Pharmacy Calculations Used In Institutional Settings

Stephanie Harris MPH, CPhT
Palmetto Health Children’s Hospital
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Objectives

- Demonstrate basic mathematic skills
- Reconstitute powder into liquid medications
- Prepare alligations and dilutions for pediatric patients
- Accurately read drug labels and calculate the correct doses/dosages of oral and parenteral liquid medications

Disclosure

I have no disclosure or conflicts of interest regarding the subject matter of this presentation.

True or False?

- When conducting math equations, units or metric abbreviations do not matter.

Metric Conversions

Guidelines for Metric Notation

- Always place the number before the abbreviation
  - 4mg not mg 4
- Place a zero to the left of the decimal when the number is less than 1
  - 0.5 ml not .5ml
- Never place a zero behind whole numbers
  - 6mcg not 6.0mcg
Guidelines for Metric Notation

- When converting small units to larger units, make sure your numbers decrease proportionately.
  - 9,000 mg = 9 g
- When converting larger units to small units, make sure your numbers increase proportionately.
  - 15 kg = 15,000 g
- Always use decimals to reflect fractions when using the metric system
  - 3.5 mls, not 3 ½ mls

Additives

- The actual drug or medication that will be added to a product
- Commercially available
- May come in liquid or powder form
- Concentrations and Units are VERY important

Examples of Additives

- Acyclovir 500mg/10ml ~ 50mg/1ml
- Bupivacaine 0.5%
  - % = g/100ml
  - 0.5/100ml = 0.005g ~ 5mg (5mg/ml)
- Caffeine Citrate 60mg/3ml ~ 20mg/ml
- Desmopressin 4mcg/1ml
- Heparin 1000 units/1ml
- Potassium Phosphate 150mm/50ml ~ 3mm/1ml
- Sodium Acetate 2 meq/ml
- Concentrated Sodium Chloride 23.4%, 4 meq/1ml, 234mg/1ml

Reconstitution

- Taking a medication from a powder to a liquid form
  - Most medications usually use either sterile water or normal saline (0.9%)
- Amount of solution used to reconstitute is determined by manufacturer and desired concentration.
  **Always read the package inserts**
- Examples of meds:
  - Cefepime
  - Meropenem
  - Ceftriaxone
  - Doxycycline

Reconstitution

- A 6 year old patient has pseudomonas and needs an antimicrobial to clear the infection. The doctor orders Cefepime to be given every 8 hours. How many mls will be added to a 2gm vial to make a concentration of 200mg/ml?

Steps to Reconstitution

- [Image of Vial Reconstitution Chart with Expirations]
A 6 year old patient has pseudomonas and needs an antimicrobial to clear this infection. The doctor orders Cefepime to be given every 8 hours. How many mls will be added to a 2gm vial to make a concentration of 200mg/ml?

**Answer:**

**REMEMBER: Everything does NOT use SWFI for reconstitution**

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**Specialized Sodium Concentrations**

- Used when a particular base fluid is not commercially available
  - 0.2% Sodium Chloride (1/4)
  - 0.3% Sodium Chloride (1/3)
- Amount added is determined by size of bag

**Specialized Dextrose Concentrations**

- Used when a particular base fluid is not commercially available
  - Dextrose 7.5%
  - Dextrose 12.5%
- Amount added is determined by size of bag

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**Alligation**

- Alligation-Mathematical method for determining the necessary amount of two solutes of two different percentage strengths to prepare a compound.

Prepare a 1 liter solution of Dextrose 12.5% using Dextrose 10% and Dextrose 50% solutions.

