Calculating Oral Liquids

Medications are also available in liquid form for oral administration. Liquid medications are desirable to use for clients who have dysphagia (difficulty swallowing) or who are receiving medications through various types of tubes such as nasogastric (tube in nose to stomach), gastrostomy (tube placed directly into stomach), or jejunostomy (tube directly into intestines). Liquid medications are also desired for use in young children, infants, and elderly clients. When medications that cannot be crushed for administration are ordered, the availability of the medication in liquid form should be investigated. Medications in liquid form contain a specific amount or weight of a medication in a given amount of solution, which is indicated on the label. Liquid medications are prepared in different forms, as follows:

1. **Elixir**—Alcohol solution that is sweet and aromatic.
   - Example: Phenobarbital elixir.
2. **Suspension**—One or more medications finely divided into a liquid such as water.
   - Example: Penicillin suspension.
3. **Syrup**—Medication dissolved in concentrated solution of sugar and water.
   - Example: Colace.

Liquid medications also come as tincture, emulsions, and extract preparations for oral use. Although oral liquids may be administered by means other than by mouth (e.g., nasogastric tube, gastrostomy), they should never be given by any other route, such as the intravenous (IV) route or by injection.

In the beginning of this chapter, you learned how to calculate medications that were in solid form (tablets, capsules). You calculated the number of tablets or capsules that contained the ordered dosage.

In calculating problems that involve oral liquids, the methods presented in Chapters 14 to 16 can be used. For oral liquids you must calculate the volume or amount of liquid that contains the prescribed dosage of the medication. This information is usually indicated on the medication label and can be expressed per milliliter, ounce, etc. For example, 25 mg per mL, 200 mg per mL (Figure 17-7, A). The amount may also be expressed in terms of multiple milliliters of solution, such as 80 mg per 2 mL, 250 mg per 5 mL (Figure 17-7, B).

Oral liquids can be measured in small amounts of volume, and a greater range of dosages can be ordered for administration. When calculating oral liquid medications, the stock, or what you have available, is in liquid form; therefore, the label (unit) on your answer will always be expressed in liquid measures such as milliliters.

According to Cohen (2010, Abridged edition), Medication Errors, “Many dosage errors occur with oral liquid medications. This dosage form may seem to have less potential for harm than injectable medications, but oral liquids are the least likely form to be dispensed in unit doses, and they are prescribed most often for pediatric and geriatric patients.”

The reason for dosing errors include: inaccurate measurements of oral liquids and the use of improper measuring devices. The use of calibrated measuring devices (droppers, calibrated spoons) should be used in the hospital and client's educated on the importance of this at home as opposed to using household spoons. Let's discuss the measurement of oral liquids.

---

**Figure 17-7**

A, CellCept oral suspension 200 mg per mL. B, Depakene oral solution 250 mg per mL.
**Measuring Oral Liquids**

Liquid medications can be measured in several ways:

1. The standard measuring cup (plastic), which is calibrated in metric and household measures, can be used. When measuring liquid medications, pour them at eye level and read at the meniscus (a curvature made by the solution) while the cup is on a flat surface (Figure 17-8). Always pour liquid medications with the label facing you to avoid covering the label with your hand or obscuring label information if the medication drips down the side of the container.

2. Calibrated droppers are also used for measuring liquid medications (Figure 17-9).

**SAFETY ALERT!**

* A calibrated dropper should be used ONLY for the medication for which it is intended; droppers are not interchangeable. Drop size varies from one dropper to another.

If a dropper comes with a medication, it can only be used for that medication. Some medicine droppers are calibrated in milliliters or by actual dosage. Clients who are being discharged and taking oral medications at home should be instructed to use only the dropper or other measuring devices that come with the particular medication as opposed to a household spoon.

3. Syringes may also be used to measure medications. The medication is poured in a medication cup and drawn up in the syringe without the use of a needle. This is often done when the amount desired cannot be measured accurately in a cup. For example, 6.3 mL cannot be measured accurately in the standard medication cup; however, the medication may be drawn up in a syringe and then squirted into a cup or administered orally with the use of a syringe without the needle. Solutions can also be measured by using a specially calibrated **oral syringe** to ensure accurate and safe dosages (Figure 17-10). Oral syringes are not sterile, are often available in colors, and have an off-center (eccentric) tip. These features make it easy to distinguish them from hypodermic syringes. Only use oral syringes with oral medications. Oral syringes may also have markings such as teaspoon and tablespoon. Figure 17-11 shows how to fill a syringe from a medicine cup. Some oral liquid medications come in containers that allow the client to drink right out of the container, eliminating the need to transfer it to a medication cup.

