug.

Side effects of opioids can include sedation, confusion, euphoria, restlessness, hypotension, and bradycardia. The respiratory rate may be depressed, urinary retention may occur, along with blurred vision, and seizures with large doses.

Extreme caution must be taken when opioids are to be administered. There are many contraindications that must be taken into consideration, such as head injuries (any condition associated with increased intracranial pressure), CNS depression, hepatic and renal disease, hypothyroidism, chronic obstructive pulmonary disease (COPD), as well as patients who are pregnant or lactating, and pediatrics.

Opioids interactions include a potentiation effect with all CNS depressants including psychotropics, alcohol, sedatives and hypnotics, muscle relaxants, antihistamines, antiemetics, antiarrhythmics, or antihypertensives.

In many cases Demerol is frequently combined with Phenergan postoperatively to potentiate analgesic effect. Morphine is chemically incompatible with solutions containing many other drugs and therefore, should not be mixed with other medication in the same syringe or IV tubing.

The following list is not an all-inclusive opioid analgesics but a sample of the more common drugs used in a MTF.

Opioid Analgesics			
Generic Name	Trade Name	Common Dosages/Routes Available	Additional information
Butorphanol	Stadol	1–4 mg IM 0.05–2 mg IV 1 mg nasal spray	For moderate to severe acute pain: migraine, labor pains.
Codeine with acetaminophen	Codeine ^a	15–60 mg po/IM/IV/SC	For mild to moderate acute, chronic, and cancer pain.
Hydrocodone with acetaminophen	Lorcet ^b Lortab Vicodin	5–10 mg po	For mild to moderate acute, chronic, or cancer pain or antitussive.
Meperidine	Demerol	50–150 mg po/IM/SC 25–100 mg slow IV	For mild to moderate acute pain. Not for chronic pain or for the elderly.
Oxycodone with and without combination			
Oxycodone	OxyContin	10–80 mg po	Serious abuse potential. Overdose (OD) can be fatal; DO NOT CRUSH.

Oxycodone with aspirin	Percodan ^c	5–10 mg po	For mild to severe acute, chronic, or cancer pain.
Oxycodone with acetaminophen	Tylox ^d Percocet ^e		
Propoxyphene HCl with and without combination			
Propoxyphene HCl	Darvon	65–100 mg po	For mild to moderate acute, chronic, or cancer pain. Not recommended for the elderly.
Propoxyphene HCl with acetaminophen	Darvocet ^f	50–100mg po	For mild to moderate acute, chronic, or cancer pain. Not recommended for the elderly.
Morphine sulfate	Morphine, MS Contin	10–60 mg po 10–20 mg	For moderate to severe acute, chronic or cancer pain. DO NOT CRUSH. OD can be fatal.
Fentanyl citrate	Sublimaze Duragesic	200–400 micrograms (µg) po 25–100 µg IV/IM/ transdermal	For moderate to severe acute, chronic, or cancer pain.
Hydromorphone	Dilaudid	1–4 mg po 1–2 mg IM/IV/SC	For moderate to severe acute, chronic, or cancer pain.
Opioid combination products			
^a Tylenol with codeine tabs contain 300 mg acetaminophen plus codeine: #2 tab 15 mg codeine, #3 tab 30 mg codeine, #4 tab 60 mg codeine.			
^b Lorcet, Lortab, or Vicodin tabs contain 500 mg acetaminophen and 5 mg hydrocodone.			
^c Percodan tabs contain 325 mg aspirin and 5 mg oxycodone.			
^d Tylox contains 500 mg acetaminophen and 5 mg oxycodone.			
^e Percocet contains 325 mg acetaminophen and 5 mg ocycodone.			
^f Darvocet-N 50 contains 325 mg acetaminophen and 50 mg propoxphene; Darvocet-N 100 contains 650 mg acetaminophen and 100 mq propoxphene.			

Opioid antagonists

These drugs are used in the *treatment of opioid OD* and in the delivery room or newborn nursery for opiate-induced respiratory depression. There are two opiate antagonists, naloxone and naltrexone. Naloxone, trade name Narcan, is used to treat all conditions listed in the opioid analgesic table.

Naltrexone, trade name ReVia, is used to treat alcohol dependence and opiate overdoses of heroin and morphine. Naltrexone is used only *after* withdrawal from the opiates, such as heroin and morphine, to help avoid any relapses. The naltrexone acts by robbing the drug of the pleasurable effects. If it is given to someone currently dependent on opiates, it can send the addict instantly into severe life-threatening withdrawals.

Nonopioid analgesics

Many nonopioid analgesics are available without prescription as OTC medications. As a medical technician, it is important to question your patients of their current medications to include any OTC medications they have self-administered before administering any new medications. The lay public needs to become aware of the dangers of self-medication, overdosage, side effects, and interactions by inappropriate use of these readily available drugs. These OTC medications are labeled with dosage

information and side effects; as a healthcare provider, it is your responsibility to understand these medications and inform the patient of these actions as well.

The nonopoids are given for relieving mild to moderate pain, fever, and anti-inflammatory conditions. The salicylates (aspirin, salsalate, choline magnesium trisalicylate) are most commonly used for their analgesic and antipyretic properties, as well as their anti-inflammatory actions. Other anti-inflammatory drugs, such as ibuprofen, are also used for analgesic properties.

The nonsteroidal anti-inflammatory drugs (NSAID) are considered a separate classification because their primary use is not for pain relief but anti-inflammatory actions.

Aspirin and acetaminophen are frequently combined with opioids or other drugs for a more effective analgesic action. There are many combination analgesic products available over the counter; patients should be instructed to check all ingredients in these combinations before taking them. Some combinations can cause potentially serious, adverse side effects with other medications that are previously prescribed.

Salicylates

Salicylate analgesic and anti-inflammatory actions are associated primarily with preventing the formation of prostaglandins. With salicylates there are side effects, especially with prolonged use and or high doses. Some side effects include prolonged bleeding time, frequent bruising, gastric distress and GI symptoms, renal insufficiency, tinnitus, and hepatic dysfunction. The most severe side effect is anaphylaxis.

Along with side effects, the contraindications for salicylates include GI ulcer and bleeding or patients with bleeding disorders being treated with anticoagulants. Contraindication is also included for children with influenza-like illness, because of the danger of Reye's syndrome. Individuals with asthma, vitamin K deficiency, and those who are pregnant or lactating should avoid salicylates. Caution is necessary when using salicylates in patients with known anemia, hepatic, renal, or Hodgkin's diseases and during pre/postoperations.

Salicylates interact with many other drugs, and use with the following medications should be avoided if possible. The interaction results may increase or decrease the effects depending on the drug. Salicylates will increase the effects of alcohol, insulin or oral anti-diabetic agents, and methotrexate. Interactions may decrease the effects of furosemide, probenecid, antacids, and NSAIDs. Salicylates will also potentiate the actions of anticoagulants, increasing the effects of the anticoagulant producing a prolonged bleeding time.

Acetaminophen

Acetaminophen (Tylenol®) is used extensively in the treatment of mild to moderate pain and fever. It has very little effect on inflammation and has fewer adverse side effects than the salicylates. Therefore, acetaminophen is primarily used for analgesic actions in treating the chronic pain of arthritis so the salicylate, used for the anti-inflammatory actions, may be reduced to safer levels with fewer side effects.

Side effects of acetaminophen are rare, but large doses can cause severe liver toxicity, renal insufficiency (decreased urine output), and rash or urticaria. Caution should be taken with frequent acetaminophen use and alcohol ingestion because of the potential liver damage.

Acetaminophen is contraindicated for repeated administration to patients with anemia, cardiac or asthmatic conditions, and renal or hepatic diseases.

As discussed earlier, acetaminophen is frequently combined with opioid analgesics when stronger pain relief is required. Keep in mind that all opioids are controlled substances, even when they are combined with a noncontrolled drug.

Tramadol

Tramadol (Ultram) is a centrally acting synthetic analgesic compound similar in effect to the opioids but is chemically unrelated. Because of the chemical makeup, it is classified as a nonopioid and is not a controlled substance. It produces analgesia by inhibiting the reuptake of norepinephrine and serotonin. Though tramadol is synthetic, there are still side effects that may occur when taking the medication. Side effects include dizziness, malaise, headache, nausea, constipation, orthostatic hypotension, anxiety, and possible allergic reactions. Because of the side effects listed, caution should be taken when administering tramadol to the elderly or anyone driving or operating machinery. The medication may impair mental or physical abilities.

Some contraindications with Ultram include increased intracranial pressure or head injury, seizure disorders, pregnant or nursing women, and children under 16. Ultram may interact with monoamine oxidase inhibitors (MAOI) or neuroleptic medications by increasing seizure risk.

The following list is not all-inclusive but a sample of the more common nonopioid analgesics and antipyretics used in the MTF.

Nonopioid Analgesics and Antipyretics			
Generic name	Trade name	Common Dosages/Routes	Additional Information
Acetylsalicylic acid	Aspirin (ASA) Empirin Ascriptin Bufferin	325–650 mg po/R	Give with milk or food.
Acetaminophen	Tylenol Panadol Tempra	325–650 mg po/R	No anti-inflammatory action.
Combinations			
ASA and caffeine	Anacin	2 tab po	
ASA and meprobamate (sedative)	Equagesic	1–2 tabs po	Used to treat pain accompanied by anxiety and/or tension.
ASA, acetaminophen, and caffeine	Excedrin	2 tabs/caps po	Also used for pain associated with migraine headaches.
Tramadol	Ultram	20–100 mg po	Strong analgesic, not controlled; CNS side effects.

Anti-inflammatory

Most often anti-inflammatory drugs are used to treat musculoskeletal system disorders due to inflammation. Inflammatory disorders, such as arthritis, bursitis, gout, muscle strains, and sprains, which cause swelling also limit an individual's mobility. Some of the analgesics previously discussed may be used to relieve the pain associated with the swelling, but many times NSAIDs are frequently used for long-term maintenance doses.

Nonsteroidal anti-inflammatories

NSAIDs inhibit the synthesis of prostaglandins. This is the substance responsible for producing inflammation and pain associated with rheumatic conditions, sprains, and menstrual cramps. There is no cure for rheumatic disorders, but the NSAIDs are used to alleviate the pain and crippling effects of the disorder. The elderly are particularly susceptible to the side effects from the NSAIDs because of the lower metabolic rates of the elderly. Elderly patients should be educated about the cautions and report any troublesome signs or symptoms to their provider without any delay.

Salicylates are the oldest drug in this category, along with being classified as an analgesic as previously discussed. New NSAIDs are on the market and with such a variety, some are tolerated better than ASA by some patients especially for short-term. With large doses and long-term use, all NSAIDs share many of the same side effects and interactions. When patients are on long-term regimens, they must be closely monitored for increased risk of gastric ulcers and other GI problems.

Cyclooxygenase-2 inhibitors

Medications such as Celebrex® and Vioxx® are the newer NSAIDs that selectively inhibit cyclooxygenase-2 (COX-2) prostaglandin synthesis. Because these medications only inhibit the COX-2, they do not inhibit platelet aggregation (clotting) the COX-1 synthesis. Consequently, these drugs do not pose the bleeding risks all of the other nonselective NSAIDs pose. Since their action inhibiting is specific to COX-2 prostaglandin synthesis, both Celebrex and Vioxx have the potential to cause fewer gastric problems but not eliminate this side effect.

The side effects and interactions of NSAIDs are virtually the same. As with any medication, however, ensure you understand the specifics of the NSAID being administered. Many of the side effects include GI problems, such as ulceration and bleeding. Epigastric pain, nausea, heartburn, and gastroesophageal reflux disease (GERD) are also noted. Other side effects are prolonged bleeding times, hematuria, and liver toxicity along with visual disturbances, headache, or dizziness. Some patients may develop a hypersensitivity reaction, rash, or bronchospasms.

Contraindications or extreme caution with NSAIDs applies to patients with asthma, cardiovascular disorders, kidney disease, liver dysfunction, or thyroid diseases. Elderly, pregnant, lactating patients, and children with viral infections should not be treated with NSAIDs. Any patients with a hypersensitivity to sulfonamides should not take Celebrex. All NSAIDs should be given with meals or with milk products to reduce GI side effects.

NSAIDs interactions, especially those derived from salicylates, interact with alcohol and anticoagulants, which potentiates the possibility of GI bleeding. NSAIDs interact with corticosteroids, potentiating the salicylate absorption and toxicity; with methotrexate, the NSAIDs potentiate the action of the methotrexate to toxic levels.

Patient education with NSAIDs should first and foremost include taking the medication in conjunction with food or milk products to reduce GI irritation. Patients should discontinue the medication and report to their healthcare provider any signs of abnormal bleeding of the gums, in stool, or in urine. Individuals should avoid taking any other drugs, either prescribed or OTC, without checking first with their provider. If a patient is to undergo elective surgery or dental procedures, they should be advised to discontinue NSAIDs 10–14 days before to reduce the risk of serious bleeding.

The following list is not an all-inclusive list of anti-inflammatories but a sample of the more common drugs used in the MTF.

Anti-Inflammatory		
Generic name	Trade name	Dosage
NSAIDs		
Diclofenac	Voltaren	PO 150–200 mg qd in divided doses.
Ibuprofen	Motrin Advil (OTC) Nuprin (OTC)	PO, 300–800 mg qid.
Indomethacin	Indocin	PO, up to 200 mg qd in divided doses.
Ketorolac	Toradol	PO or IM, 15–30 mg q6h (5 days max).
Oxaprozin	Daypro	PO, 600–1200 mg once daily.
Naproxen	Naprosyn	PO, 250–500 mg bid, q 12h.

Anti-Inflammatory		
Generic name	Trade name	Dosage
	Anaprox Aleve (OTC)	
Meloxicam	Mobic	PO, 7.5–15 mg qd.
Sulindac	Clinoril	PO, 150–200 mg bid.
COX–2 Inhibitors		
Celecoxib	Celebrex	PO, 100 mg qd or 200mg bid.
Rofecoxib	Vioxx	PO, 12.5–25 mg qd.

CNS depressants

There are several medications that depress the CNS. Some examples are: sedatives and hypnotics, barbiturates, nonbarbiturates, and benzodiazepines. These medications are given for several diseases, and signs and symptoms are different for each.

Sedatives and hypnotics

Sedatives and hypnotics are controlled substances used to promote sedation in smaller doses and to promote sleep when used in large doses. Some psychotropic drugs are used as sedative-hypnotics. For children who are prone to seizures or are undergoing treatment for seizure disorders, Phenobarbital in combination with phenytoin is used prophylactically to treat fevers.

There are two classifications of sedative-hypnotics, barbiturates and nonbarbiturates. These medications should not be used for extended periods unless under close medical supervision as with epilepsy, because of the potential for psychological and physical dependence. An additional side effect is that these medications depress the rapid eye movement (REM) phase of sleep and withdrawal after prolonged uses can result in a severe rebound effect with nightmares and hallucinations. Abrupt withdrawal of hypnotics, even after only one week, may result in rebound insomnia. Therefore, gradual reduction is indicated.

Barbiturates

These medications have been implicated in many suicides and fatalities due to accidental overdoses, especially when combined with other CNS depressants or alcohol. They are particularly dangerous because they are metabolized and excreted slowly and remain in the system longer.

Many children and elderly individuals treated with barbiturates have a paradoxical reaction seen as hyperexcitability, confusion, or hallucinations. Because of a slower metabolism, the elderly or debilitated patient is particularly susceptible to ill effects and overdose.

Side effects of barbiturates can include “hangover effects” including lethargy, lack of coordination, depression, and headache. Nausea, vomiting, constipation, confusion, and delirium are other common side effects. When administering barbiturates intravenously, it may cause apnea, bronchospasm, coma, or fatal overdose.

The interactions are numerous when barbiturates are combined with other medications. Some of the interactions can increase certain effects or decrease them. CNS depression can increase when combined with alcohol, MAOI as Nardil, sedatives, and analgesics. Barbiturates decrease the effects of oral contraceptives, corticosteroids, or anticoagulants, and theophyllin, making the primary intention of these medications less effective.

Nonbarbiturates

Nonbarbiturates have been deemed safer and having less potential for abuse than barbiturates. However, recent statistics show a growing misuse of these drugs with potentially fatal results. Hypnotics are recommended for short-term use. Older nonbarbiturates hypnotics include chloral hydrate, and the newer drugs are benzodiazepines.

Side effects of chloral hydrate include nausea, vomiting, diarrhea, rash, dizziness, and ataxia (impaired ability to coordinate movement). Side effects of the benzodiazepines include leukopenia with prolonged use, daytime sedation, confusion and headache, amnesia, and hallucinations. The use of nonbarbiturates is contraindicated for patients with known severe liver and renal impairment and porphyria.

Benzodiazepines

Benzodiazepines are one of the most often prescribed classes of drugs and are often preferred over barbiturates for many disorders. They are primarily prescribed for anxiety but can also be used to prevent seizures and as muscle relaxants.

Although benzodiazepines have the potential for abuse, it is not common. Benzodiazepines are safer than other similar medications as death from OD is fairly rare. However, if combined with alcohol or other drugs, death may occur from OD. Another positive aspect of this drug is its withdrawal syndrome is less severe than alcohol or barbiturates.

Summary

Caution should be taken when administering all sedative hypnotics to individuals who are elderly, debilitated, or are addiction prone. Individuals who have renal or liver impairment or persons who are suicidal, depressed, or mentally unstable must be followed closely by the healthcare provider. Caution should also be taken with women who are pregnant or lactating, with children, and individuals who have COPD or have sleep apnea.

Interactions of all sedative hypnotics and benzodiazepines with the following drugs can be dangerous and potentially fatal: psychotropic drugs, alcohol, muscle relaxants, antiemetics, antihistamines, and analgesics. Many of these medications are found OTC and patients must be advised of these possible interactions before taking sedative hypnotics.

The following list is not an all-inclusive list of sedative-hypnotics but some of the more common you will see used in the MTF.

Sedatives and Hypnotics			
Generic name	Trade name	Dosage	Additional Comments
Barbiturates			
Phenobarbital	Luminal	100–200 mg po hs 30–120 mg/day po/ IM/ IV	For insomnia. For sedation.
Nonbarbiturates			
Chloral hydrate	Noctec	50 mg–1 g po or R ½ hr before hs	Short-term treatment of insomnia. Pre-op sedation, especially for children.
Extazolam	Prosom	0.5–2 mg hs	Short-term use.
Flurazepam	Dalmane	15–30 mg po hs	Long elimination half-life.
Temazepam	Restoril	7.5–30 mg po hs	Short-term use.
Triazolam	Halcion	0.125–0.25 mg po hs	Can cause amnesia, hallucinations, bizarre behavior
Zolpidem	Ambien	5–10 mg po	Rapid induction 30 min Short half-life, less than 3 hrs.
Zaleplon	Sonata	5–10 mg po hs	Short-term use.

Benzodiazepines			
Generic name	Trade name	Dosage	Additional Comments
Alpazolam	Xanax	0.5–1 mg po qd	Do not give with acute narrow-angle glaucoma.
Diazepam	Valium	2–10 mg bid-qid	Do not give with acute narrow-angle glaucoma.
Temazepam	Restoril	7.5–30 mg po hs	Short-term use for insomnia.
Triazolam	Halcion	0.125–0.25 mg po hs	Short-term use for insomnia. OD may occur at 2 mg.

415. Psychotropic medications

Psychotropic refers to substances that have the effect of altering the mind. These drugs have been widely prescribed and are remarkably effective. Psychotropic medications are drugs that can exert a therapeutic effect on an individual's mental process, emotions, or behavior. Drugs in other classifications have psychotropic effects. Examples of the other classifications are sedatives and hypnotics or even analgesics that have been previously covered.

Psychotropic medications are classified according to the purpose for administration. We will cover CNS stimulants, antidepressants, antimanic agents, antipsychotic medications, and major tranquilizers. In addition, other mind-altering drugs include alcohol, amphetamines, and illicit drugs which are technically categorized as psychotropic drugs because they all alter the effects of the mind.

Psychotropic medications are frequently prescribed concurrently with psychotherapy or professional counseling.

CNS stimulants

CNS stimulants are given for promoting central nervous system functioning. Caffeine is one of the most frequently used CNS stimulants; prolonged high intake of caffeine in any form may produce tolerance, habituation, and psychological dependence. With abrupt discontinuation of the stimulant, an individual may experience withdrawal symptoms such as headaches, irritation, nervousness, anxiety or dizziness.

Other CNS stimulants include amphetamines (Adderall), and methylphenidate (Ritalin), which are both used to treat attention deficit disorders (ADD) in children over the age of six. Ritalin is also used occasionally for the treatment of senile apathy. These drugs have a high potential for abuse and should be used only under medical supervision for diagnosed medical disorders. When a healthcare provider manages the use of the drugs, the abuse potential and dependence is minimal.

Side effects of the CNS stimulants methylphenidate and amphetamines include nervousness, insomnia, and irritability. The cardiac effects can include tachycardia, palpitations, hypertension and cardiac arrhythmias. Individuals may also incur GI disturbances such as anorexia, nausea, vomiting, abdominal pain and dry mouth. With prolonged use they may become habitual or cause dependency.

Contraindications for CNS stimulants apply to patients with a history of drug dependence, alcoholism or eating disorders. Patients with hyperthyroidism, cardiovascular disorders, closed-angle glaucoma or are pregnant or nursing should not take CNS stimulants.

There are many other cautions and contraindications for CNS stimulants use for the pediatric patient. Many pediatric patients report at least a temporary suppression of normal weight and or height patterns, thus needing close monitoring. Growth rebound has been observed after the discontinuation of therapy with the CNS stimulant.

Patient education should include all of the side effects listed, and parents of children receiving CNS therapy should watch for signs of tics, gastric disturbance, insomnia, weight loss or nervousness.

These signs should be reported to the healthcare provider. For the geriatric patient, they should be warned about the dangerous cardiovascular side effects. Remind the patient, or parent of the child patient, it is important for the patient not to crush or chew sustained release products.

Use the following table as a reference for the CNS stimulants found in the lesson.

CNS Stimulants			
Generic name	Trade name	Dosage	Additional Comments
Caffeine	Cafcit	po 20–30 mg/kg x1, then 5–8 mg/kg qd	For neonatal apnea; CAUTION: do not use caffeine and sodium benzonate concurrently.
Amphetamines	Adderall Dexedrine	po 2.5–30 mg qd-bid po 2.5–20 mg bid or tid	For narcolepsy or ADD > 3 yrs old.
Methylphenidate	Ritalin Ritalin SR or Metadate ER (extended release) Concerta	po 5–20 mg bid-tid po 10–20 mg bid-tid (NOTE: 8 hr duration of action) po 18–54 mg q AM ER tab	For narcolepsy, ADD. 6 yrs old or senile apathy. For once daily treatment of ADD.

Antidepressants

Antidepressants are usually the treatment of choice for major depression and for depressive episodes of bipolar disorder. The chemicals in the brain are neurotransmitters. The chemicals include dopamine, serotonin, and norepinephrine; in many depressed patients, certain chemicals in the brain may be in short supply. The normal action of the neurotransmitters is to travel across the synapse (the contact point of two neurons) to transmit the messages between the nerve cells. If the neurotransmitters are reabsorbed by one of the nerve ending before they have had a chance to make contact with the next nerve cell, the transmission is lost and they cannot perform their function. Antidepressants are used to enable normal neurotransmitter action.

