

4

MEDICATION ADMINISTRATION

CORE CONCEPTS

- Discuss the combat medic's scope of practice to administer medication.
- Administer medications.
- State the 6 Rights of medication administration.
- Describe how to treat mild to moderate allergic reactions after medication administration.
- Describe how to treat severe allergic reactions after medication administration.
- Calculate drug dosages.

INTRODUCTION

Medications (also called pharmaceuticals or drugs) prevent and treat disease and control pain. Combat medics administer various types of medications, from vaccines to powerful pain medications. Medication administration is an exact science and one error could cause severe injury or death to a patient. To properly administer medications and prevent accidental injuries, combat medics must understand how certain drugs affect the body. They must also be able to calculate and administer the correct drug **dose** every time.

The Centers for Disease Control and Prevention (CDC) estimates that mistakes made by health care providers administering medications within health care facilities injure or kill thousands of people each year. The administration of medication is a vital combat medic skill.

SCOPE OF PRACTICE

Combat medics practice under supervision of a licensed health care provider (doctor, nurse practitioner, registered nurse, or physician assistant). In the clinical setting, you may dispense prescriptions and over-the-counter medications ordered or directed by a licensed health care provider. In the field, you may be responsible for the safe and appropriate delivery of medication in accordance with (IAW) unit standard operating procedures (SOP) or the approved formulary (off-line medical control). You are responsible for knowing all medications within their authority to dispense IAW unit SOP.

You must also understand how to treat medication allergies. Although rare, a severe hypersensitivity (**anaphylaxis**) is a life-threatening emergency that may progress suddenly from mild initial reactions.

Note: The supervising MO and the combat medic carry the same burden of responsibility for administering medications correctly and safely.

ENTERAL ROUTES OF MEDICATION ADMINISTRATION

Enteral **routes** of drug administration are those in which medications are absorbed through the gastrointestinal tract. Enteral routes include medications given by mouth (the most common way to give medications), by any tube inserted into the gastrointestinal tract (nasogastric, gastrostomy, or jejunostomy tubes), by **suppository** (rectum), or by **enema** (rectum). Medications administered via the enteral route come in many forms, such as powders, **pills**, **tablets**, **lozenges** (troches), liquids, and suppositories. Common examples of medications given by mouth include aspirin, acetaminophen, and ibuprofen.

Some medications are delivered orally, but are absorbed through mucous membranes (**transmucosal**) before reaching the intestine. Nevertheless, these are often classified as enteral medications. Sublingual medications are placed under the tongue and are absorbed through the blood vessels there (eg, nitro-

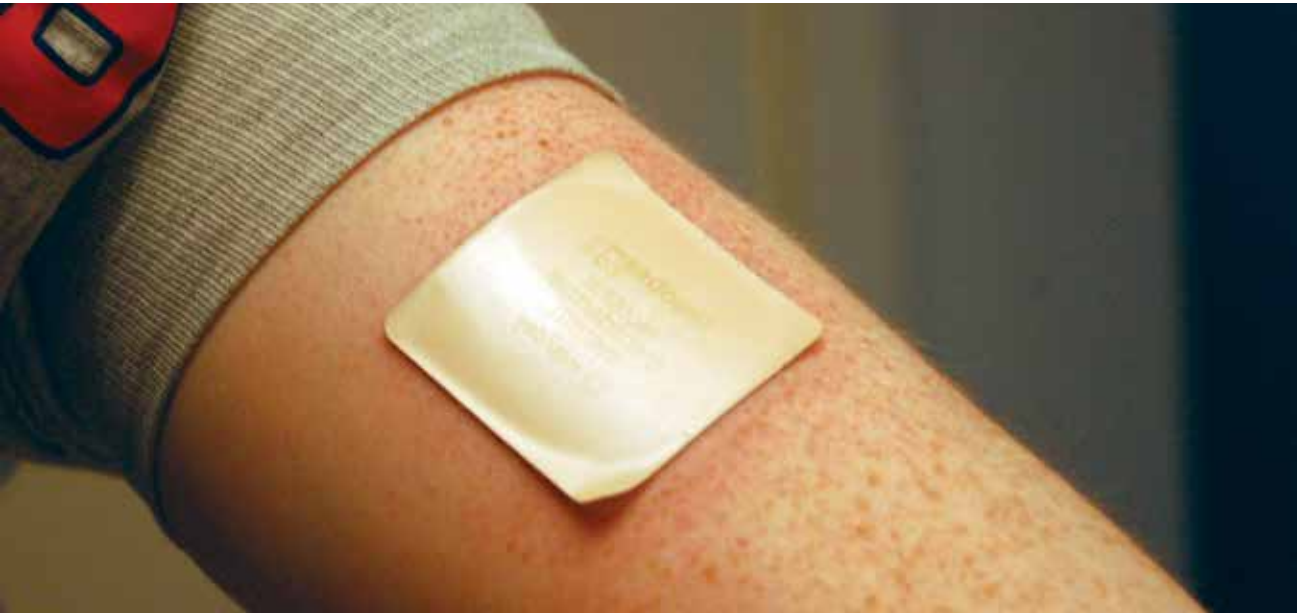


Figure 4-1. A nicotine transdermal patch. Photograph by RegBarc. Reproduced from Wikimedia Creative Commons. <https://commons.wikimedia.org/wiki/File:Nicoderm.JPG>

glycerin). Buccal medications are placed alongside the cheek and are absorbed through the blood vessels in the mouth (eg, oral glucose).

Advantages

The main advantages of administering a medication via the enteral route are safety and low cost. Administration is very convenient and easy, and most medications are available in forms approved for enteral administration. Furthermore, if a patient overdoses while taking medication via the enteral route, the medication can be removed through a procedure called **gastric lavage** or by having the patient vomit.

Disadvantages

The onset of action depends on absorption rates in the gastrointestinal (GI) tract, which vary. Unconscious patients, or those experiencing nausea or vomiting, cannot receive enteral medications that dissolve in the stomach and are absorbed in the small intestines. Some medications lose their effectiveness if mixed with gastric secretions. Some enteral medications may have an objectionable odor or taste, or may be too bulky for some patients to swallow.

PARENTERAL ROUTES OF MEDICATION ADMINISTRATION

Parenteral routes are any drug administration routes other than the mouth and alimentary canal (the passage in which food passes through the body from mouth to anus). Parenteral routes include percutaneous, subcutaneous, intradermal, intramuscular, and intravenous (IV) push.

Percutaneous Route

The percutaneous route refers to the absorption of medication through the skin or mucous membranes. Topical application is common and familiar, but inhalation and instillation (including intranasal delivery) are extremely useful for percutaneous medicine administration.

Topical

In the topical method of percutaneous medication administration, medication is applied to body surfaces such as the skin or mucous membranes (eg, with a paste or patch) and is absorbed through the surface. Topical medications may come in forms such as **ointments** (eg, **antibiotic ointments**), **creams**, **lotions**, **pastes**, and **transdermal patches (topical disks)**.

Nicotine, analgesics, nitroglycerin, and estrogen all can be delivered systemically via transdermal patches (Figure 4-1).

The main advantage of applying medication through a topical percutaneous route is localization of the drug at the site of application, which reduces possible systemic **side effects**. However, lotions, ointments, creams, powders, and topical disks (transdermal patches) can be messy and difficult to apply. To avoid accidental poisoning, gloves are required for handling or applying percutaneous medication. For example, if you handle a transdermal patch without gloves, you may absorb the medication through your skin.

The following factors affect the amount of drug absorbed through topical administration:

- drug concentration,
- skin contact time,
- application area (size),
- skin thickness,
- skin tissue hydration, and
- degree of skin disruption.

Inhalation

Inhalation is the method of medication administration that delivers aerosolized liquids and gases into the lungs. Inhaled medication is absorbed through the lower airway. The lungs, with their rich supply of blood vessels, have a large surface area over which medications are absorbed. The smaller the particles in inhaled medications, the lower in the respiratory tract the medication tends to travel. Due to the large surface area of the lung tissue and the large number of blood vessels, drug dosing can be difficult to establish. Devices such as metered-dose inhalers help deliver a consistent dose of medication during inhalation. Examples of inhalation medications include bronchodilators (eg, albuterol and ipratropium bromide) and steroids (eg, fluticasone and budesonide) used to control and reduce symptoms of asthma and chronic obstructive pulmonary disease.

Instillation

The instillation method administers medication by absorption through the mucous membranes of the mouth, eyes (ophthalmic), ears (otic), nose (nasal), rectum, and vagina.

Ophthalmic

There are many reasons to apply medications through the ophthalmic route such as to remove foreign bodies or irrigate the eye, to dilate the pupil for medical procedures, and to administer antibiotics for eye infections. Some eye medications may be absorbed systemically. Most eye medications are eye drops or ointments (eg, Visine [Johnson & Johnson, New Brunswick, NJ]), which treat many eye conditions (Figure 4-2).



Figure 4-2. A person applying medicated eye drops. Photograph courtesy of Mike Davis; Medical Center of Excellence, Joint Base San Antonio, TX.

Otic

The otic route refers to medication applied in the external auditory canal of the ear. This route is used to treat ear infections, irrigate to remove foreign objects, or remove excessive cerumen (earwax). Most ear medications are eardrops.

Rectal

In this route of administration, medications are inserted into the rectum and absorbed through mucous membranes. They are typically administered with an enema or a suppository.

Vaginal

Vaginal instillation medications are absorbed through the mucous membranes of the vagina to treat medical disorders ranging from infection to pain relief. They typically are administered with suppositories, creams, gels, or foams.



Figure 4-3. A patient being treated with an intranasal medication delivered through a 1 mL syringe and a mucosal atomization device. Photograph courtesy of Mike Davis; Medical Center of Excellence, Joint Base San Antonio, TX.

Intranasal

Intranasal (IN) delivery of medications is a relatively new transmucosal (percutaneous, instillation) route of delivery (Figure 4-3). IN refers to medicine applied to the mucous membranes of the nasal passages. The nasal cavity is large and possesses a dense vascular network providing a direct route into the bloodstream for medications that easily cross mucous membranes. Nasal cavities can absorb about 20 mL of medication.

The IN route of administration is rapidly gaining popularity among health care providers. This instillation route is especially important for emergencies, since medications are rapidly absorbed. Nasal decongestants are common IN medications.

Advantages of the Intranasal Route. The direct, transmucosal route avoids gastrointestinal destruction and **hepatic first-pass metabolism** of drugs, effectively increasing **bioavailability** (for small drug molecules) and decreasing time of onset. It is also a cost-effective way to deliver medications.

The proximity of the nose to the brain leads to a more rapid equilibration between the blood and the cerebrospinal fluid, leading to a more rapid onset than with conventional routes. The rates of absorption and time to peak plasma concentrations are comparable to IV administration and are generally superior to subcutaneous or intramuscular routes.