![Figure 17-8](image1.png)  
*Reading meniscus. The meniscus is caused by the surface tension of the solution against the walls of the container. The surface tension causes the formation of a concave or hollowed curvature on the surface of the solution. Read the level at the lowest point of the concave. (From Clayton BD, Willihnganz M: Basic pharmacology for nurses, ed 16, St Louis, 2013, Mosby.)*

![Figure 17-9](image2.png)  
*Medicine dropper. (Modified from Clayton BD, Willihnganz M: Basic pharmacology for nurses, ed 16, St Louis, 2013, Mosby.)*
Before we proceed to calculate liquid medications, let’s review some helpful pointers.

1. The label on the medication container must be read carefully to determine the dosage strength in the volume of solution because it varies.

**SAFETY ALERT!**

Do not confuse dosage strength with total volume. Read labels carefully. Confusing dosage strength with total volume can result in errors when performing calculations and lead to the administration of an unintended dose.

For example, the label on a medication may indicate a total volume of 100 mL, but the dosage strength may be 125 mg per 5 mL. It must be noted that dosage strength can be written on solutions in several ways to indicate the same thing. For example, 125 mg per 5 mL may be written as 125 mg/5 mL or 125 mg = 5 mL. Other examples of dosage strength are 20 mg per mL, 20 mg/mL, 200 mg/5 mL, and 200 mg per 5 mL.

**SAFETY ALERT!**

Although dosage strengths may be written on solutions in several ways when dosages are written—for example, 40 mg per 2 mL or 40 mg/2 mL—ISMP (Institute for Safe Medication Practices) recommends that the “/” (slash mark) not be used to separate doses. The slash mark has been mistaken as the number 1. Use “per” rather than a slash mark to separate doses.

2. Answers are labeled by using liquid measures. Example: mL.

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3. Calculations can be done by using the same methods (ratio and proportion, the formula method, or dimensional analysis) and the same steps as for solid forms of oral medications.

Now let’s look at some sample problems that involve the calculation of oral liquids.

Example 1: Order: Dilantin 200 mg p.o. t.i.d.

Available: Dilantin suspension labeled 125 mg per 5 mL

PROBLEM SETUP

1. No conversion is required. Everything is in the same units of measure and the same system.
   Order: 200 mg
   Available: 125 mg per 5 mL
2. Think critically: What would be a logical answer? Looking at Example 1, you can assume the answer will be greater than 5 mL.
3. Set up the problem using ratio and proportion, the formula method, or dimensional analysis.
4. Label the final answer with the correct unit of measure. In this case the units will be milliliters. Remember: The answer has no meaning if written without the appropriate unit of measure.

Solution Using Ratio and Proportion

\[
\frac{125 \text{ mg}}{5 \text{ mL}} = \frac{200 \text{ mg}}{x \text{ mL}}
\]

(known) (unknown)

\[125x = 200 \times 5\]

\[x = \frac{1,000}{125}\]

\[x = 8 \text{ mL}\]

Solution Using the Formula Method

\[
\frac{(D) 200 \text{ mg}}{(H) 125 \text{ mg}} \times (Q) 5 \text{ mL} = x \text{ mL}
\]

\[x = \frac{200}{125} \times 5\]

\[x = \frac{1,000}{125}\]

\[x = 8 \text{ mL}\]

Solution Using Dimensional Analysis

\[x \text{ mL} = \frac{5 \text{ mL}}{125 \text{ mg}} \times \frac{200 \text{ mg}}{1}\]

\[x = \frac{1,000}{125}\]

\[x = 8 \text{ mL}\]
Example 2: Order: Lactulose 30 g p.o. b.i.d.

Available: Lactulose labeled 10 g per 15 mL.

Solution Using Ratio and Proportion

\[
\frac{10 \text{ g}}{15 \text{ mL}} = \frac{30 \text{ g}}{x \text{ mL}}
\]

\[
\frac{10x}{10} = \frac{450}{10}
\]

\[
x = \frac{450}{10}
\]

\[
x = 45 \text{ mL}
\]

Solution Using the Formula Method

\[
(D) \frac{30 \text{ g}}{10 \text{ g}} \times (Q) 15 \text{ mL} = x \text{ mL}
\]

\[
x = \frac{30 \times 15}{10}
\]

\[
x = \frac{450}{10}
\]

\[
x = 45 \text{ mL}
\]

Solution Using Dimensional Analysis

\[
x \text{ mL} = \frac{15 \text{ mL}}{10 \text{ g}} \times \frac{30 \text{ g}}{1}
\]

\[
x = \frac{450}{10}
\]

\[
x = 45 \text{ mL}
\]

Example 3: Order: Omnicef 0.3 g p.o. q 12 h.