Antidepressants are often called mood elevators, and are prescribed to treat patients with various types of depression. There are four general categories of antidepressants: selective serotonin reuptake inhibitors (SSRI), tricyclic, heterocyclic antidepressants, and MAOIs.

Selective serotonin reuptake inhibitors

SSRIs are considered the first-line medications for treatment of depression. They have fewer side effects, greater safety in cases of overdose, and have been shown to have an increased patient compliance. SSRIs selectively block the reabsorption of the neurotransmitter serotonin, helping to restore the brain's chemical balance. Two well-known drugs in this class include fluoxetine (Prozac) and sertraline (Zoloft). With the SSRIs, symptomatic relief may take one to four weeks and there is a prolonged elimination of the drug.

Side effects of SSRIs include sexual dysfunction, nausea, anorexia, diarrhea, and sweating. Individuals may experience insomnia, anxiety, nervousness, tremors, or just the opposite effects of drowsiness, fatigue, and dizziness.

Caution is taken for individuals with liver or renal impairment, diabetes, pregnant or lactating women, or those who are underweight or have eating disorders. SSRIs may precipitate manic attacks for individuals with bipolar disorders.

SSRIs may interact with antiarrhythmics, anticoagulants, or beta-blockers. SSRIs should never be taken concurrently with MAOIs.

Tricyclics

The mechanism of the tricyclics involves the potentiation of norepinephrine and serotonin activity by blocking their reuptake presynaptically. Their pharmacology response is a strong anticholinergic activity responsible for many of the side effects seen. Remember the anticholinergic responses include the secretions production decreased (3-D effect), decreased GI and GU motility, and the dilation of pupils. A significant side effect commonly overlooked is that antidepressants have a delayed reaction of onset, usually taking two to four weeks to achieve noticeable results. Because of a mild sedative effect tricyclics have, they are often prescribed and taken at bedtime.

The anticholinergic side effects are most prevalent, but tricyclics can also cause blurred vision, constipation and urinary retention, postural hypotension, cardiac arrhythmias, and palpitations. For the elderly, confusion can also be a significant side effect.

Contraindications for tricyclics apply to individuals with cardiac, renal, GI, and liver disorders. Also patients diagnosed with glaucoma, obesity, and seizure disorders are contraindicated for tricyclic therapy.

The interactions of tricyclics include hypertensive crisis if taken with clonidine, increased risk of arrhythmias with quinolones, and interactions with other CNS drugs and alcohol.

Heterocyclic antidepressants

These drugs are considered second-generation antidepressants and are comparable in efficacy to the first-generation tricyclic antidepressants differing in the effects on the chemicals of the brain as well as different side effects. Bupropion (Wellbutrin) is considered an activating antidepressant, much like the SSRIs and can be useful in cases of severe depression characterized by extreme fatigue and lethargy. Wellbutrin is also useful in smoking cessation.

Mirtazapine (Remeron) and nafazodone (Serzone) are both calming antidepressants that are useful in treating agitated depression, mixed anxiety and depression, or fibromyalgia. A common side effect of mirtazapine is weight gain. Trazodone (Desyrel) is highly sedating and is used in low doses as a hypnotic. In higher doses Desyrel can be used to treat elderly patients for agitation secondary to dementia and treat side effects caused by the SSRIs.

Common side effects seen with heterocyclic antidepressants (except bupropion) include drowsiness or insomnia, restlessness, agitation, or anxiety. Some side effects with heterocyclic antidepressants include dry mouth, nausea, dizziness, and confusion. When taking Trazodone, male patients may experience priapism or impotence. If this occurs, the medications should be stopped and the healthcare provider notified.

Interactions with other CNS depressants, including alcohol, may potentiate the sedating effects. When taking heterocyclics, they should never be taken concurrently with MAOI or antidiabetic medications.

With each of these antidepressants, SSRIs, tricyclics, and heterocyclics, the risk of suicide attempt should never be overlooked. Along with medication therapy, professional counseling is generally added to the treatment regimen for depression.

Monamine oxidase inhibitors

The last antidepressant category is the MAOI, which were discovered as part of the research for antitubercular drug therapy involving isoniazid (INH). The antidepressant action of MAOIs is to increase the concentration of serotonin, norepinephrine, and dopamine in the neuronal synapse by inhibiting the monoamine oxidase enzyme. MAOIs are not used very often because of the potential serious side effects and the numerous food and drug interactions. MAOIs are usually reserved for atypical depressions or those associated with panic disorders and or phobias.

MAOIs side effects are adrenergic in action and can include nervousness, agitation, insomnia, headache, stiff neck, nausea, vomiting, and diarrhea. They can have fatal side effects, such as severe

hypertensive crisis, tachycardia, palpitations, and chest pain. Patients with cerebrovascular disorders and liver disease are contraindicated for taking MAOIs.

With MAOIs, there is a long list of food interactions; some include yogurt, sour cream, all cheeses, liver, figs, bananas, pineapple, broad beans, meat tenderizers, chocolate, pickled herring, and any fermented or aged foods (corned beef, salami, cheese). With so many possible interactions, a healthcare provider must follow patients taking MAOIs closely.

The following list is not an all-inclusive list of antidepressants but a sample of the more common drugs used in the MTF.

Antidepressants			
Generic name	Trade name	Dosage	Additional Comments
SSRIs			
Fluoxetine	Prozac Sarafem	po 5–80 mg qd po 5–80 mg qd	Delayed response, prolonged elimination; take in AM. For premenstrual syndrome (PMS).
Paroxetine	Paxil	po 10–60 mg qd	Geriatric pt ½ average dose; take in AM.
Sertraline	Zoloft	po 50–200 mg qd	Take in AM.
Citalopram	Celexa	po 20–60 mg qd	Take in AM or PM, with or without food.
Tricyclics			
All of these drugs interact with CNS drugs.			
Amitriptyline	Elavil	po 50–300 mg qd	Interact with CNS drugs.
Desipramine	Norpramin	po 50–300 mg qd	Less sedation, orthostatic hypotension.
Imipramine	Tofranil	po 75–300 mg qd	Effective for enuresis.
Heterocyclic Antidepressants			
Bupropion	Wellbutrin Wellbutrin SR	po 100–150 mg bid-tid po 150–200 mg qd-bid	Take early in the day; space doses at least 6 hrs apart.
Mirtazapine	Remeron	po 15–45 mg qd	Take at hrs of sleep/at bedtime (hs), sedation is common.
Nefazodone	Serzone	po 50–300 mg bid	Sedation common.
Tradodone	Desyrel	po 25–100 mg hs for insomnia po 150–600 mg in divided doses for depression	Take pc to decrease dizziness and nausea; if drowsiness occurs, take at hs.
MAOIs			
All of these drugs interact with many foods and other drugs, resulting in serious reactions.			
Isocarboxazid	Marplan	po 10–60 mg qd in divided doses	See manufacturer interaction list.
Phenelzine	Nardil	po 45–90 mg qd in divided doses	

Antianxiety

Antianxiety medications are sometimes referred to as minor tranquilizers. They are useful in short-term treatment of anxiety disorders, psychosomatic disorders, and insomnia and for the use of controlling nausea and vomiting. Valium is also used as a muscle relaxant preoperatively. When given in small doses, antianxiety can promote relaxation without causing sedation. Larger doses are sometimes prescribed at bedtime for their sedative effects. Minor tranquilizers should not be taken for prolonged treatments because of tolerance; physical and psychological dependence may develop. After prolonged use, sudden withdrawal may result in seizures, agitation, psychosis, insomnia, and gastric distress.

Side effects of antianxiety medications are often seen following the initial dose or after significant increases to include tiredness and drowsiness, as well as headaches, blurred vision, and confusion. The side effects mirror that of antipsychotic medications, but they do not have the properties of antipsychotics. Antianxieties are more closely aligned with the CNS depressant family of drugs.

Contraindications or extreme caution applies to individuals with mental depression, suicidal tendencies, depressed vital signs, or liver and kidney dysfunctions. The interactions of antianxiety medications include potentiation of CNS depressants ranging from simple analgesics to antihistamines and alcohol. Interactions also occur when taken concurrently with digitalis and phenytoin (Dilantin). When taking Valium, grapefruit juice can potentiate the effects and should not be taken concurrently.

The following table is certainly not an inclusive list of the available antianxiety medications on the market. The list is a small sample of the medications used more frequently in the MTF.

Antianxiety			
Generic name	Trade name	Dosage	Additional Comments
Benzodiazepines			
Alprazolam	Xanax	po 0.125–0.5 mg bid-tid	Abrupt withdrawal may cause severe side effects.
Chlordiazepoxide	Librium	po 5–25 mg tid-qid	Larger doses IV/IM with severe anxiety or ethanol withdrawal.
Diazepam	Valium	po 2–10 mg bid-tid IV 2–10 mg q 3–4hrs PRN	Do not mix in syringe with other medications. Also used as a muscle relaxant or IV in status epilepticus.
Other Medications Used as Antianxieties			
Buspirone	Buspar	po 15–60 mg qd in divided doses	
Hydroxyzine (antihistamine)	Atarax Vistaril	po 25–100 mg qid or deep IM 25–100 mg	Can also be given as an antiemetic, antipruritic, or preoperative.

Antimanic agents

Lithium salts are antimanic agents and have been proven the most effective in the treatment of patients with acute manic phase of bipolar disorder. Although lithium has been proven the most effective treatment for the manic state of the bipolar disorder, it is not beneficial in the other phases of the illness and therefore requires an accurate diagnosis.

A maintenance dose is established by monitoring blood levels that are checked daily at the beginning, and then every few months thereafter. Once the patient has been stabilized, lithium acts as a preventative of future manic attacks as long as therapeutic levels are maintained.

Side effects of lithium include GI distress, cardiac arrhythmias and hypotension, polyuria, tremors, and thyroid problems. Toxicity signs of lithium can include drowsiness, confusion, blurred vision, and photophobia. With toxicity, some of the side effects signs worsen, such as tremors, muscle weakness, seizures may develop, or the cardiovascular system may collapse resulting in coma or death.

Caution must be taken with individuals with known seizure disorders, Parkinsonism, cardiovascular and kidney disorders. Caution must also be taken with the elderly, debilitated patients, and thyroid disease. Lithium is known to interact with CNS drugs, diuretics, NSAIDs, angiotensin-converting enzyme (ACE) inhibitors, and sodium salts.

Antipsychotic medications

Antipsychotic medications are categorized as major tranquilizers; the most common medication used is haloperidol (Haldol). Haldol may also be called a *neuroleptic* medication. Antipsychotic medications are useful in other types of treatment:

- Relieving symptoms of psychosis or severe neuroses, including delusions, hallucinations, agitation, and combativeness.
- Relieving nausea and vomiting with prochlorperazine (Compazine).
- Potentiation of analgesics, such as promethazine (Phenergan).

Many of the typical antipsychotic medications are chemically classified as phenothiazines, such as Compazine and Thorazine. Dosage can be regulated to modify disturbed behavior and relieve severe anxiety in many cases without significant impairment of consciousness.

Phenothiazines work by blocking dopamine receptors, resulting in unbalanced cholinergic activity. This cholinergic activity frequently causes extrapyramidal side effects (EPS) and tardive dyskinesia (TD). EPS are the effects of the medication on the CNS that involves the production and control of involuntary movements. The signs of these EPS and TD effects can be seen as uncontrollable tremors, which are similar to Parkinson's disease. The individual may also begin a shuffling walk, drooling, or simply start pill-rolling movements of the hand, and may begin pacing or be unable to sit still. Muscles may become fatigued, or weak, usually in the legs leaving the patient distressed about not being able to walk. The Parkinsonian symptoms and TD effects may become permanent and irreversible. Patients and their families should be educated about these effects and to report them to their healthcare provider immediately.

A newer class of antipsychotics has been developed recently. These drugs are chemically different from the phenothiazines. The atypical antipsychotics block both serotonin and dopamine receptors. The result is a lessened potential for adverse side effects, especially EPS and TD.

The side effects of antipsychotic medications, whether typical or atypical, may be seen in varying degrees or not at all. Some require the medications be discontinued, while others may be counteracted by additional medication. The side effects list common to all antipsychotic is lengthy, a fraction include postural hypotension, tachycardia, bradycardia, and vertigo. Insomnia, agitation, depression, headaches, seizures, blurred vision, and confusion can also be witnessed. Ensure the manufacturers list of side effects is reviewed with the patient along with patient education before administration.

Contraindications for antipsychotic medications include individuals with known seizure disorders, Parkinsonian syndrome, severe depression, blood dyscrasias, or are pregnant. Caution should be taken when treating the elderly, children, and patients with hepatic, cardiovascular, renal diseases, or prostatic hypertrophy.

Interactions with antipsychotic medications include potentiation with CNS depressants, anticholinergics, and antihypertensives. Antipsychotic medications will have an antagonistic effect with anticonvulsants, potentially increasing the seizure activity.

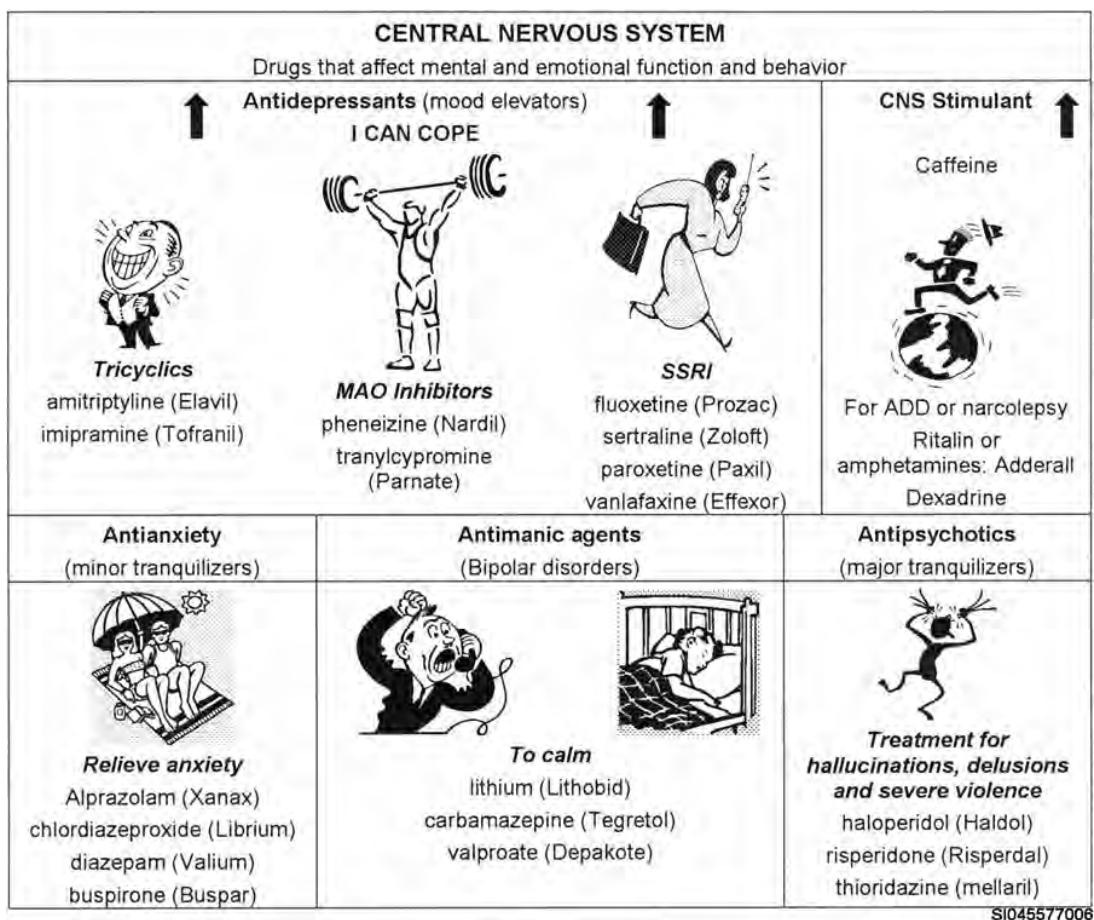
There is no ideal psychotropic medication. All of these medications have side effects, and with prolonged use, often leads to addiction. However, in many cases the benefit outweighs the risk. By altering the abnormal levels of the brain's chemicals, serotonin, norepinephrine, or dopamine, many patients with mental or emotional disorders have been helped.

Use the list below as a quick reference to the more commonly used antipsychotic medications in the MTF.

Antipsychotics			
Generic name	Trade name	Dosage	Additional Comments
Typical			
Chlorpromazine	Thorazine	po, R, IV or deep IM: 200–800 mg qd	Primarily for agitation; also for nausea, vomiting, and severe behavior problems.
Prochlorperazine	Compazine	po, R, IM, IV: 5–10 mg tid-qid	Primarily for agitation; also for nausea and vomiting in adults.
Haloperidol ^a	Haldol	po or IM: 1–20 mg qd	For agitation, especially with schizophrenia and delusions in the elderly.
Atypical			
Risperidone	Risperdal	po 1–3 mg bid	Higher incidence of ESP with >6 mg/day. Reduce geriatric dose to 0.5–1.5mg.
Clozapine	Clozaril	po 75–900 mg qd in divided doses	White blood cell (WBC) monitoring required due to the risk of agranulocytosis.

^a Not chemically classified as a phenothiazines.

All psychotropic medications affect the CNS in one form or fashion. Use fig 3–1 as a quick reference of the CNS effects.



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Figure 3–1. Central nervous system.

416. Cardiac medications

Cardiac medications are used for a number of reasons. They can be used to control blood pressure, increase heart contractility, and even thin the blood for better circulation. The key to any medication is to understand what is physiologically wrong with the body and match the medication(s) to correct the specific problem. Because the functioning of the heart and circulation of the blood are vital to life, the type of medication must be carefully evaluated and followed up for proper effects. Antiarrhythmia medications are the first of the cardiac medications to be covered.

Antiarrhythmics

Antiarrhythmic agents include a variety of drugs that act in different ways to suppress various types of cardiac arrhythmias depending on which part of the heart is being affected. The choice of a particular antiarrhythmic agent is based on careful assessment of many factors including the type of arrhythmia, the frequency, cardiac and renal condition, and the current signs and symptoms the patient is showing. Adequate knowledge of drug actions and effects and good judgment are essential when administering or observing a patient during treatment.

The side effects of the individual medications are discussed separately, but most drugs given to counteract arrhythmias have the potential for lowering blood pressure and slowing heartbeat. There are some antiarrhythmics that are the exception (e.g. procainamide and quinidine), causing tachycardia. With antiarrhythmia medications, the agent may cause the existing arrhythmia to worsen or even cause new arrhythmias. Careful monitoring is essential.

Arrhythmia detection and monitoring can include electrocardiogram (EKG) rhythm strips and 24 hr Holter monitoring as indicated. Electrolyte surveillance is very important for patients on antiarrhythmic agents.

Cardiac glycosides

Cardiac glycosides occur widely in nature or can be prepared synthetically. They are also known as cardiotonic because they strengthen the heartbeat. The action is directly on myocardium to increase the force of myocardial contractions. Cardiac glycosides are primarily used in the treatment of CHF. They are used in conjunction with antiarrhythmic agents to *slow* the heart rate in certain types of tachycardia, or atrial fibrillation or flutter.

In patients with CHF, the cardiac glycosides act by increasing the force of the cardiac contractions without increasing oxygen consumption, therefore increasing the cardiac output. As a result of increased efficiency, the heart beats slowly, the heart size shrinks, and the diuretic action decreases the edema associated with CHF.

The most common cardiac glycosides are digitalis products. The most frequently used is digoxin (lanoxin) because it can be administered orally and parenterally, and it has intermediate duration of action.

Establishing the correct therapeutic dose of digitalis is called digitalization. Therapeutic dosaging must be met to maintain the optimal functioning of the heart without toxic effects. There is a very narrow margin between effective therapy and dangerous toxicity. Careful monitoring of cardiac rate and rhythm with EKG, cardiac function, side effects, and blood digitalis level is required to determine the therapeutic maintenance dose. Before administration of digitalis, it is important to check the apical pulse to ensure the rate is not less than 60 beats per minute (bpm). If less than 60 bpm, digitalis should be withheld until the healthcare provider is consulted. Modification of dosage is based on individual requirements and responses, as determined by general condition, renal function, and cardiac function monitored by EKG.

Toxic side effects of digitalis should be reported to the healthcare provider immediately and documented. These side effects can include nausea and vomiting as the early signs of toxicity; later signs include abdominal cramping, distention, diarrhea, headache, muscle weakness, and fatigue. Side

effects are also seen in signs and symptoms of vertigo, tremors and seizures, or visual disturbances including blurring, diplopia (double vision), or halos. Cardiac arrhythmias of all kinds, especially bradycardia and electrolyte imbalance, are toxic side effects of digitalis.

Treatments for digitalis toxicity include discontinuing the drug immediately and monitoring electrolytes for hyperkalemia and especially hypokalemia. Cardiac arrhythmias that occur are treated with antiarrhythmics as indicated, such as atropine for severe bradycardia. For life-threatening toxicity, Digoxin Immune Fab is used as an antidote.

With any drug used to correct cardiac problems, there are contraindications for the medication and the parameters when extreme caution must be taken. These include, but are not limited to, persons with hypothyroidism, severe pulmonary disease, acute myocardial infarction, acute myocarditis, impaired renal function, arrhythmias *not* caused by heart failure, and high doses in the elderly.

There are possibilities of interaction when digoxin is used with antacids, sulfa, neomycin, and rifampin. These drugs reduce the absorption of the digitalis and should be administered far apart. Diuretics, calcium, verapamil, and corticosteroids can increase the chance of arrhythmias when taken with digoxin. Antiarrhythmics, especially quinidine, may potentiate digitalis toxicity. Adrenergic drugs, such as epinephrine, ephedrine, and isoproterenol, increase the risk of arrhythmias, while phenobarbital or phenytoin reduces digitalis level.

With all cardiac medications, caution must be taken when calculating, administering, monitoring, recording, and reporting all aspects of the patient's care. Early recognition of potentially fatal side effects is essential to your patient's care.

Adrenergic blockers

Beta-adrenergic blockers, for example propranolol (Inderal), combat arrhythmias by inhibiting adrenergic (sympathetic) nerve receptors. Inderal is a nonselective beta-blocker; it is effective in the management of some cardiac arrhythmias and less effective with others. It is also used in the treatment of hypertension and some forms of chronic angina. Atenolol (Tenormin) is a selective beta antagonist that has the same actions by causing a sustained inhibition of adrenergic effects, used for cardiac arrhythmia. It is also used in low doses for patients with lung conditions that cause bronchospasm.

Contraindications or extreme caution with the beta-blockers applies to withdrawal after prolonged use. Additional contraindications include diabetes as it may cause hypoglycemia. Caution is vital with renal and hepatic impairment, patients with known bradycardia, heart block, and CHF. Individuals who have asthma, COPD, or allergic rhinitis may have a reaction with beta-blockers causing bronchospasm.