Medications administered through the GI tract pass through the liver, which metabolizes a portion of the drug. This hepatic first-pass metabolism reduces the amount of usable medication. IN delivery (just as any parenteral route) bypasses the liver, and therefore maintains the drug's strength. The nasal passage enables better bioavailability for smaller drug molecules. With an absorption enhancer added to medications with larger molecules, those drugs also have good bioavailability when administered IN.

The IN drug administration route is painless and may reduce the patient's anxiety during treatment. In addition, since IN drugs do not require needles, there is no risk of an accidental needle stick. This safety feature is particularly valuable in low visibility and kinetic environments.

Disadvantages of the Intranasal Route. A limited number of medications can be administered via the IN route because many medications are not adequately concentrated to achieve the desired effect. The effectiveness of an IN-approved medication also will depend on the condition of the patient's nasal mucosa.

Subcutaneous Route

Medications delivered by the subcutaneous (SC, SQ, or subq) route are injected under the epidermis and dermis, into the fatty subcutaneous layer of the skin. SC injections are useful for delivering medications that cannot be absorbed in the intestines (eg, insulin) or are destroyed by digestive acids and enzymes. Their effects are produced more slowly than medications delivered by the intravenous (IV) route. SC injections generally have less pain and risk of infection than other forms of injections. Other common examples of medications delivered by SC injections are heparin, epinephrine, and allergy medications.

Intradermal Route

Intramuscular (IM) injections deliver medications into the muscle tissue. Medications are absorbed more quickly than in ID or SC routes of administration. IM injections are commonly used for antibiotics (eg, penicillin G and streptomycin) and biologicals (eg, immunoglobulins and toxoids).

Intravenous Push Medication Administration

When ordered by a medical officer (MO), IV push medications are administered directly into a vein through a saline lock or through the injection port of IV tubing attached to an IV catheter inserted into the vein (Figure 4-4). This route is most useful for emergencies



Figure 4-4. Medication delivered into a vein by intravenous push.

because the medications are rapidly absorbed. Some medications are delivered very rapidly, while others must be administered slowly over several minutes. However, in all cases, medication delivery is faster than through an IV drip.

Advantages of IV Push Medication Route

IV push medications have faster onsets of action than most delivered through other parenteral and enteral routes. Since IV push medications bypass the liver and go straight to the cardiovascular system, they do not undergo hepatic first-pass metabolism, and have no reduction in volume or concentration. Full-strength drugs reach the target site. Functionally, a smaller medication dose is needed for IV push than for other routes of administration.

IV push is a viable alternative if the patient is unable or unwilling to swallow a medication. It is also a good choice if digestive juices in the GI tract would alter the drug's effects.

Disadvantages of IV Push Medication Route

When administering an IV push, use aseptic technique to avoid infection. Infection risk is elevated because of the direct line into the cardiovascular system. In addition, any drug given through an IV can leak into the extravascular spaces and cause **lipodystrophy**, tissue necrosis or abscess, skin sloughing, nerve injuries, prolonged pain, and **periostitis**.

There is no margin of error when calculating dosages for IV push. The intravascular route, rapid absorption, and lack of hepatic first-pass metabolism eliminate any buffer to reduce the amount or concentration of the drug. A miscalculation results in too little or too much drug administered. While an insufficient dose may reduce the drug's efficacy, an overdose can have severe medical consequences.

Intravenous medications can be more expensive than the same drug prepared for other administration routes, such as by mouth.

The rate of injection of an IV push medication can sometimes be difficult, especially if the volume of fluid to be administered is very small (a drug volume less than 1 mL that must be pushed over several minutes).

Check on Learning

1. What are two advantages and two disadvantages of enteral medication administration?
2. Which of the following is not considered a parenteral route?
 - a. Percutaneous administration.
 - b. IN administration.
 - c. IV push administration.
 - d. Oral administration.

THE 6 RIGHTS OF MEDICATION ADMINISTRATION

The 6 Rights of medication administration decrease human error and increase patient safety. They are the right patient, the right medication, the right time, the right route, the right dose, and the right documentation.

Right Patient

To prevent errors, confirm the identity of the patient before you dispense medication. In particular, misidentification of patients with common last names is possible if you fail to confirm their first names and dates of birth. Additionally, verify the patient's DOD ID number.

Note: Check patient identification every time you administer any medication, even if this is not the first time you have managed the patient in a day.

Verify inpatient identification by checking the patient's name on the medical record. Verify the patient's name on the MO's orders, such as those found on an SF 600, Chronological Record of Medical Care, or DA Form 4678, Medication Administration Record. Additionally, ask the patient to state their name and check the identification wristband provided by the hospital.

Verify outpatient (Troop Medical Clinic, Battalion Aid Station) identification. Ask the patient to state their name and confirm that this matches their ID card or ID tags.

Right Medication

If an MO provides a verbal medication order, repeat it back to confirm. Verify the medication a minimum of three times. The first verification occurs when removing the medication or container from the storage area. The next verification occurs when preparing the medication dose. If the medication is an IV push or injection medication, perform the second check prior to drawing the drug from the vial. Check for the third time before administering the medication to the patient. Verify and prepare the correct dose. Check again, just before administration.

Be familiar with formulary medications: **brand name**, **generic name**, usual dosages, **indications**, contraindications, common side effects, and other considerations. For example, the MO ordered Motrin (Johnson and Johnson, New Brunswick, NJ) 800 mg tablets, but you have no brand name product on hand. Verify that ibuprofen is the generic equivalent of Motrin and obtain it from the storage area. Have resources available to answer your medication questions when your MO is not available. Verify all information needed for safe and effective use of the drug.

When dispensing a medication ordered by an MO, do not assume the MO has ensured that the medication is right for the patient. You have the same responsibility as the ordering health care provider to prevent medication errors. Ensure the patient is not allergic to the medication. When a patient states they are allergic to a medication, document their description of the reaction. A patient with a known allergy to one medication is commonly allergic to others. A patient who is allergic to ibuprofen, for example, may be allergic to most, if not all, other anti-inflammatory medications, including aspirin.

Right Time

In a field or combat environment, most medications that you administer will be in urgent or emergent situations. However, during sick call (limited primary care), you may be required to give medications on a scheduled basis. Giving a medication too early could lead to an overdose with undesired effects such as toxicity, sedation, and even death. Giving a medication too late could result in other undesired effects, such as loss of pain control or infection control. Proper medical record documentation helps maintain correct intervals between doses.

Right Route

A medication’s onset of action can vary widely, and depends largely on its route of administration. Many medications come in multiple dosage forms so you must ensure that the form of medication on hand is approved for the route of administration intended. Not all medications are available in every method of administration.

All medications, regardless of route administered, eventually enter the bloodstream. The time it takes a medication to enter the bloodstream is its absorption rate. The more quickly a medication enters the bloodstream, the more quickly it will act; however, quick action is not appropriate in all situations.

Right Dose

Familiarity with common medication dosages can enhance safety. For example, 800 mg doses of ibuprofen are common, but patients usually should not take more than 2,400 mg in 24 hours. Combat medics should have enough knowledge to question a written order, such as "administer 800 mg of ibuprofen every 8 hours by mouth for pain." Failure to question could inadvertently cause an overdose.

Medications are prescribed and dispensed based on concentration (amount of medication in a given volume). Medications are never ordered by volume alone (eg, milliliters or number of tablets), because various concentrations can exist for any drug. An order that calls only for milliliters of a medication does not give a dose, but only a volume of fluid. The fluid form of medications is produced by dissolving a drug (**solute**) in a sterile fluid (**solution**) for dispensing. Most injectable medications come in various concentrations, as the number of micrograms (or milligrams) per milliliter (eg, morphine is available in either 10 or 20 mg/mL). An order that calls only for 1 mL of morphine can result in two different possible dosages, depending on which concentration is on hand. There are many solid forms of medications with more than one concentration as well. For example, ibuprofen is available in 200 or 800 mg tablets.

Right Documentation

Thorough medication documentation is vital in the continuity of patient care. The most commonly used forms are SF 600, Chronological Record of Medical

Care; DA 4678, Medication Administration Record; and DD 1380, Tactical Combat Casualty Care (TCCC) Card. All medication documentation should become a part of the patient’s permanent medical records. Professional language should be used, but if necessary, describe the patient’s reaction to medication in clear, concise, and simple terms. Before administering any drug, document the following:

- vital signs,
- pain levels,
- anatomic location of pain, and
- all signs and symptoms that indicate the need for medication (eg, lung sounds prior to giving an inhaler).

When administering any drug, document the following:

- name of the medication,
- time of administration,
- reason for the medication,
- a description of the location of the application (for topical medication),
- the condition of the skin at the time of application (for topical medication), and
- follow-up action taken (if applicable).

After administering any drug, document the vital signs and all effects of the medication. For example, document the patient’s lung sounds after administering medication through an inhaler. Record the omission of any scheduled medication administration, whether by accident or on purpose. If a patient refuses a medication, offer it again in 5 minutes. If it is refused a second time, record the omission and the reason for the omission in the patient’s medical record and notify your supervisor.

PREGNANCY CONSIDERATIONS

Many medications, both prescription and over-the-counter, are either **contraindicated** in pregnancy or should be used only in limited circumstances. To prevent accidental administration of medications that could harm a fetus, obtain the First Day of Last Menstrual Period (FDLMP) for female patients. This date raises or lowers the index of suspicion for pregnancy. If there are any doubts about the patient’s pregnancy status, check with the supervising MO before administering medication. A good rule of thumb is to assume that *all* female patients are pregnant until reasonably proven otherwise.

Check on Learning

3. An MO orders you to administer a specific medication to a pregnant patient, which is contraindicated. Are you, as a combat medic who is following orders, potentially liable for causing injury to the fetus?
4. List the 6 Rights of medication administration.
5. How many times should you verify medications?
6. Restate the times a medication should be verified.

ALLERGIC REACTIONS

Always ask the patient about allergies to medications before administering or dispensing any medication. Ask what happens when they take the medication. For example, if a patient states they are allergic to penicillin, ask them to describe the reaction. Check unconscious patients for a medical alert bracelet or a medal indicating a medication allergy before administering medications. If the patient informs you of a medication allergy, do not administer the medication. Discuss the issue with an MO. After the patient receives the injection, direct them to remain in the treatment area for 20 minutes and monitor them for a severe reaction. See Chapter 3, Pharmacology, for more information on drug allergies.

Caution: An allergic reaction may progress rapidly to anaphylaxis without warning.

Mild to Moderate Allergic Reactions

These are localized or generalized self-limiting reactions such as itching or swelling. They are not life threatening. Bronchodilators (eg, albuterol) may relieve mild to moderate lung symptoms, such as wheezing or coughing. These are short-acting medications, delivered through a nebulizer or inhaler.

Anti-inflammatory agents, such as corticosteroids, are useful for mild or moderate symptoms. They have cooling and antiseptic effects and reduce itching and other symptoms. They are manufactured in many forms, such as pills, nose or eye drops, creams, injections, and as liquids for inhalation.

