Objectives

- Calculate IV flow rates.
- Understand ratio or percent strength of a medication expressed as weight/weight, weight/volume or volume/volume.
- Calculate powder volume to prepare solutions.
- Understand how to prepare solutions using the alligation method.
- Utilize dilutions so that medications can be measured more accurately and easily.

Compounding

- The preparation, mixing, assembling, packaging, or labeling of a drug in accordance with a licensed practitioner’s prescription. This includes both sterile and non-sterile products.
- Pharmacy technicians may often aid the pharmacist in compounding. The role of the pharmacy technician includes:
  - Calculation of the correct amount of product to be mixed
  - Calculation of dose to be given to the patient
  - Weighing and mixing the product

Reducing and Enlarging Formulas

- Using the principles of ratios and proportions for extemporaneous compounding

  Example:
  - Zinc Oxide: 50gm
  - Pine Tar: 120gm
  - Petrolatum: 264gm
  - Total Weight: 454gm = 1lb

- Example: How much pine tar would be required to prepare 1kg of ointment?

  - 1kg = 1,000gm
  - \[ \frac{120gm}{120gm} = \frac{x}{454gm} \]
  - \[ x = \frac{120gm}{120gm} \times \frac{454gm}{1,000gm} \]
  - \[ x = 264.3 \text{ gm pine tar} \]
Reducing and Enlarging Formulas

How much zinc oxide would be required to prepare 100gm of ointment?

\[
\frac{50\text{gm}}{454\text{gm}} = \frac{x}{100\text{gm}}
\]

\[x = 11\text{gm} \text{ zinc oxide}\]

Flow Rate

- Flow Rate (Infusion Rate): rate that an IV medication leaves bag and enters patient’s blood stream
  - Expressed as ml/hr or drops/min
  - Time of infusion = \text{volume of fluid} / \text{rate of infusion}

Flow Rate Calculations

- A 1L IV bag is running at 125ml/hr. How often will you need to send a new bag?

\[
X \text{ hr} = \frac{\text{volume}}{\text{rate of infusion}}
\]

X hr = \[
\frac{1000\text{ml}}{125\text{ml/hr}} = 8\text{hours}
\]

Flow Rate Calculations

- Rate of Infusion
  - Prepare 750mg of Vancomycin in 75 ml for infusion over 30 minutes. Use a 10 drop set (10drops/ml). How many drops/min will that be?

\[
\frac{75\text{ml}}{1\text{L}} \times \frac{10\text{drops}}{1\text{ml}} = 25 \text{ drops/min}
\]

Flow Rate Calculations

- Volume to be Dispensed
  - If the flow rate is 24 drops/min using a 15 drop set (15drops/ml), how many liters will be delivered in 24 hours?

\[
\frac{24\text{drops}}{1\text{ml}} \times \frac{1\text{ml}}{15\text{drops}} = 1.6\text{ml/min}
\]

\[
1.6\text{ml/min} \times 1440\text{min} = 2.3\text{ Liter}
\]
Flow Rate Calculations

- Amount of Drug the Patient will Receive
  - If a patient receives 40 gtts/min of an IV solution containing 1 gram of drug per Liter calibrated at 15 gtts/ml, how many mg of drug will the patient receive per hour?
  
  \[
  \begin{align*}
  40 \text{gtts/min} & \times \frac{1 \text{ml}}{15 \text{gtts}} & \times \frac{1000 \text{mg}}{1 \text{L}} & \times \frac{1 \text{hr}}{60 \text{min}} \\
  & = 160 \text{mg/hr}
  \end{align*}
  \]

Flow Rate - Example

- You have a 1.5 liter bag that needs to be run over 12 hours. What is the flow rate in ml/min?

\[
\begin{align*}
1.5 \text{L} & \times \frac{1000 \text{ml}}{1 \text{L}} & \times \frac{1 \text{hr}}{60 \text{min}} \\
& = 2.5 \text{ml/min}
\end{align*}
\]

Flow Rate - Answer

- Part 1: What volume of fluid is administered per hour? (ml/hr)
  \[
  \text{ml} = 50 \text{ml} = \frac{100 \text{ml}}{0.5 \text{hr}}
  \]
- Part 2: What amount of drug is given per hour? (mg/hr)
  \[
  \text{mg} = 250 \text{mg} = \frac{500 \text{mg}}{0.5 \text{hr}}
  \]