Interactions include antagonism of propranolol by epinephrine and isoproterenol, anticholinergics, and tricyclic antidepressants. Potentiation of the hypotensive effect of propranolol occurs with diuretics and other antihypertensives, such as calcium channel blockers (verapamil), phenothiazine, and other tranquilizers. Tagamet slows the metabolism of the propranolol when taken together. Alcohol, muscle relaxants, and sedatives may precipitate hypotension, dizziness, confusion, or sedation when combined with beta-blockers.

Calcium channel blockers

Calcium channel blockers counteract arrhythmias by suppressing the action of calcium during contraction of the heart muscle, thereby reducing the cardiac excitability and dilation of the main coronary arteries. As with many of the antiarrhythmics, calcium channel blockers are also used in the treatment of angina and hypertension.

Side effects of calcium channel blockers can include hypotension with vertigo and headache. Bradycardia with heart block, edema, constipation, nausea, and abdominal discomfort are also side effects of calcium channel blockers.

The contraindications or extreme caution applies to patients *with* heart block, heart failure, or angina. Patients with hepatic and renal impairment and children or women who are pregnant and lactating must be treated with extreme caution during treatment with calcium channel blockers.

Interactions of verapamil with other cardiac drugs can potentiate both good and adverse effects. Verapamil has antagonistic effects with barbiturates, salicylates, sulfonamides, rifampin, and lithium. Hypotensive effects are potentiated with diuretics and ACE inhibitors. Take note that when taking a calcium channel blocker, drinking grapefruit juice will potentiate adverse effects.

Local anesthetic

Local anesthetics are administered for their antiarrhythmic effects and membrane-stabilizing actions. The actions of the anesthetic depress excitability of the myocardium to electrical stimulation and reduce conduction velocity in the atria, ventricles, and throughout the bundle-of-His and Purkinje fibers. Local anesthetics produce slight change in the contractility of the cardiac muscle and cardiac output. With IV use, anesthetics produce peripheral vasodilation and hypotension.

Lidocaine is the drug of choice for premature ventricular contractions (PVC) associated with a myocardial infarction (MI). Another anesthetic, tocainide (Tonocard), is not recommended for post-MI patients because of the substantial risks. It is reserved for life-threatening ventricular arrhythmias.

The side effects of lidocaine are usually of short duration and dose related (if you give three doses of lidocaine, the effects last longer than if you give only one dose). Some of the side effects can include CNS symptoms, such as tremors, seizures, dizziness, confusion, and blurred vision. The effects to the cardiorespiratory system include hypotension, bradycardia, heart block, dyspnea, respiratory depression, and arrest. When administering lidocaine IV, EKG monitoring and the availability of resuscitative equipment are necessary. With tocainide, pulmonary fibrosis, anemia, and bone marrow depression are possible.

Administration of lidocaine is contraindicated for patients who are hypersensitive to local anesthetics (amide-type), which have respiratory depression or known heart block, children, and for women who are pregnant and lactating. Interactions with other cardiac drugs may be additive or antagonistic and may potentiate adverse effects.

Procainamide

Procainamide (Pronestyl) is usually administered orally in antiarrhythmic therapy. It is used primarily as prophylactic therapy to maintain normal rhythm after cardioversion. It has similar anticholinergic properties to that of quinidine.

The side effects of procainamide are numerous and include hypotension, conduction defects, or asystole. Patients can develop hypertensive reactions as rash, fever, and weakness. Nausea and vomiting or diarrhea is more common with large doses. With procainamide, tachycardia is the side effect that makes it different than most of the other antiarrhythmic drugs.

Contraindications for procainamide include persons with known heart block CHF, hypersensitivity to local anesthetics (ester-type), pregnancy, or systemic lupus erythematosus (SLE). Caution should be taken for patients with renal and hepatic diseases. Interactions may occur with potentiation of neuromuscular blockers, anticholinergics, and other cardiac drugs.

Quinidine

Quinidine (Quinaglute or Cardioquin) is one of the oldest antiarrhythmic agents. It acts by decreasing myocardial excitability and may depress myocardial contractility. As with procainamide, quinidine is used primarily as prophylactic therapy to maintain normal rhythm after cardioversion. It is commonly administered orally in tablet or time-release capsules. It also possesses anticholinergic properties.

The side effects of quinidine are numerous and may necessitate stopping the treatment. Some of the common side effects include diarrhea, anorexia, nausea, and vomiting. It can also produce

tachycardia, syncope, and severe hypotension. The CNS can be affected seen through the signs and symptoms of headache, tinnitus, vertigo, tremors, visual abnormalities, or hearing disturbances. Quinidine can cause blood dyscrasias including anemia, clotting deficiencies, and leukopenia. Vascular collapse and respiratory arrest are also side effects of quinidine. With so many side effects, care must be taken when monitoring patients taking quinidine.

Use the following table as a reference for some of the cardiac medications covered in this section. This is not an inclusive list of all of the available medications in these categories, but they are some of the more common used in the MTF.

Cardiac Glycoside and Antiarrhythmics			
Generic name	Trade name	Dosage	Additional Comments
Cardiac Glycoside			
Digoxin	Lanoxin Lanoxin caps	Dosage varies po: tablets, liquid-filled capsules, elixir IV	Intermediate duration. Maximum dose 0.125 mg. Long-term use for elderly.
Adrenergic Blockers			
Atenolol	Tenormin	50 mg po qd 5–10 mg IV	Beta-blocker.
Propranolol	Inderal	10–30 mg po qid 0.5–3 mg IV	Beta-blocker.
Calcium Channel Blockers			
Verapamil	Isoptin Calan	5–10 mg IV 240–280 mg po qd in divided doses	Calcium channel blocker.
Antiarrhythmics			
Lidocaine	Xylocaine	IM or IV <i>diluted</i>	Local anesthetic. <i>Check IV dilution directions.</i>
Tocainide	Tonocard	po, dose varies	Local anesthetic. For life-threatening conditions ONLY.
Procainamide	Pronestly Procan SR	po dose varies IV or IM for emergency	Local anesthetic. Anticholinergic properties.
Quinidine	Quinaglute Cardioquin	po tabs, extended release, IV IM dose varies	Myocardial depressant. Anticholinergic properties.

Antihypertensive

There are a number of antihypertensive (hypotensives) treatments and management regimens. In many mild cases of hypertension, the initial treatment includes lifestyle changes that range from diet modification (low sodium), weight reduction, mild exercise program, smoking cessation, and stress reduction planning. Antihypertensive drugs do not cure hypertension; hypertensive medications only control an individual's blood pressure. After medication is stopped, the blood pressure will return to levels similar to those before treatment with medication if all other factors stay the same.

You will see some of the drugs that are used to treat arrhythmias are the same medications used to treat hypertension. Drugs given to lower blood pressure have various actions and the drug choice depends on the degree of hypertension (e.g., mild, moderate or severe) and other physical factors of the patient. Many times, antihypertensives are prescribed on a "trial" or short-term basis (less than 30 days). The provider will then evaluate the current dose and possibly change or even combine

medications to reach the therapeutic dose and reduce side effects. Thiazide diuretics are sometimes introduced as a stand-alone treatment for mild hypertension or combined with other antihypertensive medications to potentiate the hypotensive effects.

Side effects of most antihypertensives are common and monitored by the healthcare provider by observing changes in vital signs and adverse side effects reported by the patient. The most common side effect is hypotension, especially postural hypotension (dizziness occurring from the sitting position to standing). Many of the antihypertensives can also produce bradycardia, except those that include hydralazine (Apresoline), which causes tachycardia.

β-adrenergic and calcium channel blockers

Review the β-adrenergic blocker effects on the sympathetic nervous system. You will notice Inderal and Tenormin are both included as a β-adrenergic blocker. The effects include lowering blood pressure and pulse. With calcium channel blockers like Cardiazem and Procardia, the medications work by suppressing the action of calcium during contraction of the heart muscle, reducing the cardiac excitability and dilating the main coronary arteries.

Side effects and contraindications are the same as previously listed in the antiarrhythmic section.

ACE inhibitors

Angiotensin-converting enzyme inhibitors, such as captopril or enalapril, lower blood pressure by decreasing vasoconstriction. ACE inhibitors are effective in mild to moderate hypertension or even in CHF. They can be used alone or combined with a diuretic. ACE inhibitors slow the progression of renal disease and are the drugs of choice for hypertensive patients with nephropathy.

Side effects of ACE inhibitors include rash, photosensitivity, loss of taste perception, blood dyscrasias, severe hypotension, and possible hyperkalemia. The contraindications or cautions apply to patients with renal impairment or heart failure and patients with a collagen disease, such as lupus or scleroderma.

ACE inhibitors can interact by potentiating or antagonizing effects when taken in conjunction with other medications. ACE inhibitors potentiate hypotension when taken with diuretics, vasodilators. With potassium-sparing diuretics (Aldactone, and Dyrenium) and ACE inhibitors, there is a higher risk of hyperkalemia. NSAIDs antagonize the effects of the ACE inhibitors and further deterioration of renal functions. ACE inhibitors increase the risk of toxicity with both digoxin and lithium. Careful follow-up and close monitoring must be taken for patients using ACE inhibitors in conjunction with other medications.

Central-acting alpha-adrenergic inhibitors

An additional antihypertensive classification that is used for moderate to severe hypertension is the central-acting alpha-adrenergic inhibitors. Aldomet and Catapres are two drugs in this classification. These antihypertensive medications are usually combined with a diuretic. The exact mechanism of action is unknown; metabolic products of the drugs appear to act on both the CNS and the peripheral vascular systems by displacing norepinephrine from its storage sites. They reduce the renal vascular resistance and maintain cardiac output without increasing the heart rate. These drugs tend to support sodium and water retention, thus the reason why they are taken in conjunction with diuretics. This is also the treatment of choice for pregnant women because of the safety to the fetus.

Side effects of the central-acting alpha-adrenergic inhibitors can include hypotension and drowsiness, GI symptoms as nausea, vomiting, diarrhea, or constipation. Sexual dysfunction, nasal congestion, sore tongue, and liver disorders have also been noted as side effects. In rare cases, anemia or leucopenia has developed.

Central-acting alpha-adrenergic inhibitors are contraindicated for patients with liver disorders, patients undergoing dialysis, elderly patients, and patients with blood dyscrasias. Interactions occur when taking lithium, levodopa and phenothiazines, such as Thorazine or Compazine.

The following is a list of some of the antihypertensive medication and categories more commonly used in the MTF. Keep in mind the actions of each of the categories of these antihypertensive medications.

Antihypertensives			
Generic name	Trade name	Dosage	Additional Comments
β-adrenergic			
Metoprolol	Lopressor Toprol XL	50–100 mg po tid 50–100 mg po qd (SR)	None. Slow release (SR) must be swallowed intact. Can cause blood pressure to drop suddenly sending the patient into shock if taken in any other manner.
Timolol	Blocadren	10–20mg po bid	None.
Calcium Channel Blockers			
Diltazem	Cardizem CD Cardizem SR	240–360 mg po qd (SR) 120–180 mg po bid (SR)	SR must be swallowed intact. Can cause blood pressure to drop suddenly sending the patient into shock if taken in any other manner.
Nifedipine	Procardia XL Adalat CC	30–90 mg po qd (SR)	
Amlodipine	Norvasc	5–10 mg po qd	None.
ACE Inhibitors			
Captopril	Capoten	25–50 mg po bid-tid	None.
Enalapril	Vasotec	5–20 mg po bid	
Benazepril	Lotensin	10–20 mg po qd-bid	
Central-Acting Alpha-Adrenergic Inhibitors			
Methyldopa	Aldomet	250–500 mg po bid-qid	None.
Clonidine	Catapres	0.1–1.2 mg po qd	Given in divided doses.

Diuretics

Diuretics are drugs that increase the amount of urine output as a way to excrete excess fluid from the body. Some instances where a provider may want the patient to get rid of excess fluid that is impairing the body functions through edema are problems such as hypertension, heart failure, chronic renal (kidney) failure, hepatic cirrhosis (liver failure), and pulmonary edema. The blocking of sodium reabsorption is the most common way that diuretics work. Two of the most commonly used diuretics used are loop diuretics or high-ceiling diuretics.

Loop or high-ceiling diuretics

Most effective diuretics are drugs that affect the loop of Henle and are referred to as “loop” or “high-ceiling diuretic.” As you might guess, these drugs block the reabsorption of sodium and chloride in the loop of Henle. Common drugs used in this class are furosemide (Lasix) or torsemide (Demadex). These loop diuretics are most often used to decrease edema associated with chronic renal failure, heart failure, and hepatic cirrhosis. Side effects from this drug may be dehydration and electrolyte imbalances, which may lead to hypotension, dizziness, fainting, and hypokalemia due to loss of potassium that may cause dysrhythmias. Extra care should be taken with this medication if the patient is taking digoxin due to the increased risk of ototoxicity. Due to this drug’s potential negative side effects, it is normally reserved for patients who have moderate to severe fluid retention or when other drugs have failed to produce the desired therapeutic effect.

Thiazides

Thiazides are the most commonly prescribed class of diuretic and work by blocking sodium reabsorption and increasing the amount of water excretion. Thiazides are primarily used to treat mild to moderate hypertension but are less effective than Furosemides (loop diuretic) when used on

patients with severe renal failure. Side effects from this class are normally minor and do not generally cause a need for therapy to be discontinued. Patients may feel dizziness when moving from the supine to upright position and may become dehydrated. To assist in limiting the side effects, patients should be instructed to drink plenty of water and ensure an adequate intake of electrolytes through food and/or beverages.

Anticoagulants

Anticoagulants are divided into two general groups: coumarin derivatives and heparins. The actions of each group are different, but the purpose is the same: to prevent the formation of clots or decrease the extension of an existing clot, preventing thrombosis, pulmonary embolus, or coronary occlusion. Many times, patients with artificial heart valves, mitral valve disease, or chronic atrial fibrillation receive anticoagulants to prevent embolism or thrombosis. Patients receiving anticoagulant therapy should be monitored constantly to determine bleeding times and evaluate for bleeding complications such as cerebrovascular accidents (CVA). The coumarin derivatives and heparin do not dissolve clots; this action is acquired through thrombolytic agents. Coumarin derivatives and heparin only interfere with the coagulation process as a prophylaxis.

Coumarin derivatives

Coumarin derivatives (Coumadin) are administered orally. The coumarin derivatives alter the synthesis of blood coagulation factors in the liver by interfering with vitamin K. The *antidote* for serious bleeding complications while under coumarin therapy is to administer vitamin K. The action of the coumarin derivative is slower than that of heparin; therefore the coumarin derivative is used as follow-up or long-term anticoagulant therapy. In some cases, the coumarin derivative may be started at the same time as heparin. The patient is then monitored, weaned from the heparin, and continues with the coumarin derivative for the long-term therapy.

The most significant side effect is bleeding complications when taking coumarin derivatives, but the interactions are many. Some of the following drugs may increase the response to the coumarin derivative and must be monitored carefully. These drugs include anabolic steroids, all NSAIDs, including aspirin, thyroid drugs, and many anti-infective agents. Drugs that cause a decreased response to coumarin derivatives include alcohol, barbiturates, estrogen, including oral contraceptives, and corticosteroids. As with all medications, check for possible interaction before administration.

Heparin

Heparin is not absorbed through the GI tract and is usually administered by IV or subcutaneously. Heparin acts on thrombin, inhibiting the action of fibrin in the clot formation. The *antidote* for serious bleeding complications during heparin therapy is that the heparin is discontinued and protamine sulfate is administered. When heparin is administered through an IV, the action is immediate. Heparin is also used to maintain the patency of indwelling catheters used for arterial blood specimens. Heparin should never be used full strength as a flush but should be diluted according to manufacturing instructions. For peripheral vein-puncture devices (PRN adapters, saline lock), 0.9 percent sodium chloride should be used due to drug incompatibility and laboratory test interferences.

Currently, low-molecular weight heparin is approved for the prevention of deep vein thrombosis (DVT) in patients undergoing hip or knee replacement or abdominal surgery, for the treatment of unstable angina and non-Q-wave myocardial infarction, and for the inpatient treatment of acute pulmonary embolism (PE).

When heparin is administered subcutaneously at home for patients undergoing outpatient treatment, patient-education must include:

- Rotating injection sites.
- Ensuring no bleeding from the injection site.
- Reviewing all contraindications and side effects of heparin administration.

- Properly using alcohol pad to include simply holding the pad on the site gently for a few seconds. Do not rub the site with the alcohol pad.
- Effectively administering heparin, to include injecting it subcutaneously in the fat pad along the lower abdomen, taking care not to inject intradermally. Care must also be given not to aspirate.

Patients receiving heparin treatment are monitored using the laboratory test of activated partial thromboplastin time (PTT) tests. As stated previously, when long-term anticoagulant therapy is begun, there is a short-term overlap period in which both heparin and coumarin derivatives are administered concurrently.

Side effects of heparin therapy include major hemorrhage; minor bleeding, such as petechia, nosebleeds, and bruising; or blood in urine or stools. Contraindications for anticoagulant treatment include GI disorders and ulcerations of GI tract, hepatic and renal dysfunction, blood dyscrasias, or patients with stroke histories, increasing the risk of fatal cerebral hemorrhage.

Any patient undergoing anticoagulant therapy should receive patient-education covering the following:

1. Carefully observing skin, gums, urine, and stools. Reporting any sign of bleeding.
2. Avoiding sports and activities that may cause bleeding.
3. Immediately reporting any falls, blows, or injuries that could result in internal bleeding.
4. Taking special care when shaving, brushing teeth, and flossing.
5. Wearing an ID tag or carrying a card identifying the use of anticoagulant therapy.
6. Immediately reporting severe or continued headache or backache, dizziness, joint pain or swelling, tarry stools, abdominal distention, vomiting of material resembling coffee grounds, or nosebleeds.
7. Avoiding taking any other medications, especially OTC aspirin, anti-inflammatory drugs, and antacids, without the approval of the healthcare provider.
8. Avoiding alcohol consumption.
9. Patients should also be educated on foods rich in vitamin K. The amount of daily intake must be monitored to keep the prothombin level stable.

Thrombolytic agents

The body maintains a process to dissolve clots after they have formed called fibrinolysis. Thrombolytic drugs (streptokinase and alteplase) potentiate this process. The administration of a thrombolytic agent is administered in the emergency room or intensive care unit in the first few hours (less than six) after the onset of acute MI or CVA. Close monitoring of hemodynamics and vital signs is standard for the first 48 hours with thrombolytic therapy.

Bleeding is the most serious complication of thrombolytic therapy and can manifest as either minor bleeding or major internal bleeding. Patients with preexisting coagulation problems or who are being treated with anticoagulants are at the highest risk to develop bleeding complications during thrombolytic therapy. If severe bleeding occurs during thrombolytic therapy, the drug should be discontinued promptly.

The following is a small sampling of the available anticoagulants and thrombolytic agents more commonly used in the MTF.

Anticoagulants and Thrombolytic Agents		
Generic Name	Trade Name	Average Dosage/Route
Anticoagulants		
Coumarin derivatives (warfarin)	Coumadin	po, doses vary based on PTT results.
Heparin (unfractionated type heparin)	Heparin	IV, Sub Q, doses vary.
Enoxaparin (low-molecular weight heparin)	Lovenox	Sub Q, doses vary.
Thrombolytic agents		
Streptokinase	Streptase	IV bolus, then IV infusion.
Alteplase, TPA	Activase	IV bolus, then IV infusion.
Retepase, r-PA	Retavase	IV bolus x 2 (30 min apart).

417. Gastrointestinal medications

GI drugs are divided into different categories based on their action. *Antacids* partially neutralize gastric acids. *Antidiarrhea* agents act in various ways to reduce the number of loose stools. *Cathartics* promote the evacuation of the intestine. *Antiemetics* are used to prevent or treat nausea, vomiting, or motion sickness.

Antacids

Antacids are widely available in many OTC preparations for the relief of indigestion, heartburn, and sour stomach by partially neutralizing gastric hydrochloric acid. Antacids may be prescribed to help relieve pain and promote the healing of gastric and duodenal ulcers. Antacids can also be prescribed to manage esophageal reflux.

Antacid products may contain aluminum, calcium carbonate, or magnesium, both individually and in combination. Antacids also contain sodium. Sodium bicarbonate alone is not recommended because of flatulence, metabolic alkalosis, and electrolyte imbalance with prolonged use. Calcium carbonate antacids like Tums may cause constipation.

The choice of antacid will depend on palatability, adverse effects, acid-neutralizing capacity, the sodium content, and the patient's renal and cardiovascular function. Magnesium and/or aluminum antacids are the most commonly used. Magnesium can cause diarrhea, and aluminum causes constipation. Combinations are frequently used to control the frequency and consistency of bowel movements.

Side effects with frequent use of antacids may include constipation with aluminum or calcium carbonate antacids. Another side effect of aluminum antacids can be osteoporosis. Electrolyte imbalance, urinary calculi, and renal complications may occur with frequent use of any antacid. Diarrhea can be associated with magnesium antacids, while belching and flatulence is associated with calcium carbonate and sodium bicarbonate antacids.

Because of the chemical makeup of antacids, contraindications or extreme caution should be applied to patients with CHF, renal pathology, or history of renal calculi. Individuals with cirrhosis of the liver or edema or dehydration or electrolyte imbalance must be considered carefully when antacid treatment is being considered.

The interactions with almost any other drug administered concurrently can alter the effectiveness of the other drugs. Therefore, antacids should not be taken within two hours of most other drugs. Antacids may decrease the effectiveness of antibiotics, especially tetracyclines and quinolones, digoxin, iron, and salicylates.

Antacids may increase the action and precipitate side effects when administered concurrently with coumarin derivatives by increasing bleeding time and sedation. Using concurrently with diazepam, amphetamines, and quinidine will increase cardiac irregularities.

With antacids, patient education should include avoiding prolonged use. For example, they should be used no longer than two weeks without medical supervision. Avoid taking antacids at the same time as any other medication because of the potential interactions. Patients with cardiac, renal, or liver disease should avoid antacids because of possible fluid retention.

Antidiarrheal

The primary use of antidiarrheal agents is to reduce the number of loose stools an individual is having. Individuals should avoid self-medicating diarrhea for longer than 48 hours or if a fever develops. Not all diarrheas are medically stopped. There are instances where a provider may deem it necessary not to stop the diarrhea due to particular bacteria that needs to run its course through the body. A medical provider must determine the presence of bacteria through lab tests; never self-diagnose. With antidiarrheal agents, there are three actions of classifications: absorbent and protectant, slowing intestinal motility, and acid-producing bacterium.

Absorbent and protectant

Kaolin and pectin preparations, like Kaopectate, act as an absorbent and protectant to achieve a drying effect to the GI tract. Side effects are relatively nonexistent, other than constipation on occasion. Interactions are possible when administered concurrently with digoxin, causing impaired absorption. Administering antidiarrheal agents to infants and elderly is contraindicated.

Patient-education should include the avoidance of self-medicating for longer than 48 hours or if a fever develops. A diet should consist of bland foods, such as apples without peels or sugar added, rice, or bananas. Roughage should be taken out of the diet when trying to control diarrhea. Individuals should also be advised to increase their fluid intake to prevent dehydration. Drinking soda and apple juice should be avoided, but water should be encouraged or power drinks with high-electrolyte content in moderation.

