Chapter 4: Medication Administration

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Basic Concepts of Administering Medications

The scope of practice regarding a nurse's ability to legally dispense and administer medication is based on each state's Nurse Practice Act. Registered Nurses (RNs) and Licensed Practical Nurses (LPNs or LVNs) may legally administer medications that are prescribed by a health care provider, such as a physician, nurse practitioner, or physician's assistant. Prescriptions are "orders, interventions, remedies, or treatments ordered or directed by an authorized primary health care provider."[1]

Types of Orders

Prescriptions are often referred to as orders in clinical practice. There are several types of orders, such as routine orders, PRN orders, standing orders, one-time orders, STAT orders, and titration orders.

- A **routine order** is a prescription that is followed until another order cancels it. An example of a routine order is “Lisinopril 10 mg PO daily.”
- A **PRN** (or as-needed) order is a prescription for medication to be administered when it is requested by, or as needed by, the patient. PRN orders are typically administered based on patient symptoms, such as pain, nausea, or itching. An example of a PRN order for pain medication is “Acetaminophen 500 mg PO every 4-6 hours as needed for pain.”
- A **standing order** is also referred to in practice as an “order set” or a “protocol.” Standing orders are standardized prescriptions for nurses to implement to any patient in clearly defined circumstances without the need to initially inform a provider. An example of a standing order set or protocol for patients visiting an urgent care clinic reporting chest pain is to immediately administer four chewable aspirin, establish intravenous (IV) access, and obtain an electrocardiogram (ECG).
- A **one-time order** is a prescription for a medication to be administered only once. An example of a one-time order is a prescription for an IV dose of antibiotics to be administered immediately prior to surgery.
- A **STAT order** is a one-time order that is administered without delay due to the urgency of the circumstances. An example of a STAT order is “Benadryl 50 mg PO stat” for a patient having an allergic reaction.
- A **titration** order is an order in which the medication dose is either progressively increased or decreased by the nurse in response to the patient’s status. Titration orders are typically used for patients in critical care as defined by agency policy.

Components of a Medication Order

In the United States, all orders for the administration of drugs and biologicals must contain the following information:[2]

- Name of the patient
- Age or date of birth
- Date and time of the order
- Drug name
- Dose, frequency, and route
- Name or Signature of the prescriber
- Weight of the patient to facilitate dose calculation when applicable. (Note that dose calculations are based on metric weight: kilograms for children/adults or grams for newborns)
- Dose calculation requirements, when applicable
- Exact strength or concentration, when applicable
- Quantity and/or duration of the prescription, when applicable
- Specific instructions for use, when applicable

When reviewing a medication order, the nurse must ensure these components are included in the prescription before administering the medication. If a pertinent piece of information is

not included, the nurse must contact the prescribing provider to clarify and correct the order.

Drug Name

The name of the drug may be ordered by the generic name or brand name. The generic name is considered the safest method to use and allows the pharmacist to trade various brand names of medicines.

Dose

The dosage of a drug is prescribed using either the metric or the household system. The metric system is the most commonly accepted system internationally. Examples of standard dosage are 5 mL (milliliters) or 1 teaspoon. Standard abbreviations of metric measurement are frequently used regarding the dosage, such as mg (milligram), kg (kilogram), mL (milliliter), mcg (microgram), or L (liter). However, it is considered safe practice to avoid other abbreviations and include the full words in prescriptions to avoid errors. If a dosage is unclear or written in a confusing manner in a prescription, it is always best to clarify the order with the prescribing provider before administering the medicine.

Frequency

Frequency in prescriptions is indicated by how many times a day the medication is to be administered or how often it is to be administered in hours or minutes. Examples of frequency include verbiage such as once daily (qd), twice daily (b.i.d), three times daily (t.i.d), four times daily (q.i.d), every 30 minutes (q30min), every hour (q1hr), every four hours (q4hr) , or every eight hours (q8hr).

Route of Administration

Common routes of administration and standard abbreviations include the following:

- Oral (PO) – the patient swallows a tablet or capsule
- Sublingual (SL) – applied under the tongue
- Enteral (NG or PEG) – administered via a tube directly into the GI tract
- Rectal (PR) – administered via rectal suppository
- Inhalation (INH) – the patient breathes in medication from an inhaler
- Intramuscular (IM) – administered via an injection into a muscle
- Subcutaneous – administered via injection into the fat tissue beneath the skin
- Transdermal (TD) – administered by applying a patch on the skin

Provider Name/Signature

Signature of the prescribing provider is required on the order and can be electronic or handwritten. Verbal orders from a prescriber are not recommended, but may be permitted in some agencies for urgent situations. Verbal orders require the nurse to “repeat back” the order to the prescriber for confirmation.

Rights of Medication Administration

]The rights of medication administration are the vital last safety check by nurses to prevent errors in the chain of medication administration that includes the prescribing provider, the pharmacist, the nurse, and the patient.

It is important to remember that if a medication error occurs resulting in harm to a patient, a nurse can be held liable even if "just following orders." It is absolutely vital for nurses to use critical thinking and clinical judgment to ensure each medication is safe for each specific patient before administering it. The consequences of liability resulting from a medication error can range from being charged with negligence in a court of law, to losing one's job, to losing one's nursing license.

The six rights of medication administration must be confirmed by the nurse at least three times before administering a medication to a patient. These six rights include the following:

1. Right Patient
2. Right Drug
3. Right Dose
4. Right Time
5. Right Route[5]
6. Right Documentation

Recent literature indicates that up to ten rights should be completed as part of a safe medication administration process. These additional rights include Right History and Assessment, Right Drug Interactions, Right to Refuse, and Right Education and Information. Information for each of these rights is further described below.[6], [7]

Right Patient

Acceptable patient identifiers include, but are not limited to, the patient's full name, an identification number assigned by the hospital, or date of birth. A patient's room number must never be used as an identifier because a patient may change rooms. Identifiers must be confirmed by the patient wristband, patient identification card, patient statement (when possible), or other means outlined in the agency policy such as a patient picture included on the MAR. The nurse must confirm the patient's identification matches the **medication administration record** (MAR) and medication label prior to administration to ensure that the medication is being given to the correct patient.[8] See Figure 4.1[9] for an illustration of the nurse confirminging the patient's identify by scanning their identification band and asking for their date of birth. See Figure 4.2[10] for a close-up image of a patient identification wristband.