Solutions

- Solution: a mixture of 2 or more substances
  - 2 liquids: a mixed drink
  - Solid in a liquid: Kool-aid
  - Gas in a liquid: carbonated water
- The concentration of one substance in another substance may be expressed as either a percentage or ratio strength.
Ratio/Percent Strength

Concentrations are expressed in percentages and there are 3 types:
- Weight-in-weight (w/w)
  - Example: 2 gm drug in 100gm product = 2%
- Volume-in-volume (v/v)
  - Example: 5 ml drug in 100ml solution = 5%
- Weight-in-volume (w/v)
  - Example: 17 gm drug in 100ml = 17%

Example #1
You have a 1% w/w container of Tinactin powder. How many grams of Tinactin are present in an 8 ounce container of powder?

Answer #1
w/w expressed as gm/gm
1% = 1g Tinactin/100g powder

8ounces x (28.3g/ounce) x (1g Tinactin/100g powder) =

2.3g Tinactin

Example #2
How many grams of sodium chloride are provided by 500ml of normal saline?
(hint: normal saline is 0.9% NaCl)

Answer #2
w/v expressed as g/ml
Therefore 0.9% = 0.9g/100ml

500ml NS x (0.9g/100ml) = 4.5g NaCl

Example #3
There are 1250mg of hydrocortisone in 5 g of ointment. What is the percentage of drug?
Concentration expressed as w/w:
1st convert to the same unit of measure
1250mg x (1g/1000mg) = 1.25g

Then convert to a percentage
(1.25gm/5gm) x 100 = 25%

If a patient is to receive 25 mg of drug in 1 Liter of solution, what is the concentration of the prepared product?

w/v expressed as gm/ml
If convert to proper units of measure
25mg (1gm/1,000mg) = 0.025gm
1L (1,000ml/1L) = 1,000ml
(0.025gm/1,000ml) x 100 = 0.0025%

Alligation
Calculation used to make dilutions from 2 sources of different concentrations.
Final concentration can NOT be higher than the source concentrations.
Final concentration can NOT be lower than the source concentrations.
Must be a concentration between the 2 sources
Alligation

The results of the subtraction indicates how many parts of each solution are needed to prepare the mid-range concentration.

In this case we will need 2.5 parts of the 50% dextrose solution and 42.5 parts of the 5% dextrose solution to make 250mL of the 7.5% dextrose solution.

Step 3: Add together the number of parts needed to determine the total parts of the solution we are preparing.

For this problem we will add: 2.5 parts + 42.5 parts = 45 parts

Step 4: Calculate the volume of each concentration needed.

50% Dextrose Solution

\[ x \text{ mL} = \frac{250 \text{ mL}}{45 \text{ parts}} \]

\[ x \text{ mL} = 2.5 \text{ mL} \times 45 \text{ parts} \]

\[ x \text{ mL} = 113.89 \text{ mL of D}_{50}W \]

5% Dextrose Solution

\[ x \text{ mL} = \frac{250 \text{ mL}}{45 \text{ parts}} \]

\[ x \text{ mL} = 236.11 \text{ mL of D}_{5}W \]

To check your work add the two volumes together. They should equal the total volume you need to make.

13.89 mL of D$_{50}$W + 236.11 mL of D$_{5}$W = 250.00 mL

Alligations - Example

A prescription requires a 15% solution of IPAmycin*, but all you have available in stock is 25% and 10% solutions. How many mL of each solution should you use to make 60mL of a 15% solution?

