**Pharmaceutical Calculations in Marketed Formulations**

**I. Introduction**

* Pharmaceutical calculations are essential for ensuring accurate dosing and safe medication use.
* Marketed formulations often require calculations for:
  + Dilution
  + Reconstitution
  + Dosage adjustments
  + Calculating the amount of active ingredient
  + Calculating flow rates for IV infusions.
* Understanding these calculations minimizes medication errors and improves patient outcomes.

**II. Key Concepts**

* **Concentration:**
  + Expressed as:
    - Weight/volume (e.g., mg/mL, g/L)
    - Weight/weight (e.g., % w/w)
    - Volume/volume (e.g., % v/v)
    - Percentage strength
    - Ratio strength
  + Example: A solution containing 10 mg of drug in 1 mL has a concentration of 10 mg/mL.
* **Dilution:**
  + Reducing the concentration of a solution by adding a diluent.
  + Formula: C1​V1​=C2​V2​
    - C1​ = initial concentration
    - V1​ = initial volume
    - C2​ = final concentration
    - V2​ = final volume
* **Reconstitution:**
  + Adding a diluent to a powdered drug to form a solution.
  + Requires careful attention to the manufacturer's instructions.
* **Dosage Calculations:**
  + Determining the correct amount of medication to administer based on patient weight, age, or other factors.
  + Commonly used in pediatrics and critical care.
* **Flow Rate Calculations (IV Infusions):**
  + Calculating the rate at which an IV fluid should be administered.
  + Expressed in mL/hour or drops/minute.

**III. Common Calculations and Examples**

1. **Dilution Calculations**
   * **Example:** You have a 25% w/v solution and need to prepare 500 mL of a 5% w/v solution. How much of the original solution is needed?
     + C1​=25%
     + V1​=?
     + C2​=5%
     + V2​=500 mL
     + 25%×V1​=5%×500 mL
     + V1​=(5%×500 mL)/25%=100 mL
     + Therefore, you need 100 mL of the 25% solution and 400mL of diluent.
2. **Reconstitution Calculations**
   * **Example:** A vial of powdered antibiotic contains 1 gram of drug. The label states to add 9.6 mL of sterile water to yield a concentration of 100 mg/mL. How much diluent is required?
     + 1 gram = 1000mg
     + 1000mg/100mg/ml = 10 ml total volume.
     + Therefore 10ml - the powder volume (0.4ml, because 9.6ml of water was added) = 9.6 ml.
     + The label is correct.
3. **Dosage Calculations (Weight-Based)**
   * **Example:** A child weighing 20 kg needs a medication at a dose of 15 mg/kg. The medication is available as a 50 mg/mL solution. What volume should be administered?
     + Total dose: 20 kg × 15 mg/kg = 300 mg
     + Volume: 300 mg / 50 mg/mL = 6 mL
     + Therefore, administer 6 mL.
4. **Flow Rate Calculations (mL/hour)**
   * **Example:** A patient needs 1 L of IV fluid to be infused over 8 hours. What is the flow rate in mL/hour?
     + 1 L = 1000 mL
     + Flow rate: 1000 mL / 8 hours = 125 mL/hour
5. **Flow Rate Calculations (Drops/minute)**
   * **Example:** The IV tubing delivers 20 drops/mL. The patient needs 125 mL/hour. What is the flow rate in drops/minute?
     + Flow rate (mL/minute): 125 mL/hour / 60 minutes/hour = 2.083 mL/minute
     + Flow rate (drops/minute): 2.083 mL/minute × 20 drops/mL ≈ 42 drops/minute
6. **Percentage Strength Calculations**
   * **Example:** How many grams of dextrose are in 500 mL of a 5% w/v dextrose solution?
     + 5% w/v means 5 grams of dextrose in 100 mL of solution.
     + (5 g / 100 mL) × 500 mL = 25 grams of dextrose.
7. **Ratio Strength Calculations**
   * **Example:** How many milligrams of epinephrine are in 10mL of a 1:1000 epinephrine solution?
     + 1:1000 means 1g in 1000mL or 1000mg in 1000mL, or 1mg/1mL
     + 1mg/mL \* 10mL = 10mg.

**IV. Important Considerations**

* Double-check all calculations.
* Use appropriate units and conversions.
* Pay close attention to the manufacturer's instructions.
* Use calibrated measuring devices.
* When in doubt, consult with a pharmacist.
* When dealing with potent medications, triple check calculations.
* Consider patient specific factors, such as renal or hepatic impairment.

**V. Practice Problems**

* A prescription calls for 250 mg of amoxicillin. The available suspension is 125 mg/5 mL. How many milliliters should be administered?
* A patient needs a dopamine infusion at 5 mcg/kg/minute. The patient weighs 70 kg. The dopamine concentration is 400 mg/250 mL. What is the flow rate in mL/hour?
* You have a 10% w/v solution. How much diluent is required to make 500mL of a 2% w/v solution.