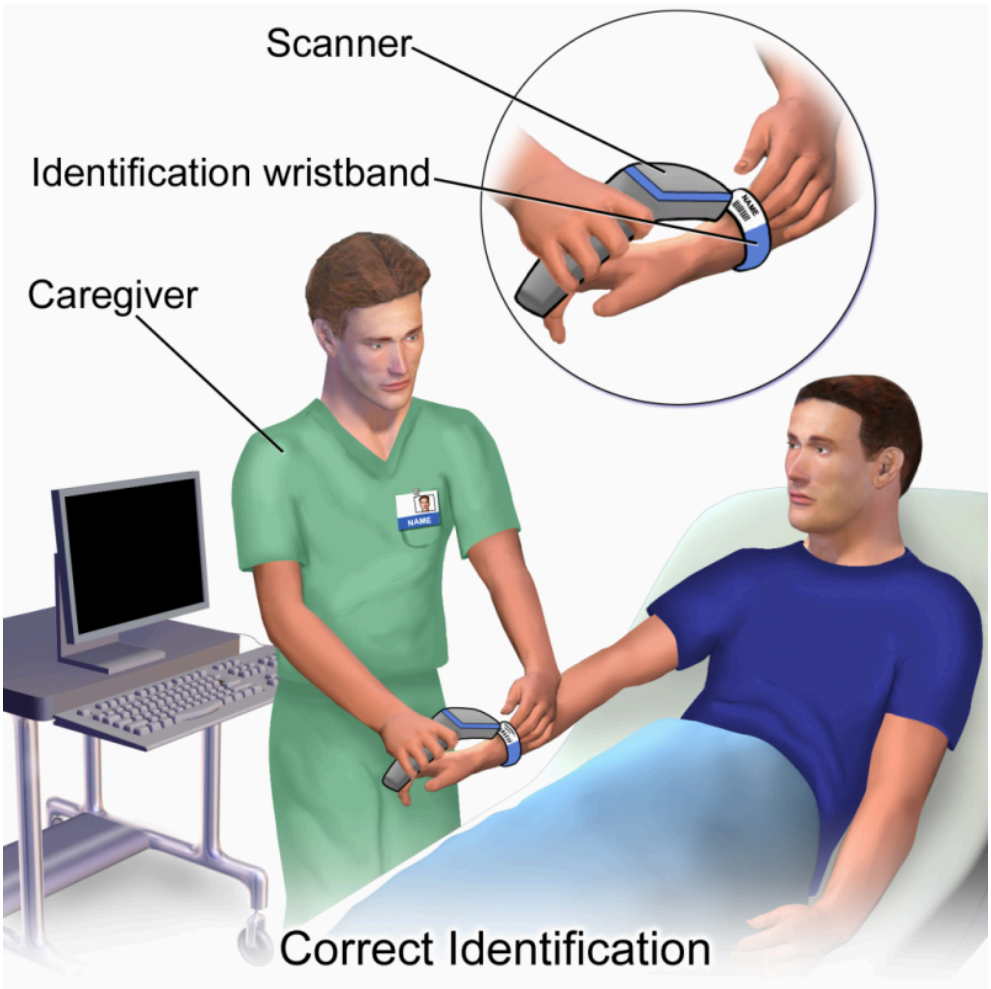


Figure 4.1 Patient Identification by Scanning Armband

Figure 4.2 Patient Identification Band

If barcode scanning is used in an agency, this scanning is not intended to take the place of confirming two patient identifiers, but is intended to add another layer of safety to the medication administration process.

Right Drug

During this step, the nurse ensures the medication to be administered to the patient matches the order or Medication Administration Record (MAR) and that the patient does not have a documented allergy to it.[12] The Medication Administration Record (MAR), or **eMAR**, an electronic medical record, is a specific type of documentation found in a patient's chart. Beware of look-alike and sound-alike medication names, as well as high-alert medications that bear a heightened risk of causing significant patient harm if they are used in error. The nurse should also be aware of what medication can be crushed and those that cannot be crushed.

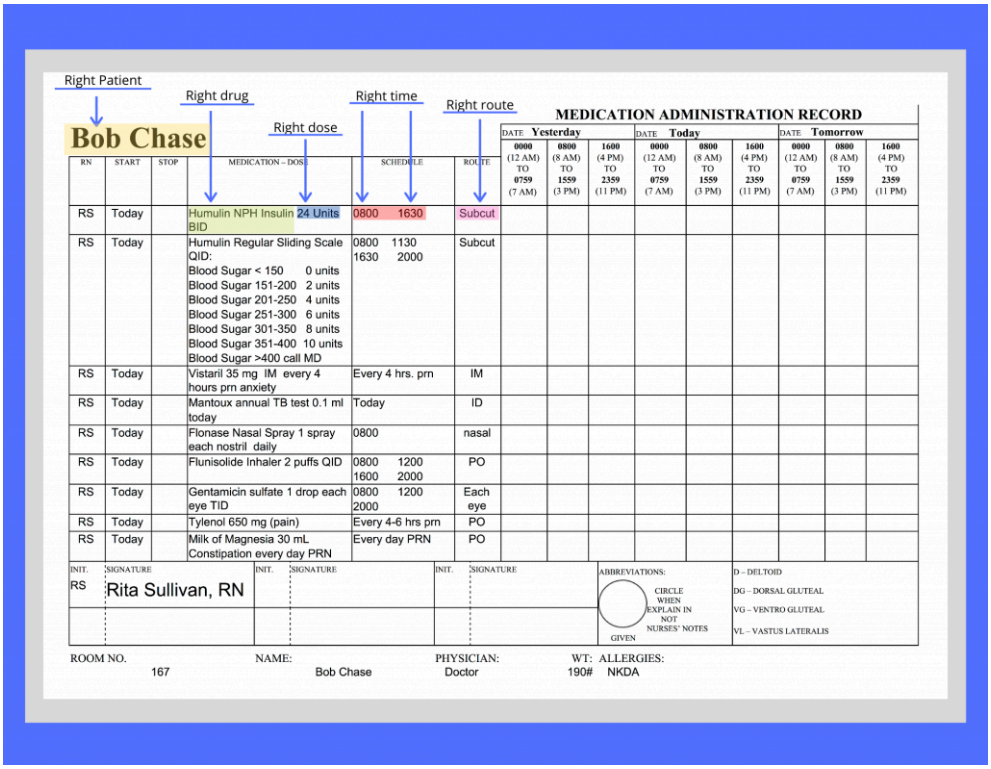


Figure 4.3 Medication Administration Record

Right Dose

During this step, the nurse ensures the dosage of the medication matches the prescribed dose, verifies the correct dosage range for the age and medical status of the patient, and also confirms that the prescription itself does not reflect an unsafe dosage level (in other words, a dose that is too high or too low).[14] For example, medication errors commonly occur in children, who typically receive a lower dose of medication than an adult. Medication errors also commonly occur in older patients who have existing kidney or liver disease and are unable to metabolize or excrete typical doses of medications.