Available: Omnicef oral suspension labeled 125 mg per 5 mL

1. Convert grams to milligrams. 1,000 mg = 1 g.
   Any of the methods presented for converting can be used. Because the measures are metric in this problem (grams, milligrams), the other method that can be used is to move the decimal point the desired number of places.

\[
(0.3 \text{ g} = 0.300 = 300 \text{ mg})
\]

Solution Using Ratio and Proportion

\[
125 \text{ mg} : 5 \text{ mL} = 300 \text{ mg} : x \text{ mL}
\]

\[
\frac{125x}{125} = \frac{300 \times 5}{125}
\]

\[
x = \frac{1,500}{125}
\]

\[
x = 12 \text{ mL}
\]

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Solution Using the Formula Method

\[
\frac{(D)}{125 \text{ mg}} \times \frac{(Q)}{5 \text{ mL}} = x \text{ mL}
\]

\[
x = \frac{300 \times 5}{125} = 12 \text{ mL}
\]

Solution Using Dimensional Analysis

\[
x \text{ mL} = \frac{5 \text{ mL}}{125 \text{ mg}} \times \frac{1,000 \text{ mg}}{1 \text{ g}} \times \frac{0.3 \text{ g}}{1}
\]

\[
x = \frac{5,000 \times 0.3}{125} = 12 \text{ mL}
\]

Points to Remember

- Liquid medications can be calculated by using the same methods as those used for solid forms (tabs, caps).
- Read labels carefully on medication containers; identify the dosage strength contained in a certain amount of solution.
- Administration of accurate dosages of liquid medications may require the use of calibrated droppers or syringes. Oral syringes are designed for oral use; they are not sterile.
- The use of ratio and proportion, the formula method, or dimensional analysis is a means of validating an answer; however, it still requires thinking in terms of the dosage you will administer and applying principles learned to calculate dosages that are sensible and safe.
- Dosage strength on solutions can be written several ways. Do not confuse it with total volume (total amount in container). Use “per” to separate dosages when writing.
- For accurate measurement, oral solutions are poured at eye level and read at eye level while resting on a flat surface.
- Always pour away from the label to keep hands from covering it and spills from obscuring it.
- Use only the calibrated measuring devices for the medication it is intended for.

Practice Problems

Calculate the following dosages for oral liquids in milliliters using the labels or information provided. Do not forget to label your answer. Round answers to the nearest tenth where indicated.

42. Order: Colace syrup 100 mg by jejunostomy tube t.i.d.

Available: Colace syrup 50 mg per 15 mL

________________________
43. Order: Biaxin 100 mg p.o. q12h.
Available:

44. Order: Kaon-Cl (potassium chloride) 40 mEq p.o. daily.
Available:

45. Order: Theophylline elixir 120 mg p.o. b.i.d.
Available: Theophylline elixir 80 mg per 15 mL

46. Order: Erythromycin oral suspension 250 mg p.o. q6h.
Available: Erythromycin oral suspension labeled 200 mg per 5 mL
47. Order: Dilantin 100 mg p.o. t.i.d.  

Available: Dilantin suspension 125 mg per 5 mL

48. Order: Digoxin 125 mcg p.o. every day.

Available:

49. Order: Imodium (loperamide hydrochloride) 4 mg p.o. as initial dose and then 2 mg after each loose stool.

Available:

How many mL will you administer for the initial dose? ______________________
50. Order: Amoxicillin 0.5 g p.o. q6h.
   Available: Amoxicillin oral suspension labeled 125 mg per 5 mL

51. Order: Phenobarbital 60 mg p.o. at bedtime.
   Available: Phenobarbital elixir 20 mg per 5 mL

52. Order: Mellaril 150 mg p.o. b.i.d.
   Available:

53. Order: Diphenhydramine HCl 25 mg p.o. b.i.d. p.r.n. for agitation.
   Available: Diphenhydramine hydrochloride elixir 12.5 mg per 5 mL

54. Order: Lithium carbonate 600 mg p.o. at bedtime.
   Available: Lithium citrate syrup. Each 5 mL contains lithium carbonate 300 mg.
   Each unit-dose container contains 5 mL
   a. How many milliliters are needed to administer the required dosage?  
   b. How many containers of the medication will you need to administer the dosage?