Antihistamines effectively reduce mild symptoms by inhibiting histamine action within the body. They

provide only temporary relief, so patients must use them frequently for continuous effect. Prolonged use has undesirable effects, such as an increasing tolerance to the medication (most commonly seen in first-generation antihistamines). First-generation antihistamines (eg, diphenhydramine) may cause drowsiness. Use great caution in prescribing antihistamines in a combat environment. Be cautious when the patient is returned to duty as well (consider if the patient will be operating machinery or driving).

Severe Allergic Reactions

Anaphylaxis is a life-threatening emergency that can affect more than one organ system. Anaphylaxis refers to a hypersensitivity reaction to an antigen and is the most severe form of an allergic reaction. Even someone experiencing a mild allergic reaction may progress into anaphylaxis. Signs include **angioedema**, difficulty breathing, hives, vomiting, and dangerously low blood pressure (see Chapter 3, Pharmacology, for more information). Immediate medical intervention is required. Treatment of anaphylaxis starts with securing the patient’s airway. Give supplemental oxygen and perform positive pressure ventilations if necessary. Administer epinephrine 0.3 to 0.5 mg (of 1:1,000 solution) IM or SC for an adult. Repeat epinephrine every 5 to 10 minutes if symptoms continue or recur. The administration of epinephrine and a 500 mL fluid bolus will aid in combatting hypotension caused by the anaphylaxis. Other medications may be prescribed by an MO as needed, including antihistamines (diphenhydramine: 25–50 mg IM or IV) and corticosteroids (methylprednisolone sodium succinate or methylprednisolone acetate: 125 mg IV).

DOSAGE CALCULATION MATH

Fractions

The concentration of a drug (amount of drug in solution) appears as a fraction (eg, 1 mg/10 mL). This concentration fraction is always constructed with the drug weight (eg, 1 mg) per (“/”) the solution (eg, 10 mL). An easy way to remember the numerator (the number on top) and the denominator (the number on the bottom) is to use a boat analogy, where the boat (numerator) is the weight of the drug and the boat is always on top of the water (denominator).

When calculating medication dosages, reduce (convert) the concentration to the amount of drug mixed in 1 mL of solution by dividing the drug weight by the water volume (solution).

Example

Reduce a 5 mg/20 mL concentration of a drug. First, identify the weight (5 mg) and water volume (20 mL). Next, divide the weight by the volume:

5 mg ÷ 20 mL = 0.25 mg/mL.

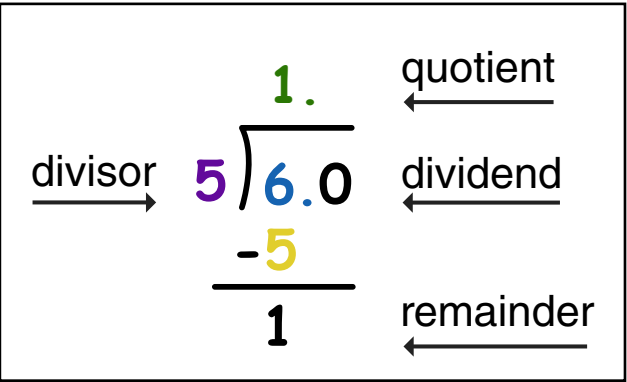


Figure 4-5. Terminology used for numbers in a long division formula.

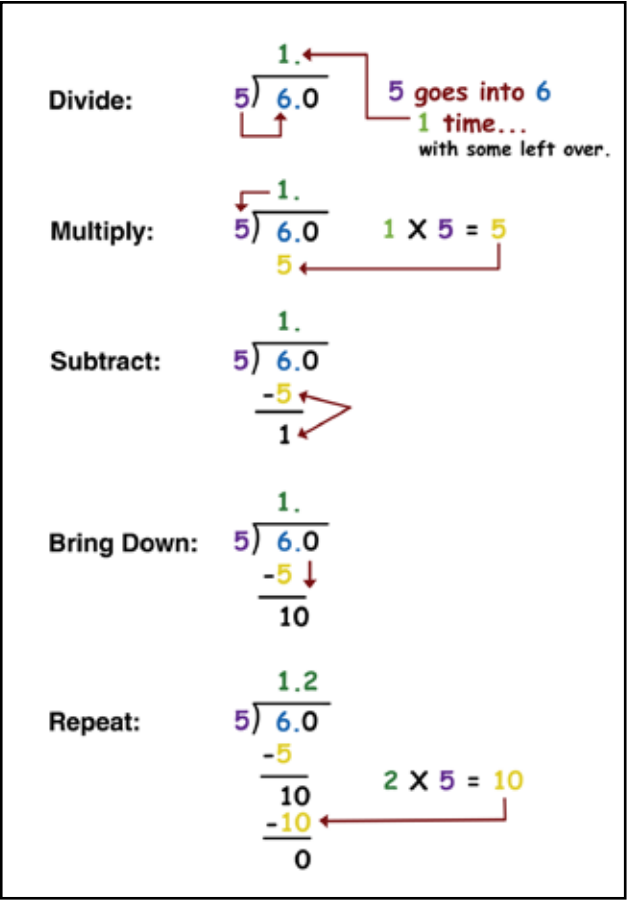


Figure 4-6. A guide to completing math problems using long division.

In division with fractions, the **divisor** is also in the denominator position, following the slash (“/”) symbol (eg, the divisor is 6 in the fraction 5/6). In traditional long division, the divisor is placed outside the division box and the **dividend** (the number to be divided) inside the box. The result or answer of the division is also called the **quotient**. Figure 4-5 shows the terminology in a traditional long division problem. Figure 4-6 shows how to calculate a quotient using long division.

Proper Fractions

In proper fractions, the number is less than one and the numerator is less than the denominator (eg, 3/4, 1/2, 7/8). Use the following steps to reduce (simplify) a proper fraction to its lowest terms:

- 1. Identify the numerator and denominator.
- 2. Find the **greatest common factor** of both numbers.
- 3. Divide both the numerator and denominator by the greatest common factor.
- 4. Write the simplified fraction as the new numerator over the new denominator.

Example 1: Reduce 5/10 to its lowest terms.

- Step 1. The numerator is 5 and the denominator is 10.
- Step 2. The greatest common factor is 5 (5 is the largest number that divides into both the numerator and denominator).
- Step 3. Divide both the numerator (5) and the denominator (10) by the greatest common factor (5):
 $5 \div 5 = 1$ and $10 \div 5 = 2$.
- Step 4. Write the reduced fraction as the new numerator (1) over the new denominator (2).
 $1 \text{ over } 2 \text{ is } 1/2$.

Example 2: Reduce 9/27 to its lowest terms.

- Step 1. The numerator is 9 and the denominator is 27.
- Step 2. The greatest common factor is 9.
- Step 3. $9 \div 9 = 1$ and $27 \div 9 = 3$.
- Step 4. $1 \text{ over } 3 \text{ is } 1/3$.

Example 3: Reduce 7/8 to its lowest terms.

- Step 1. The numerator is 7 and the denominator is 8.
- Step 2. The greatest common factor is 1.
- Step 3. $7 \div 1 = 7$ and $8 \div 1 = 8$.
- Step 4. 7/8. This fraction cannot be reduced.

Example 4: Reduce 8/12 to its lowest terms.

- Step 1. The numerator is 8 and the denominator is 12.
- Step 2. The greatest common factor is 4.
- Step 3. $8 \div 4 = 2$ and $12 \div 4 = 3$.
- Step 4. 2 over 3 is 2/3.

Improper Fractions

In improper fractions, the numerator is greater than the denominator (eg, 4/3, 11/5). Use the following three steps to convert an improper fraction into a mixed number (one with a combination of a whole number and a fraction [eg, 1 1/3]):

- 1. Divide the numerator by the denominator.
- 2. Write down the whole number.
- 3. After the whole number, write down any remainder over the original denominator.

Example 1: Convert 25/3 into a mixed number.

- Step 1. $25 \div 3 = 8$, with remainder 1.
- Step 2. 8 (whole number).
- Step 3. 8 1/3 (whole number [8] and remainder [1] over the original denominator [3]).

Example 2: Convert 11/5 into a mixed number.

- Step 1. $11 \div 5 = 2$, with remainder 1
- Step 2. Write down the whole number 2.
- Step 3. 2 1/5 (whole number [2] and remainder [1] over the original denominator [5]).

Mixed Numbers

Mixed Numbers are a combination of a whole number and a fraction (eg, 1 1/2, 5 7/8). Use the following four steps to convert a mixed fraction into a decimal:

- Step 1. Multiply the whole number by the denominator.
- Step 2. Add the result from step 1 to the numerator. This sum is the new numerator.
- Step 3. Place the new numerator over the denominator.
- Step 4. Divide the numerator by the denominator.

Example 1: Convert 3 5/6 to its decimal form.

- Step 1. 3 (whole number) \times 6 (denominator) = 18.
- Step 2. $18 + 5$ (numerator) = 23 (new numerator).
- Step 3. 23 (new numerator)/6 (denominator).
- Step 4. $23 \div 6 = 3.833$.

Note: The formula is $(3 \times 6 + 5) \div 6$.

Example 2: Convert 4 7/8 to its decimal form.
Step 1. $4 \times 8 = 32$.
Step 2. $32 \div 7 = 39$.
Step 3. 39/8.
Step 4. $39 \div 8 = 4.875$.

Note: The formula is $(4 \times 8 + 7) \div 8$.

Check on Learning

- 7. Reduce the fraction 5 mg/10 mL to its lowest terms.
- 8. Reduce the fraction 500 µg/5 mL to its lowest terms.
- 9. Convert the improper fraction 1,000 mg/250 mL into a mixed number.
- 10. Convert the concentration 25 mg/10 mL into a decimal form.

Decimal Fractions

A decimal is a real number expressed in base 10. A decimal fraction is a fraction or mixed number in which the denominator is expressed as a power of 10. The decimal point (a dot) identifies the beginning of a decimal fraction. All numbers to the left of the decimal are whole numbers. All numbers to the right of the decimal point are fractions of a base 10 number. The first number to the right of a decimal point represents tenths, the second represents hundredths, and the third represents thousandths. Read the number 5.125 as, “five point one two five.” The numeric places are 5 (whole number), point, 1 (tenths), 2 (hundredths), 5 (thousands). If a decimal answer does not contain a whole number, place a zero to the left of the decimal (eg, 0.75, 0.2). A zero at the end of a decimal number does not add value, so in many cases, it can be dropped (eg, 2.0 becomes 2).

In some cases, you may round a number up or down. Round up if the number is 5 or greater and round down if the number is less than 5. For example, 5.5 and 5.6 are both rounded up to 6, but 5.4 is rounded down to 5.

Metric System

The metric system, also known as the International System of Units (SI), is a globally accepted, decimal standard of measure. The metric system of weights and volume is used to calculate medication dosages. It is simpler and more widely used around the world than the US Customary System of Measurement. Metric units of length or distance are based on the meter. From small to large, the most common units are millimeter (mm), centimeter (cm), meter (m), and kilometer (km). Metric units of weight are based on the kilogram. From small to large, the most common units are microgram (µg or mcg), milligram (mg), gram (g), and kilogram (kg). Most drug doses are measured in grams (g), milligrams (mg), and micrograms (mcg or µg). Metric units of volume are based on the liter. From small to large, the most common units are microliter (µL), milliliter (mL), and liter (L). Table 4-1 shows the relationships between metric units of measure.