Right Time and Frequency

During this step, the nurse checks for the correct prescribed frequency and scheduled time of administration of the medication.[15] This step is especially important when PRN medications are administered because it is up to the nurse to check the time of the previous dose and compare it to the ordered frequency.

Medications should be administered on time whenever possible. However, when multiple patients are scheduled to receive multiple medications at the same time, this goal of timeliness can be challenging. Most facilities have a policy that medications can be given within a range of 30 minutes before or 30 minutes after the medication is scheduled. For example, a medication ordered for 0800 could be administered anytime between 0730 and 0830. However, some medications must be given at their specific ordered time due to pharmacokinetics of the drug. For example, if an antibiotic is scheduled every eight hours,

this time frame must be upheld to maintain effective bioavailability of the drug, but a medication scheduled daily has more flexibility with time of actual administration.

Right Route

During this step, the nurse ensures the route of administration is appropriate for the specific medication and also for the patient.[16] Many medications can potentially be administered via multiple routes, whereas other medications can only be given safely via one route. Nurses must administer medications via the route indicated in the order. If a nurse discovers an error in the order or believes the route is unsafe for a particular patient, the route must be clarified with the prescribing provider before administration. For example, a patient may have a PEG tube in place, but the nurse notices the medication order indicates the route of administration as PO. If the nurse believes this medication should be administered via the PEG tube and the route indicated in the order is an error, the prescribing provider must be notified and the order must be revised indicating via PEG tube before the medication is administered.

Right Documentation

After administering medication, it is important to immediately document the administration to avoid potential errors from an unintended repeat dose.

In addition to checking the basic rights of medication administration and documenting the administration, it is also important for nurses to verify the following information to prevent medication errors.

Right History and Assessment

The nurse should be aware of the patient's allergies, as well as any history of any drug interactions. Additionally, nurses collect appropriate assessment data regarding the patient's history, current status, and recent lab results to identify any contraindications for the patients to receive the prescribed medication.[17]

Right Drug Interactions

The patient's history should be reviewed for any potential interactions with medications previously given or with the patient's diet. It is also important to check the medication's expiration date before administration.

Right Education and Information

Information should be provided to the patient about the medication, including the expected therapeutic effects, as well as the potential adverse effects. The patient should be encouraged to report suspected side effects to the nurse and/or prescribing provider. If the patient is a minor, the parent may also have a right to know about the medication in many states, depending upon the circumstances.

Right of Refusal

After providing education about the medication, the patient has the right to refuse to take medication. If a patient refuses to take the medication after proper education has been performed, the event should be documented in the patient chart and the prescribing provider notified.

Medication Dispensing

Medications are dispensed for patients in a variety of methods. During inpatient care, unit dose packaging is a common method for dispensing medications. See Figure 4.4[18] for an image of unit dose packaging.

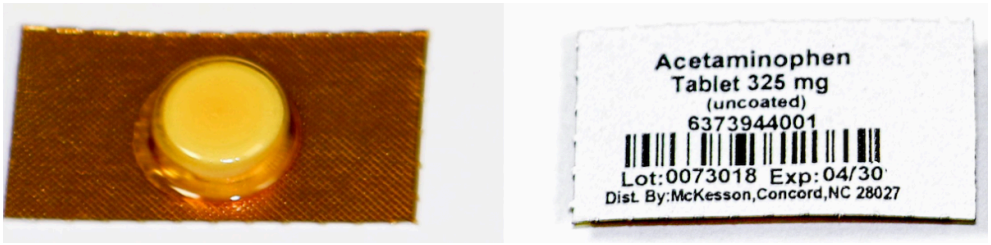


Figure 4.4 Unit Dose Packaging

Unit dose dispensing is typically used in association with a medication dispensing system, sometimes referred to in practice with brand names such as “Pyxis” or “Omnicell.” Medication dispensing systems help keep medications secure by requiring a user sign-in and password. They also reduce medication errors by only allowing medications prescribed for a specific patient to be removed unless additional actions are taken. However, it is important to remember that medication errors can still occur when using a medication dispensing system if the incorrect medication is stored in the wrong compartment. See Figure 4.5[19] for an image of a medication dispensing system.

Figure 4.5 Medication Dispensing System

Bar codes are often incorporated with unit dose medication dispensing as an additional layer of safety to prevent medication errors. Each patient and medication is identified with a unique barcode. The nurse scans the patient's identification wristband with a bedside portable device and then scans each medication to be administered. The portable device will display error messages if an incorrect medication is scanned or if medication is scanned at an incorrect time. It is vital for nurses to stop and investigate the medication administration process when an error is received. The scanning device is typically linked to an electronic MAR and the medication administered is documented immediately in the patient's chart.

In long-term care agencies, weekly blister cards may be used that contain a specific patient's medications for each day of the week. See Figure 4.6[20] for an image of a blister pack.