Slowing intestinal motility

The drugs Lomotil and Imodium have the action of slowing the intestinal motility. They are used only until initial bowel control returns. With these drugs, side effects range from a possible anticholinergic effect (drying of secretions, blurred vision, urinary retention), to abdominal distention, nausea, or vomiting. With the possibility of the anticholinergic effect, dehydration is still a concern for the patient taking these medications.

Contraindications for taking these medications include diarrhea induced by infection or poisoning. The same is true for patients with colitis associated with broad-spectrum antibiotics, ulcerative colitis, and cirrhosis. It is also contraindicated to medicate young children and pregnant patients with these drugs.

Patients should be educated not to exceed the recommended dosage and to use only short term as directed by the provider. Adequate fluid intake and bland diet is important for these patients to follow until the diarrhea has been controlled. Any patient with diarrhea caused by infection or food poisoning should not take medications to slow intestinal motility, but kaolin and pectin preparations are preferred.

Acid-producing bacterium

Diarrhea caused by antibiotics or infection is treated with acid-producing bacterium medications. Lactinex is an acid-producing bacterium, in culture, which is administered orally for simple diarrhea caused by antibiotics, infection, irritable colon, colostomy or amebiasis (infection caused by pathogenic amebas). This medication is a fixed combination drug containing Lactobacillus acidophilus, and Lactobacillus bulgaricus. These two ingredients are bacterium found in milk, yogurt, and other dairy products. The medication can be mixed with cereal, food, juice, or just water. Because the products of the medication are readily found in a normal diet, the contraindications are low for the use of this medication. It is contraindicated for anyone with a high fever, those who are sensitive to

milk products, and it should also be used short term. Use the following table as a reference for the more common antacids and antidiarrheal agents.

GI Medications Table I		
Generic Name	Trade Name	Average Dosage
Antacids		
Aluminum	Amphojel	Suspension, 320 mg/5 ml. Tabs, 300–600 mg.
Calcium carbonate	Tums	Tabs, 500–100 mg.
Aluminum-magnesium combination	Riopan, Maalox, Mylanta	Suspension, tabs, dose varies with each product.
Antidiarrhea agents		
Absorbent and Protectant		
Kaolin and pectin	Kaopectate	Suspension, 60–120 ml after each bowel movement.
Slowing the intestinal motility		
Diphenoxylate with atropine	Lomotil	Solution or tabs, 2.5–5 mg qid.
Loperamide	Imodium	Solution, tabs, caps 2 mg after each bowel movement with a max dose of 16 mg qd.
Acid-producing bacterium		
LACTOBACILLUS acidophilus	Lactinex, Bacid	2 caps, 4 tabs, or 1 pkg granules 3 or 4 times qd.

Antiflatulants

Intestinal gas is a byproduct of digestion that we have all experienced at some time in our lives. While medical personnel know that intestinal gas is a normal action of the digestive tract, excess gas can be very embarrassing and uncomfortable for some individuals. Symptoms of excess intestinal gas may include one or any combination of flatulence, bloating, and burping.

Intestinal gas can be caused by carbonated beverages, foods, medication, and intestinal illnesses. Carbohydrates that contain indigestible sugars, fiber, or starch may contribute to intestinal gas caused by foods. Examples of common causes of excess gas include lactose found in milk products, fructose contained in onions, wheat and soft drinks; sorbitol found in many fruits, candy, and gum; and raffinose, a sugar contained in vegetables like cabbage and broccoli, whole grains, and the infamous beans.

Many of the same medications used for digestive problems, such as heartburn or diarrhea, are used for the control of intestinal gas. Simethicone (Immodium advanced), alpha-galactosidase (Beano), and Mylicon are the commonly used medications for antiflatulence.

Side effects from the medications may include bloating, constipation, diarrhea, and more complicated symptoms if the flatulence is caused by bacteria in the intestinal tract.

Treatment for individuals with chronic gas problems is normally aimed at changing the diet. For acute problems, OTC medications are often used or a medication such as Simethicone may be prescribed.

Laxatives

Cathartics or purgatives are categorized as laxatives. Cathartics and stool softeners promote rapid evacuation of the intestine and alter the consistency of stool. Many of the OTC laxatives are self-prescribed and overused by a large portion of the population. Prevention and relief of constipation is better achieved through natural methods using high-fiber diets, adequate fluid intake, and exercise. The normal frequency of bowel movements varies from daily to several times a week. When constipation occurs, the cause should be identified before laxatives are used. Laxatives are subdivided

into six categories according to their action: bulk-forming laxatives, stool softeners, mineral oil, saline laxatives, stimulant laxatives, and hyperosmotic laxatives.

Bulk-forming laxatives

Psyllium, cellulose derivatives, and bran are all bulk-forming laxatives and are the treatment of choice for simple constipation unrelieved by natural methods. These products are available in powders, flakes, granules, tablets, or liquids and must be dissolved and or diluted according to the manufactures' directions. The usual procedure is to dissolve the product in one full glass of water or juice and taken orally, followed immediately with another glass of fluid. The proper dosage is administered one to three times per day. With bulk-forming laxatives it may take 12–72 hours for results.

This type of laxative is the choice for the geriatric or laxative-dependent patient. They are also useful in maintaining regularity for patients with known diverticulosis or patients with chronic, watery diarrhea. Contraindications apply to patients with acute abdominal pain, partial bowel, or esophageal obstruction, and dysphagia. Patients taking bulk-forming laxatives should be thoroughly educated regarding dissolving the laxative in a full glass of liquid and following it up with an additional glass to prevent obstruction.

Stool softeners

Docusate is a mild form of laxative administered orally. The patient's condition will dictate the dosage of the stool softener and the type used. For pregnant or nursing women and children with hard stools, stool softeners are the medication of choice to combat constipation or hard, dry stools. The onset of action with stool softeners can be seen in 12–72 hours. Side effects are rare with stool softeners, but the individual may develop mild, transitory GI cramping or rash. Stool softeners are contraindicated with acute abdominal pain or prolonged use (over one week) without medical supervision.

Patient-education should include discontinuation of the medication if there are signs of diarrhea or abdominal pain. Large quantities of fluids should be taken when using stool softeners. Mineral oil does interact with stool softeners, leading to mucosal irritation.

Mineral oil

Mineral oil is usually administered orally in emulsion form to promote palatability. It can also be administered rectally as an oil-retention enema. The effect of mineral oil is seen in six to eight hours after administration. With prolonged oral use, because there is a potential for the malabsorption of vitamins A, D, E, and K, diet must be carefully considered. A primary side effect of mineral oil is seepage of the oil from the rectum, causing anal irritation.

There are some contraindications for mineral oil use, to include children less than six years of age or bedridden, debilitated, or geriatric patients. It is also contraindicated for patients with dysphagia, gastric retention, or hiatal hernias. Mineral oil should be avoided for frequent or prolonged use.

Saline laxatives

Saline laxatives include milk of magnesia or citrate of magnesia and should be taken only infrequently in single doses. Saline laxatives should never be taken regularly or on a repeated basis without the consultation of a healthcare provider. Onset of the saline laxative action is within a half-hour to three hours.

Side effects of saline laxatives, especially when used for prolonged periods or in overdose, can include electrolyte imbalance, CNS symptoms of weakness, sedation and confusion, or edema. More severe side effects are seen in cardiac, renal, and hepatic complications. Saline laxatives are contraindicated for patients with CHF or other cardiac diseases, cirrhosis, or renal disorders and those taking diuretics.

Stimulant laxatives

These laxatives are cathartic in action. They produce strong peristaltic activity and may also alter intestinal secretions in several ways. Many stimulant laxatives are found OTC and are habit forming. Long-term use may result in laxative dependence and loss of normal bowel functions. With all stimulant laxatives there are some degree of abdominal discomfort. Stimulating laxatives should be used when rapid, thorough emptying of the bowel is required. When a patient is scheduled for a sigmoidoscopy, GI x-rays when barium is used or proctoscopies, the use of stimulant laxatives is commonly given as preprocedure medication dosaging. The onset of action can be as quickly as 25 minutes up to eight hours.

Side effects of stimulant laxatives are common, especially with frequent use. These side effects include abdominal cramps or discomfort, frequent nausea, rectal and or colonic irritation (with suppositories), loss of normal bowel function, and electrolyte disturbances.

The contraindications include acute abdominal pain or cramping because of the danger of rupturing of the appendix. Additionally, children, patients who are pregnant or lactating, or who have ulcerative colitis should not use stimulating laxatives. Some stool softeners also contain stimulant laxative ingredients and should be used with caution.

Hyperosmotic laxatives

Hyperosmotic laxatives such as glycerin and lactulose are generally given rectally, while sorbitol is a solution taken orally. All of these medications produce an action that draws water from the tissues into the feces and reflexively stimulates evacuation. All three of the hyperosmotic laxatives have different properties making the action times different. The lactulose response may take 24–48 hours, where the glycerin suppositories or enemas can cause evacuation of the colon within 15–60 minutes. With sorbitol, only extremely high doses exert laxative actions, but the result is usually diarrhea.

As with any laxative, patient-education includes increasing fluids, adequate high-fiber diet, regular exercise, and avoiding long-term use of any laxative product without the direction from a healthcare provider.

Use the following table as a quick reference to the more common GI cathartic medications used in the MTF.

GI Medications Table II		
Generic Name	Trade Name	Average Dosage
Laxatives		
Bulk-forming	Metamucil Konsyl-D Fiberall	Powder, 1 tsp dissolved in full glass of fluid 1–3 times per day.
Stool softener	Surfak Doxidan Dialose Colace	Oral caps, liquid 50–360 mg qd.
Mineral oil	Milkinol Kondremul	5–45 ml po.
Saline laxatives	Milk of Magnesia	300–600 mg tabs. 30–60 ml suspension qd.
Stimulant laxatives Cascara sagrada		5 ml single dose.
Senna	X-prep Senokot	8.6 mg tab, 1–2 bid. 10–15 ml syrup bid.

GI Medications Table II		
Generic Name	Trade Name	Average Dosage
Laxatives		
Bisacodyl	Dulcolax	5-15 mg tabs.
Hyperosmotic laxatives Glycerin	glycerin supp or enema	2-3 supp PRN. 5-15 ml PRN.
Sorbitol	D-Glucitol	po, 30-100 ml of 70% sol. R, 120 ml of 25-30% sol.
Lactulose	Cephulac Enulose	po, 15-60 ml qd.

Antiemetics

Antiemetics are used to treat or prevent nausea, vomiting, or motion sickness. There are many different types of products available, varying in their actions, the condition treated, and the route of administration. For many, preoperative antiemetic prevention or postoperative treatment for nausea and vomiting, Phenergan is usually the drug of choice. For patients undergoing chemotherapy, Sofran, Kytril, and Anzemet are also used.

For prophylaxis of motion sickness, dimenhydrinate drugs (Dramamine or Scopolamine) are used. The most effective is the Transderm-Scop patch. It is applied behind the ear four hours before anticipated exposure to motion lasting up to 72 hours. Dramamine is taken orally 30 minutes before expected motion. Both of these drugs are available via IM injection for patients who have already developed motion sickness.

Meclizine (Antivert) is classified as an antihistamine as well as an antiemetic. It is used in the prevention and treatment of nausea, vomiting, and/or vertigo associated with motion sickness. It is also used for the symptoms associated with Meniere's disease. The onset of action is about one hour with effects persisting 8-24 hours after a single oral dose. Meclizine produces fewer adverse anticholinergic effects than Scopolamine, but it can cause drowsiness and is not recommended for children under 12 years of age.

Side effects of antiemetics vary with the drug, dosage, and route chosen, but many side effects are common among all of the types. These side effects include confusion, anxiety, restlessness, sedation, drowsiness, and depression. Anticholinergic effects as dry mouth and blurred vision are also common. When administering IV, it may cause cardiac arrhythmias when administered too fast.

When administering antiemetics to children and adolescents, there is an increased risk of Reye's syndrome especially with Compazine. Other contraindications include patients who are pregnant or lactating, geriatric, have known history of cardiac arrhythmias or hypertension and seizure disorders. Caution should also be taken when administering to patients with prostatic hypertrophy and angle-closure glaucoma.

Antiemetic interactions may cause a sedative effect when taken in conjunction with CNS depressants, including tranquilizers, hypnotics, analgesics, and antipsychotics. Alcohol, muscle relaxants, and metoclopramide also increase the potentiation of sedation.

Patients taking antiemetics should be informed of the interactions list, to report effectiveness or complications, and take these medications only under medical supervision.

The following table is a quick reference list to the common emetic and antiemetic medications used more often in the MTF.

GI Medications Table III		
Generic Name	Trade Name	Average Dosage
Emetics		
Ipecac syrup		Adult dose: po, 30 ml followed by 1–2 8 oz glass of water; may be repeated once in 20 min if necessary.
Apomorphine hydrochloride		Adult dose: sub q, 2–10 mg as a single dose.
For children, follow manufacturer instructions for appropriate age, weight, and dosage necessary.		
Antiemetics		
Prochlorperazine	Compazine	po, IM, IV or supp, 25 mg. po or IM, 5–10 mg qid.
Promethazine	Phenergan	Tabs, syrup, IM or supp 25 mg.
Dimenhydrinate	Dramamine	po or IM 50–100 mg q4h PRN for motion sickness.
Scopolamine	Transderm-Scop	0.5 mg q 72h for motion sickness.
Meclizine	Antivert	25–50 mg qd, 1hr before motion. 25–100 mg divided doses for Meniere's.

Antimigraine

Antimigraine drugs are medicines used to prevent or reduce the severity of migraine headaches. Migraine headaches usually cause a throbbing pain on one side of the head. Nausea, vomiting, dizziness, increased sensitivity to light and sound, and other symptoms may accompany the pain. The attacks may last for several hours or for a day or more and may come as often as several times a week. Some people who get migraine headaches have warning signals before the headaches begin, such as restlessness, tingling in an arm or leg, or seeing patterns of flashing lights, smelling, tasting, or hearing something strange. This set of signals is called an aura. Common triggers for migraines are foods or substances that contain nitrates and monosodium glutamate (MSG), such as red wine, Asian food, caffeine, chocolate, aspartame (a sugar substitute), perfume, and food additives. Most patients who suffer from migraines avoid these substances to prevent migraines. There are two primary goals of migraine therapy: treatment to stop the migraine in progress and to prevent the onset of migraines (prophylaxis). It is best to treat the migraine early in the onset as therapy is most effective if started before the migraine is severe. The two major antimigraine drug classes are triptans and ergot alkaloids. Both of these classes stimulate serotonin.

Triptans

Serotonin receptors are found in the CNS, cardiovascular, and GI systems. If OTC medications do not work to subside the migraine pain, triptans are normally the first drug of choice. A commonly used triptan drug is sumatriptan (Imitrex). While this medication is available in oral form, it is often administered intranasally or injected subcutaneously due to nausea and vomiting caused by the migraine.

Ergot alkaloids

Ergotamine is an inexpensive drug available in oral, sublingual, or suppository forms and was originally derived from a purified alkaloid that was isolated from the ergot fungus. Other forms of ergot alkaloids are dihydroergotamine and may be administered in a nasal spray or injection.

Other types of antimigraine drugs are antiseizure medicines, antidepressants, calcium channel blockers, and beta-blockers. These medications are sometimes prescribed as prophylaxis for patients

who do not respond well to triptans or ergot alkaloids to prevent attacks in people with very severe or frequent migraines.

418. Endocrine medications

What is the first medication that comes to mind when you think of the endocrine medications? Is it insulin, or maybe Synthroid? Both are correct, and both affect hormones differently. With so many different hormones released in the body and a variety of reasons there may be a lack of production, we will cover the highlights most common to the patient population in the MTFs.

The five-level anatomy and physiology volume went into detail of the endocrine system and all of the different glands and the hormones they produce. The production of these hormones is what is expected, but not always achieved, in every individual. Endocrine refers to an internal secretion (hormone) produced by a ductless gland that secretes directly into the bloodstream. Endocrine medications include both natural hormones secreted by the ductless glands and their synthetic hormone substitutes.

This lesson will not include the hormones related to the reproductive system. The deficiency of reproductive hormones is generally related specifically to reproduction or in association with age and does not affect the majority of the population on military facilities. This lesson will focus on three categories of endocrine medications: adrenal corticosteroids, thyroid agents, and the most common, antidiabetic agents.

Adrenal corticosteroids

The adrenal glands are located atop of each kidney and secrete hormones called corticosteroids. These hormones act on the immune system to suppress the body's response to either infection or trauma. There are two broad categories corticosteroids are divided into: replacement therapy when secretions of the pituitary or adrenal glands are deficient, and anti-inflammatory/ immunosuppressant properties. Keep in mind that corticosteroid therapy is not *curative* but is supportive therapy.

Adrenal corticosteroids are more widely used for short-term therapy than long-term. The risks and side effects increase with long-term therapy. With long-term therapy, it is recommended to use corticosteroids by alternate-day therapy. Withdrawal of corticosteroids following long-term therapy should always be gradual with a tapering of the doses. Abrupt withdrawal can lead to acute adrenal insufficiency, shock, and possibly death.

Some of the conditions used to treat on a short-term therapy regimen include:

- Allergic reactions—Insect bites, poison plants, chemical, or other medication reactions. Symptoms include rash, hives, or anaphylaxis.
- Acute flare-ups of rheumatic or collagen disorders—A few inflamed joints can be injected with corticosteroids to decrease crippling, or in life-threatening situations, rheumatic carditis.
- Acute respiratory disorders—Status asthmaticus (oral inhalations are preferred). May be used to prevent hyaline membrane disease in premature neonates by administering IM to the mother at least 24 hrs before delivery.
- Organ transplant—Corticosteroids are used with other immunosuppressive drugs to prevent rejection of transplanted organs.

Because of the potentially serious side effects, corticosteroids are administered for the shortest time possible. Local administration to the affected area is beneficial and decreases the possibility to systemic effects. Local administration through ointments, intra-articular injections, ophthalmic drops, and respiratory aerosol inhalants are just some of the options available.

Side effects of corticosteroids are worse with long-term use and include:

- Adrenocortical insufficiency and atrophy.
- Delayed wound healing and increased susceptibility to infection.

- Fluid and electrolyte imbalance, possibly resulting in edema, potassium loss, hypertension, and CHF.
- Muscle pain and weakness.
- Increased risk with elderly women developing osteoporosis with fractures.
- Stunting the growth in children from a premature closure of bone ends.
- Increased intraocular pressure or cataracts.
- Endocrine disorders: cushingoid state (physical characteristics of the swollen cheeks associated with Cushing's syndrome), amenorrhea, hyperglycemia.
- Nausea, vomiting, diarrhea, or constipation.
- Gastric or esophageal irritation, ulceration, or hemorrhage.
- CNS effects including headache, vertigo, insomnia, euphoria, psychosis, or anxiety.
- Petechia, easy bruising, and skin thinning and tearing.

The following are the list of contraindications or extreme caution uses:

- Long-term use must be regulated carefully.
- Viral or bacterial infections; used only in life-threatening situations along with appropriate anti-infectives.
- Exaggerated responses to corticosteroids when treating hypothyroidism or cirrhosis.
- Hypertension or CHF.
- Patients with history of psychosis or emotional instability.
- Increased hyperglycemia with diabetic drugs.
- Increases intraocular pressure caution with glaucoma drugs.
- Precipitates ulcers, caution with history of gastric or esophageal irritation.
- Retards growth in children.
- Patients with a history of thromboembolic disorders, seizures, or immunosuppression.

Corticosteroid drugs interact with barbiturates, estrogen and oral contraceptives, diuretics, NSAIDs as well as vaccines and toxoids.

Administration of corticosteroids must be accompanied by strict patient-education. Patients must know to follow the exact dosage and administration or never take the medication longer than indicated and *never stop taking the medication abruptly*. The patient must notify the healthcare provider of any signs of infection or trauma while taking corticosteroids. If a patient was treated with long-term therapy, he or she must notify the healthcare provider up to 12 months after the discontinuation of the therapy. Educate the patient of the dangers of infection, delayed wound healing, osteoporosis, and mental disorders that may occur during corticosteroid therapy.

Use the following table as a quick reference for the more common corticosteroids used in the MTF. Keep in mind to always review the side effects, contraindications, and interactions prior to administration.

Adrenal Corticosteroids		
Generic Name	Trade Name	Route ^a
Cortisone	Cortone	po, IM for replacement.
Dexamethasone	Decadron	po, IV, IM, inhalation.
Methylpredisone	Medrol or Solu-Medrol	po, IV, deep IM.
Prednisone	Predisone, Deltasone	po tabs or solution.
Triamcinolone	Aristocort, Kenalog	po, IM.

^a The dosage will vary greatly, depending on the condition treated. Massive doses are given for acute conditions on a short-term basis. Long-term therapy is usually alternative-day and dosage is reduced gradually.

Thyroid agents

Thyroid agents are used to treat either hyperthyroidism or hypothyroidism. With hyperthyroidism the thyroid is usually enlarged and is secreting greater than normal amounts of thyroid hormones. Antithyroid medications may be used in conjunction with the preparation for surgical radioactive iodine therapy.

Side effects of antithyroid medications are rare and may include rash, urticaria, purities, and blood dyscrasias. Prolonged therapy of antithyroid medications is seldom used. Caution should be taken when patients are using the antithyroids for a significant amount of time while waiting for surgical treatment. Antithyroids are contraindicated for patients with a history of hepatic disorders or are pregnant or lactating. Make sure the patient knows to notify his or her healthcare provider at the immediate onset of illness. Signs include chills, fever, rash, sore throat, malaise, and jaundice.

Hypothyroidism is an underutilization of the thyroid. The causes can be from an overdose of antithyroid medication, surgical removal of the thyroid, a lack of stimulating hormones from either the hypothalamus or the pituitary glands, or atrophy of the thyroid gland itself. Symptoms of hypothyroidism are caused by a slowed metabolism. These symptoms range from fatigue, dry skin, weight gain, sensitivity to cold, irregular menses, and mental deterioration, if untreated.

Toxic effects of thyroid agents manifest in the signs of hyperthyroidism. These signs can include palpitations, tachycardia, and increased blood pressure. They may also include nervousness, tremors, headaches, excessive sweating, weight loss, and insomnia. The patient must be advised to notify the healthcare provider if these symptoms occur while taking thyroid agents.

Thyroid agents are contraindicated for patients with known cardiovascular disease, elderly persons, and patients with adrenal insufficiency or with diabetes. Interactions of thyroid agents may occur with anticoagulants and oral hypoglycemics. Patient education for taking thyroid agents should include not only the possible toxic effects but also the importance of taking the prescribed dosage consistently every day. Periodic follow-up with a laboratory test is also important to ensure the medication is effective at the dosage being taken.

The following table is a small sample of the thyroid agents more commonly used in the MTF.

Thyroid Agents		
Generic Name	Trade Name	Average Dosage
Antithyroid Agents		
Methimazole	Tapazole	Tabs, 5–30 mg qd, in divided doses.
Propylthiouracil	Propylthiouracil (PTU)	Tabs 100–150 mg qd in divided doses.
Thyroid		
Levothyroxine	Synthroid, Levothroid, Levoxyl	po 100–200 µg qd.
Thyroid	Thyroid	po 60–180 mg qd.