55. Order: Haldol 10 mg p.o. b.i.d.
   Available: Haldol concentrate labeled 2 mg per mL
56. Order: E.E.S. 0.5 g by gastrostomy tube q6h.

Available:

![Erythromycin Ethylsuccinate Oral Suspension, USP](image1.jpg)

57. Order: Penicillin V Potassium 500,000 units p.o. q.i.d.

Available:

![Penicillin V Potassium](image2.jpg)

58. Order: Keflex 1 g by nasogastric tube q6h.

Available: Keflex oral suspension 125 mg per 5 mL

59. Order: Depakene 500 mg p.o. daily.

Available:

![Depakene Syrup](image3.jpg)
60. Order: Acetaminophen (Tylenol) 650 mg by nasogastric tube q4h p.r.n. for temperature greater than 101° F.

Available:

![Acetaminophen Image]

61. Order: Tagamet 400 mg p.o. q6h.

Available: Tagamet oral liquid labeled 300 mg per 5 mL

62. Order: Epivir 150 mg p.o. b.i.d.

Available:
63. Order: Retrovir 0.3 g p.o. b.i.d.
   Available:

64. Order: Amoxicillin 375 mg p.o. q8h.
   Available:
65. Order: Norvir 600 mg p.o. b.i.d.
Available:

66. Order: Amoxicillin and Clavulanate Potassium 0.25 g p.o. q8h (ordered according to the dose of amoxicillin).
Available:
67. Order: Zovirax 200 mg p.o. q4h for 5 days.

Available:

![Zovirax Suspension Label]

68. Order: Prozac 30 mg p.o. every day in AM.

Available:

![Prozac Liquid Label]

69. Order: Zantac 150 mg b.i.d. by nasogastric tube.

Available: Zantac syrup labeled 15 mg per mL

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70. Order: Oxycodone Hydrochloride 30 mg p.o. q12h p.r.n. for pain.

Available:

![Image of Oxycodone Hydrochloride label]

Answers on pp. 345-347

**CLINICAL REASONING**

1. **Scenario:** Order: Digoxin 0.75 mg p.o. daily. In preparing to administer medications, you find 0.125 mg tabs (scored) in the medication drawer for the client.
   a. Based on the tablets available, how many would you have to administer? ______
   b. What action should you take? ____________________________________________
   c. What is the rationale for your action? _____________________________________

2. **Scenario:** Order: Diflucan 150 mg p.o. daily. The pharmacy sends two 100-mg unscored tabs.
   a. What action should you take to administer the dosage ordered? ______________
   b. What is the rationale for your action? _____________________________________

3. **Scenario:** Order: Percocet 2 tabs p.o. q4h p.r.n. for pain for a client who is allergic to aspirin. The nurse administers Percodan 2 tabs.
   a. What client right was violated? ____________________________________________
   b. What contributed to the error? ____________________________________________
   c. What is the potential outcome of the error? _________________________________
   d. What preventive measures could have been taken to prevent the error? ________

Answers on p. 348
CHAPTER REVIEW

Calculate the following dosages using the medication label or information provided. Express volume answers in milliliters; round answers to the nearest tenth as indicated. Remember to label answers: tab, caps, mL.

1. Order: Tylenol 975 mg p.o. q6h p.r.n. for earache.
   Available: 
   ![Tylenol Label]

2. Order: Zyvox 400 mg p.o. q12h.
   Available: 
   ![Zyvox Label]

3. Order: Lopressor 100 mg p.o. b.i.d. Hold for blood pressure less than 100/60.
   Available: 
   ![Lopressor Label]
4. Order: Carvedilol 18.75 mg p.o. b.i.d.

Available:

5. Order: Janumet 50 mg/1,000 mg p.o. b.i.d.

Available:

6. Order: Zithromax 250 mg p.o. daily for 3 days.

Available:
7. Order: Cialis 20 mg p.o. 1 hr before sexual activity for a client with erectile dysfunction.