Converting Common Medication Weights

Dosage calculations often require conversion from one medication weight to another, using the metric system and decimals. In the metric system, simply move the decimal point either right or left. For example, a combat medic plans to administer an IV microdrip drug at 600 µg/min. However, the drug comes in a 200 mg vial. The first step of calculating medication doses is to convert the dosage on hand to the same metric multiple as ordered. In this example, the dosage on hand is 200 mg, but the dose ordered is 600 µg/min. Simply move the decimal point three places to the right to convert milligrams to micrograms. The dosage on hand is now 200,000 µg. Use Table 4-1 to convert between multiples of a weight or volume.

Check on Learning

- 11. Convert 1 g to mg.
- 12. Convert 1 mg to µg.
- 13. Convert 1,000 mg to g.
- 14. Convert 1.5 L to mL.
- 15. Convert 70.000 g to kg.
- 16. Convert 0.0017 g to µg.
- 17. Convert 5 mg to g.
- 18. Convert 0.04 L to mL.
- 19. Convert 400 µg to g.
- 20. Convert 1,500 mL to L.

Table 4-1. Metric System Units of Measure and Nomenclature with the Most Common Measures Shaded.

Prefix names	Weight prefix symbols	Volume prefix symbols	Multiples and submultiples
tera	Tg	TL	1,000,000,000,000 (12 zeros)
giga	Gg	GL	1,000,000,000 (9 zeros)
mega	Mg	ML	1,000,000 (6 zeros)
kilo	Kg	kL	1,000 (3 zeros)
hecto	hg	hL	100 (2 zeros)
deka	dag	daL	10 (1 zero)
N/A	g	L	1 (base [decimal point goes to the right of this number])
deci	dg	dL	0.1 (one place to the right of the decimal)
centi	cg	cL	0.01 (two places to the right of the decimal)
milli	mg	mL	0.001 (three places to the right of the decimal)
micro	µg	µL	0.000 001 (six places to the right of the decimal)
nano	ng	nL	0.000 000 001 (nine places to the right of the decimal)
pico	pg	pL	0.000 000 000 001 (twelve places to the right of the decimal)

CALCULATE DRUG DOSAGE USING THE 4-STEP METHOD

Required Information

The following information is required to calculate drug dosages:

- The amount of medication the doctor ordered (may be weight based).
- The concentration of the medication on hand.
- The unit of measure needed (how much the doctor ordered).
- The formula for calculating drug dosage.
- The patient’s weight (for weight-based drug dosages).

How to Use the 4-Step Method

Use the 4-Step Method to calculate medication dosage¹:

- 1. Identify the required dose (the amount the doctor ordered). If the dose is not weight based (eg, the doctor orders 25 mg), go to step 2. If the dose is weight based (eg, the doctor orders a dose of 2 mg/kg), follow steps a and b.

- a. Convert the patient’s weight from pounds to kilograms: divide the patient’s weight (lb) by 2.2 (conversion factor).
- b. Multiply the required dose by the patient’s weight (kg).
- 2. Determine the concentration of the drug on hand. If the unit of the required dose differs from the unit of the medication on hand (eg, the drug on hand is in milligrams, but the required dose is in micrograms), convert the drug on hand to the same unit as the required dose.
 - a. Follow Table 4-1 to convert the weight of the drug on hand to the weight of the required dose.
 - b. Is the concentration reduced to the amount of drug mixed in 1 mL? If not, divide the weight by the amount of solution to get the reduced concentration of drug in 1 mL
- 3. Calculate the amount of fluid to draw into the syringe from the medication vial by dividing the required dose by the concentration.

Note: Stop here for IV push or injection drugs. Continue to step 4 for IV infusions.

- 4. If the drug is an IV drip medication, perform this step in addition to the previous three steps to calculate how many drops per minute over a specified time will deliver the correct dosage of medication.

Amount to be infused \times gtts/mL infusion tubing/time of infusion.

Note: If providing only IV fluid (eg, fluid resuscitation) over a specified duration, calculate only step 4. Skip steps 1 through 3.

Example 1: A patient experiencing anaphylaxis needs 25 mg of diphenhydramine. The combat medic has a prefilled syringe containing 100 mg/5 mL. How many mL of fluid will the combat medic administer?

- Step 1. What is the required dose? It is 25 mg of diphenhydramine. The medication is not weight based, so go to step 2.
- Step 2. Is the required dose in the same metric weight units as the medication on hand? Yes, the required dose (25 mg) is in milligrams as is the drug on hand (100 mg), so there is no need to convert units.
- Step 2, continued. Is the concentration reduced to its simplest form (amount of drug mixed in 1 mL)? No, the concentration given is 100 mg mixed in 5 mL of fluid. Reduce the concentration by dividing the weight of the drug (100 mg) by the amount of solution (5 mL). The result is 20 mg/mL.
- Step 3. Divide the required dose by the concentration (25 mg \div 20 mg/mL = 1.25 mL). Withdraw 1.25 mL of diphenhydramine from the medication vial.

Note: Step 3 always calculates the amount of fluid to draw up into the syringe.

Step 4. **STOP HERE.**

Example 2: A combat casualty suffered burns over 30% of her body surface area. She weighs 170 lbs (77 kg). By applying the **Rule of Ten** fluid resuscitation calculation for treating burn casualties, the combat medic calculated that the casualty needs 300 mL of Ringer solution per hour. A 1,000 mL bag of Ringer IV solution is attached to a 10 gtts/mL macro IV tubing set. How many drops per minute will deliver 300 mL of Ringer solution in 1 hour?

- Steps 1–3 do not apply. Step 4 is the only step used to calculate the amount of IV fluid to be infused over a stated duration.
- Step 4. The amount to be infused is $300 \text{ mL} \times 10 \text{ gtts/mL} = 3,000 \text{ mL}$.

Divide 3,000 by the time of infusion in minutes (1 hour = 60 min, so divide by 60 min, which results in 50 gtts/min. Adjust the flow rate of the IV tubing until you see 50 drops of fluid from the IV solution enter the IV tubing through the drip chamber.

Example 3: The MO orders 2 mg of a drug to be given IM. You have a vial with 10 mg of medication dissolved in 5 mL of fluid. How many milliliters of medication do you administer?

- Step 1. Identify the required dose: 2 mg.
- Step 2. Reduce the given concentration of the drug on hand: $10 \text{ mg}/5 \text{ mL} = 2 \text{ mg/mL}$.
- Step 3. Calculate the amount of medication to administer: $2 \text{ mg/mL (concentration)} \div 2 \text{ mg (required dose)} = 1 \text{ mL}$.

Check on Learning

21. A patient experiencing anaphylaxis needs 50 mg of diphenhydramine. The combat medic has a prefilled syringe containing 100 mg/5 mL. How many milliliters of fluid will the combat medic administer?
22. The same patient in Check on Learning 21 must now receive 0.3 mg of 1:1,000 epinephrine through a subcutaneous injection. The epinephrine that the medical clinic has on hand is 1 mg of 1:1,000 epinephrine mixed in 1 mL of solution contained in an ampule. How much fluid must be drawn from the ampule to administer 0.3 mg of 1:1,000 epinephrine?
23. A combat medic is treating a combat casualty who is in severe pain and is developing hemorrhagic shock. The combat medic selects TCCC option 3 to administer ketamine to the casualty. The protocol directs the combat medic to administer 30 mg of ketamine slow IV/IO push. The combat medic has a vial of ketamine with 500 mg of ketamine in 10 mL of fluid. How much fluid must be withdrawn from the vial to administer 30 mg?
24. A combat casualty has suffered severe burns to his body with 50% body surface area burned. The casualty weighs 210 lbs, which is calculated to be 95 kg. The casualty needs 700 mL of Ringer solution per hour (fluid resuscitation calculated using the Rule of Ten). A 1,000 mL bag of Ringer IV solution is attached to a 10 gtts/mL macro IV tubing set. How many drops per minute will deliver 700 mL of Ringer solution in 1 hour?

25. A combat medic is treating a combat casualty who was wounded about 30 minutes prior and has severe internal bleeding. The combat medic must administer tranexamic acid (TXA). Per protocol, the combat medic mixed 1 g of TXA in a 100 mL bag of normal saline for administration over 10 minutes. The IV tubing is 15 gtts/mL. How many drops per minute will deliver the drug over 10 minutes?

ADMINISTER MEDICATIONS

Administer Solid Medications Through the Oral Route

There are many common forms of solid medications, such as tablets, capsules, soft gels, liquids, chewable forms, and powders. To administer any medication by mouth, the patient must be able to protect the airway, have an intact gag reflex, and be alert.

Solid medications are not manufactured in every conceivable dose. Sometimes splitting tablets in half is the best way to get a required dose. Many tablets are scored across the middle to make splitting easier. Capsules are great for patients who have trouble swallowing tablets. Capsules can be opened and the medicine added to water or juice.

Note: Do not crush enteric-coated tablets. Crushing them destroys the special coating that prevents drugs from being released too soon.

Use the following steps to administer a solid medication by mouth:

1. After receiving the MO's order to administer an oral medication, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients. Always verify medication, check the 6 Rights, check for allergies, and document appropriately.

Caution: If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

Caution: Always check allergies prior to the administration of any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate the administration of the medication.

2. Don personal protective equipment (PPE). Gloves and eye protection are minimum PPE for administering an oral medication.
3. Check and assemble equipment.
- a. Select the correct medication from the storage area.
- i. Conduct the first verification by ensuring that the medication and dose (or concentration) are exactly what was ordered by the MO.
- ii. Verify that the medication was properly stored (medication specific).
- b. Obtain the equipment.
- i. Selected medication.
- ii. Medication dispensing cup.
- c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.
- d. If there is any evidence of medicine or packaging contamination or damage, or if the medication is outdated, discard the product into the appropriate receptacle and obtain new medication.
4. Read and follow the medication instructions. For example, some oral liquid medications require shaking prior to dispensing them.
5. Place the tablet, pill, or capsule in a small, disposable dispensing cup so that the patient can see the medication.

Caution: When giving different oral medications, place each medication in its own labeled dispensing cup and administer the medications one at a time. Also, if giving medications to different patients, label each dispensing cup.

Caution: Do not pass pills, capsules, or other solid medications from your hand to the patient's hand. Put them into a medication dispensing cup to reduce contamination. Patients expect cleanliness when asked to swallow a medication.

6. Recheck to ensure that the medication is the correct medication ordered by the MO.
7. Perform a final check to ensure that the proper medication is about to be administered to the patient.
8. Administer the medication and watch to ensure that the patient swallows all of the medication.

Note: If the patient has difficulty swallowing large capsules, open the capsule and mix the medication in juice or water.

Caution: When dispensing more than three units of the same solid medication at one time, pour the medication onto a clean surface (pill counting tray), count one by one, and place the medication into a dispensing cup.