Antidiabetic agents

Diabetes is classified as either type I or type II. Type I is considered insulin dependent, while type II is noninsulin dependent. Type II was previously described as maturity-onset diabetes because it was identified in adults over age 40. However, adults can also develop type I, requiring insulin. In recent years, there has been an increase in children and young adults with type II diabetes due to an increase in obesity at an earlier age. The purpose of antidiabetic agents is to manage a person's diabetes by lowering blood glucose levels.

Insulin

Insulin is required as a replacement therapy for type I diabetics; there is an insufficient production of insulin from the pancreas to control the amount of glucose in the blood. For patients type II diabetics who have failed to maintain satisfactory blood glucose with diet regulation and oral antidiabetic medications, insulin may be necessary. Insulin may also be required for stable type II at the time of surgery, fever, severe trauma, infection or pregnancy.

Insulin is generally administered parenterally because it is destroyed through the GI tract. In the past, insulin was prepared from beef or pork pancreas. Although pork insulin is still used, a new and different form has recently become available. The new form of insulin is called insulin human, because the structure is identical to human insulin. However, it is prepared in the laboratory two different ways:

- Biosynthetic preparation—This preparation includes a complex series of scientific steps in which cultures of *Escherichia coli* are modified by *recombinant deoxyribonucleic acid (DNA) technology* to produce Humulin R (regular) and Humulin N (isophane).
- Semisynthetic preparation—This involves purifying or modifying pork insulin to produce such insulin as Iletin II Purified (Regular) and Iletin II Purified NPH (isophane).

The only insulin administered intravenously is Humulin R. Biosynthetic insulin human (Humulin) is preferred to insulin from animal sources for inpatients with systemic allergic reactions or for patients who are very difficult to regulate.

Most insulin used today is U-100; there are 100 units of insulin in each millimeter. To ensure accurate dosage, you must use the insulin syringe marked U-100. Each mark on the U-100 insulin syringe represents two units of insulin. If a smaller U-50 syringe is used, each line represents 1 unit of insulin (fig 3-2). Always have someone else compare the insulin in the syringe with the dosage ordered before administration to prevent errors. Improper dosage could have serious consequences.

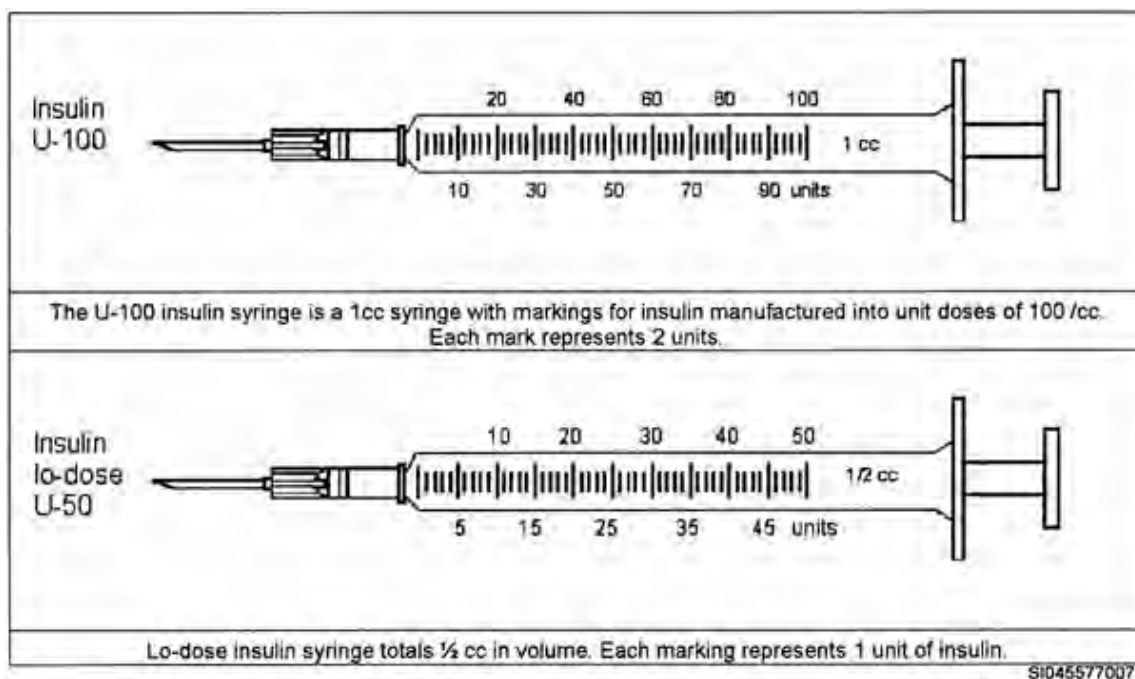


Figure 3-2. Insulin syringes.

When beginning insulin therapy, close monitoring for hypoglycemia is necessary. Insulin preparations differ mainly in their onset, peak, and duration of action. The onset is the amount of time between the time a drug is administered and the first sign of its effects. The peak is the highest

concentration attained from a dose. The duration is the time period from the onset of the drug action to the time when response is no longer seen (fig. 3-3).

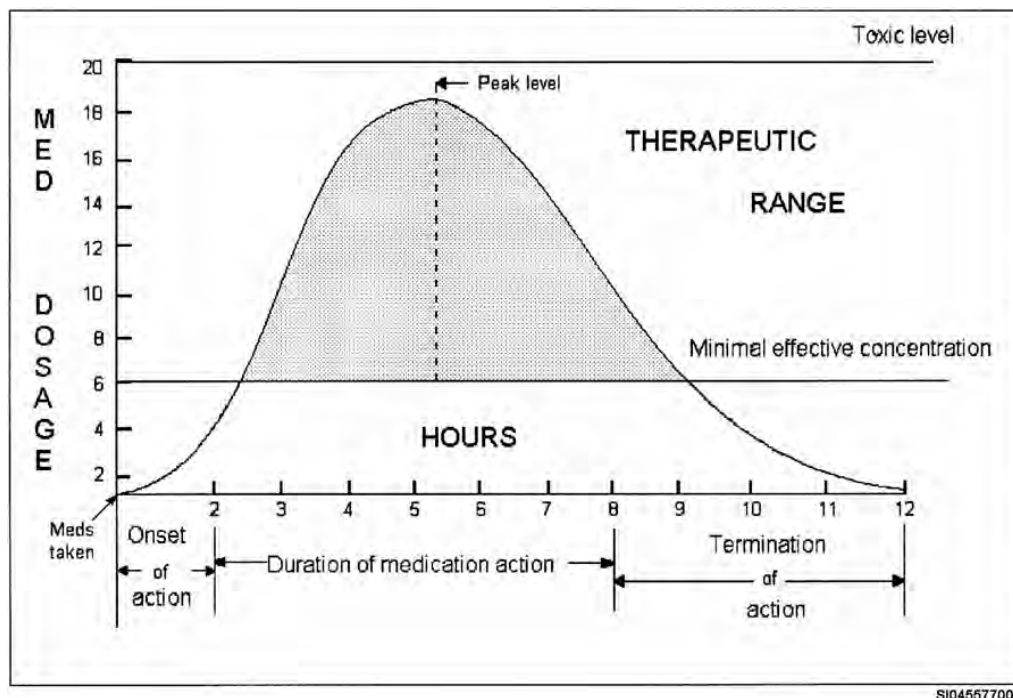


Figure 3-3. Medication concentration.

Insulin is used to counteract, prevent, or control hyperglycemia. Hyperglycemia is not only caused by insufficient insulin production by the pancreas but may also result from insufficient insulin doses, infections, surgical or other trauma, emotional stress, other endocrine disorders, and pregnancy. Some of the symptoms of hyperglycemia may include dehydration and excessive thirst, unexplained weight loss, polyuria, fruity breath, and ketoacidosis.

The treatment for acute hyperglycemia includes IV fluids to correct electrolyte imbalance and *regular insulin* administered IV. Insulin has an antagonistic action with corticosteroids or epinephrine, necessitating the increased insulin dosage. Oral contraceptives and estrogen may also increase the need for a higher dose of insulin.

Insulin may potentiate a hypoglycemic effect when taken concurrently with alcohol, MAOIs, salicylates, and anabolic steroids.

Diabetic patients may also become hypoglycemic as a result of an overdose of insulin, a delay or insufficient food intake, excessive or unusual exercise, or when there has been a change in the type of insulin being used. An example may be when the patient changes from pork to human insulin. The body will take time to adjust to the different onset, duration, and termination action of the new insulin.

Some symptoms of hypoglycemia may develop suddenly and are usually seen during the peak of the insulin action. These symptoms may include increased perspiration, irritability, confusion, or bizarre behavior. Individuals may experience tremors, weakness, headache, or tingling of the fingers. In severe cases the individual may lose consciousness and have convulsions, if untreated.

The treatment for hypoglycemia depends if the individual is conscious and coherent or comatose. For the conscious patient, a small glass of orange juice, hard candy, honey, or syrup can be used for initial treatment of hypoglycemia. If the patient is comatose, administer 10–30 ml of 50 percent dextrose solution IV or administration of 0.5–1 U of glucagons (1 mg) IM or IV followed up with a carbohydrate snack when the patient awakens to prevent a secondary hypoglycemia incident. It is

very important for the patient to follow up with the healthcare provider and to closely monitor blood glucose levels.

The following table is **not** an all-inclusive list of insulin. Dosages vary among each medication and manufacturer. With all medication administration, you must check the expiration date. Make sure you check the *clarity* of *regular* insulin. *Isophane* and *zinc* insulins are *cloudy*. Open vials may be stored at room temperature.

Insulins					
Preparation	Trade Name	Action	Onset (hr)	Peak (hr)	Duration (hr)
Regular	Humulin R	Rapid acting	$\frac{1}{2}$ –1	1–3	8–12
	Novolin R				
	Regular Iletin II				
Isophane (NPH)	Humulin N	Intermediate acting	1–2½	4–15	18–24
	Novolin N				
	NPH Iletin II				
Lenten	Humulin L	Long acting	4–8	10–30	36
	Novolin L				
	Lenten Iletin II				
Ultralente	Humulin U				

Oral antidiabetic agents

Insulin is not the only treatment for diabetes. Exercise is part of the treatment, along with a well-balanced diet and proper eating schedule. Oral medications may also be part of the type II diabetic treatment.

Oral antidiabetic medications may be administered as a single daily dose before breakfast or divided into two daily doses: one before breakfast and once before the evening meal. These medications are *not* a substitute for dietary management, only a part of the prescribed diabetic treatment. Weight reduction and modified diet that is low-fat, low-calorie, and sugar-free, are still considered the principal therapy for the management of type II diabetes.

Some of the symptoms associated with type II diabetes may include excessive weight gain (especially noted after age 40), excessive thirst (polydipsia), polyuria, excessive weakness, slow healing, and vision problems. If these symptoms occur, diagnosis of type II diabetes must be confirmed and managed by a healthcare provider.

Oral antidiabetic medications are available in several pharmacology classifications. Each classification differs in mechanism of action offering different avenues to reduce the glucose level. Because these medications work at different sites, they are often synergistic; some may be used in combination with other oral antidiabetic medication or with insulin.

Sulfonylureas

The sulfonylureas work by increasing the insulin production from the pancreas and by improving peripheral insulin activity. There are first- and second-generation sulfonylureas. The second-generation medications are used more often because of the higher potency, better tolerance, and fewer drug interactions.

Some of the side effects of sulfonylureas may include GI distress, especially at the beginning of the treatment. Dermatologic effects may include pruritus, rash, urticarial, or photosensitivity. Other side effects include weakness, fatigue, lethargy, vertigo, and headache.

Contraindications or extreme caution with sulfonylureas include patients with known liver and kidney impairment, debilitated or malnourished patients, and patients with severe infection. Caution must also be taken when patients must undergo major surgery or have severe trauma.

Interactions with sulfonylureas that cause a potentiation of hypoglycemic effects include beta-blockers, MAOIs, sulfonamides, salicylates, and other nonsteroidal anti-inflammatory agents. Sulfonylureas may also have antagonistic actions with thyroid hormones, Thiazide diuretics, corticosteroids, estrogens and oral contraceptives, as well as calcium channel blockers. When any of these medications are administered along with the sulfonylureas, the patient should be observed closely for loss of diabetic control.

Biguanides

Glucophage (metformin) is one of the more common biguanides. It works by decreasing hepatic glucose output and enhancing insulin sensitivity in muscle. Glucophage is often used as initial monotherapy but can be used in combination with sulfonylureas.

Biguanides affect the GI system; signs and symptoms include diarrhea, nausea, vomiting, bloating, flatulence, and anorexia. These will generally resolve during the course of treatment tolerance. To minimize epigastric discomfort, medication can be taken with food. Some patients may also experience hypoglycemia effects initially with treatment.

The contraindications or extreme cautions apply to patients with known impaired liver and kidney function, patients with history of CHF, or for pregnant or lactating mothers. Notify the healthcare provider when an individual is in need of radio contrast dye for a procedure; metformin may need to be withheld before the test being performed. The result of administration of a radio contrast dye with metformin may result in acute alteration of renal functions for the individual.

An increased metformin effect is seen when combined with the following:

- Alcohol.
- Calcium channel blockers.
- Cimetidine (Tagamet).
- Furosemide (Lasix).
- Digoxin.
- Morphine.
- Procainamide.
- Quinidine.
- Ranitidine (Zantac).
- Vancomycin.

Monitor closely for hypoglycemia when patients are taking any of these drugs concurrently with metformins.

Use the following table as a reference to some of the more common oral antidiabetic agents used in the MTF.

Oral Antidiabetic Agents		
Generic Name	Trade Name	Average Dosage
Sulfonylureas		
Chlorpropamide	Diabinese	100–500 mg qd with meals (not used in the elderly).
Glipizide	Glucotrol	2.5–20 mg qd before meals (ac) or divided.
	Glucotrol XL	5–20 mg qd with meal.
Glyburide	Diabeta, Micronase	1.25–20 mg qd or divided with meals

Biguanides		
Metformin	Glucophage	500–2550 mg divided with meals.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

414. Pain relief

1. How can a healthcare worker assess a patient's level of pain?
2. Define endorphins.
3. What are the three classifications of analgesics?
4. List the side effects of opioids.
5. Match the name of the medications in column A to the analgesic classification in column B. The answers in column B may be used more than once.

Column A

- ____ (1) ReVia.
- ____ (2) Bufferin.
- ____ (3) Stadol.
- ____ (4) Panadol.
- ____ (5) Codine.
- ____ (6) Narcan.
- ____ (7) Ultram.
- ____ (8) Demerol.
- ____ (9) Equagesic.
- ____ (10) Percocet.

Column B

- a. Nonopioid analgesic.
- b. Opioid antagonist.
- c. Opioid analgesic.

6. What does the lay public need to be aware of when considering nonopioid analgesics?
7. List five disorders for which anti-inflammatories are commonly prescribed.
8. Explain the function of a COX-2 inhibitor.

9. Barbiturates are commonly associated with what situations, and why?
10. List the side effects of nonbarbiturates.

415. Psychotropic medications

1. How do psychotropic medications work?
2. Why are CNS stimulants given?
3. Antidepressants work in conjunction with which neurotransmitters?
4. What is the function of an antidepressant?
5. What disorders are both Remeron and Serzone used to treat?
6. What is the antidepressant action of the MAOIs?
7. What are the signs of lithium toxicity?

416. Cardiac medications

1. What are some of the factors considered when antiarrhythmic agents are chosen?
2. How do β -adrenergic blockers work?

3. Match the disorders in column A to the drug of choice in column B. The answers of column B may be used more than once.

<i>Column A</i>	<i>Column B</i>
____ (1) Angina.	a. Atenolol.
____ (2) Atrial fibrillation.	b. Calcium channel blocker.
____ (3) Lung conditions.	c. Procainamide.
____ (4) Life-threatening ventricular arrhythmias.	d. Cardiac glycoside.
____ (5) Atrial flutter.	e. Lidocaine.
____ (6) Hypertension.	f. Inderal.
____ (7) Prophylactic after cardioversion.	g. Tonocard.
____ (8) PVC.	h. Quinidine.
____ (9) CHF.	
____ (10) Tachycardia.	

4. The use of local anesthetics for antiarrhythmic therapy is contraindicated for what type of patients?
5. What are the initial treatments used for mild hypertension?
6. What drug is used to treat hypertensive patients with neuropathy, and why?
7. Explain the action of coumarin derivatives.
8. Explain the guidelines for giving thrombolytic agents.

417. Gastrointestinal medications

1. What factors will the choice of antacid be dependant upon?
2. What is the primary use of antidiarrheal agents?
3. What should the patient education include when taking absorbents and protectants?
4. What are the contraindications for taking Lomotil and Imodium?

5. Lactinex is used for the treatment of what conditions?
6. What is the treatment of choice for simple constipation, and what form is it available in?
7. Which form of cathartic is the primary choice for pregnant women and children?
8. What situations are stimulant laxatives used for?
9. Under what conditions are antiemetics used?

418. Endocrine medications

1. How do the adrenal glands function?
2. Match the conditions in column A to the short or long-term corticosteroid therapy in column B. The answers in column B may be used more than once.

Column A

- ____ (1) Delayed wound healing.
- ____ (2) Organ transplant.
- ____ (3) Muscle pain and weakness.
- ____ (4) Fluid and electrolyte imbalance.
- ____ (5) Acute respiratory disorders.
- ____ (6) Gastric or esophageal irritation, ulceration, or hemorrhage.
- ____ (7) Acute flare-ups of rheumatic or collagen disorders.
- ____ (8) Stunting the growth in children.
- ____ (9) Allergic reactions.
- ____ (10) Petechia, easy bruising, and skin thinning or tearing.

Column B

- a. Short-term therapy.
- b. Long-term side effects.

3. Explain hypothyroidism and the signs and symptoms.
4. Why is insulin administered parenterally?
5. Explain peak, onset, and duration of medication concentration.

6. List the signs and symptoms of hypoglycemia, and when do these signs usually occur?
7. List the contraindications of sulfonylureas.
8. Explain the action of Glucophage.

3-2. Medications for Infection Treatment and Disease Prevention

Treatment of infection with medications is complicated by the large variety of drugs available and the differing modes of action of each drug.

As an Aerospace Medical Service technician, you will be involved in coordinating or providing annual or mobility immunizations. As a military member, you will receive updates to many immunizations that were given during childhood as well as receiving annual vaccines. Journeymen are eligible to become certified Immunizations Back-Up Technicians (IBT) or apply to take the Immunizations Technician course to obtain the SEI 454 with your commander's approval. Your supervisor can help you obtain all of the information on these courses from the current career field education and training plan (CFETP).

419. Infection-fighting agents

Most of us have been to the doctor for an infection of some kind at least once in our lives. It may have been for strep throat, a sinus infection, or perhaps an infection from a wound. This section will introduce you to some common categories of infection-fighting agents.

Anti-infectives/antibiotics

The first step in anti-infective drug therapy is to determine the causative organism and the specific medication to which it is sensitive. The provider will order a culture and sensitivity test based on the individual symptoms and where the infection is located. Since a culture and sensitivity test takes 24-48 hrs to become available, the use of broad-spectrum antibiotics may be ordered and administered in the meantime.

It would be unrealistic to list all of the anti-infective agents on the market. There are six categories of anti-infective agents you will review and just a few of the more common drugs in each category. The six categories are aminoglycosides, cephalosporins, macrolides, penicillins, quinolones, and tetracyclines. Vaccines, which are also classified as anti-infectives, are covered in the next lesson.

Aminoglycosides

In combinations with other antibiotics, aminoglycosides are used to treat many infections caused by either gram-negative bacteria (*pseudomonas* and *salmonella*) or gram-positive bacteria (*staphylococcus aureus*). Aminoglycosides are for the short-term treatment of many serious infections (septicemia) only when other less toxic anti-infectives are ineffective or are contraindicated. Because of the poor absorption from the GI tract, aminoglycosides are usually administered parenterally.

Side effects of aminoglycosides can be serious, especially in the elderly, dehydrated, or those with renal or hearing impairment. Side effects can include CNS symptoms such as headache, tremors, lethargy, numbness, or seizures. Neuromuscular blocking can include respiratory paralysis. Vision impairment, rash, or urticaria, along with nephrotoxicity and ototoxicity, can occur.

Contraindications or extreme caution should be noted with patients who have tinnitus, vertigo, and high-frequency hearing loss. This also includes individuals having reduced renal functions, dehydration, pregnant or nursing, and with infants and the elderly. Interactions may occur with general anesthetics or neuromuscular-blocking agents causing respiratory paralysis and antiemetics, which mask symptoms of vestibular ototoxicity. Patients should be educated to carefully monitor intake and urinary output and prompt reporting of any side effect.

Cephalosporins

These are semisynthetic antibiotics derivatives produced by a fungus and are closely related to the penicillins. Some patients allergic to penicillin are also allergic to cephalosporins. As a general rule, cephalosporins are broad-spectrum and active against many gram-positive and gram-negative bacteria. Cephalosporins are classified as first-, second-, third-, or fourth-generation drugs, according to the organism susceptible to their activity.

First generation is usually effective against gram-positive organisms, such as those that cause some pneumonias or urinary tract infections. Second generations are usually effective against many gram-positive and gram-negative bacteria like many strains causing bacterial influenza. Third-generations drugs are used in the treatment of mostly gram-negative bacteria and sometimes used for sexually transmitted disease as gonorrhea. The fourth generation of cephalosporins is new. The parenteral cephalosporin, Maxipime, works well with both gram-positive and gram-negative bacteria.

A culture and sensitivity are essential to determine which cephalosporin is appropriate. Different drugs are used to treat different infections of the respiratory tract, skin, urinary tract, bones, and joints just to name a few. They can also be used prophylactically for many types of surgery, especially for high-risk patients.

The side effects are not new, but remember that cephalosporins are known to produce a hypersensitivity reaction in individuals with known penicillin allergies. Other side effects include blood dyscrasias (increased bleeding time), renal toxicity, mild hepatic dysfunction, nausea, vomiting, and diarrhea. Parenteral administration may cause phlebitis and pain at the site of an IM injection. The more severe side effects can include respiratory distress and seizures.

Contraindications or extreme caution applies to patients with renal impairment or known allergies to penicillin (3–6 percent cross-sensitivity). Prolonged use may lead to superinfections or severe colitis. Caution is taken with pregnant or nursing women. The interactions can include flushing, tachycardia, and shock when mixed with alcohol and increased risk of nephrotoxicity with aminoglycosides or loop diuretics.

Macrolides

Erythromycin is just one of the many macrolides used for multiple types of infections. It is used in the treatment of infections of the respiratory tract, skin conditions, and sexually transmitted infections when patients are allergic to penicillins. The erythromycins are considered among the least toxic antibiotics and are therefore preferred for treating susceptible organism under conditions in which more toxic antibiotics might be dangerous (in patients with known renal diseases, pregnant patients, or small infants). Organisms resistant to erythromycins are increasing in number.

While serious side effects are rare, mild side effects, usually dose related, include anorexia, nausea, vomiting, diarrhea, and cramps. An individual may develop urticaria and rash or a superinfection from macrolides.