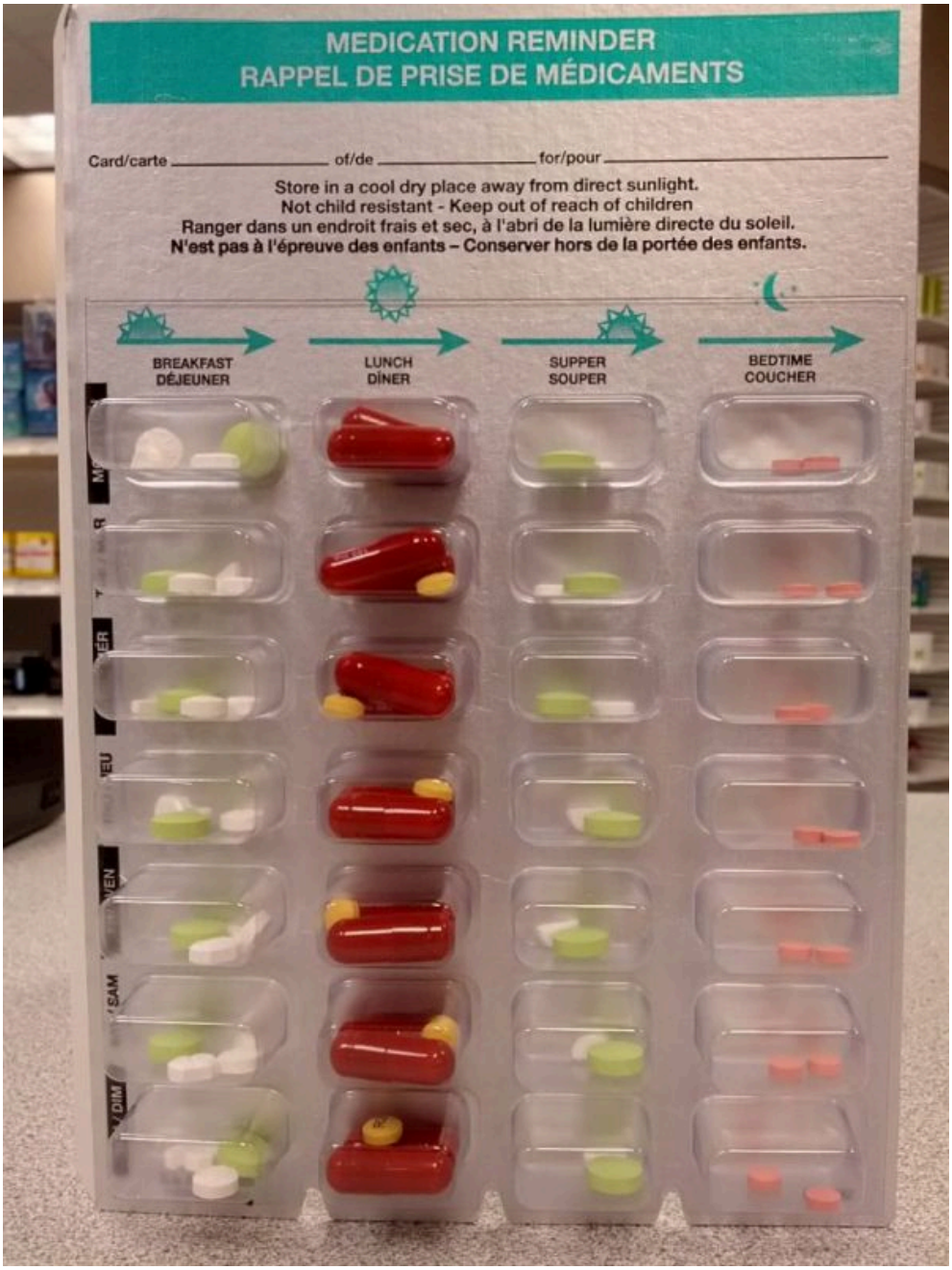


Figure 4.6 Blister Pack of Medications

Agencies using blister cards or pill bags typically store medications in a locked medication cart to keep them secure. Supplies used to administer medications are also stored on the cart. The MAR is available in printed format or electronically with a portable computer. See Figure 4.7[21] for an image of a medication cart.

Figure 4.7 Medication Cart

Process of Medication Administration

No matter what method of medication storage and dispensing is used in a facility, the nurse must continue to verify the rights of medication administration to perform an accurate and safe medication pass. Using a medication dispensing system or bar coding does not substitute for verifying the rights, but are used to add an additional layer of safety to medication administration. Nurses can also avoid medication errors by creating a habitual process of performing medication checks when administering medication. The rights of medication administration should be done in the following order:

1. Perform the first check as the unit dose package, blister pack, or pill bag is removed from the dispensing machine or medication cart. Also, check the expiration date of the medication.
2. A second check should be performed after the medication is removed from the dispensing machine or medication cart. This step should be performed prior to pouring or removing from a multidose container. Note: Some high-alert medications, such as insulin, require a second nurse to perform a medication check at this step due to potentially life-threatening adverse effects that can occur if an error is made.
3. The third check should be performed immediately before administering the medication to the patient at the bedside or when replacing the multidose container back into the drawer.

See Figure 4.8[22] for an image of a nurse comparing medication information on the medication packet to information on the patient's MAR.

Figure 4.8 Comparing Medication Information to the MAR

When performing these three checks, the nurse should ensure this is the right medication, right patient, right dosage, right route, and right time. See Figure 4.10[23] for an image of the nurse performing patient identification prior to administering the medication. The sixth right, correct documentation, should be done immediately after the medication is administered to the patient to avoid an error from another nurse inadvertently administering the dose a second time. These six rights completed three times have greatly reduced medication errors.

As discussed earlier, other rights to consider during this process are as follows:

- Is the patient receiving this medication for the right reason?
- Have the right assessments been performed prior to giving the medication?
- Has the patient also received the right education regarding the medications?
- Is the patient exhibiting the right response to the medication?

Is the patient refusing to take the medication? Patients have the right to refuse medication. The patient's refusal and any education or explanation provided related to the attempt to administer the medication should be documented by the nurse and the prescribing provider should be notified.

Figure 4.9

- Listen to the patient if they verbalize any concerns about medications. Explore their concerns, verify the order, and/or discuss their concerns with the prescribing provider before administering the medication to avoid a potential medication error.
- If a pill falls on the floor, it is contaminated and should not be administered. Dispose the medication according to agency policy.
- Be aware of absorption considerations of the medications you are administering. For example, certain medications such as levothyroxine should be administered on an empty stomach because food and other medications will affect its absorption.
- Nurses are often the first to notice when a patient has difficulty swallowing. If you notice a patient coughing immediately after swallowing water or has a “gurgling” sound to their voice, do not administer any medications, food, or fluid until you have reported your concerns to the health care provider. A swallow evaluation may be needed and the route of medication may need to be changed from oral to another route to avoid aspiration.
- If your patient has a nothing by mouth (NPO) order, verify if this includes all medications. This information may be included on the MAR or the orders, and if not, verify this information with the provider. Some medications, such as diabetes

medication, may be given with a sip of water in some situations where the patient has NPO status.

If the route of administration is not accurately listed on the MAR, contact the prescribing provider before administering the medication. For example, a patient may have a PEG tube but the medication is incorrectly listed as “PO” on the order.