9. Monitor the patient for any adverse reaction to the medication.
10. Document the following information into the patient's medical records: medication administration, the patient's condition prior to administering the medication, and any effects after the medication administration.

Check on Learning

26. How do you ensure that oral medication has been administered to the patient?
27. What must you assess to ensure the patient may accept medication orally?
28. What is the advantage of a capsule over a tablet?

Administer Medications Through the Respiratory Route

Combat medics may encounter and treat patients who require respiratory medications. Place patients with a respiratory complaint in a comfortable position that also facilitates a thorough examination. The proper approach to treating a patient with a respiratory complaint is to perform a primary assessment to rule out all life threats first and then perform a focused physical exam. Assess the patient's respiratory status and communicate any unexpected findings to the MO.

The two most common delivery methods for respiratory medications are meter-dosed inhalers (MDI) and small-volume nebulizers. As with any medication, combat medics must read the manufacturer's insert for administration guidelines for an MDI or small-volume

nebulizer. Explain the treatment procedure to the patient before attempting to administer medication.

If the patient will operate an MDI or nebulizer, ensure that they have the knowledge and ability to operate the equipment. Certain disabilities can hinder self-administered respiratory treatment, such as patients being unable to make an airtight seal between their mouths and the equipment, having insufficient strength to sit up, or being unable to hold the equipment. Other disabilities, such as blindness, may also affect their ability to self-treat.

Metered-Dose Inhaler

MDI respiratory medications are portable and are self administered by the patient. An MDI provides a consistent, measured dose of medication dispensed under pressure. MDIs are more effective when used with an attachment called a spacer (a holding chamber with a valve). The spacer retains the dispensed medication in a chamber, which allows the patient to breathe most of the medication into the lungs (Figure 4-7). The spacer is most beneficial for patients who have severe shortness of breath and cannot take long deep breaths.



Figure 4-7. A metered-dose inhaler and spacer. Photograph by Tradimus. Reproduced from Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Asthma_spacer_adult.JPG

Use the following steps to administer medications with a metered-dose inhaler:

1. After receiving the MO's order to administer an MDI respiratory medication, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

Caution: If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

Caution: Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering respiratory medication from an MDI.
3. Check and assemble equipment.
 - a. Select the correct medication from the storage area.
 - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
 - ii. Verify that the medication was properly stored.
 - b. Obtain the equipment.
 - i. MDI actuator.
 - ii. MDI spacer (a valved holding chamber).
 - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container. If there is any evidence of medicine or packaging contamination or damage, or if the medication canister is outdated, discard the product into the appropriate receptacle and obtain new medication.
 - d. If separated, place the medication canister into the MDI actuator.
4. Recheck to ensure that the medication is the correct medication ordered by the MO.
5. Shake the assembled MDI vigorously.
6. Attach the MDI spacer.
7. Perform a final check to make sure the proper medication is about to be administered to the patient.
8. Remove the oxygen mask from the patient's face if supplemental oxygen is in use.
9. Have the patient exhale forcefully.
10. Have the patient make a good seal with their mouth on the mouthpiece of the MDI spacer.
11. Depress the medication canister on the MDI and encourage the patient to inhale deeply. Give the patient plenty of time to inhale the medication from the MDI spacer.
12. Monitor the patient's respiratory status to ensure that the medication is working.

- a. Observe the patient's oxygen saturation (94% or greater).
- b. Observe the patient's end tidal CO₂ status if able (35–45 mmHg).

Small-Volume Nebulizer

A small-volume nebulizer dispenses liquid respiratory medication by dispersing it with pressurized oxygen. The patient breathes the resulting fine spray or mist into the lungs. Nebulizers come in two configurations. One configuration is a pipe with a reservoir that temporarily holds the nebulized medication until it is breathed into the lungs (Figure 4-8). Another configuration is a nebulizer attached to a mask strapped to the patient's face, eliminating the need for the patient to hold it in place (Figure 4-9). Medication for a small-volume nebulizer comes prepared as a liquid, in a single-use, low-density, polyethylene (LDPE) vial (Figure 4-10).

Assemble the items listed below for dispensing medications with a small-volume nebulizer:

- blue chux pad
- two oxygen sources with regulators
- nebulizer
- oxygen tubing
- oxygen mask



Figure 4-8. Pipe configuration of a small-volume nebulizer. Photograph by James Heilman, MD. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:Nebulizerpipe.JPG>



Figure 4-9. Face mask configuration of a small-volume nebulizer. Photograph by Marco Verch. Reproduced from flickr. <https://www.flickr.com/photos/30478819@N08/49918283661>

Use the following steps to administer medications with a small-volume nebulizer:

1. After receiving the MO's order to administer a nebulized respiratory medication, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

Caution: If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

Caution: Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering respiratory medication via a nebulizer.
3. Check and assemble equipment.
 - a. Select the correct medication from the storage area.
 - i. Conduct the first verification by ensuring that the medication and concentration (if



Figure 4-10. A single-use medication vial for a nebulizer.

- applicable) are exactly what was ordered by the MO.
- ii. Verify that the medication was properly stored (eg, in aluminum foil for some respiratory medications).

Caution: The different types of respiratory medications packaged in single-use LDPE vials look very similar to each other. Read the LDPE vial carefully.

- b. Obtain the equipment.
 - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.
 - d. If possible, check the medication for floating particles and changes in color and consistency by holding the single-use LDPE vial to the light.
 - e. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the appropriate receptacle and obtain new medication.
 - f. Ensure that the oxygen source has plenty of oxygen to complete the treatment.
4. Place respiratory medication into the nebulizer.
 - a. Unscrew the medication chamber of the nebulizer.
 - b. Twist off the top of the respiratory medication LDPE vial.
 - c. Squeeze the entire LDPE vial contents into the medication chamber of the nebulizer.
 - d. Screw and close the medication chamber of the nebulizer.

Note: Ensure that the nebulizer does not tilt more than 90 degrees after placing medication into the medication chamber or the medication may spill out of the chamber.

5. Recheck to ensure that the medication placed in the nebulizer is the correct medication ordered by the MO.
6. Attach the mouthpiece and reservoir extension tubing to the nebulizer (if a pipe-style nebulizer is being used).
7. Attach the oxygen tubing to the oxygen source.
8. Turn on the oxygen and verify that the medication is misting from the mouthpiece of the nebulizer.
 - a. Attach the oxygen tubing to oxygen source and turn on oxygen (8–10 L/min).
 - b. Verify that medication is misting from the mouthpiece.
9. Perform a final check to make sure the proper medication is about to be administered to the patient.
10. Remove the oxygen mask from the patient and have patient hold the nebulizer.
11. Have patient place the mouthpiece into their mouth and make a seal with their lips.
12. Coach the patient to breathe the medication into their lungs.
13. Monitor the patient's respiratory status to verify that the medication is working.
 - a. Observe the patient's oxygen saturation (94% or greater).
 - b. Observe the patient's end tidal CO₂ status if capable (35–45 mmHg).

Check on Learning

29. After administering an inhaler, you should document the patient's condition. Specifically what should you assess and document, and why?
30. What types of patients benefit most from an inhaler with a spacing device?

Administer Medications Through the Intranasal Route

Assemble the items listed below for dispensing medications through the IN route:

- blue chux pad
- syringe—appropriate size for the type of medication being given

- 18 G or blunt needle used for drawing the medication from the vial
- mucosal atomization device (MAD)
- alcohol prep pad

Use the following steps to administer IN medications:

1. After receiving the MO's order to administer an IN drug, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

Caution: If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

Caution: Always check allergies prior to the administration of any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate the administration of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering a medication via the IN route.
3. Check and assemble required equipment.
 - a. Select the correct medication from the storage area.
 - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
 - ii. Verify that the medication was properly stored (medication specific).
 - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
 - b. Obtain the equipment.
 - i. blue chux pad.
 - ii. syringe—appropriate size for the type of medication being given.
 - iii. 18 G or blunt needle used for drawing the medication from the vial.
 - iv. mucosal atomization device (MAD).
 - v. alcohol prep pad.
 - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.

Note: The protective cap should be in place on single-dose vials. If the protective cap has been removed, discard the vial and select a new one from the medication storage area.

- d. If possible, check the medication for floating particles and changes in color and consistency by holding the vial up to light. If it is a dark, light-obscuring vial, conduct this check when drawing up the medication into the syringe.
- e. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain a new vial.
- f. Open the packaging of the 18 G or blunt needle, MAD, alcohol prep pad, and syringe.
- g. Connect the hub of the 18 G or blunt needle to the needle adapter on the syringe.
4. Remove the cap from the medication vial and cleanse the vial with the alcohol prep pad.
5. Remove the protective cap from the needle safely and pull the needle cover straight off without bending or touching the needle.
6. Pull back on the plunger to draw air into the syringe for injection into the medication vial.
 - a. The amount of air to draw up equals the amount of fluid to be administered.
 - b. Follow the directions on the medication vial, if provided.
 - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
7. Insert the 18 G or blunt needle into the medication vial on the table.
 - a. Place the medication vial on a table, standing up, and insert the 18 G or blunt-needled syringe through the rubber stopper, ensuring that the needle tip passes completely through. Make sure the hub of the needle does not touch the rubber stopper.
 - b. Pick up the syringe and vial and turn them upside down.
 - c. Hold the syringe and vial at eye level.
8. Push the plunger forward injecting air from the syringe into the vial. The amount of air injected should equal the amount of fluid that must be withdrawn.

9. Pull the plunger back to the desired milliliter mark, withdrawing the prescribed medication into the syringe.
10. Remove the needle from the vial and recap the needle using the scoop method.
11. Attach the MAD.
 - a. After the medication is drawn up and ready to be administered, conduct a final recheck to make sure the medication and concentration are exact to what was ordered by the MO. This is the third and final recheck prior to administration.
 - b. Pull back on the plunger slightly to move any fluid from the 18 G or blunt withdraw needle into the syringe.
 - c. Detach the 18 G or blunt withdraw needle by twisting it counterclockwise and discard it into a sharps container.
 - d. Attach the MAD by connecting the leuer lock mechanism with a twisting motion.
12. While using your free hand to hold the crown of the patient's head to stabilize it, place the tip of the atomizer snugly against either nostril. Aim slightly up and outward (toward the top of the ipsilateral ear).
 - a. Briskly compress the syringe plunger to deliver approximately half of the medication into the nostril (not to exceed 1 mL per nostril).
 - b. Move the MAD to the opposite nostril and administer the remaining medication (not to exceed 1 mL).
 - c. If more than 1 mL per nostril is needed, wait 2 to 3 minutes and administer the remaining medication.

Administer Medications Through Intravenous Push

IV push medications are delivered rapidly or slowly through an IV fluid administration set, by way of a syringe. Each medication is different and you must understand the specific requirements before administering a drug. For example, ketamine sedates patients and treats severe pain. Rapid administration of ketamine may cause respiratory depression, so slow delivery is standard.