The contraindications or cautions apply to patients with liver dysfunction and alcoholism. With macrolides, the interactions may occur with potentiation of the following drugs and possible toxicity or effects: Tegretol—ataxia, dizziness, drowsiness; Cyclosporine—immunosuppressant with kidney/liver transplants; Halcion—potentiation of sedative effect of other benzodiazepines; Warafin—may prolong prothrombin time and bleeding.

Patients being treated with erythromycins should be instructed that GI side effects are expected and adding buttermilk or yogurt to their diet may help regulate the intestinal flora and reduce the incidence of diarrhea. The patient should also be reminded most erythromycins should be taken with a full glass of water one hour before or two hours after meals and to check the medication insert for the dosage being administered.

Penicillins

Penicillins are antibiotics produced from certain species of a fungus. They are used to treat many streptococcal and some staphylococcal and meningococcal infections, including respiratory and intestinal infections. Penicillin is the drug of choice when treating gonorrhea and syphilis; penicillin is prophylactically used for rheumatic fever and endocarditis. Some semisynthetic penicillins have a wider spectrum of activity and are called extended-spectrum penicillins. These wide-spectrum penicillins are used in the treatment of infections due to organisms such as *Pseudomonas*. A culture and sensitivity are essential to determine the appropriate form of penicillin to be used.

Serious side effects of penicillins can include hypersensitivity reactions ranging from rash to fatal anaphylaxis. Superinfections can develop when taking oral penicillin. Other side effects include nausea, vomiting, diarrhea, and renal and hepatic disorders. Blood dyscrasias may develop but are reversible with the discontinuance of the drug. CNS effects, including confusion, anxiety, and seizures, may also be experienced.

When administering penicillins, there are contraindications and extreme caution should be taken with patients having known history of drug allergies, impaired renal function, or electrolyte imbalance. Treatment for a severe reaction includes the discontinuance of the drug immediately; prompt medical attention (including airway maintenance, epinephrine and corticosteroids) or antihistamines may be used.

Penicillin interactions with other medications are varied. Potentiation of penicillin is seen with Benemid, anti-inflammatory drugs, and the salicylates given at the same time. Antagonistic effects of oral penicillins are evident when given with antacids or with food (delayed absorption). When taking penicillin or ampicillin, it has been noted to inhibit the action of estrogen-containing oral contraceptives, rendering them less effective.

Patient education for penicillins should include the discontinuance of the medication during, and immediate reporting of, any hypersensitivity reactions. Medication should be taken with full glass of water, on time, and with an empty stomach. Antacids should not be taken with penicillins, and alcohol consumption should be avoided. For women taking estrogen contraceptives for birth control, they should receive counseling to use a back-up method of birth control while taking the penicillin. Lastly, adding yogurt or buttermilk to their diet may help regulate intestinal flora and reduce incidence of diarrhea that may occur.

Quinolones

Cipro or Levaquin are just two of the quinolones used for adults in the treatment of some infections of the urinary tract, lower respiratory tract, GI tract, skin, bones, and joints. The problem is that these agents have potentially serious side effects, especially with children and the elderly. There are also some organisms showing an increased resistance to the quinolones. Because of the resistance increasing, culture and sensitivity should be accomplished before the treatment with quinolones.

Side effects of the quinolones can include nausea, vomiting, diarrhea, abdominal pain, and possibly colitis, especially in geriatric patients. CNS functions affected include dizziness, headache, confusion, irritability, seizures, and anxiety. Superinfection, hypersensitivity, and phototoxicity may also occur. Exposure to sunlight should be limited, as even small amounts of sun exposure can cause severe sunburn.

The contraindications or extreme cautions should be applied to elderly patients, especially with GI diseases or arteriosclerosis. Children or adolescents are at higher risk for cartilage damage. Patients

who are pregnant, lactating, have severe renal impairment, seizure disorders, or cardiac disease must be monitored for adverse effects.

Interactions of quinolones that may occur with theophylline can potentiate serious or fatal CNS effects to include cardiac arrest or respiratory failure. With Probenicid, increased blood levels of Cipro may be noted. Antacids, iron, magnesium, zinc, and calcium decrease the absorption, while coumadin increases the risk of bleeding.

When taking quinolones, patient education should include the need to drink liberal quantities of fluids, restrict caffeine intake, avoid excessive exposure to the sun, and report all side effects immediately.

Tetracyclines

This antibiotic is a broad-spectrum antibiotic used in the treatment of infections caused by rickettsiae, chlamydia, or some uncommon bacteria. Diseases, such as Rocky Mountain spotted fever, atypical pneumonia, some sexually transmitted diseases, and some severe cases of inflammatory acne are treated with tetracyclines. However, some organisms are showing an increased resistance to the tetracyclines, necessitating the use of these drugs only when other antibiotics are ineffective or contraindicated.

Side effects of tetracyclines can include nausea, vomiting, and diarrhea, usually dose related. Superinfections like vaginitis and stomatitis are frequent while being treated with tetracyclines. Other side effects include photosensitivity, discolored teeth, and retarded bone growth in young children or fetuses, CNS symptoms of vertigo, and cerebral edema. In addition, thrombophlebitis is possible with IV therapy.

Contraindications include patients who are pregnant, lactating, or are under the age of eight. Patients with liver or kidney disease or with esophageal obstruction or dysfunction should not take tetracycline. Interactions may occur with antagonistic effects (decreased absorption) when also taking antacids, calcium supplements, iron, zinc, or magnesium laxatives. Antidiarrheal agents containing kaolin, pectin, or bismuth also produce the antagonistic effects. When a patient is taking oral contraceptives for birth control, breakthrough bleeding and efficacy is lessened when taking tetracycline.

Patient education with tetracycline should include that administration is preferable on an empty stomach and with a full glass of water. Tetracyclines are not to be taken at bedtime to prevent irritation from esophageal reflux. To prevent extreme sunburn, direct sunlight should be avoided during the treatment.

The following table is a small sample of the more common anti-infective medications within the six categories. This list is not all-inclusive and is just a guideline for the average doses prescribed.

Anti-infectives/Antibiotics		
Generic Name	Trade Name	Average Dosage/Route
Aminoglycosides		
Gentamycin	Garamycin	IM, IV—1 mg/kg body weight q8h.
Cephalosporins		
First generation: effective against gram-positive organisms.		
Cephalexin	Kflex	po Cap, liquid, tab 250–500 mg q6h.
Cefasolin	Kefzol, Ancef	IM, IV 250 mg–2g q8h.
Second generation: effective against many gram-positive and gram-negative organisms.		
Cefaclor	Ceclor	po 250–500 mg q8h, cap, liquid.
	Ceclor CD	po 375–500 mg q12h, tab.
Cefurozime	Ceftin	po tab, liquid 125–500 mg q12h.

Anti-infectives/Antibiotics		
Generic Name	Trade Name	Average Dosage/Route
	Kefurox, Zinacef	IM, IV 750–1500 mg q6h.
Third generation: effective against more gram-negative bacteria and chancroid or gonorrhea.		
Cefixime	Suprax	po tab, liquid 400 mg q24h.
Ceftriaxone	Rocephin	IV, deep IM 250 mg–2g qd.
Fourth generation: effective against gram-positive and gram-negative bacteria.		
Cefepime	Maxipime	IV 500 mg–2 g q12h.
Macrolides		
Erythromycin	E-mycin, Ery-Tab Ilosone EES, EryPed Erythrocin	po tab, cap 250 q6h—500 mg q12h. po suspension, 250–500 mg q6–q12h. po tab, suspension 400–800 mg q6–q12h. IV 15–20 mg/kg/day divided q6h.
Azithromycin	Zithromax	IV 500 mg qd.
Penicillins		
Penicillin G	Bycillin L-A, Wycillin	Deep IM 600,000–2.4 million U.
Penicillin VK	V-Cillin K, Pen Vee K	po tab, liquid 250–500 mg q6h.
Amoxicillin	Amoxil	po caps, liquid 250 mg–1 g q8h.
Ampicillin	Ominpen	po caps, liquid 250 – 500 mg q6h. IM, IV 1–2 g q4–6h.
Extended-spectrum Amoxicillin-clavulanate	Augmentin	po tab, liquid 250 mg q8hr, 500–875 mg q12h.
Ticarcillin-clavulanate	Timentin	IV 3 g q4–6h.
Quinolones		
Ciprofloxacin	Cipro	po 250–750 mg tab q12h. IV 200–400 mg q12h.
Levofloxacin	Levaquin	po, IV 250–500 mg q24h.
Tetracyclines		
Tetracycline HCL	Sumycin	po cap, tab, suspension 250–500 mg q6–12h.
Doxycycline	Vibramycin	po cap, tab, suspension, IV 100–200 mg qd divided doses.

Antivirals

A class of medications used specifically to treat viral infections are called antiviral drugs. These drugs are used for specific viruses. Antiviral drugs are one class of antimicrobials and also a larger group, which includes antibiotic, antifungal, and antiparasitic drugs. They are used to treat infections since they are relatively harmless to the host. Antivirals available today are designed to help deal with human immunodeficiency virus (HIV), herpes viruses, hepatitis B and C viruses, as well as influenza A and B viruses. There is research being done to extend the range of antivirals to other disease-causing pathogens. Almost all antimicrobials including antivirals are subject to resistance due to the fact that pathogens adapt and change to survive even with the treatment.

Antifungals

Patients with healthy immune systems rarely experience serious fungal infections. However, those with suppressed immune systems may be affected by frequent and severe fungal infections that require intensive drug therapy. Both yeasts and molds are classified as types of fungi. Fungal infections are generally broken into two categories, superficial or systemic.

Superficial

Superficial fungal infections typically affect the scalp, skin, nails, and mucous membranes (oral cavity and vagina). These infections are commonly known as athlete's foot, ringworm, and candidiasis (thrush) and are often treated with topical medications.

Topical antifungals may be in cream, lotion, powder, aerosol, or solution form. Commonly used drugs are:

- Nystatin (Mycostatin) cream or powder applied two to three times a day to the affected area.
- Terbinafine HCl 1 percent (Lamisil Solution) solution or cream applied twice daily for two to six weeks.
- Tolnaftate 1 percent (Tinactin) cream, powder, solution, or aerosol applied twice daily for up to four weeks.

Systemic

Systemic fungal infections affect internal organs such as the brain, lungs, or digestive organs. While these infections are less common than superficial fungal infections, they can be serious or even fatal and may affect multiple body systems. These infections are generally treated with aggressive oral or parenteral medications. The drawback to this treatment is there are more side effects to these medications than with topical medications.

- Nystatin (Mycostatin, Nilstat, Nystex) 500,000–1,000,000 units three times a day (tid) for candidiasis.
- Voriconazole (Vfend) IV 6 mg/kg q 12h day 1, then 3–4 mg/kg q 12h for aspergillosis (lung infection).

420. Vaccines

Vaccines are used to stimulate active immunity against a variety of diseases, including typhoid fever, cholera, whooping cough, diphtheria, tetanus, polio, chicken pox, measles (rubeola), German measles (rubella), mumps, influenza, and hepatitis A and B. Through childhood vaccinations, the number of cases for many of these diseases have decreased greatly and virtually been eliminated from the world. Unfortunately, the distribution of vaccines is not equitable worldwide. Many thousands of people living in underdeveloped countries die of these infectious diseases for which vaccines are widely available in other nations.

Influenza

In 1991, approximately 77,000 died from influenza in the United States alone. This vaccine is administered annually to all active duty military and available to high-risk individuals as directed by their healthcare provider. Each year, there is a new vaccine manufactured corresponding to the strain identified for that year. It is a mandatory vaccination for all active duty members and is recommended for all healthcare workers in close contact with high-risk individuals.

Side effects of the flu vaccine are tenderness at the injection site, fever, and malaise. Currently, the flu vaccines contain only noninfectious, inactive (killed) viruses and cannot cause influenza. The flu vaccine is contraindicated for anyone with a history of a serious adverse reaction to the vaccine or its components or is allergic to eggs. In these cases, the individual should be referred for appropriate allergy testing by his or her healthcare provider. The flu vaccine should be delayed for individuals with any acute febrile illness, or have neurological disorders, until symptoms resolve.

Hepatitis

Hepatitis vaccines are given to military members. Hepatitis A is given to all individuals over the age of 19 years. Hepatitis B is indicated for healthcare workers and any persons in occupations that may be exposed to blood or blood products (housekeeping, police, firemen).

Hepatitis A

Annually there are 10 million reported cases of hepatitis A. Of these reported cases, 14,000 result in death. Hepatitis A is contracted through the transmission of fecal-oral contact with contaminated food or water. The purpose of the vaccine is to introduce an active immunity against infection, which can cause liver damage, caused by the hepatitis A virus. The hepatitis A vaccine is given in a two-series dose. The second injection is given 6–12 months after the initial dose. There has been no booster established at this time.

As with most injections, the side effects include soreness and redness at the site, with possible fatigue, fever, malaise, or nausea. The only contraindication to receiving the vaccine is a history of serious adverse reaction to components of the vaccine. Precautions should be taken when administering to persons with bleeding disorders, since bleeding may occur after injection. Immunization deferment should be advised for individuals with acute febrile illness or active infection.

Hepatitis B

There are approximately 170 million reported cases of hepatitis B annually. Of these reported cases 250,000 deaths occur. Hepatitis B is given in a series of three doses. The second dose is given one month after the initial dose, and the third is given six months from the initial dose. With an efficacy of 98 percent, currently there is no indication for a booster dose for individuals in good health. Hepatitis B is transmitted through direct contact with infected blood or blood products to include sexual contact.

The most frequent side effect of the hepatitis B vaccine is a warm, red, sore spot at the site of injection. Sometimes fatigue, fever, malaise, or nausea may occur. This vaccine is contraindicated for individuals with a history of serious reaction to the vaccine or its components. This reaction is possibly caused by hypersensitivity to yeast. Like the hepatitis A vaccine, immunization deferment should be advised for individuals with acute febrile illness or active infection.

Tetanus/diphtheria

The purpose of the tetanus/diphtheria (Td) vaccine is to introduce active immunity against tetanus and diphtheria. Tetanus immunity is important for military personnel and individuals whose occupation renders them susceptible to even simple lacerations and abrasions (crew chiefs, maintenance, or civil engineering). All recruits receive a booster dose upon entry into the Air Force. The primary series of tetanus is generally completed during routine childhood immunizations, consisting of a total of three doses. First an initial dose is given, followed by a second dose at 30 days, and a third dose 6–12 months later. Boosters are then given every 10 years. Prolonging the interval between primary immunizing doses equal or greater than six months does not interfere with final immunity. Count any dose, even if it was received a decade earlier, as one of the immunizing injections.

The side effects of the vaccination are localized to the injection site and include erythema, pain, tenderness, heat, and edema. It is not unusual for these side effects to show up 72 hours after receiving the vaccine. The vaccine is contraindicated for anyone having a history of serious adverse reaction to the vaccine or its components.

Measles, mumps, rubella

As the name implies, the measles, mumps, rubella (MMR) vaccine stimulates an active response against measles, mumps, and rubella. The transmission of this disease is airborne. All Air Force recruits, regardless of prior history, are screened by antibody test for measles and rubella upon entering active duty. If the test result is negative for the antibodies, the MMR vaccine is given. Individuals in high-risk groups, such as healthcare workers, may need a second dose. If a second dose is required, and the individual is negative to the antibodies, they will receive two injections 30 days apart from each other. If an individual has received the MMR vaccine after their first birthday, only one booster injection is necessary.

Side effects of the vaccine include burning or stinging for a short time at the injection site, along with soreness and redness. Reactions are usually mild and transient. A fever may develop, and a generalized rash that looks like the measles may develop 5–12 days after the injection. This is not contagious and should disappear in 2–5 days. The efficacy of the MMR vaccine is 97 percent.

Patients who are undergoing immunosuppressive therapy, are pregnant, have HIV, or a disease affecting the bone marrow or lymphatic system should not receive the MMR vaccine. Women should be advised to avoid becoming pregnant for at least one month after receiving the MMR vaccine. This counseling must be completed and documented in the patient's medical record.

Inactivated polio vaccine

All Air Force personnel are required to have one dose of the polio vaccine. The inactivated polio vaccine (IPV) induces the production of naturalizing antibodies against each type of virus that is related to protective efficacy and induces antibody responses. The efficacy of IPV is 95 percent; there is no evidence for booster doses at this time.

Side effects noted are limited to a mild fever. Contraindications are specific to individuals with a history of serious adverse reactions to the vaccine or its components. Moderate or acute illnesses, including any advanced condition or persistent vomiting or diarrhea, are reasons to postpone administration of the vaccine.

Varicella-virus vaccine

Varicella, also known as chicken pox, is a highly communicable disease in children, adolescents, and adults and is caused by the varicella-zoster virus. The varicella vaccine is administered to individuals after one year of age.

The side effects of the vaccination manifest themselves in the same manner as the active virus would show. These side effects can occur within 24-hours or up to 42 days post-vaccination. Effects such as redness and soreness at the injection site are possible, as well as a generalized rash that looks like true chickenpox. If the rash appears, the individual is considered infectious until the rash has subsided.

Contraindications for receiving this vaccine include persons who have a history of serious adverse reactions to the vaccine or any of its components including gelatin. Individuals with blood dyscrasias, leukemia, history of lymphomas of any type, or any other malignant neoplasm affecting the bone marrow or lymphatic system are contraindicated for the vaccine. Any individuals receiving immunosuppressive therapy or are pregnant should not receive the varicella vaccine.

Precautions should be taken for women of childbearing ages; individuals must be advised, and counseling documented in the patients' medical records that pregnancy should be avoided for three months following vaccination.

Mobility vaccines

There are some vaccinations that are directed based on an individual's mission requirements. Not all military personnel receive every vaccination listed, but only if they are mobility recommended. The mission requirements will dictate the need. Listed below is a sample of the mobility vaccinations that may be given. The *Immunizations Back-Up Technician* course gives a full list of mobility immunizations.

Typhoid

Typhoid fever is transmitted through the contamination of food or water. The greatest risk is for persons deploying to areas that include the Indian subcontinent, such as Asia, Africa, and Central and South America. The vaccine efficacy is 96 percent, and the regimen should be completed two weeks before potential exposure.

Side effects are minor. They include transient local reaction of erythema or induration at the injection site. The contraindications and precautions for the typhoid vaccination include individuals with

typhoid fever, are chronic typhoid carriers, or individuals with the presence of acute respiratory or other active infections.

Anthrax

Anthrax is an infection caused by bacteria that affects your skin, digestive system, and lungs. The disease occurs naturally in animals, such as sheep, cattle, and horses, and can be transmitted to humans. Transmission can occur through ingestion or inhalation of spores from live or dead, infected animals. Anthrax can be treated with antibiotics. Treatment must occur early to be effective. If no treatment occurs, the infection will become fatal.

The FDA-licensed schedule for anthrax vaccine is six doses given over 18 months: 0–2–4 weeks, 6–12–18 months, plus annual boosters. It is important to stay on schedule and not to get a dose earlier than your due date. It is also important to continue the series once you start, even when returning from deployment.

Side effects range from mild to severe, severe being anaphylactic reactions among those who have previously received one or more doses in the series of six. The mild reactions seem to be the most common. Effects include soreness, redness, and a lump or itching at the injections site, muscle or joint aches, headache, fever and chills, as well as fatigue.

Some individuals should not receive the anthrax vaccination. This includes anyone who has had a serious allergic reaction to a previous dose of anthrax vaccine should not get another dose. Anyone who has recovered from cutaneous (skin) anthrax should not get the vaccine. Pregnant women should not be routinely vaccinated with anthrax vaccine. This is merely a precaution. There is no evidence that the vaccine is harmful to either a pregnant woman or her unborn baby. Vaccination *may* be recommended for pregnant women who have been exposed, or are likely to be exposed, to anthrax.

Smallpox

The following information was obtained from the Center for Disease Control (CDC) website. Smallpox is caused by the virus variola, which spreads from person to person. Objects, such as bedding or clothing, that have the smallpox virus on them and infected body fluids are ways smallpox can be spread. It has killed millions of people over the centuries. The vaccination was developed in 1796. The last outbreak of smallpox was in 1949. Routine American public vaccination against smallpox ended in 1972, and the world's last case of naturally occurring smallpox was in 1977. Since the early 2000s, smallpox has become a part of mobility requirements. The smallpox vaccine is made from a living virus called "vaccinia." The vaccinia virus is like the smallpox virus but less harmful. The smallpox vaccine *cannot* give you smallpox. The vaccine is not a shot like other vaccines. The needle is pricked into the skin a number of times in a few seconds (usually in the upper arm). The pricking is not deep but will cause one or two small drops of blood to form. The place on the skin where the vaccine is given is called the "vaccination site."

Side effects of the vaccine include fever of over 100°F, mild rash that resolves without medication, and blisters on other parts of the body aside from the vaccination site. If an individual touches the blistering vaccine site and then touches one of his or her eyes, an eye infection can occur, leading to a loss of vision in the infected eye, if left untreated. In some cases, individuals with eczema or atopic dermatitis can develop scarring that can lead to death, if vaccinated. The smallpox vaccine can result in infection in unborn children leading to premature delivery, skin rash with scarring, stillbirth, or death of the child after delivery.

There are numerous contraindications for the smallpox vaccine. An individual with the potential of the following contraindications needs to be evaluated by a provider before receiving the smallpox vaccine. If there are known immune system problems, heart problems, pregnancy or breastfeeding, using steroid drops for their eyes, or if an individual is allergic to streptomycin or even latex, the individual should be cleared by the healthcare provider before being vaccinated. Immune system contraindications include individuals with HIV/acquired immune deficiency syndrome (AIDS), lupus,

leukemia lymphoma, or other cancers. Heart problems include known heart disease as heart attack, or angina, CHF, stroke, or transient ischemic attack. If anyone has three or more risk factors, such as high-blood pressure, high-blood cholesterol, diabetes, and smoking, they are to be evaluated by a healthcare provider for clearance.

There are normal side effects and precautions that must be followed after receiving the vaccination. Usually three to four days post-vaccination a red, itchy bump will form, most often the size of a dime. The site can become larger than three inches in some cases. The bump will then become a blister, fill in with pus, and then start to drain. The vaccination site should be checked six to eight days after the initial vaccination to ensure proper administration. The area should be covered with a loose semipermeable gauze bandage to allow airflow to the site and reduce drainage to the surrounding area. This bandage should be changed at least every three days. The blister will dry up and form a scab. When this has occurred, the bandage may be removed. Be careful, however, to take wound precautions until the scab has fallen off, leaving a scar.

Wound precautions the individual should be advised of first and foremost include not to touch the site and not to let others touch the site. The virus in the vaccine is live and can be spread from the vaccination site to other parts of the body or to other people through close physical contact until the scab falls off. Items that have come in contact with the site (especially when the site is an open, seeping wound), such as towels, sheets, and clothing, should be washed immediately. When doing laundry that has become contaminated, it should be washed separately in hot water with detergent or bleach. Keep the site dry, cover with a waterproof bandage when bathing, and do not scratch or put ointment on the vaccination site. And always wash hands thoroughly with soap and water.