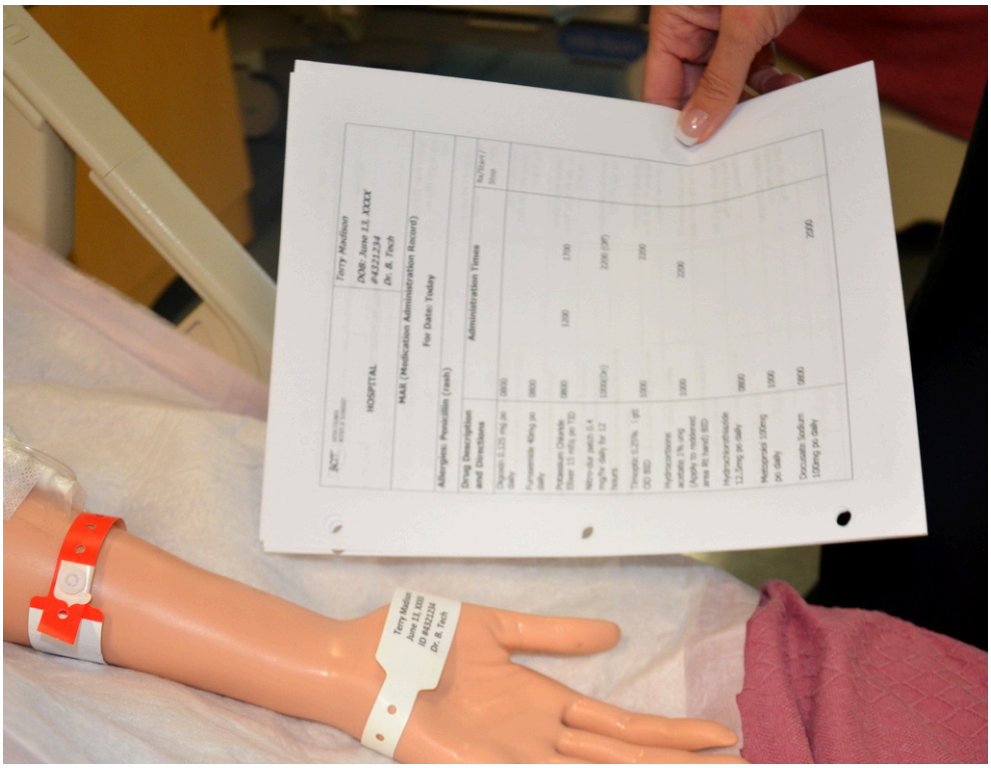


Figure 4.10 Identifying the Patient Prior to Medication Administration

Special Considerations for Administering Controlled Substances

Controlled substances, also called Scheduled Medications, are kept in a locked system and accounted for using a checks and balance system. Removal of a controlled substance from a medication dispensing system must be verified and documented by a second nurse witness. Removal of a controlled substance from a medication cart needs to be documented on an additional controlled substance record with the patient’s name, the actual amount of substance given, the time it was given, associated pre-assessment data, and the name of the nurse administering the controlled substance.

Controlled substances stored in locked areas of medication carts must also be counted at every shift change by two nurses and then compared to the controlled substance administration record. If the count does not match the documentation record, the discrepancy must be reported immediately according to agency policy.

Additionally, if a partial dose of a controlled substance is administered, the remainder of the substance must be discarded in front of another nurse witness to document the event. This process is called “wasting.” Follow agency policy regarding wasting of controlled substances.

These additional safety measures help to prevent drug diversion, the use of a prescription medication for other than its intended purpose.

Oral Medication Administration

Most medications are administered orally because it is the most convenient and least invasive route for the patient. Medication given orally has a slower onset, typically about 30-60 minutes. Prior to oral administration of medications, ensure the patient has no contraindications to receiving oral medication, is able to swallow, and is not on gastric suction. If the patient has difficulty swallowing (**dysphagia**), tablets are typically broken up and placed in a substance like applesauce or pudding for easier swallowing (based on the patient’s prescribed diet). However, it is important to verify that a tablet may be broken up by consulting a drug reference or a pharmacist. For example, medications such as enteric-coated tablets, capsules, and sustained-release or long-acting drugs should never be crushed because doing so will affect the intended action of the medication. In this event, the provider must be contacted for a change in route. [24]

Position the patient receiving oral medication in an upright position to decrease the risk of aspiration. Patients should remain in this position for 30 minutes after medication administration, if possible. If a patient is unable to sit, assist them into a side-lying position. See Figure 15.10[25] for an image of a nurse positioning the patient in an upright position prior to medication administration. Offer a glass of water or other oral fluid (that is not contraindicated with the medication) to ease swallowing and improve absorption and dissolution of the medication, taking any fluid restrictions into account.[26]

Remain with the patient until all medication has been swallowed before documentation to verify the medication has been administered.[27]

If any post-assessments are required, follow up in the appropriate time frame. For example, when administering oral pain medication, follow up approximately 30 minutes to an hour after medication is given to ensure effective pain relief.

If medication is given sublingual (under the tongue) or buccal (between the cheek and gum) the mouth should be moist. Offering the patient a drink of water prior to giving the medication can help with absorption. Instruct the patient to allow the medication to completely dissolve, and reinforce the importance of not swallowing or chewing the medication.

Liquid medications are available in multidose vials or single-dose containers. It may be necessary to shake liquid medications if they are suspensions prior to pouring. Make sure the label is clearly written and easy to read. When pouring a liquid medication, it is ideal to place the label in the palm of your hand so if any liquid medication runs down the outside of the bottle it does not blur the writing and make the label unidentifiable. When pouring liquid

medication, read the dose at eye level measuring at the meniscus of the poured fluid. Always follow specific agency policy and procedure when administering oral medications.

Figure 4.11 Placing the Patient in an Upright Position Prior to Medication Administration

Military Time

Military time is a method of measuring the time based on the full 24 hours of the day rather than two groups of 12 hours indicated by a.m. and p.m. It is also referred to as using a 24-hour clock. Using military time is the standard method used to indicate time for medication administration. The use of military time reduces potential confusion that may be caused by using a.m. and p.m. and also avoids potential duplication when giving scheduled medications. For example, instead of stating medication is due at 7 a.m. and 7 p.m., it is documented on the medication administration record (MAR) as due at 0700 and 1900. See Figure 4.12[1] for an example clock and Table 5.3 for a military time conversion chart.

Figure 4.12 Military Time Clock

- Conversion of an a.m. time to military time simply involves removing the colon and adding a zero to the time. For example, 6:30 a.m. becomes 0630.
- Conversion of a p.m. time to military time involves removing the colon and adding 1200 to the time. For example, 7:15 p.m. becomes 1915.

Normal Time	Military Time	Normal Time	Military Time
12:00 a.m.	0000	12:00 p.m.	1200
1:00 a.m.	0100	1:00 p.m.	1300
2:00 a.m.	0200	2:00 p.m.	1400

3:00 a.m.	0300	3:00 p.m.	1500
4:00 a.m.	0400	4:00 p.m.	1600
5:00 a.m.	0500	5:00 p.m.	1700
6:00 a.m.	0600	6:00 p.m.	1800
7:00 a.m.	0700	7:00 p.m.	1900
8:00 a.m.	0800	8:00 p.m.	2000
9:00 a.m.	0900	9:00 p.m.	2100
10:00 a.m.	1000	10:00 p.m.	2200
11:00 a.m.	1100	11:00 p.m.	2300

Table 4.1: Military Time Conversion Chart

Equivalencies

The nurse performs a variety of calculations in the clinical setting including intake and output conversions, weight conversions, dosages, volumes, and rates. The metric system is typically used when documenting and performing calculations in the clinical setting. Dosages may be calculated and converted into micrograms (mcg), milligrams (mg), milliequivalents (mEq), and grams (gm); volumes may be calculated in cubic centimeters (cc), milliliters (mL), and liters (L); and rates may be calculated in drops per minute (gtt/min), milliliters per hour (mL/hr), or units per hour (units/hr). Each of these types of calculations will be described in the following sections. Let's begin by discussing equivalencies.