It is easier to deliver a small-volume, slow IV push drug after diluting it in a larger volume of solution. For example, ketamine may come prepared with 500 mg of ketamine mixed in 10 mL of sterile saline solution. The reduced concentration is 50 mg/mL. TCCC

guidelines recommend 30 mg slow IV or IO push. If 50 mg of ketamine is in 1 mL of saline and the required dose is 30 mg, the amount of fluid to administer is 0.6 mL. This is a very small volume to administer slowly (over 60 seconds). To make administration easier, mix the syringe contents of 0.6 mL (of ketamine) with more sterile saline solution, such as 0.4 mL, or more. The 0.6 mL of ketamine combined with 0.4 mL of normal saline provides 1 mL of fluid. Slowly depress the 1 mL syringe containing the dilution over a 60-second interval. A mix of 0.6 mL of ketamine with 4.4 mL of fluid yields 5 mL of fluid, and requires a larger syringe. In this case, administer approximately 1.2 mL every 10 seconds to deliver the entire 5 mL (with the 30 mg of ketamine) within 1 minute. Dilution in a larger volume of solution reduces the chance of accidentally pushing the drug too fast.

Note: IV push may be easier to accomplish for some small-volume doses by adding a diluent to increase the overall volume. For example, ketamine 30 mg comes in a vial that is 100 mg/10 cc. A clinician will dilute the 30 mg (equivalent to 0.3 mL) with another 0.7 mL to make it easier to push 1 mL of fluid over 2 minutes.

Assemble the items listed below for dispensing IV push medications through an IV fluid administration set:

- blue chux pad
- syringe—appropriate size for the type of medication being given
- 18 G or blunt needle used for drawing the medication from the vial
- 18 G needle for administering the IV push medication
- two alcohol prep pads

Use the following steps for preparing and administering an IV push medication through an IV fluid administration set:

1. After receiving the MO's order to administer a drug by IV push, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

Caution: If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

Caution: Always check allergies prior to the administration of any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate the administration of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering an IV push medication.
3. Check and assemble equipment.
 - a. Select the correct medication from the storage area.
 - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
 - ii. Verify that the medication was properly stored (medication specific).
 - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
 - b. Gather the supplies and equipment.
 - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container. Check the rubber stopper for defects, such as small holes or torn plugs, if it is an open multi-dose vial.

Note: The protective cap should be in place on single-dose vials. If the protective cap was previously removed, discard the vial and select a new one from the medication storage area.

- d. Check the date the multidose vial was opened and check the expiration date of the medication.
 - i. Multidose vials should have the following information written on the label once opened—time, date, and initials detailing first use.
 - ii. Multidose vials are good for 28 days from the date of first use, unless specified differently by the manufacturer.

- e. If possible, check the medication for floating particles and changes in color and consistency by holding the vial up to light. If it is a dark, light-obscuring vial, conduct this check when drawing up the medication into the syringe.
 - f. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain a new vial.
 - g. Open the packaging of the 18 G or blunt needle, administration needle (depending on type of injection), and syringe.
 - h. Connect the hub of the 18 G or blunt needle to the needle adapter on the syringe.
 - i. Open the alcohol prep pad.
4. Remove the cap from the medication vial and cleanse the rubber stopper with the alcohol prep pad.
 5. Remove the protective cap from the needle safely and pull the needle cover straight off without bending or touching the needle.
 6. Pull back on the plunger to draw air into the syringe for injection into the medication vial.
 - a. The amount of air to draw up equals the amount of fluid to be administered.
 - b. Follow the directions on the medication vial, if provided.
 - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
 7. Insert the 18 G or blunt needle into the medication vial on the table.
 - a. Place the medication vial on a table, standing up, and insert the 18 G or blunt-needled syringe through the rubber stopper, ensuring that the needle tip passes completely through. Make sure the hub of the needle does not touch the rubber stopper.
 - b. Pick up the syringe and vial and turn them upside down.
 - c. Hold the syringe and vial at eye level.
 8. Push the plunger forward injecting air from the syringe into the vial. The amount of air injected should equal the amount of fluid that must be withdrawn.
 9. Withdraw the prescribed medication into the syringe by pulling back on the syringe to the desired milliliter mark.
 10. Remove the needle from the vial and recap the needle using the scoop method (see Chapter 5, Injections).
 11. Attach the appropriate needle to the syringe.
 - a. After the medication is drawn up and ready to be administered, conduct a final recheck to ensure that the medication and concentration (if applicable) are exactly what was ordered by the MO. This is the third and final recheck prior to administration.
 - b. Pull back on the plunger slightly to move any fluid from the 18 G or blunt withdraw needle into the syringe.
 - c. Detach the 18 G or blunt withdraw needle by twisting it counterclockwise and discard it into a sharps container.
 - d. Attach the administration needle.

Note: Some medication Y-ports or hubs do not require a needle to attach and administer medications.

- e. Slowly advance the plunger of the syringe to expel the air bubble from the top of the syringe and the new administration needle. Place the syringe at eye level and position the plunger exactly on the prescribed milliliter mark.
12. Cleanse the medication Y-port or hub on the IV tubing administration set with the second alcohol prep pad.
13. Stop IV flow (either shut off IV flow with a roller clamp on tubing or pinch the tubing).
14. Connect the syringe to the medication Y-port or hub and administer at the proper push rate (fast IV push versus slow IV push).
15. Remove the syringe and dispose of it into a sharps container.
16. Flush the administration tubing by opening up the roller clamp or unpinching the tubing and allow it to flow wide open for a short period of time (5–10 sec).
17. Adjust the IV drip to the rate ordered by the MO.
18. Document the medication given (time, place, route, and strength) on the patient's medical records.
19. Assess the patient for desired effects of the medication and take full vital signs.



Figure 4-11. Piggyback intravenous medication administration.

Administer Medications Though Intermittent Infusion

Intermittent infusion (IV piggyback) medication administration is a convenient way to administer IV infusion medications through a patent IV drip set because there is no need to obtain a new IV access site (Figure 4-11). The IV piggyback prevents repetitive disconnections of IV lines from the primary infusion to attach a second infusion to the inserted IV catheter. This is important because repeated line disconnections and exchanges increase the risk of infections or other complications.

Recall that the IV push technique (via syringe injection) requires you to deliver medication quickly, or over 1 to 2 minutes, depending on label or MO instructions. An IV intermittent infusion medication requires you to inject a medication into an IV bag and slowly administer the bag contents over a longer time. Some medications require a very slow administration that would be impractical or impossible to administer via IV push.

The type of IV tubing to use, when administering an IV intermittent infusion, will also depend on the time needed to infuse the medication. IV tubing usually

comes in two forms, macrodrip (10, 15, 20 gtts/mL) and microdrip (60 gtts/mL). The more drops needed to equal 1 mL of fluid, the longer it will take to administer the fluid (and the medication in that fluid). For example, a rapid IV infusion of TXA over 10 minutes requires macrodrip tubing. This tubing is large enough to deliver 1 mL of fluid in 10, 15, or 20 drops. Therefore, macrodrip tubing will deliver the medication at a faster rate than microdrip tubing, which requires 60 drops to equal 1 mL of fluid. Some medications (eg, IV antibiotics and some cardiac medications) are infused slowly over many minutes (more than 10) to hours. To deliver medication this slowly, microdrip tubing is required. Medication delivered through microdrip tubing is measured in units as small as micrograms (μg or mcg).

Primary IV infusion bags are usually 250 mL or larger. For IV piggyback infusions, the smaller IV bags (50–100 mL) are normally used.

Assemble the items listed below for dispensing medications through intermittent infusion (IV piggyback):

- primary infusion bag
- secondary (piggyback) IV bag
- appropriate primary infusion tubing
- IV piggyback tubing
- three alcohol prep pads
- two 18 G or blunt needles
- two appropriate size IV catheters
- constricting band
- clear dressing

Use the following steps to administer medication through intermittent infusion (IV piggyback):

1. After receiving the MO's order to administer a drug by IV infusion (via piggyback), ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

Caution: If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

Caution: Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering an IV infusion medication.
3. Check and assemble equipment.
 - a. Select the correct medication from the storage area.
 - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
 - ii. Verify that the medication was properly stored (medication specific).
 - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.

Warning: Some medications cannot be given with certain IV fluids. Always ensure that the medication is compatible with the fluid in the primary infusion bag, as well as in the piggyback infusion bag.

- b. Gather the supplies and equipment.
- c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.

Note: The protective cap should be in place on single-dose vials. If the protective cap has been removed, discard the vial and select a new one from the medication storage area.

- d. If possible, check the medication for floating particles and changes in color and consistency by holding the vial to the light. If it is a dark, light-obscuring vial, conduct this check when drawing up the medication into the syringe.
- e. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain a new vial.
- f. Open the packaging of both the 18 G or blunt needle and the syringe.
- g. Connect the hub of the 18 G or blunt needle to the needle adapter on the syringe.
- h. Open the alcohol prep pads.

4. Remove the cap from the medication vial and cleanse the rubber stopper with the alcohol prep pad.
5. Remove the protective cap from the needle safely and pull the needle cover straight off without bending or touching the needle.
6. Pull back on the plunger to draw air into the syringe for injection into the medication vial.
 - a. The amount of air to draw up equals the amount of fluid to be administered.
 - b. Follow the directions on the medication vial, if provided.
 - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
7. Insert the 18 G or blunt needle into the medication vial on the table.
 - a. Place the medication vial on a table, standing up, and insert the 18 G or blunt needled syringe through the rubber stopper, ensuring that the needle tip passes completely through. Make sure the hub of the needle does not touch the rubber stopper.
 - b. Pick up the syringe and vial and turn them upside down.
 - c. Hold the syringe and vial at eye level.
8. Push the plunger forward injecting air from the syringe into the vial. The amount of air injected should equal the amount of fluid to be withdrawn.
9. Pull the plunger back to the desired milliliter mark, withdrawing the prescribed medication into the syringe.
10. Remove the needle from the vial and recap the needle using the scoop method.
11. Attach the appropriate administration needle to the syringe.
 - a. After the medication is drawn up and ready to be injected into the infusion bag, conduct a final recheck to make sure the medication and concentration (if applicable) are exactly what was ordered by the MO. This is the third and final recheck prior to administration.
 - b. Pull back on the plunger slightly to move any fluid from the 18 G or blunt withdraw needle into the syringe.
 - c. Detach the 18 G or blunt withdraw needle by twisting counterclockwise and discard it into sharps container.