Yellow fever

Yellow fever occurs only in Africa and South America. In South America, sporadic infections occur almost exclusively in forestry and agricultural workers from occupational exposure in or near forests. In Africa, the virus is transmitted in three geographic regions: principally and foremost, in the moist savanna zones of West and Central Africa during the rainy season; secondly, outbreaks occur occasionally in urban locations and villages in Africa; and finally, to a lesser extent, in jungle regions.

Yellow fever is a viral disease transmitted between humans by mosquitoes. Yellow fever is a very rare cause of illness in travelers, but most countries have regulations and requirements for yellow-fever vaccination that must be met before entering the country. General precautions to avoid mosquito bites should be followed. These include the use of insect repellent containing 50 percent N, N-diethyl-meta-toluamide (DEET), protective clothing, and mosquito netting. Yellow-fever vaccine is a live-virus vaccine, which has been used for several decades. A single dose confers immunity lasting 10 years or more. This vaccine is only administered at designated times determined by your local immunizations department or clinic.

Common side effects of the yellow fever vaccine can include high fever, redness and soreness, or swelling at the injection site and flu-like symptoms occurring up to 30 days post-vaccination. Severe side effects, such as anaphylactic shock, are rare; signs include difficulty breathing, hoarseness or wheezing, hives, fast heart rate, or dizziness. These signs can take effect within just a few minutes or a few hours after the injection.

Contraindications include individuals with a history of allergy to eggs, chicken, or gelatin. Any individual, who has an immune deficient disease, such as HIV/AIDS, cancer, or has been treated with cancer drugs or radiation, should not receive the yellow fever vaccine.

The following table is a quick reference of the immunizations provided to the active duty military population and their requirements.

Immunizations			
Vaccine/Toxoid	Upon Entry Into the Military	Mobility/Deployment	Other Requirement
Hepatitis A	X		<i>Twinrix</i> (Hepatitis A Inactivated & Hepatitis B [Recombinant] Vaccine) may be given instead of two separate injections. See manufacturer's instructions for dosage requirements.
Hepatitis B	X		
Tetanus/diphtheria (Td)	X		
Measles, mumps, rubella (MMR)	X		If antibody screen is negative.
Inactivated polio vaccine (IPV)	X		
Typhoid		X	
Anthrax		X	
Small pox		X	
Yellow fever		X	
Influenza			Annual.
Varicella virus vaccine			As necessary for high-risk occupational groups, indicated with a negative antibody screen.

Immune serums

Occasionally, a person is exposed to a disease and must receive antibodies to protect him or her against the infectious agent. An immune globulin is a solution obtained from pooled blood plasma (generally human) that is sterilized and contains immunoglobulins (IG) or antibodies. Using IG allows the affected individual to have injected antibodies to fight or prevent an illness from occurring. IG is different from a vaccination because it only provides temporary protection, while an immunization provides longer protection often for years. Immune globulins may also be called gamma globulins or immune serum globulins. Some of the more common IG products are listed here along with the disease the IG is protecting against:

- Rabies (rabies immune globulin–RIG).
- Tetanus (tetanus immune globulin–TIG).
- Hepatitis B (hepatitis B immune globulin–HBIG).
- Varicella (chickenpox) (varicella zoster immune globulin–VZIG).

Antitoxins and antivenins

An antitoxin is the result of an antibody that forms in the body. This occurs with the introduction of a bacterial poison or toxin into the body and the body's ability to neutralize the toxin. Antitoxins are made within organisms but can also be injected into organisms, such as animals and humans. It is best to use the same antitoxin made from the same organism. An example would be to use a human antitoxin to treat humans. This will help in preventing serum sickness.

An antivenin is used to neutralize the venom of a poisonous animal. It is created by injecting small amounts of venom into an animal, such as a horse. The result is an immune response developed by the animal, which produces antibodies against the venom. The venom can later be taken from the animal's blood to treat others.

421. Miscellaneous medications

In this lesson, we will take a look at some additional medications that are commonly encountered in medical treatment facilities and in taking care of patients.

Respiratory medications

In this section, we will explore some of the common medications used for various aspects of the respiratory system. Remember many medications have more than one action.

Antihistamines

Histamine is an important chemical mediator of inflammation to bodily injury from a pathogen, chemical, or physical trauma. When injury occurs from one of these methods, histamine is released, causing an immediate inflammatory response as well as stimulating pain receptors. This action dilates blood vessels in the response area and causes the capillaries to become more permeable or to leak. You can often see this area due to swelling and pain that occur at the site of injury. When the process of histamine release occurs throughout the body rapidly, a state of anaphylaxis occurs. You should remember that anaphylaxis is a life-threatening allergic response that can lead to shock or death without prompt medical attention and counteracting medications.

Now that you understand what histamine is, we can look at antihistamines and it should make more sense to you. A simple explanation of an antihistamine is that it is a drug or agent that blocks or inhibits the release or action of histamine in the body. Antihistamine can be used to describe any histamine antagonist, but it is usually reserved for the classical antihistamines that act on the H₁ histamine receptor. Antihistamines are used as treatment for allergies. Allergies are caused by an excessive response of the body to allergens, materials that are sometimes omnipresent, such as the pollen released by grasses and trees. An allergic reaction indicates an excessive release, by the body, of histamines.

The antihistamines epinephrine or diphenhydramine (Benadryl) are the most common drugs used in the treatment of anaphylactic shock. These medications are generally given by IM or SC routes. Bronchodilators, such as albuterol (Ventolin or Proventil), may also be administered by inhalation for acute shortness of breath caused by histamine release.

Patients who have seasonal allergies, asthma, or other respiratory diseases may use medications that are antihistamines or a combination of antihistamine with other medications to help block histamine release. Medications you may be familiar with are brand names, such as Allegra-D, Benadryl, and Claritin-D. A common side effect from many antihistamines is drowsiness, so antihistamines are sometimes used on a short-term basis to help with insomnia.

Antitussives/expectorants

If you have ever had a cold with an irritating cough, you have likely used an antitussive and/or an expectorant. Coughing is one of the most common complaints that drive patients to seek medical attention. Before treating a cough with one or both of these medications, the healthcare provider will normally attempt to determine the cause of the cough as there are many causes of coughing. Symptoms may range from an acute cough from an upper respiratory infection to chronic coughing from irritants, such as tobacco smoke. There are also some medications like ACE inhibitors and β -adrenergic blockers that can actually cause a cough. Cough symptoms that are dry and nonproductive are often treated with an antitussive.

Antitussive

The three most commonly used antitussive agents are opioids, dextromethorphan, and benzonate (Tessalon perles). The most effective class of antitussives is the opioids, such as Hydrocodone or codeine. These drugs work by raising the cough threshold in the cough center located in the medulla of the brain. These drugs are prescribed by a provider and most are codeine-cough mixtures classified as Schedule III, IV, or V drugs. While they are controlled, they rarely cause serious side effects and have a fairly low potential for dependence. One note of caution is to ensure the patient is not allergic to codeine before an opioid drug is prescribed to avoid an allergic reaction.

Dextromethorphan is the most frequently used OTC antitussive. It is commonly included in most severe cold-and-flu-combination medicines and rarely has side effects and has no risk for dependence. Like the opioids, dextromethorphan works by raising the cough threshold.

Benzonatate (Tessalon) is also popular for controlling cough and also requires a prescription. Unlike its opioid and dextromethorphan counterparts, it does not act on the cough center. Instead, benzonatate has an anesthetic effect on receptors in the lungs and interrupts the cough message. It is essential to warn patients not to chew these soft capsules as it will cause numbness to the throat and tongue to the point the patient may feel like he or she cannot swallow. While this medication may be taken up to three times a day, many patients take it in the evening prior to bedtime to get a good night's sleep without waking up from coughing.

Expectorants

Expectorants are often the counterpart to antitussives in a large number of cough-and-cold-combination drugs. Antitussives are often prescribed with expectorants to decrease the amount of coughing caused by the expectorant. You may wonder why someone would want to take an expectorant if the coughing has to be controlled with an antitussive. The actions of these medications are very different. While the antitussive is used to control or stop coughing, the expectorant is given to help thin and stimulate the flow of bronchial secretions and expel the loosened mucus. One of the most effective and commonly used expectorants is guaifenesin. It is used in many combination cold medicines, such as Robitussin-DM (which includes dextromethorphan and guaifenesin). Patients requiring a higher dosage of guaifenesin may obtain a prescription from a healthcare provider.

Other expectorants used to directly loosen thick bronchial secretions, by breaking down the mucous molecules, are mucolytics. Instead of an oral administration, mucolytics, like acetylcysteine (Mucomyst), are delivered by inhalation. OTC mucolytics have recently become available. All patients should be advised to drink plenty of liquids with these medications to help relieve thirst and to thin mucous secretions. An additional use for the mucolytic acetylcysteine is as a 5 percent oral solution for acetaminophen overdose. If used within the first 24 hours of an acetaminophen OD (as in Tylenol®), this medication may prevent liver damage.

Bronchodilators

Patients suffering from respiratory distress, such as asthma, often use a bronchodilator to assist in relieving the acute inflammatory response.

Bronchodilators open up the bronchial tubes to aid in air movement as well as help clear mucus from the lungs. The mucus is able to move more freely and be coughed out more easily as the airways open. There are two types of bronchodilators that are used. One is a short-acting bronchodilator, and the other is a long-acting bronchodilator. Short-acting bronchodilators are used as rescue meds and only as needed, while long-acting bronchodilators are used to control asthma on a daily basis.

Administering medication through the respiratory systems offers a rapid and efficient means of delivering some drugs due to the large surface area of the bronchioles, alveoli, and rich blood supply in the lungs. Medications delivered through this route are almost instantaneous. I'm sure you can imagine how someone in severe respiratory distress, due to constriction of the bronchioles, would be grateful for these medications! To administer medication through the respiratory system, the drug must be delivered in small particles. This can be done through aerosol, nebulizers, dry-powder inhalers, or metered-dose inhalers.

An aerosol is composed of very small liquid droplets of fine, solid particles suspended in a gas. Drugs delivered in this manner can give immediate relief for bronchospasms or to loosen thick mucus in the bronchial tree. An advantage to this method is the reduced risk of systemic side effects because medication action occurs at the site and can be given in a lower dose than oral medications. However, any agent delivered by inhalation can produce a systemic effect because of absorption.

Nebulizers

Nebulizers are small machines that convert a liquid drug into a fine mist that can be inhaled. A drawback to this method can be that it is normally delivered using a face mask that some patients, especially young children, find intimidating or irritating. An example is levalbuterol (Xopenex), 0.63 mg by nebulizer three to four times daily. When preparing nebulizer treatments, ensure you check the orders for any solution (such as sterile water) that may need to be added with the medication.

Dry-powder inhalers

Dry-powder inhalers (DPI) deliver a solid drug in a fine powder directly to the bronchial tree. Two types of DPI are the Turbohaler and rothaler. An example is Advair Diskus, one inhalation twice daily.

Metered-dose inhalers

Metered-dose inhalers (MDI) use a propellant to deliver a measured dose of medication to the lungs as the patient takes a breath. The patient must time his or her inhalation with the “puff” when the drug is delivered. The patient must be instructed on the correct usage of the MDI to ensure the medication is not swallowed instead of being inhaled. An example of a medication given by MDI is Metaproterenol sulfate (Alupent) administered in two to three inhalations (puffs) every three to four hours, with a maximum of 12 inhalations daily.

NOTE: Only medications approved and packaged for inhalation use should be administered via the respiratory route.

Common side effects from inhaled bronchodilator medications include tachycardia, nervousness, dizziness, headache, and hypertension.

Antineoplastics

Antineoplastics or anticancer drugs are medications that inhibit and combat the development of tumors. There are many adverse health effects associated with antineoplastic agents (cancer chemotherapy drugs, cytotoxic drugs) because they are harmful to healthy cells and tissues as well as the cancerous cells. There can be tremendous benefits of treatment with these agents for cancer patients with a life-threatening disease. However, healthcare workers should take precautions to eliminate or reduce exposure to antineoplastic agents as part of their work practice. Hospital staffs, such as supply personnel, custodial workers, laundry workers, and waste handlers, all have potential exposure to these drugs during the course of their work. It is essential that all medication, supplies, and equipment be handled and disposed of properly to avoid unintended exposure to these toxic chemicals.

Common side effects of these medications include nausea, vomiting, anorexia, thrombocytopenia, (bruising) and alopecia (hair loss).

Antineoplastic drugs work through several mechanisms but generally involve cell killing or cytotoxicity. These drugs are quite complicated in part because they kill cancer cells by several mechanisms, have characteristics from more than one class of drugs, and actions of some medications are not completely understood. Antineoplastics are classified into six groups:

Alkylating agents

These agents chemically bind to nucleic acids and inhibit cell division. Some of the most widely used alkylating agents include antineoplastic drugs (e.g., Cyclophosphamide [Cytosan]). Peak effect is 1–2 days after administration. In addition, it interacts with many herbs and drugs.

Antimetabolites

These inhibit folic acid metabolism and are occasionally used to treat non-neoplastic disorders, such as rheumatoid arthritis, that are unresponsive to other medications.

Antitumor antibiotics

These antibiotics prevent cancer cell division by distorting the double-strand DNA. This medication has a unique delivery method. It can be enclosed in small sacs of lipids, called liposomes, and releases the antitumor antibiotic when the liposome reaches the cancer cell. This aids in sparing normal cells while delivering a high concentration of drug to the cancer cells.

Plant alkaloids/natural products

Drugs in this class have the capability to stop cell division and are sometimes called mitotic inhibitors. Common plants that have been discovered to have antineoplastic activity include the common periwinkle, the Pacific yew, the mandrake plant or May apple, and a shrub called *Camptotheca acuminata*. An adverse reaction that may occur with most natural drug products is bone marrow suppression.

Hormones and hormone blockers

Hormones and hormone blockers are generally used to slow the growth of hormone-dependent tumors. Some tumors of the reproductive tissues are greatly stimulated by natural hormones and administering high doses of specific hormones or hormone antagonists may block receptors and slow the growth of the tumor (e.g., Tamoxifen [Nolvadex] administered po 10–20 mg bid for breast cancer treatment).

Miscellaneous drugs for cancer patients

There are several other anticancer drugs that work through various methods. One of the most recent is the Biologic Response Modifier. This class does not kill the tumor cells; instead, it stimulates the body's immune system to fight the cancer. These drugs may also be given to minimize the toxic effects of other antineoplastics. An example is Interferon Alfa-2 (Roferon A, Intron A).

Another class works to treat hematopoietic abnormalities that frequently occur in patients undergoing chemotherapy. These drugs do not cure the disease; instead, they aid in reducing anemia and increase the patient's ability to perform daily activities. An example is Epoetin Alfa (Epoen and Procrit).

Hormone contraceptives

Hormone contraceptives are made up of estrogen and progestin, which are female sex hormones. The most popular contraceptive is the birth control pill. Most women have used oral contraceptives in their lifetime. At this time hormonal contraceptives are only designed for women. These contraceptives work in many ways to prevent pregnancy, which include ceasing ovulation, thickening the woman's cervical mucus, and altering and thinning the endometrium wall making it difficult for the egg to implant. As well as preventing pregnancy, there are many benefits of taking the pill. Some health benefits include reducing the risk for ovarian and endometrial cancer, regulating the menstrual cycle, and managing acne.

Advantages and disadvantages

Advantages and disadvantages differ between different formulations of hormonal contraception due to the large group of diverse products. When used properly, hormonal contraceptives are highly effective. Except for abstinence, intrauterine device, vasectomy, and tubal ligation, no other method of birth control is as effective as hormone contraceptives. Hormonal contraceptives do allow spontaneous intercourse but do not offer any protection against sexually transmitted diseases. Another disadvantage of hormonal contraceptives is that effectiveness is reliant upon the woman to use them correctly. Some methods, such as implants, require relatively little attention; others, such as injections or transdermal patches, require a schedule ranging from a week to several months, and oral contraception requires a daily schedule. General guidelines state that a back-up method of birth control should be used when first beginning hormone contraceptive and if two or more doses of oral contraceptive are missed. An example of a *back-up measure* is the use of condoms and a spermicide, which patients are encouraged to consider for a period of time when taking interactive medications.

As with any medication, hormone contraceptive is not without risks or possible side effects. Before starting hormone contraceptives, a thorough health history must be obtained. Information that must be obtained includes:

1. Whether the patient is pregnant or lactating.
2. If the patient smoke cigarettes, how many per day?
3. The medications the patient is currently taking.
4. Whether the patient has any history of hypertension, cardiovascular disease/problems, or thromboembolic disease.
5. Whether the patient is allergic to any medications.
6. Any patient history of cancer.

Oral contraceptives

Obviously, the provider would not want to prescribe an oral contraceptive to a woman who was currently pregnant as it could damage the fetus or the pregnancy itself, and some forms may stop or slow down the production of milk for women who are nursing an infant. There is an increased risk of thromboembolic disorders (blood clots) with women who have cardiovascular disease and/or smoke cigarettes. Additionally, some hormone medications may be contraindicated for women with a history of neoplasm.

The estrogen-progestin hormone contraceptives are the most widely used oral contraceptives (this formulation prevents ovulation) and are formulated in three methods: monophasic, biphasic, and triphasic.

Monophasics

Monophasics deliver a constant amount of estrogen and progestin (a synthetic progestagen) throughout the menstrual cycle and are the most common form used. An example of a monophasic is Lo/Ovral (ethinyl estradiol 30 mcg [estrogen] and norgestrel 0.3 mg [progestin]).

Biphasics

Biphasics deliver a constant amount of estrogen in each pill, but the amount of progestin increases toward the end of the menstrual cycle (e.g., Ortho-Novum 10/11 [ethinyl estradiol 35 micrograms (mcg) and norethindrone 0.5 mg in Phase I, and ethinyl estradiol 35 mcg and norethindrone 1 mg in Phase II]).

Triphasics

Triphasics deliver a varying amount of estrogen and progestin through three distinct phases during the 28-day cycle (e.g., Ortho-Tri-Cyclen [ethinyl estradiol 35 mcg and norgestimate 0.5 mg in Phase I; ethinyl estradiol 35 mcg and norgestimate 0.75 mg in Phase II; ethinyl estradiol 35 mcg and norgestimate 1 mg in Phase III]).

Aside from the estrogen-progestin formulation, there are also progestin-only drugs. This method works by producing a thick, viscous mucous at the uterine entrance. Progestin-only formulas are less effective than the estrogen-progestin combinations and may produce an increased incidence of irregular menstrual cycles and are normally used with women who have a high risk of side effects from estrogen. Oral contraceptives are available in 21- and 28-day doses. All pills in the 21-day method contain active ingredients, and no pills are taken during the week of menses. In the 28-day method, the last seven days of pills during menses are inactive. However, they assist the patient in staying in the routine of taking a pill each day. The start of a new package of pills normally begins the first Sunday after menses begins. This is called the Sunday-start regimen.

Injectable contraceptives

An injectable form of contraception is also available for women who prefer not to have to remember to take a pill each day or for those that have problems with oral contraceptives. The medication medroxyprogesterone acetate (Depo-Provera) 150 mg/mL is administered once every three months intramuscularly. The first dose is given within five days of the onset of normal menses. A negative pregnancy test is normally required before the first injection, and many clinics require a negative pregnancy test before every injection.

Implants

The method of using implants is also available but is not as widely used as a minor surgical procedure is required to place the implants and to remove them. The Norplant system uses six small plastic tubes that are filled with levonorgestrel and are implanted in the SC tissue in the upper arm. These tubes will provide contraceptive protection for up to five years. This method is best used by women who are certain they do not want to become pregnant for several years.

Transdermal

The last method of hormone contraceptive we will explore is the transdermal patch. The patch is worn on the skin and changed according to specific medication instructions. An example is the Ortho-Evra transdermal patch, which may be applied to the abdomen, buttocks, upper outer arm, or upper torso, excluding breasts. Apply one patch once weekly for three weeks, then let the patient have one week free of patches, and then repeat the cycle. The application site should be rotated each time a new patch is applied. Ensure the patient understands the old patch must be removed when a new one is applied! Precautions and contraindications are the same as with the other hormone contraceptive medications.

General drug information

As you have learned throughout this volume, a thorough patient history, current medications, herbs, and allergies are all essential information that must be obtained to avoid possible drug interactions. When learning about new medications, make sure you read the information that specifies how a medication should be taken, any precautions, and contraindications. For instance, some medications need to be taken on an empty stomach, while others need to be taken with food or milk to enhance absorption or limit side effects, such as nausea or abdominal pain. Care must also be taken with what foods or beverages are consumed with certain medications. Some foods and beverages are known to enhance or detract from the effectiveness of drug therapy. For example, grapefruit juice should not be taken with many medications, especially certain antibiotics, antihistamines, antifungals, cholesterol medications, and sedative-hypnotic drugs. Grapefruit juice can lower activity levels of specific enzymes in the intestinal tract that normally break down medications and end up allowing larger amounts of the medication to reach the bloodstream and result in increasing the drug activity.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

419. Infection-fighting agents

1. What is the first step in anti-infective drug therapy?
2. List the four classifications of cephalosporins and what they treat.
3. What instructions should be given to patients being treated with erythromycin?

4. Penicillins are used prophylactically for what diseases?
5. List the contraindications or extreme cautions of quinolones.
6. Match the generic anti-infective/antibiotic name in column A with the trade name in column B. The answers in column B can only be used once.

<i>Column A</i>	<i>Column B</i>
_____ (1) Doxycycline.	a. Augmentin.
_____ (2) Ampicillin.	b. Zithromax.
_____ (3) Ceftriaxone.	c. Cipro.
_____ (4) Gentamycin.	d. Vibramycin.
_____ (5) Cefazolin.	e. Ancef.
_____ (6) Amoxicillin-clavulanate.	f. Rocephin.
_____ (7) Cefurozime.	g. Ominpen.
_____ (8) Cephalexin.	h. Ceftin.
_____ (9) Azithromycin.	i. Garamycin.
_____ (10) Ciprofloxacin.	j. Kflex.

420. Vaccines

1. Match the condition in column A to the necessary vaccine in column B. The answers in column B can be used only once.

<i>Column A</i>	<i>Column B</i>
_____ (1) For individual whose occupation makes them susceptible to simple lacerations and abrasions (i.e., crew chief, maintenance, and civil engineering).	a. Tetanus/diphtheria (Td).
_____ (2) This disease causes approximately 250,000 deaths annually.	b. Typhoid.
_____ (3) Chicken pox.	c. Anthrax.
_____ (4) For persons going to areas such as Asia, Africa, Central and South America.	d. Hepatitis A.
_____ (5) A viral disease transmitted between humans by a mosquito.	e. Yellow Fever.
_____ (6) Can be spread by person-to-person contact until scab falls off.	f. Measles, Mumps, Rubella (MMR).
_____ (7) All Air Force recruits receive antibody screening and receive the vaccine only if results are negative.	g. Influenza.
_____ (8) Vaccine administered annually to all active duty military.	h. Inactivated polio vaccine (IPV).
_____ (9) This disease causes approximately 14,000 deaths annually.	i. Hepatitis B.
_____ (10) This disease may affect your skin, digestive system, and lungs.	j. Small pox.
_____ (11) 95 percent effective; no booster doses at this time.	k. Varicella.