*Fictitious drug

First:

25% 10% 5 parts of 25%

Next:

Add the number of parts 10 + 5 = 15 total parts

Finally:

Determine amount of each solution by using cross multiplication.

\[ \text{parts} = 60 \text{ mL} \times x \text{ mL of 25% solution} \]

\[ \text{parts} = 60 \text{ mL} \times x \text{ mL of 10% solution} \]

15 parts 10 parts 15 parts

20 mL + 40 mL = 60 mL total

**Check your answer:** 20 mL + 40 mL = 60 mL total
Reconstituting Dry Powders

- Powder volume is the space occupied by dry medication.
- Powder volume can be determined by subtracting the diluent volume from the final volume.

\[ \text{powder volume} = \text{final volume} - \text{diluent volume} \]

\[ \text{pv} = \text{fv} - \text{dv} \]

Reconstituting Dry Powders

Example #1

A dry powder antibiotic must be reconstituted for use. The label states that the dry powder occupies 0.5mL. Using the formula for solving for powder volume, determine the diluent volume (the amount of solvent added) if the final volume is 15mL.

\[ \text{powder volume} = \text{final volume} - \text{diluent volume} \]

\[ 0.5\text{mL} = 15\text{mL} - \text{dv} \]

\[ 15\text{mL} - 0.5\text{mL} = 14.5\text{mL} \]

Reconstituting Dry Powders

Example #2

You are to reconstitute 1g of dry powder. The package insert states that you are to add 9mL of diluent to make a final solution of 100mg/mL. What is the powder volume?

Step 1: Calculate the final volume. (hint 1gm=1,000mg)

\[ x\text{mL} = \frac{1\text{mL}}{1000\text{mg}} \times \frac{100\text{mg}}{1\text{mL}} = 10\text{mL} \]

Step 2: Calculate the powder volume.

\[ \text{pv} = \text{fv} - \text{dv} \]

\[ \text{pv} = 10\text{mL} - 9\text{mL} = 1\text{mL} \]

Reconstituting Dry Powders

Example #3

You must reconstitute 500mg of Rocephin with 2.1ml of Lidocaine. The final concentration is 125mg/ml. What is the powder volume?

\[ \frac{125\text{mg}}{1\text{mL}} \times x = 4\text{mL} \]

\[ x = 4\text{mL} \]

\[ \text{pv} = 4\text{mL} - 2.1\text{mL} = 1.9\text{mL} \]
Often manufacturers distribute a concentrated product. Frequently, it is necessary to dilute the solution for accurate measurement.

- A volume less than 0.1 ml is usually considered too small to measure accurately.

**Dilutions - Example**

Dexamethasone is available from the manufacturer in a 4 mg/ml preparation. An infant is to receive 0.4 mg. Prepare a dilution with a concentration of 1 mg/ml. How much diluent will you need if the original product is in a 1 ml vial and you use the entire vial?

**Dilution Answer #1**

1st: Determine the volume of the final product.

\[ \frac{xml}{4mg} = \frac{1ml}{1mg} \]

\[ x = 4ml \]

2nd: Subtract the volume of the concentrate from the volume of the final product to determine the amount of diluent needed.

\[ 4ml - 1ml = 3ml \text{ diluent} \]

**Dilution Example #2**

You have a 20% solution of KCl and must prepare 250 ml of a 0.4% solution. How many ml of stock solution and distilled water would you need to prepare this solution?

**Dilution Answer #2**

1st: Determine how many gm in the final product

\[ \frac{x}{250ml} = \frac{0.4gm}{100ml} \]

\[ x = 1gm \]

2nd: Determine how much concentrate is needed

\[ \frac{20gm}{1gm} = \frac{x}{5ml \text{ of stock solution}} \]

\[ x = 5ml \]

3rd: Determine ml of diluent is needed

\[ 250ml - 5ml = 245ml \text{ of distilled water} \]

**Dilution Example #3**

You need to make 250 ml of a 1:500 solution. You have a concentrate solution of 80%. How much of the concentrate and diluent will you need to make the final product?
Dilution
Answer #3

<table>
<thead>
<tr>
<th>Step</th>
<th>Calculation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>( \frac{x \text{ gm}}{250 \text{ ml}} = \frac{1 \text{ gm}}{500 \text{ ml}} ) x = 0.5gm in final solution</td>
<td></td>
</tr>
<tr>
<td>Next</td>
<td>( \frac{0.5 \text{ gm}}{X \text{ ml}} = \frac{80 \text{ gm}}{100 \text{ ml}} ) x = 0.625 ml of concentrate</td>
<td></td>
</tr>
<tr>
<td>Finally</td>
<td>250 ml – 0.625 ml = 249.38 ml diluent needed</td>
<td></td>
</tr>
</tbody>
</table>

Thank You!!!!!!

GOOD LUCK ON THE CERTIFICATION EXAM!