Equivalency is a mathematical term that refers to 2 values or quantities that are the same amount. For example, one cup is equivalent to 8 ounces. Nurses must memorize common household and metric equivalents to perform drug calculations and convert quantities easily.

Household Equivalencies

The household system of measurement is familiar to patients and includes drops, teaspoons, tablespoons, ounces, cups, and pounds. See Table 4.2 for common household measurement conversions and abbreviations that must be memorized by nurses.

Measurement and Abbreviation	Common Conversions
drop (gtt)	15 -20 gtt = 1 mL
teaspoon (tsp)	1 tsp = 5 mL
tablespoon (Tbs)	1 Tbsp = 3 tsp = 15 mL
ounce (oz)	1 oz = 30 mL
pound (lb)	1 lb = 16 oz
cup (C)	1 C = 8 oz = 240 mL
pint (pt)	1 pt = 2 C
quart (qt)	1 qt = 4 C
gallon (gal)	1 gal = 4 qt

Table 4.2 Common Household Conversions

Metric Equivalencies

The metric system is organized by units of 10. The basic units of measurement in the metric system include meter for length, liter for volume, and gram for weight. The decimal point is easily moved either to the right or left with multiplication or division in units of 10. For example, there are 1,000 mL in 1 liter, and 0.5 liters is the same as 500 mL. See Table 4.3 for a metric equivalency chart.

When converting to a smaller unit, the decimal moves to the right →→→→→→→→→→

When converting to a larger unit, the decimal moves to the left. ←←←←←←←←←←

Kilo-	Hecto-	Deca-	1	Deci-	Centi-	Milli-
1000 units	100 units	10 units	Unit	0.1 units	0.01 units	0.001 units

Table 4.3 Common Metric Equivalencies in Health Care

Nurses often need to convert household measurements to metric equivalents or vice versa. See Table 4.4 for common metric conversions that nurses must memorize.

Metric Measurement	Common Conversions
1 kilogram (kg.)	1 kg = 2.2 pounds = 1000 grams
1 centimeter (cm.)	1 in. = 2.54 cm. = 25.4 mm.
37 degrees Celsius	97.8 degrees F
1 liter	1000 mL = 1000 cc.
1 gram	1000 mg
1 mg	1000 mcg

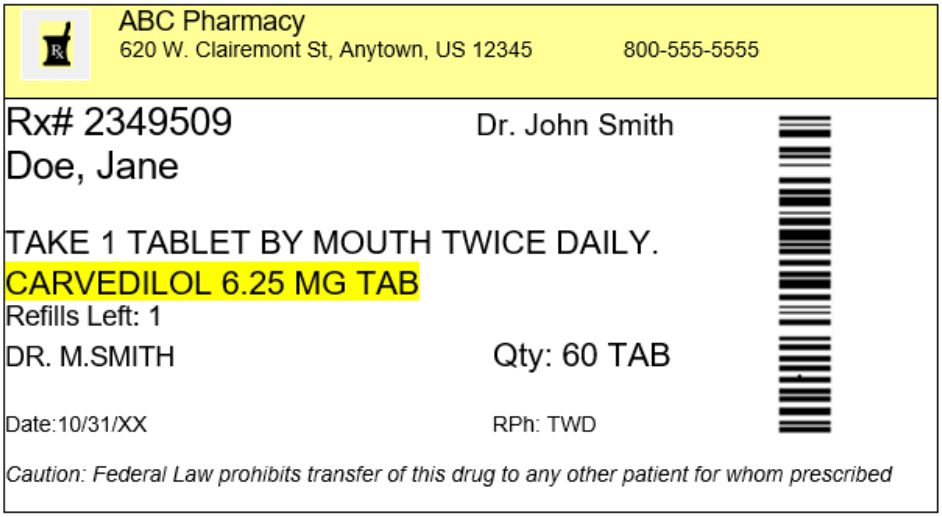
Table 4.4 Common Metric Conversions in Health Care

Tablet Dosage

When tablets are prescribed for a patient, the dosage of the tablets supplied is often different from the prescription, and nurses must calculate the number of tablets to administer. Dimensional analysis can be used to calculate the number of tablets to administer. Let's practice using dimensional analysis using a practice problem.

Practice Problem: Tablet Dosage

Jane Doe recently had her prescription changed by her provider from Carvedilol 6.25 mg twice daily to Carvedilol 25 mg once daily. Jane shows you her prescription bottle and asks, “How many pills can I take every day so I can use up what I have before purchasing another refill?” How many 6.25 mg tablets will you instruct Jane to take based on the new prescribed dose of Carvedilol 25 mg once daily?


ABC Pharmacy
620 W. Clairemont St, Anytown, US 12345 800-555-5555

Rx# 2349509 Dr. John Smith
Doe, Jane

TAKE 1 TABLET BY MOUTH TWICE DAILY.
CARVEDILOL 6.25 MG TAB
Refills Left: 1
DR. M.SMITH Qty: 60 TAB

Date:10/31/XX RPh: TWD

Caution: Federal Law prohibits transfer of this drug to any other patient for whom prescribed

Figure 4.13

Solve this question by using dimensional analysis.

1. Start by identifying the goal unit for which you are solving, which is a tablet (tab) in this scenario:

$$Tab = \frac{}{}$$

2. Set up the first fraction with tab in the numerator to match the goal unit. From the prescription bottle, we know that one of the supplied tablets has a concentration of 6.25 mg., so plug in 1 in the numerator and 6.25 mg in the denominator:

$$Tab = \frac{1\ tab}{6.25\ mg}$$

3. Set up the second fraction with the intent to cross out mg, so place mg in the numerator. By reviewing the prescription, we know the new dosage prescribed is 25 mg., so plug in 25 in the numerator, and 1 in the denominator to cross off units:

$$Tab = \frac{1\ tab}{6.25\ mg}\ x\ \frac{25\ mg}{1}$$

4. Cross out mg diagonally:

$$Tab = \frac{1\ tab}{6.25\ \cancel{mg}}\ x\ \frac{25\ \cancel{mg}}{}$$

5. Multiply across the numerators and denominators, and then divide the final fraction to solve the problem:

$$Tab = \frac{1\ tab}{6.25\ \cancel{mg}}\ x\ \frac{25\ \cancel{mg}}{1} = 4\ tabs$$

Liquid Concentrations

Medications can also be supplied in liquid instead of tablets or capsules. Liquid concentrations are typically provided in milligrams (mg) per a given number of milliliters (mL). The nurse must calculate how many milliliters (mL) to administer based on the prescribed dose in milligrams (mg). Let's practice using dimensional analysis to solve how much liquid medication to administer based on the prescription and the medication supplied.