- d. Attach a new 18 G or blunt needle onto the syringe.
- e. Slowly advance the plunger of the syringe to expel the air bubble from the top of the syringe and the new administration needle. Place the syringe at eye level and position the plunger exactly on the prescribed milliliter mark.
12. Open a second alcohol prep pad and cleanse the medication injection port on the piggyback infusion bag.
13. Insert the needled syringe into the medication infusion bag and inject the medication.
14. Remove the needled syringe from the medication infusion bag and discard it into a sharps container.
15. Gently shake the medication infusion bag to mix the medication in the fluid.
16. Spike the medication infusion bag with the appropriate size IV tubing.
17. Prime the medication infusion bag's IV tubing with fluid and shut off flow with the roller clamp. Prime in a manner where fluid is not lost, which will result in lost medication.
18. If not completed already, have a trained person start a primary IV infusion.
19. Stop the flow of fluid from the primary IV by closing the roller clamp.
20. Clean the Y-port or hub of the primary infusion tubing with an alcohol prep pad.
21. Connect the piggyback medication infusion's IV tubing to the primary infusion's Y-port or hub.
 - a. Connect needle-less systems by screwing the end of the medication IV tubing into the medication port of the IV infusion tubing.
 - b. If the system requires a needle, insert an 18 G IV catheter through the rubber medication port of the IV infusion tubing and then connect the medication IV tubing to the 18 G IV catheter.

22. Hang the piggyback medication infusion bag higher than the primary IV infusion bag.
23. Open the roller clamp on the primary IV infusion tubing and set it at the proper drip rate for the type of fluid being administered.
24. Open the roller clamp on the piggyback medication infusion tubing and set the drip rate.
25. Once the piggyback medication has been completely administered, close the roller clamp on the piggyback medication's IV tubing and disconnect the piggyback's tubing from the primary IV infusion tubing.
26. Assess the patient for desired effects of the medication and take full vital signs.
27. Document the medication given (time, place, route, strength) on the patient's medical records.

Check on Learning

31. If a patient tells you they are allergic to a certain medication, what additional information do you need to obtain from them?
32. How long should you observe the patient after administering immunizations, IV, or IM medication?
33. What is the treatment for anaphylaxis?

SUMMARY

Proper medication administration can greatly help patients recover from illness or injury and maintain health. All health care professionals must mitigate risks and potential harm to patients. By knowing and applying the 6 Rights, therapeutic effects, contraindications, side effects, treatments for allergic reactions, and how to calculate drug dosages, you can greatly increase the chance of recovery for your patients. Proper medication administration improves overall health readiness by facilitating soldier recovery and return to duty.

ADMINISTERING METERED DOSE INHALER MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If separated, place the medication canister into the MDI actuator.



STEP 4: Recheck to ensure that the medication is exactly what the MO ordered.



STEP 5: Shake the assembled MDI vigorously.



STEP 6: Attach the MDI spacer to the actuator.

ADMINISTERING METERED DOSE INHALER MEDICATION, CONT.



STEP 7: Conduct a final recheck to ensure that the medication is exactly what the MO ordered.



STEP 8: If the patient is receiving supplemental oxygen, remove their mask.



STEP 9: Ask the patient to exhale forcefully.



STEP 10: Have the patient make a good seal with their mouth on the mouthpiece of the MDI spacer.



STEP 11: Depress the medication canister on the MDI and encourage the patient to inhale deeply.



STEP 12: Monitor the patient's respiratory status to ensure that the medication is working.

ADMINISTERING SMALL VOLUME NEBULIZER MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: Check the medication for floating particles or changes in color. Ensure that the oxygen source has plenty of oxygen to complete the treatment.



STEP 4: Place the respiratory medication into the nebulizer and close the medication chamber by screwing the medication chamber and nebulizer together.

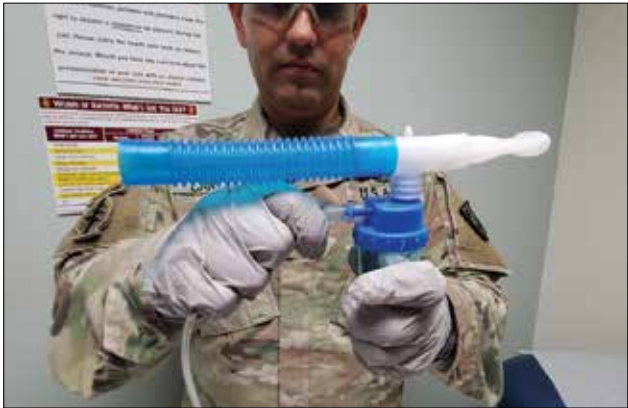


STEP 5: Recheck to ensure that the medication placed in the nebulizer is exactly what the MO ordered.

ADMINISTERING SMALL VOLUME NEBULIZER MEDICATION, CONT.



STEP 6: Attach the mouthpiece and extension tubing to the nebulizer (if using a pipe-style nebulizer).



STEP 7a: Attach the oxygen tubing to the nebulizer.



STEP 7b: Attach the oxygen tubing to the oxygen source.



STEP 8: Turn on the oxygen at a flow rate of 8–10 L/min. Make sure the medication is misting from the mouthpiece of the nebulizer.



STEP 9: Perform a final check to verify that you are using the correct medication.



STEP 10: If the patient is wearing an oxygen mask, remove it and have the patient hold the nebulizer.

ADMINISTERING SMALL VOLUME NEBULIZER MEDICATION, CONT.



STEP 11: Ask the patient to place the mouthpiece into their mouth and make a seal with their lips.



STEP 12: Coach the patient to breathe the medication into their lungs.



STEP 13: Monitor the patient's respiratory status to ensure that the medication is working.

ADMINISTERING INTRANASAL MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If possible, check the medication for floating particles or changes in color.



STEP 3c: Open the packaging on the 18 G or blunt needle, MAD, alcohol prep pad, and syringe.



STEP 3d: Connect the hub of the 18 G or blunt needle to the syringe.

ADMINISTERING INTRANASAL MEDICATION, CONT.



STEP 4: Remove the cap from the medication vial and cleanse the vial with alcohol.



STEP 5: Safely remove the protective cap from the needle.



STEP 6a: Pull back the plunger to draw air into the syringe for injection into the medication vial.



STEP 6b: Recheck to verify that the medication and concentration (if applicable) are exactly what the MO ordered. This is the second check for accuracy.



STEP 7: Insert the 18 G or blunt needle into the medication vial on the table. Pick up the syringe and vial and turn them upside down. Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward to inject air from the syringe into the vial. The amount of air injected equals the amount of fluid to withdraw.

ADMINISTERING INTRANASAL MEDICATION, CONT.



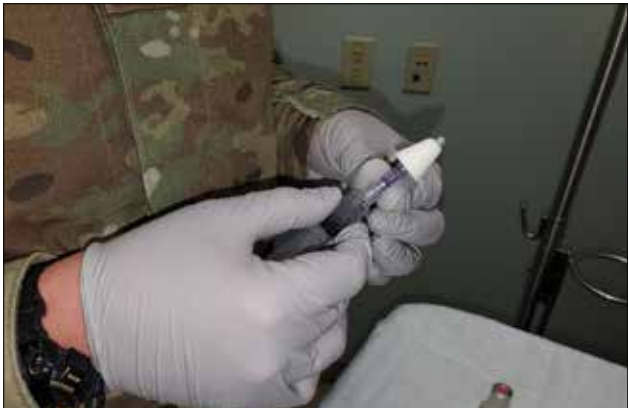
STEP 9: Pull the plunger back to the desired milliliter mark, withdrawing the prescribed medication into the syringe.



STEP 10: Remove the needle from the vial and recap the needle using the scoop method.



STEP 11a: Attach the MAD. Conduct a final recheck to ensure that the medication and concentration (if applicable) are exactly what the MO ordered.



STEP 11b: Pull back on the plunger to withdraw the medication from the needle into the syringe. Detach the needle and attach the MAD.



STEP 12: Use your free hand to hold the crown of the patient's head. Place the tip of the atomizer snugly against either nostril. Aim slightly up and outward and briskly compress the syringe plunger to deliver the medication.

ADMINISTERING IV PUSH MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If possible, check the medication for floating particles or changes in color.



STEP 3c: Attach the medication withdraw needle to the syringe with a twisting motion.



STEP 4a: Remove the cap from the medication.

ADMINISTERING IV PUSH MEDICATION, CONT.



STEP 4b: Clean the rubber stopper with an alcohol prep pad.



STEP 5: Remove the protective cap from the needle safely.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air into the syringe (follow the directions on the medication vial). Recheck the medication to make sure it is exactly what the MO ordered.



STEP 6b: Recheck to verify that the medication and concentration (if applicable) are exactly what the MO ordered. This is the second check for accuracy.



STEP 7: Insert the 18 G or blunt needle into the medication vial on the table. Pick up the syringe and vial and turn them upside down. Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward to inject air from the syringe into the vial. The amount of air injected equals the amount of fluid to withdraw.

ADMINISTERING IV PUSH MEDICATION, CONT.



STEP 9: Withdraw the prescribed amount of medication from the vial.



STEP 10: Remove the needle from the vial and recap it using the scoop method.



STEP 11: Detach the medication withdraw needle and discard it into a sharps container. Attach the appropriate administration needle (if required by the administration set medication Y-port or hub). Conduct a final medication recheck.



STEP 12: Cleanse the medication Y-port or hub with an alcohol prep pad.



STEP 13: Stop IV flow by closing the roller clamp or pinching the tubing.



STEP 14: Connect the syringe to the medication Y-port or hub and administer the medication at the proper push rate.

ADMINISTERING IV PUSH MEDICATION, CONT.



STEP 15: Remove the syringe and dispose of it into a sharps container.



STEP 16: Flush the administration tubing by opening up the roller clamp or unpinching the tubing and allowing wide-open flow for 5-10 seconds.



STEP 17: Adjust the IV drip to the rate ordered by the MO.



STEP 18: Document the medication given (time, place, route, and strength) on the patient's medical records.



STEP 19: Stop IV flow by closing the roller clamp or pinching the tubing.

ADMINISTERING IV PIGGYBACK MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If possible, check the medication for floating particles or changes in color.



STEP 3c: Attach the medication withdraw needle to the syringe with a twisting motion.



STEP 4a: Remove the cap from the medication.

ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 4b: Clean the rubber stopper with an alcohol prep pad.



STEP 5: Remove the protective cap from the needle safely.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air into the syringe (follow the directions on the medication vial). Recheck to verify that the medication is exactly what the MO ordered.



STEP 7: Insert the 18 G or blunt needle into the medication vial on the table, pick up the needle and vial, and turn them upside down. Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward so air is pushed into the vial (see directions on insert of medication).



STEP 9: Withdraw the prescribed amount of medication from the vial.

ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 10: Remove the needle from the vial and recap it using the scoop method.



STEP 11: Detach the medication withdraw needle and discard it into a sharps container. Attach the appropriate administration needle. Recheck the medication for the final time.



STEP 12: Open the second alcohol prep pad and cleanse the medication injection port on the piggyback infusion bag.



STEP 13a: Insert the needled syringe into the medication infusion bag.

