CHAPTER 8

Calculating Doses from Oral Solutions and Suspensions

INTRODUCTION

Medications are available in a wide range of dosage formulations, suitable for various routes of administration (e.g., oral, rectal, parenteral, topical). Oral dosage forms may be solid (tablets or capsules), semisolid (troches, lozenges), or liquid (solutions, suspensions, or emulsions). This chapter is not about opioid *conversion* calculations specifically; rather it is to learn how to calculate an appropriate volume of an oral solution or suspension to give a specific prescribed dose. This may seem like a simple calculation, but done incorrectly, the results could be disastrous. Common liquid analgesics are shown in Appendix 8-A.

OBJECTIVES

After reading this chapter and completing all practice problems, the participant will be able to:

1. Define what is meant by a medication solution or suspension.
2. Explain why these dosage formulations are used in caring for patients with advanced illnesses, and how they should be administered.
3. Calculate the appropriate volume of a medication solution or suspension to administer a specific prescribed dose.
4. Verify the calculated volume of an oral solution or suspension intended to deliver a specific prescribed dose.

A **solution** is a homogeneous mixture (uniform in composition throughout) prepared by mixing two or more substances. The **solute** (the substance being added for dissolution, usually present in the smaller amount) may be a solid, liquid, or gas. The **solvent** (volume to which the solute is added) is a liquid, hence the reference to **oral solution.** Because one substance is completely dissolved in another, there is generally no need to shake the oral solution prior to administration, as there is with a **suspension.** A suspension is a mixture in which solid particles are suspended in a fluid. The particles are prone to settle on standing; therefore, the mixture must be shaken prior to administration.

Oral solutions *are used to treat patients with advanced illnesses for several reasons, including the following:*

- The dose of medication may be individualized to a greater degree than that allowed by dividing tablets or taking multiple tablets or capsules. This is especially important in managing small dose increments in upward or downward titration.
- The administration of certain medications at higher dosages would not be feasible due to pill burden (e.g., taking 18 tablets at a time).
- Most commonly, patients with advanced illnesses are often unable to swallow solid oral dosage formulations or may have a feeding tube in place. Also, some patients of all ages have an aversion or inability to swallow pills or capsules.

- Opioids and other medications may be administered as a concentrated oral solution in the sublingual or buccal cavity when the oral route is not available (e.g., bowel obstruction, difficulty swallowing, nausea or vomiting, reduced level of consciousness), or when parenteral or rectal routes of opioid administration are not desired or feasible.

Oral solutions may be administered by mouth to be swallowed or administered via a feeding tube. They may be administered by the **sublingual** (under the tongue) route or into the **buccal** cavity (cheek of the mouth) if the oral solution is sufficiently concentrated. Hikma makes a line of highly, or intensely, concentrated oral solutions (referred to as concentrates or Intensols) of medication that are dispensed with a calibrated dropper. Examples include alprazolam 1 mg/mL, dexamethasone 1 mg/mL, diazepam 5 mg/mL, lorazepam 2 mg/mL, methadone 10 mg/mL, morphine 20 mg/mL, oxycodone 20 mg/mL, and prednisone 5 mg/mL. Other pharmaceutical manufacturers offer some of these products in the same concentrations.

Some oral solutions are simply referred to as *liquids* while others are called *elixirs*, *concentrates*, *syrups*, or *drops*. Elixirs historically referred to oral solutions that contained alcohol and syrups used to contain sugar. Today, the terms do not hold these meanings. *Drops* generally refer to an oral solution in a dropper bottle and *concentrates* are concentrated solutions as discussed in the preceding paragraph.

PRINCIPLES

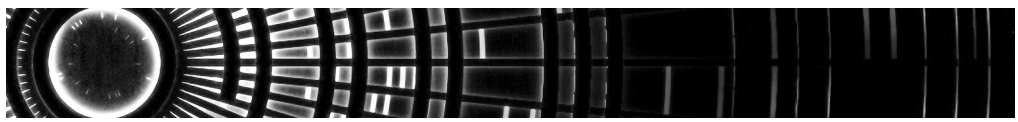
So, how do you go about calculating the appropriate volume of an oral solution to give a specific prescribed dose? Look at the following equation. On the left is the concentration of the oral solution in milligrams per milliliters. On the right is the desired dose in the numerator, and the unknown variable (X), the appropriate volume, in the denominator.

$$\frac{\text{concentration of oral solution in } \textbf{milligrams}}{\text{per } \textit{milliliters}} = \frac{\text{desired dose of medication in } \textbf{milligrams}}{\text{unknown (X) volume of medication in } \textit{milliliters}}$$

Note in the above equation that **milligrams** are in the numerator on both sides of the equation, and *milliliters* are in the denominator on both sides of the equation.

To determine the appropriate volume of medication to administer, cross-multiply and solve for the unknown (X), as shown in the following example.

CASE EXAMPLES



CASE 8.1

Calculating the Volume of an Oral Solution

Patient is an 82-year-old man with esophageal cancer. He had been receiving morphine extended-release tablets 15 mg by mouth every 12 hours with good pain control. His cancer has progressed, and now he struggles to swallow the morphine tablets. His prescriber would