Practice Problem: Liquid Concentrations

John Smith has been prescribed Phenergan as needed every 4-6 hours for nausea and vomiting. John is feeling nauseated and is requesting another dose of Phenergan. It has been 8 hours since the last dose was given. How many mL will you administer?

Prescription: Phenergan 12.5 mg IV PRN every 4 to 6 hours for nausea and vomiting.

Drug Supplied: See Figure 4.19[1] for an image of the label of the drug as it is supplied.

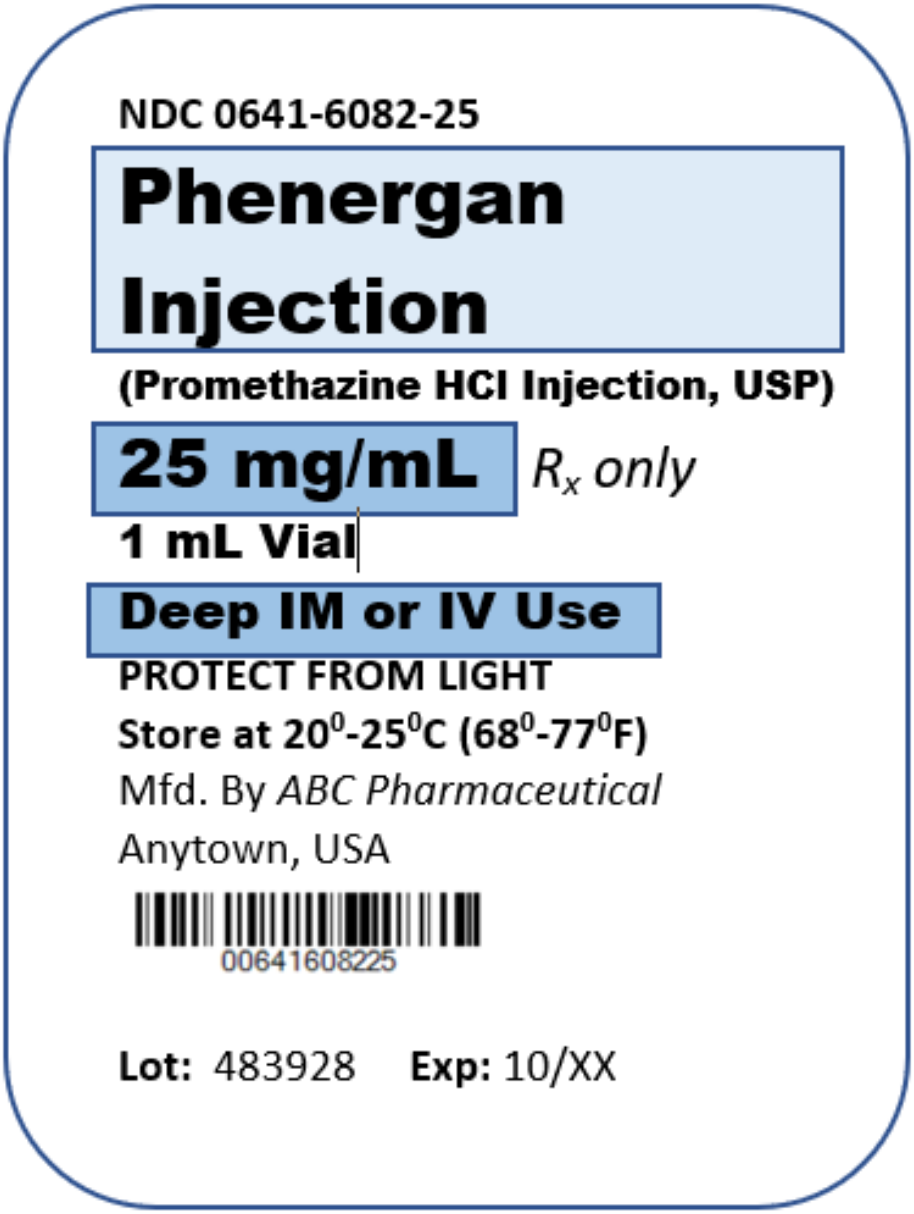
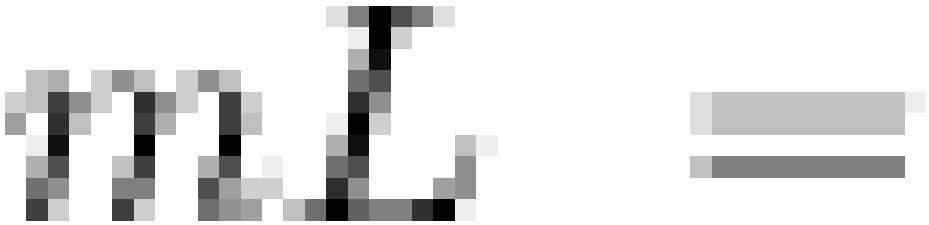


Figure 4.19: Drug Label

Solve this question by using dimensional analysis.

1. Start by identifying mL as the goal unit for which you are solving because you need to know how many mL of medication to administer:



2. Set up the first fraction with mL in the numerator to match the goal unit. In this problem, we know from the drug label that 1 mL contains 25 mg of medication, so plug in 1 in numerator and 25 mg in the denominator:

$$mL = \frac{1\ mL}{25\ mg}$$

3. Set up the second fraction to cross out mg, so place mg in the numerator. We know from the order that the new dosage prescribed is 12.5 mg., so plug in 12.5 next to mg in the numerator and 1 in the denominator to cross off units:

$$mL = \frac{1\ mL}{25\ mg} = x = \frac{12.5\ mg}{1}$$

4. Cross out mg diagonally:

$$mL = \frac{1\ mL}{25\ \cancel{mg}}\ x\ \frac{12.5\ \cancel{mg}}{1}$$

5. Multiply across the numerators and denominators, and then divide the final fraction to solve the problem:

$$mL = \frac{1\ mL}{25\ \cancel{mg}}\ x\ \frac{12.5\ \cancel{mg}}{1} = \frac{12.5\ mL}{25} = 0.5\ mL$$

IV Completion Time

In addition to calculating IV flow rates, nurses also commonly calculate when an infusion will be completed so they will know when to discontinue the infusion or hang another IV bag. Let's practice calculating how long it will take an IV infusion to complete.