421. Miscellaneous medications

1. When is histamine released?
2. Explain the difference between an antitussive and an expectorant.
3. What are some of the common side effects of antineoplastic medications?
4. What type of oral contraceptive is the most widely used, and what methods is it formulated in?
5. How should transdermal hormone contraception patches be applied? What should you ensure the patient understands?
6. Why should drinking grapefruit juice be avoided with many medications?

Answers to Self-Test Questions**414**

1. Observing the patient's reaction to pain through vital signs, positions, and emotional responses by the patient.
2. Endogenous analgesics produced within the brain as a reaction to severe pain or intense exercise (aka runner's high), and these endorphins block the transmission of pain.
3. Opioid, nonopioid, and adjuvant.
4. Sedation, confusion, euphoria, restlessness, hypotension, and bradycardia. The respiratory rate may be depressed, urinary retention may occur, along with blurred vision, and seizures with large doses.
5. (1) a
(2) a.
(3) c.
(4) a.
(5) c.
(6) b.
(7) a.
(8) c.
(9) a.
(10) c.
6. Aware of the dangers of self-medication, overdosage, side effects, and interactions by inappropriate use of these readily available drugs.
7. Arthritis, bursitis, gout, muscle strains, and sprains that cause swelling, limiting an individual's mobility.

8. NSAIDs that selectively inhibit cyclooxygenase-2 prostaglandin synthesis; they do not inhibit platelet aggregation.
9. Fatalities due to accidental ODs, especially when combined with other CNS depressants or alcohol. They are particularly dangerous because they are metabolized and excreted slowly and remain in the system longer.
10. Nausea, vomiting, diarrhea, rash, dizziness, ataxia, leukopenia with prolonged use, daytime sedation, confusion and headache, amnesia, and hallucinations. It is contraindicated for patients with known severe liver and renal impairment and porphyria.

415

1. Exert a therapeutic effect on an individual's mental process, emotions, or behavior.
2. For promoting CNS functioning.
3. Dopamine, serotonin, and norepinephrine.
4. Usually the treatment of choice for major depression and for depressive episodes of bipolar disorder. Enables neurotransmitters to travel across the synapse (the contact point of two neurons) to transmit the messages between the nerve cells.
5. Calming antidepressants that are useful in treating agitated depression, mixed anxiety and depression, or fibromyalgia.
6. Increase the concentration of serotonin, norepinephrine, and dopamine in the neuronal synapse by inhibiting the monoamine oxidase enzyme.
7. Drowsiness, confusion, blurred vision, and photophobia. With toxicity some of the side-effects signs worsen, such as tremors, muscle weakness, seizures may develop, or the cardiovascular system may collapse, resulting in coma or death.

416

1. The type of arrhythmia, the frequency, cardiac and renal condition, and the current signs and symptoms the patient is showing.
2. They combat arrhythmias by inhibiting adrenergic (sympathetic) nerve receptors.
3. (1) b, f.
(2) d.
(3) a.
(4) g.
(5) d.
(6) b, f.
(7) c, h.
(8) e.
(9) d.
(10) d, h.
4. Patients who are hypersensitive to local anesthetics (amide-type), which have respiratory depression or known heart block, children, and for women who are pregnant and lactating.
5. The initial treatment includes lifestyle changes that range from diet modification (low sodium), weight reduction, mild exercise program, smoking cessation, and stress reduction planning.
6. ACE inhibitors can be used alone or combined with a diuretic. ACE inhibitors slow the progression of renal disease.
7. They alter the synthesis of blood coagulation factors in the liver by interfering with vitamin K.
8. Administration of a thrombolytic agent is administered in the emergency room or intensive care unit in the first few hours (less than six) after the onset of acute MI or CVA. Close monitoring of hemodynamics and vital signs is standard for the first 48 hrs with thrombolytic therapy.

417

1. Palatability, adverse effects, acid-neutralizing capacity, the sodium content, and the patient's renal and cardiovascular function.
2. Reduce the number of loose stools an individual is having.
3. Avoidance of self-medicating for longer than 48 hrs or if a fever develops. A diet should consist of bland foods, such as apples without peels or sugar added, rice, or bananas. Roughage should be taken out of the diet when trying to control diarrhea. Individuals should also be advised to increase their fluid intake to prevent dehydration. Drinking soda and apple juice should be avoided, but water should be encouraged or power drinks with high-electrolyte content in moderation.
4. Diarrhea induced by infection or poisoning, patients with colitis associated with broad-spectrum antibiotics, ulcerative colitis, and cirrhosis. It is contraindicated to medicate young children and pregnant patients with these drugs.
5. Simple diarrhea caused by antibiotics, infection, irritable colon, colostomy, or amebiasis.
6. Cellulose derivatives and bran, powders, flakes, granules, tablets, or liquids.
7. Stool softener, Docusate.
8. When rapid, thorough emptying of the bowel is required. When a patient is scheduled for a sigmoidoscopy, GI x-rays when barium is used or proctoscopies, the use of stimulant laxatives is commonly given as preprocedure medication dosaging.
9. To treat or prevent nausea, vomiting, or motion sickness.

418

1. Secrete hormones called corticosteroids that act on the immune system to suppress the body's response to either infection or trauma.
2. (1) b.
(2) a.
(3) b.
(4) b.
(5) a.
(6) b.
(7) a.
(8) b.
(9) a.
(10) b.
3. It is the underutilization of the thyroid. Symptoms are caused by a slowed metabolism, and include fatigue, dry skin, weight gain, sensitivity to cold, irregular menses, and mental deterioration, if untreated.
4. Because it is destroyed through the GI tract.
5. The onset is the amount of time between the time a drug is administered and the first sign of its effects. The peak is the highest concentration attained from a dose. The duration is the time period from the onset of the drug action to the time when response is no longer seen.
6. Develops suddenly and is usually seen during the peak of the insulin action. These symptoms may include increased perspiration, irritability, confusion, or bizarre behavior. Individuals may experience tremors, weakness, headache, or tingling of the fingers. In severe cases the individual may lose consciousness and have convulsions, if untreated. These signs usually occur as a result of an OD of insulin, a delay or insufficient food intake, excessive or unusual exercise, or when there has been a change in the type of insulin being used. An example may be when the patient changes from pork to human insulin.
7. Patients with known liver and kidney impairment, debilitated or malnourished patients, and patients with severe infection.
8. Works by decreasing hepatic glucose output and enhancing insulin sensitivity in muscle.

419

1. Determine the causative organism and the specific medication to which it is sensitive.

2.
 - (1) First generation is usually effective against gram-positive organisms, such as those that cause some pneumonias or urinary tract infections.
 - (2) Second generations are usually effective against many gram-positive and gram-negative bacteria like many strains causing bacterial influenza.
 - (3) Third-generations drugs are used in the treatment of mostly gram-negative bacteria and sometimes used for sexually transmitted diseases, such as gonorrhea.
 - (4) The fourth generation of cephalosporins is new. The parenteral cephalosporin, Maxipime, works well with both gram-positive and gram-negative bacteria.
3. That GI side effects are expected and adding buttermilk or yogurt to their diet may help regulate the intestinal flora and reduce the incidence of diarrhea. Erythromycins should be taken with a full glass of water one hour before or two hours after meals.
4. Rheumatic fever and endocarditis.
5. For elderly patients, especially with GI diseases or arteriosclerosis. Children or adolescents are at higher risk for cartilage damage. Patients who are pregnant, lactating, have severe renal impairment, seizure disorders, or cardiac disease must be monitored for adverse effects.
6.
 - (1) d.
 - (2) g.
 - (3) f.
 - (4) i.
 - (5) e.
 - (6) a.
 - (7) h.
 - (8) j.
 - (9) b.
 - (10) c.

420

1.
 - (1) a.
 - (2) i.
 - (3) k.
 - (4) b.
 - (5) e.
 - (6) j.
 - (7) f.
 - (8) g.
 - (9) d.
 - (10) c.
 - (11) h.

421

1. When bodily injury from a pathogen, chemical, or physical trauma occurs.
2. Antitussives work by raising the cough threshold in the cough center located in the medulla of the brain, thereby controlling coughing. Expectorants help thin and stimulate the flow of bronchial secretions and expel the loosened mucous.
3. Common side effects include nausea, vomiting, anorexia, thrombocytopenia (bruising), and alopecia (hair loss).
4. Estrogen-progestin hormone contraceptives are the most widely used and it is formulated in monophasic, biphasic, and triphasic methods.

5. Apply one patch once weekly for three weeks, then let the patient have one week free of patches, and then repeat the cycle. The application site should be rotated each time a new patch is applied. Ensure the patient understands that the old patch must be removed when a new one is applied!
6. Grapefruit juice can lower activity levels of specific enzymes in the intestinal tract that normally break down medications and end up allowing larger amounts of the medication to reach the bloodstream and result in increasing the drug activity.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

35. (414) Which medication's primary action is pain relief?
 - a. Endorphins, hypnotics and sedatives.
 - b. Analgesics, sedatives and hypnotics.
 - c. Placebo, tricyclics, and analgesics.
 - d. Stimulant, sedatives, and placebo.
36. (414) Opioids are contraindicated with
 - a. the treatment of extremity injuries.
 - b. a Phenergan combination.
 - c. head injury treatment.
 - d. caffeine use.
37. (414) Opioid antagonists are used in the treatment of
 - a. acetaminophen overdose.
 - b. ibuprofen overdose.
 - c. vitamin C overdose.
 - d. opioid overdose.
38. (414) Nonopioid analgesics are available
 - a. through product sampling.
 - b. during clinical trials.
 - c. by prescription only.
 - d. over the counter.
39. (414) Anti-inflammatory actions are associated with
 - a. preventing the formation of prostaglandins.
 - b. the recovery of alcohol abuse.
 - c. increased kidney functions.
 - d. curing joint dysfunctions.
40. (414) A common side effect of sedatives and hypnotic medications is
 - a. a depressed state of rapid eye movement (REM) phase of sleep.
 - b. an increased risk for developing cardiovascular disease.
 - c. the constant stimulation to the central nervous system.
 - d. the high level of red blood cell production.
41. (415) Which *over the counter* central nervous system stimulant is frequently taken in prolonged high doses producing habituation and psychological dependence?
 - a. Dexadrine.
 - b. Concerta.
 - c. Caffeine.
 - d. Ritalin.

42. (415) What *is not* a side effects of tricyclics?
- a. urinary retention.
 - b. pupil constriction.
 - c. cardiac arrhythmias.
 - d. postural hypotension.
43. (415) Antianxiety medications are prescribed for
- a. suicidal tendencies treatment.
 - b. the treatment of withdrawals.
 - c. prolonged treatment.
 - d. the treat of insomnia.
44. (415) Antipsychotic medications are categorized as
- a. hypnotics.
 - b. major tranquilizers.
 - c. seizure medications.
 - d. antisyndromal producers.
45. (415) Extrapyramidal side effects (EPS) common to typical phenothiazines antipsychotic medications is a result of
- a. increasing body secretion function.
 - b. decreasing norepinephrine relay.
 - c. increasing serotonin reuptake.
 - d. blocking dopamine receptors.
46. (416) Which pulse point should be checked before the administration of digitalis?
- a. Brachial.
 - b. Apical.
 - c. Radial.
 - d. Pedal.
47. (416) Toxic side effects of digitalis include the following *except*
- a. vertigo.
 - b. diplopia.
 - c. tachycardia.
 - d. bradycardia.
48. (416) Adrenergic blockers are used in *low doses* for patients with
- a. lung conditions that cause bronchospasm.
 - b. heart block and congestive heart failure.
 - c. renal and hepatic impairment.
 - d. diabetes militeus.
49. (416) Calcium channel blockers should not be taken with
- a. grapefruit juice.
 - b. soy products.
 - c. water.
 - d. milk.
50. (416) The drug of choice when treating premature ventricular contractions associated with a myocardial infarction is
- a. Epinephrine.
 - b. Lidocaine.
 - c. Tonocard.
 - d. Ultram.

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51. (416) Quinidine is used primarily as prophylactic therapy to
- treat anemia.
 - produce bradycardia.
 - increase myocardial excitability.
 - maintain normal rhythm after cardioversion.
52. (416) What is the *most common* side effect of antihypertensives?
- Tinnitus.
 - Tachycardia.
 - Vasoconstriction.
 - Postural hypotension.
53. (416) Angiotensin-converting enzyme (ACE) inhibitors lower blood pressure by
- antagonizing myocardial excitability.
 - producing the enzyme protease.
 - decreasing vasoconstriction.
 - increasing heart rate.
54. (416) When angiotensin-converting enzyme (ACE) inhibitors are taken in conjunction with diuretics or vasodilators, what affect is produced?
- Antagonize hypokalemia.
 - Potentiate hypotension.
 - Potentiate depression.
 - Synergism.
55. (416) Central-acting alpha-adrenergic inhibitors are usually combined with
- barbiturates.
 - stimulants.
 - diuretics.
 - aspirin.
56. (416) What is the *primary* side effect of central-acting alpha-adrenergic inhibitors?
- Swelling to lower extremities.
 - Sodium and water retention.
 - Severe rhinitis.
 - Polyuria.
57. (416) What antidote is administered for serious bleeding complications while under coumarin (Coumadin) therapy?
- Protamine sulfate.
 - Vitamin B₁₂.
 - Vitamin K.
 - Heparin.
58. (416) Mr. Johnson has undergone a hip replacement and is receiving heparin treatment. Mr. Johnson's daughter has received education from the nurse at the hospital regarding the heparin treatment. What patient education instructions would Mr. Johnson's daughter receive in regards to the site of the heparin injection?
- Give injections in close proximity.
 - Rub injection site vigorously.
 - Give intramuscular.
 - Do not aspirate.

59. (416) While undergoing heparin treatment, Mr. Johnson's diet should be monitored closely for foods rich in vitamin
- A.
 - D.
 - E.
 - K.
60. (416) The *most serious complication* of thrombolytic therapy is
- bleeding.
 - arrhythmia.
 - tachycardia.
 - vasoconstriction.
61. (417) Antacids containing aluminum or calcium carbonate have the common side effect of?
- Excessive gas.
 - Constipation.
 - Vomiting.
 - Diarrhea.
62. (417) What is a potential side effect when antacids are taken concurrently with coumarin derivatives?
- Antagonist effect on the coumarin.
 - Both medications are synergistic.
 - Decreases bleeding time.
 - Increase bleeding time.
63. (417) Which medication acts as an absorbent and protectant to achieve a drying effect to the gastrointestinal tract?
- Tums.
 - Riopan.
 - Maalox.
 - Kaopectate.
64. (417) Cathartics are categorized as
- Antidiarrheal.
 - Antiemetics.
 - Laxatives.
 - Emetics.
65. (417) What type of laxative is sorbitol?
- Saline.
 - Stimulant.
 - Hyperosmotic.
 - Bulk forming.
66. (417) When should Dramamine be taken when orally administered?
- 2 hours before expected sleep.
 - 30 minutes before expected motion.
 - When in a large crowd for longer than 30 minutes.
 - When activity will raise heart rate over 80 beats per minute.

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67. (418) Among the endocrine medications, what drug action category do adrenal corticosteroids fall within?
- Curative.
 - Palliative.
 - Restorative.
 - Supportive.
68. (418) Which endocrine therapy drugs are used to prevent organ transplant rejection?
- Insulin.
 - Tapazole.
 - Corticosteroids.
 - Thyroid agents.
69. (418) A major contributor of young children developing type II diabetes is
- family history.
 - increased obesity.
 - too much exercise.
 - excessive sugar in their diet.
70. (418) With type I diabetes, the pancreas
- releases more glycogen into the blood for the cells to use for energy.
 - produces excessive amounts of insulin to control blood sugar.
 - takes over the production of bile salts to control blood sugar.
 - is unable to produce enough insulin to control blood sugar.
71. (418) Insulin may potentiate a hypoglycemic effect when taken concomitantly with
- daypro or antacids.
 - alcohol or salicylates.
 - tricyclics or caffeine.
 - procordia or anticoagulants.
72. (418) What are the actions of sulfonylurea medications?
- Decrease the absorption of the blood sugar by the stomach to use the sugar for the cells.
 - Decrease the insulin production of the gall bladder for better peripheral insulin activity.
 - Increase the absorption of the blood sugar to be excreted rapidly through the kidneys.
 - Increase the insulin production of the pancreas and better peripheral insulin activity.
73. (419) Aminoglycosides are used for
- short term treatment.
 - long term treatment.
 - the treatment of tinnitus.
 - the treatment of renal dysfunction.
74. (419) Patients who are allergic to penicillin are also most likely to be allergic to
- macrolides.
 - tetracyclines.
 - cephalosporins.
 - aminoglycosides.
75. (419) When a patient is receiving penicillin for the treatment of severe strep throat, what further patient-education is appropriate if the patient is also taking oral contraceptives for birth control?
- Use a back up method of birth control while taking the penicillin.
 - There are no contraindications with oral contraceptives.
 - Avoid taking the two medications at the same time.
 - Always take the two medications at the same time.

76. (419) If after five days of the penicillin treatment the patient develops diarrhea, what advice would be appropriate?
- a. Stop taking the medication.
 - b. Crush the penicillin before taking the dose.
 - c. Add yogurt or buttermilk to her diet and monitor the number of episodes.
 - d. Bring the medication in to exchange for a different lot to begin treatment over.
77. (419) Which medication can interact with quinolones to potentiate cardiac arrest?
- a. Tetracyclines.
 - b. Theophylline.
 - c. Gentamycin.
 - d. Procardia.
78. (420) Which vaccine should not be administered to individuals allergic to eggs or egg products?
- a. Anthrax.
 - b. Influenza.
 - c. Small Pox.
 - d. Hepatitis B.
79. (420) Hepatitis A is contracted through the transmission of
- a. contaminated food or water.
 - b. droplets through the air.
 - c. blood and body fluids.
 - d. reused linen.
80. (420) Which vaccine do all recruits receive a booster for upon entering the Air Force?
- a. Small Pox.
 - b. Influenza.
 - c. Anthrax.
 - d. Tetanus.
81. (420) What vaccines are given to individuals deploying to Africa?
- a. Hepatitis and polio.
 - b. Anthrax and influenza.
 - c. Small Pox and varicella.
 - d. Yellow Fever and typhoid.
82. (420) Which childhood disease was nearly eradicated worldwide by 1972 and in early 2000's the vaccine was reintroduced as a mobility vaccine for military personnel?
- a. Typhoid.
 - b. Varicella.
 - c. Small pox.
 - d. Yellow fever.
83. (420) Which viral disease do mosquitoes transmit?
- a. Yellow fever.
 - b. Influenza.
 - c. Typhoid.
 - d. Anthrax.

84. (421) What type of medication would be prescribed for a patient with allergies to grass and tree pollen?
- a. Antineoplastics.
 - b. Antihistamines.
 - c. Antifungals.
 - d. Antivirals.
85. (421) What patient-education would be appropriate for a patient who has been prescribed Tessalon perles to help stop coughing?
- a. Take only at bedtime.
 - b. Take with orange juice.
 - c. Do not chew the capsule.
 - d. Do not take with food or milk.
86. (421) What food or drink is known for its high potential to change intestinal tract enzymes and interfere with the effectiveness of certain antibiotics, antifungals, antihistamines and sedative-hypnotic drugs?
- a. Milk.
 - b. Bread.
 - c. Cranberry juice.
 - d. Grapefruit juice.

Student Notes

Glossary

Abbreviations and Acronyms

ABG	arterial blood gases
ac	before meals
ACE	angiotensin-converting enzyme
ADD	attention deficit disorder
ADL	approved drug list
AF	Air Force
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFPAM	Air Force Pamphlet
AIDS	acquired immune deficiency syndrome
AM	ante meridiem/before noon
AMSC	Aerospace Medical Service Craftsman
ASA	aspirin
bpm	beats per minute
BVM	bag-valve-mask
C	cup
Ca	calcium
cc	cubic centimeter
CDC	Career Development Course or Center for Disease Control
CDER	Center for Drug Evaluation and Research
CFETP	career field education and training plan
CFSAN	Center for Food Safety and Applied Nutrition
CHF	congestive heart failure
cm	centimeter
CMSgt	chief master sergeant
CNS	central nervous system
COPD	chronic obstructive pulmonary disease
COX	cyclooxygenase
CSP	compounded sterile products
CVA	cerebrovascular accident
CVP	central venous pressure

DEA	Drug Enforcement Administration
DEET	diethyl-meta-toluamide
DNA	deoxyribonucleic acid
DOB	date of birth
DPI	dry-powder inhalers
DVT	deep vein thrombosis
EKG or ECG	electrocardiogram
EPS	extrapyramidal side effects
ER	extended release
FDA	Food and Drug Administration
ft	feet
FVD	fluid volume deficit
FVE	fluid volume excess
g/gr	gram
gal	gallon
GERD	gastro-esophageal reflux disease
GI	gastrointestinal
GU	genitourinary
HBIG	hepatitis B immune globulin
HIV	human immunodeficiency virus
hr	hour
hs	hours of sleep/at bedtime
IAW	in accordance with
IBT	immunizations back-up technicians
ID	intra-dermal or identification
IG	immunoglobulins
IM	intramuscular
in	inch
INH	isoniazid
IPPB	intermittent positive-pressure breathing
IPV	inactivated polio vaccine
IV	intravenous
JCAHO	Joint Commission on Accreditation of Healthcare Organizations
K	potassium
kg	kilogram
KVO	keep vein open

L	liter
lb	pound
LOC	level of consciousness
LSD	lysergic acid diethylamide
μ	micro
MAOI	monoamine oxidase inhibitor
MAR	Medication Administration Record
MDI	metered-dose inhalers
MS	Morphine Sulfate
mcg/μg	microgram
mEq/L	milliequivalent
mg	milligram
MI	myocardial infarction
mL	milliliter
MMR	measles, mumps, rubella
MSG	monosodium glutamate
MSgt	master sergeant
MTF	military treatment facility
Na	sodium
Narcan	Narcotic antagonist
NF	National Formulary
NPO	nothing by mouth
NSAID	nonsteroidal anti-inflammatory drug
OD	overdose
OI	operating instructions
OTC	over-the-counter
oz	ounce
P&T	Pharmacy and Therapeutics
PCN	penicillin
PDR	Physician's Desk Reference
PE	pulmonary embolism
pH	percentage of hydrogen ions
PMS	premenstrual syndrome
PNS	peripheral nervous system
po	<i>per os</i> (by mouth)

PRN	<i>pro re nata</i> (as needed)
pt	pint
PTT	partial thromboplastin time
PTU	propylthiouracil
PVC	premature ventricular contractions
qt	quart
RBC	red blood cells
REM	rapid eye movement
RIG	rabies immune globulin
SC	subcutaneous
SEI	special experience identifier
SL	sublingual
SLE	systemic lupus erythematosus
SR	slow release
SSRI	selective serotonin reuptake inhibitors
STS	Specialty Training Standard
Tb	tablespoon
TD	tardive dyskinesia
Td	tetanus/diphtheria
TIG	tetanus immune globulin
tsp	teaspoon
TJC	The Joint Commission
USP	United States Pharmacopoeia
VZIG	varicella zoster immune globulin
WBC	white blood cell
yd	yard

Student Notes

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