Available:

![Cialis Tablet](image)

8. Order: Ativan 1 mg p.o. q4h p.r.n. for agitation.

Available: Ativan tablets labeled 0.5 mg

9. Order: Lopressor 25 mg per nasogastric tube b.i.d.

Available: Scored Lopressor tablets labeled 50 mg

10. Order: Aldactone 100 mg p.o. daily.

Available:

![Aldactone Tablet](image)
11. Order: Digoxin 0.1 mg p.o. daily.
   Available:

   ![Image](image1.png)

12. Order: Amoxicillin 0.475 g p.o. q6h.
   Available:

   ![Image](image2.png)

13. Order: Hydrochlorothiazide 12.5 mg p.o. daily. Hold for blood pressure less than 90/60.
   Available: Scored tablets

   ![Image](image3.png)
14. Order: Tylenol 500 mg by nasogastric tube q4h p.r.n. for temp greater than 101.4° F. Available:

15. Order: Lexapro 20 mg p.o. daily in the PM. Available: Lexapro oral solution labeled 5 mg per 5 mL

16. Order: Elixophyllin Elixir 300 mg by nasogastric tube b.i.d. Available: Elixophyllin liquid labeled 160 mg per 15 mL

17. Order: Xanax 0.75 mg p.o. t.i.d. Available:
18. Order: Prandin 3 mg p.o. b.i.d.
Available:

Which dosage strength will be best to use?

19. Order: Meclizine HCl (Antivert) 25 mg p.o. every day.
Available: Meclizine tablets labeled 12.5 mg

20. Order: Erythromycin (Delayed Release) 0.5 g p.o. b.i.d.
Available:
21. Order: Clonidine 0.5 mg p.o. t.i.d. Hold for blood pressure less than 100/60.
   Available: Clonidine tablets labeled 0.1 mg, 0.2 mg, 0.3 mg
   Which would be the best combination to administer to the client? ____________

22. Order: Nitrostat 0.3 mg SL stat.
   Available:

   ![Nitrostat Image]

23. Order: Procanbid extended release 1 g p.o. q12h.
   Available:

   ![Procanbid Image]
24. Order: Lactulose 20 g by gastrostomy tube b.i.d.  
   Available:  

   ![Lactulose Solution USP label](image1)

25. Order: Kanamycin (Kantrex) 1 g p.o. q6h for 5 days.  
   Available:  

   ![Kanamycin Sulfate Capsules, USP label](image2)

26. Order: Clozaril 50 mg p.o. daily.  
   Available:  

   ![Clozaril (clozapine) tablets label](image3)

   a. How many tabs will you administer for each dosage?  
      ____________________________

   b. How many tabs will be needed for 7 days?  
      ____________________________
27. Order: Lipitor 30 mg p.o. every day.

Available:

What will you administer to the client?

28. Order: Cimetidine 0.8 g p.o. t.i.d.

Available:
29. Order: Cefprozil 0.5 g p.o. q12h.

Available:

30. Order: Nexium (delayed release) 40 mg p.o. every day for 4 weeks.

Available:

What will you administer to the client?
31. Order: Compazine 7.5 mg p.o. t.i.d.

Available:

![Compazine Label]

32. Order: Avandia 8 mg p.o. daily.

Available:

![Avandia Label]

33. Order: Allopurinol 0.25 g p.o. every day.

Available: Scored tablets

![Allopurinol Label]
34. Order: Geodon 120 mg p.o. b.i.d.

Available:

35. Order: Lasix (furosemide) 100 mg by gastrostomy tube once a day.

Available:
36. Order: Strattera 0.1 g p.o. daily.

Available:

Which dosage strength will you administer?

37. Order: Viagra 50 mg p.o. ½ hour before sexual activity for a client with erectile dysfunction.

Available:
38. Order: Tranxene 30 mg p.o. b.i.d.
   Available: Tranxene tablets labeled 15 mg

39. Order: Valproic acid (Depakene) 1 g p.o. every day.
   Available:

![Depakene Label]

40. Order: Synthroid 175 mcg p.o. daily.
   Available:

![Synthroid Label]
41. Order: Zyprexa 10 mg p.o. b.i.d.

Available:

![Image of Zyprexa 2.5 mg Tablets]

What will you administer to the client?

____________________

42. Order: Wellbutrin 150 mg p.o. b.i.d.

Available:

![Image of Wellbutrin Tablets]

____________________
43. Order: Zoloft 150 mg p.o. daily
   Available: Scored tablets

44. Order: Famvir 0.25 g p.o. t.i.d. for 5 days.
   Available:

45. Order: Cytotec 200 mcg p.o. q.i.d.
   Available:
46. Order: Trileptal 0.6 g p.o. b.i.d.
   Available: 

   ![Trileptal Image]

47. Order: Benadryl 100 mg p.o. at bedtime.
   Available: Benadryl capsules labeled 50 mg

48. Order: Zofran 8 mg p.o. ½ hour before chemotherapy.
   Available: 

   ![Zofran Image]

49. Order: Terbutaline 15 mg p.o. daily.
   Available: 

   ![Terbutaline Image]

How many of which dosage strength will you administer? ________________________