Practice Problem: IV Completion Time (Example 1)

Patient Information:

Name: Amanda Parks, DOB: 09/29/19xx, Allergies: NKDA, Weight: 70 kg

Prescription: 0.9% Sodium Chloride IV at 75 mL/hr

Fluid Supplied: See Figure 5.20[1] for the IV fluid bag supplied.

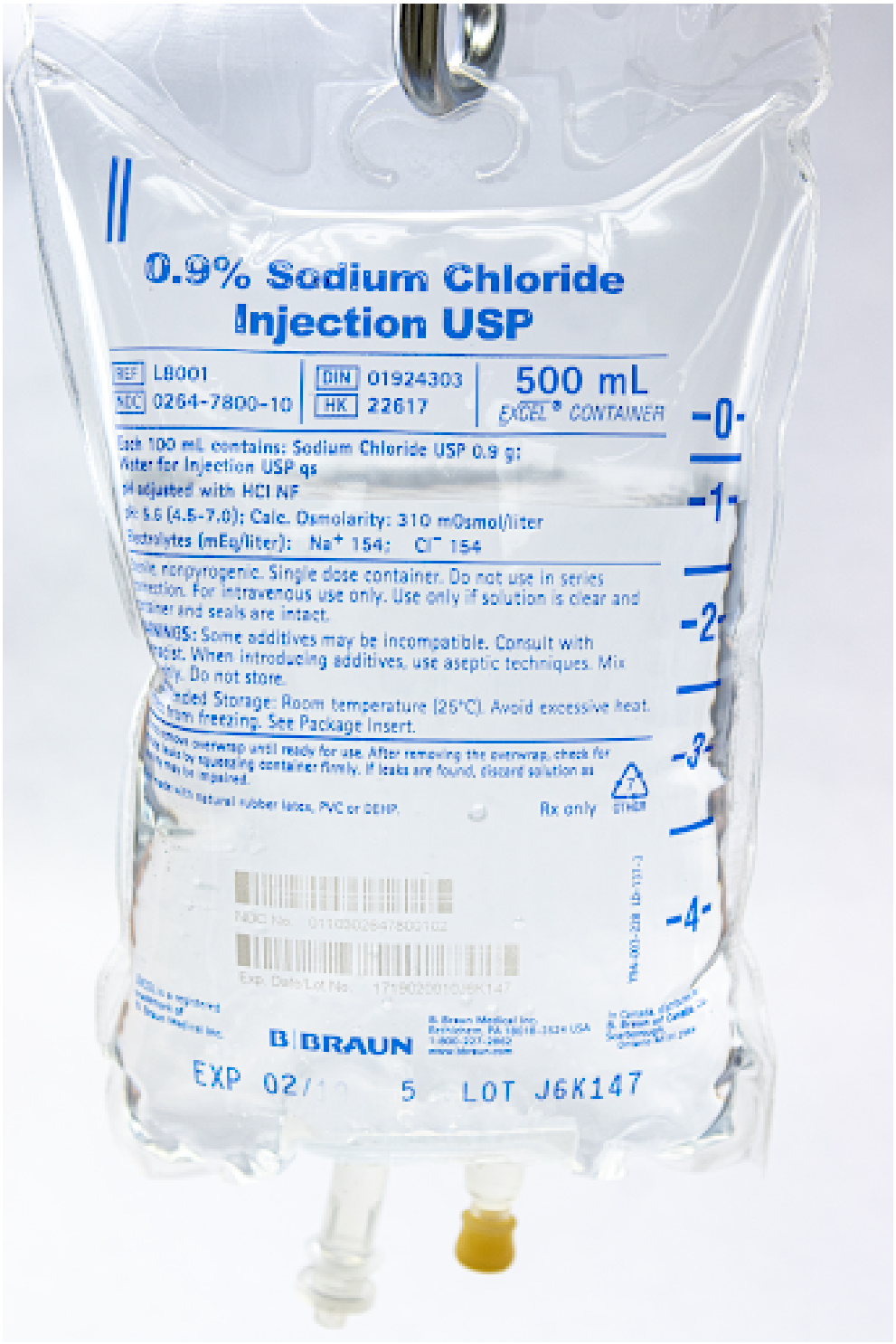


Figure 5.20: 0.9% Normal Saline in 500 mL

1. Begin by setting up the goal unit being solved for, which is an hour:

$$\text{Hour} = \ ?$$

2. Set up the first fraction by matching the numerator to hour. Look at the information in the problem related to hours. The order states the IV should be administered at 75 mL per hour, so add 75 mL to the denominator:

$$Hour = \frac{1\ hour}{75\ mL}$$

3. Set up the second fraction with the intent to cancel out mL, so add mL to the numerator of the second fraction. Look at the information in the problem related to mL. By looking at the bag, we know there are 500 mL to infuse, so plug in 500 in the numerator and place 1 in the denominator with the intent to cross out units:

$$Hour = \frac{1\ hour}{75\ \cancel{mL}} x \frac{500\ \cancel{mL}}{1}$$

4. Cross off units then multiply across the numerators and denominators. Divide the final fraction for the final answer:

$$Hour = \frac{1\ hour}{75\ \cancel{mL}} x \frac{500\ \cancel{mL}}{1} = \frac{1\ hour\ x\ 500}{75\ x\ 1} = \frac{500\ hour}{75} = 6.666667\ hours$$

5. When performing calculations related to time, it is important to remember that anything after the decimal is a portion of an hour and needs to be converted to minutes. To finish the answer, multiply 60 minutes X 0.6667 = 40.02 minutes. The final answer is the infusion will be completed in 6 hours and 40 minutes.

Practice Problem: IV Completion Time (Example 2)

Now let's add a start time to the above problem and calculate what time the infusion will end. We determined that the IV infusion will take 6.6667 hours to infuse 500 mL at 75 mL/hr.

Let's assume the infusion started at 0800.

1. Add the total infusion time to the start time of the infusion, so add 6 hours to the start time of 0800. Use military time and put a "0" before the six for 6 hours:

$$0800 + 0600 = 1400$$

2. Add the minutes to the time:

$$1400 + 40 = 1440$$

3. Answer: Our infusion will be complete at 1440.