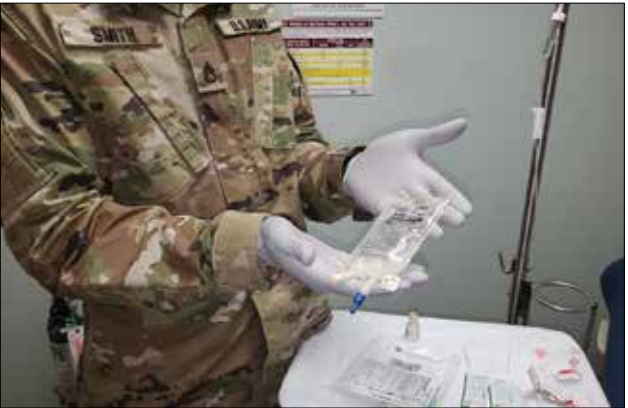


STEP 13b: Inject the medication into the infusion bag.



STEP 14: Remove the needled syringe from the medication infusion bag and discard it into a sharps container.

ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 15: Gently shake the medication infusion bag to mix the medication in the fluid.



STEP 16: Spike the medication infusion bag with the appropriate size IV tubing.



STEP 17: Prime the medication infusion bag's IV tubing with fluid and shut off flow with the roller clamp.



STEP 18: If not completed already, have a trained person start a primary IV infusion.



STEP 19: Stop fluid flow from the primary IV by closing the roller clamp.



STEP 20: Clean the Y-port or hub of the primary infusion tubing with an alcohol prep pad.

ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 21a: Connect the piggyback medication infusion's IV tubing to the primary infusion's Y-port or hub. If the system requires a needle, insert an 18 G IV catheter through the rubber medication port of the IV infusion tubing.



STEP 21b: Connect the medication IV tubing to the 18 G IV catheter. Secure the medication IV tubing to the patient with medical tape.



STEP 22: Hang the piggyback medication infusion bag higher than the primary IV infusion bag.



STEP 23: Open the roller clamp on the primary IV infusion tubing and set it at the proper drip rate, depending on type of fluid being administered.



STEP 24: Open the roller clamp on the piggyback medication infusion tubing and set the drip rate.

ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 25: Once the piggyback medication has been completely administered, close the roller clamp on the piggyback medication's IV tubing and disconnect the piggyback's tubing from the primary IV infusion tubing.



STEP 27: Document the medication given (time, place, route, strength) on the patient's medical records.



STEP 26: Assess the patient for desired effects of the medication and record full vital signs.

KEY TERMS AND ACRONYMS

Anaphylaxis. An acute allergic reaction to an antigen (eg, venom from a bee sting) to which the body has become hypersensitive.

Angioedema. Diffuse swelling that may start with the lips, hands, feet, or mucous membranes, and sometimes progresses to the airway, causing difficulty breathing.

Antibiotic. A medication used to treat microbial (eg, bacterial) infections; abbreviated as ABX.

Bioavailability. The amount of drug absorbed into the circulatory system.

Brand name. Trade name. The name by which a company markets a particular drug. Brand names are usually capitalized. There may be several trade names for a single generic named drug.

Capsule. A form of medication that contains a powder, liquid, or oil enclosed in a hard or soft gelatin outer shell. Some capsules (sustained release, extended release, controlled release, or timed release) release medication over time and they may not be divided or crushed.

Contraindication. A situation or condition where you would not administer the medication because it may do more harm than good.

Cream. A semisolid emulsion of oil and water used as a topical medication.

Dividend. A number that is being divided.

Divisor. A number that the dividend is divided by.

Dosage. The calculation or administration of the proper amount, number, and frequency of doses.

Dose. The amount (quantity) of medication administered.

Enema. Injection of a fluid into the lower bowels via the rectum. Enemas are frequently used to administer medications.

Gastric lavage. The medical procedure to wash stomach contents out of the body.

Generic name. The official chemical name for a drug. Generic names are not capitalized.

Greatest common factor. The highest number (factor) that divides exactly into two or more numbers. For example, 9 and 36 both share the factors 1, 3, and 9. The number 9 is the greatest common factor.

Gtts. Drops. From the Latin “guttae.”

Hepatic first-pass metabolism. When a drug is absorbed through the enteral route (GI tract), it first passes through the liver where a portion of the drug is metabolized reducing the amount of drug in the circulatory system to be used in the body.

Indications. The reason the medication is administered (approved uses). Indications are guided by the conditions being treated.

Lipodystrophy. Defective fat metabolism.

Lotion. A liquid medicinal preparation applied to the skin. Lotions can act as a soothing agent and provide skin protection. Some lotions can cleanse the skin or act as astringents.

Lozenge (troche). A sweet, mucilage-type tablet that dissolves in the mouth and releases medication.

Ointment. A semisolid medicinal preparation applied to the skin.

Paste. A semisolid medicinal preparation applied to the skin. It has a firmer consistency than creams, lotions, or ointments.

Periostitis. Inflammation of the bone.

Pill. A round, solid form of medication that is either swallowed or chewed and is broken down in the stomach or small intestines.

Quotient. The answer resulting from the division of one number by another.

Route. The means of access for medication delivery.

Rule of Ten. An adult burn fluid resuscitation protocol created by the US Army Institute of Surgical Research that rounds up the casualty’s total body surface area to the nearest ten and then uses the casualty’s body weight in calculating the amount of fluid to be administered.

Side effects. Negative effects or actions other than the desired actions.

Solute. A substance that is dissolved in a solution.

Solution. A liquid containing a dissolved medication.

Suppository. A medication prepared as a dissolvable solid form that is designed for insertion into the rectum.

Tablet. A round, spherical, or oddly shaped form that dissolves in the stomach or small intestines.

Topical disk. Another name for transdermal patch.

Transdermal. Transfer through unbroken skin and into the bloodstream.

Transdermal patch. An adhesive patch placed on unbroken skin to deliver medication through the skin and into the bloodstream for systemic effects.

Transmucosal. Transfer through mucosal tissue directly into the bloodstream.

CHECK ON LEARNING ANSWERS

- What are two advantages and two disadvantages of enteral medication administration?
Two advantages of enteral medication administration are safety and low cost. Two disadvantages are varying absorption rates in the GI tract and the ability of the patient to swallow the medication.
- Which of the following is not considered a parenteral route?
 - Percutaneous administration.
 - IN administration.
 - IV push administration.
 - Oral administration. (The correct answer.)*
- An MO orders you to administer a specific medication to a pregnant patient, which is contraindicated. Are you, as a combat medic who is following orders, potentially liable for causing injury to the fetus?
Yes. Combat medics carry the same burden of responsibility as MOs for administering a medication correctly and safely.
- List the 6 Rights of medication administration.
Right patient, medication, dose, route, time, and documentation.
- How many times should you verify medications?
Three times at a minimum.
- Restate the times the medication should be verified.
 - After retrieving the medication from the storage area.*
 - When preparing the medication dose prior to removing it from its storage container or drawing it from the vial or ampule.*
 - Just prior to administering the medication.*
- Reduce the fraction 5 mg/10 mL to its lowest terms.
0.5 mg/mL.
- Reduce the fraction 500 µg/5 mL to its lowest terms.
100 µg/mL.
- Convert the improper fraction 1,000 mg/250 mL into a mixed number.
4 mg/mL.

10. Convert the concentration 25 mg/10 mL into a decimal form.
2.5 mg/mL.
11. Convert 1 g to mg.
1,000 mg.
12. Convert 1 mg to µg.
1,000 µg.
13. Convert 1,000 mg to g.
1 g.
14. Convert 1.5 L to mL.
1,500 mL.
15. Convert 70.000 g to kg.
0.070 kg.
16. Convert 0.0017 g to µg.
1,700 µg.
17. Convert 5 mg to g.
0.005 g.
18. Convert 0.04 L to mL.
40 mL.
19. Convert 400 µg to g.
0.0004 g.
20. Convert 1,500 mL to L.
1.5 L.
21. A patient is experiencing mild anaphylaxis and needs 50 mg of diphenhydramine. The combat medic has on hand a prefilled syringe that contains 100 mg/5 mL. How many milliliters of fluid will the combat medic administer?
2.5 mL.
22. The same patient in Check on Learning question 21 must now receive 0.3 mg of 1:1,000 epinephrine through a subcutaneous injection. The epinephrine that the medical clinic has on hand is 1 mg of 1:1,000 epinephrine mixed in 1 mL of solution contained in an ampule. How much fluid must be drawn from the ampule to administer 0.3 mg of 1:1,000 epinephrine?
0.3 mL.
23. A combat medic is treating a combat casualty who is in severe pain and is developing hemorrhagic shock. The combat medic selects TCCC option 3 to administer ketamine to the casualty. The protocol directs the combat medic to administer 30 mg of ketamine slow IV/IO push. The combat medic has a vial of ketamine with 500 mg of ketamine in 10 mL of fluid. How much fluid must be withdrawn from the vial to administer 30 mg?
0.6 mL.

24. A combat casualty has suffered severe burns to his body with 50% body surface area burned. The casualty weighs 210 lbs, which is calculated to be 95 kg. The casualty needs 700 mL of Ringer solution per hour (fluid resuscitation is calculated using the Rule of Ten). A 1,000 mL bag of Ringer IV solution is attached to a 10 gtts/mL macro IV tubing set. How many drops per minute will deliver 700 mL of Ringer solution in 1 hour?
116.6 gtts/min.
25. A combat medic is treating a combat casualty who was wounded about 30 minutes prior and has severe internal bleeding. The combat medic must administer TXA. Per protocol, the combat medic mixed 1 g of TXA in a 100 mL bag of normal saline for administration over 10 minutes. The IV tubing is 15 gtts/mL. How many drops per minute will deliver the drug over 10 minutes?
150 gtts/min.
26. How do you ensure oral medication has been administered to the patient?
Observe the patient swallowing the prescribed medication.
27. What must you assess to ensure the patient may accept medication orally?
The patient must be able to protect their airway, have an intact gag reflex, and be alert.
28. What is the advantage of a capsule over a tablet?
Capsules are easier to administer to a patient with problems swallowing because the capsule can be opened and the medication poured into water or juice and then administered.
29. After administering an inhaler you should document the patient’s conditions. Specifically what should you assess and document, and why?
Rate, rhythm, and quality of breathing to ensure a lessening of the patient’s respiratory effort.
30. What types of patients benefit most from an inhaler with a spacing device?
A patient who is unable to depress an inhaler canister while simultaneously breathing in deeply would benefit from using a spacer.
31. If a patient tells you they are allergic to a certain medication, what additional information do you need to obtain from them?
Inquire specifically what happens when the patient takes the medication.
32. How long should you observe patients after administering immunizations, IV, or IM medication?
Observe patients for at least 20 minutes to make sure they do not experience an allergic reaction.
33. What is the treatment for anaphylaxis?
Secure the airway, provide supplemental oxygen and positive pressure ventilations, administer epinephrine (0.3 mg of 1:1,000 solution IM or SC for an adult, repeated every 5–10 minutes), administer diphenhydramine (25–50 mg IM or IV), and administer corticosteroids (methylprednisolone sodium succinate or methylprednisolone acetate).

REFERENCES

1. Foust SD. *Easy 4-Step Method to Drug Calculations*. 1st ed. Pearson/Prentice Hall; 2004.

SOURCES

Taber's Cyclopedic Medical Dictionary. 22nd ed. F.A. Davis Co; 2013.