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**Steps for Alligations**

- Step 1: Prepare graph
- Step 2: Place the strength to be calculated in the center box
- Step 3: Place the highest percentage in upper left box
- Step 4: Place the lowest percentage in lower left box
- Step 5: Subtract the center square from the upper left box
- Step 6: Subtract the center square from the lower left box

<table>
<thead>
<tr>
<th>50%</th>
<th>12.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>37.5%</td>
</tr>
</tbody>
</table>
Steps for Alligations

- Step 7: Add the parts of the concentration to find the total parts in the compound
  - Add the parts and make this number the denominator

<table>
<thead>
<tr>
<th>Percentage we have</th>
<th>Percentage desired</th>
<th>Parts needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>2.5</td>
<td>40</td>
</tr>
<tr>
<td>12.5%</td>
<td></td>
<td>37.5</td>
</tr>
<tr>
<td>10%</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

- Step 8: Multiply the parts of the solution times the total amount (mls) of solution that is needed i.e. 1 liter = 1000ml

<table>
<thead>
<tr>
<th>Percentage we have</th>
<th>Percentage we desire</th>
<th>Parts needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>2.5</td>
<td>40 x 1000ml</td>
</tr>
<tr>
<td>10%</td>
<td>1.25</td>
<td>37.5 x 1000ml</td>
</tr>
</tbody>
</table>

2.5/40 x 1000mls = 62.5mls needed of 50% solution
37.5/40 x 1000mls = 937.5mls needed of 10% solution
Balance check: 62.5mls + 937.5mls = 1000mls

Diluting a medication means reducing the concentration of the drug

Whether to dilute medications will be determined based on patient's size and effectiveness.

A doctor orders Filgrastim 180mcg for a 2 year old patient for Neutropenia. The concentration available in the pharmacy is 300mcg/ml. A 15 ml dilution needs to be made and the resulting concentration of the dilution should be 20mcg/ml.

How do we make this dilution?

- Step 1: Write the concentration you WANT to make
- Step 2: How many mls do you want
- Step 3: Solve for x

20mcg | X mcg ? |
1ml  | 15mls  |

X =
Step 4: What is the concentration of the drug available in the pharmacy

Step 5: Place answer found in “Step 3” into the equation

- This will tell you how many mls of the drug will be needed for the dilution

<table>
<thead>
<tr>
<th>mcg</th>
<th>mcg</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>1ml</td>
</tr>
</tbody>
</table>

- \( X = \) 

Step 6: Subtract the total amount of mls needed for the dilution from the amount of mls of drug that is needed (Step 5).

- 15 mls total needed
- 1ml of drug (Filgrastim)

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Reading and interpreting IV drug labels

Technicians must understand how to read and interpret intravenous (IV) medication orders. Here are some easy questions to ask yourself...

- 1. Is it a bag or syringe?
- 2. Is there a base fluid? If so, what is it?
- 3. What is the drug and its concentration?
- 4. What does the doctor want for the patient?

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Base Fluid

- Fluids used to prepare IV solutions
  - Normal Saline 0.9% (Sodium Chloride)
  - 0.45% Saline
  - Dextrose 5%
  - Sterile Water

- There are also base fluids that have both Saline and Dextrose:
  - D5/ 0.9%
  - D5/ 0.45%
  - D5/0.225%
How much Acyclovir does the doctor want to be added to the bag? X=

How much Epinephrine does the doctor want in the syringe?

How much Dextrose 10% is needed for this syringe?
- 50mls total needed
- 1.25mls of Epinephrine
- X

Patient safety is the upmost priority.

There are some parenteral medications that are read according to a specific number of units per milliliter. Such medications are heparin, penicillin, and insulin.

These units are not interchangeable and are specific to a particular medication and strength.

Milliequivalents are measurements of the strength of ion concentration in a medication indicating the number of grams of solute dissolved in a milliliter of solution or the chemical combining power of the substance.
How much Heparin will be added to the bag?

<table>
<thead>
<tr>
<th>1000 units</th>
<th>500 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ml</td>
<td>X mls?</td>
</tr>
</tbody>
</table>

A doctor orders Humulin R 30 units subcutaneously 30 minutes before meals for a person with poor eyesight.

What volume of medication should the patient be given?

A physician orders KCL 20 mEq to be added to D5W 1000 mL bag. The available medication label reads 2 mEq/1 mL.

What volume of KCL should be added to the fluids?

Always have a pharmacist re-check your calculations prior to dispensing the medication.

<table>
<thead>
<tr>
<th>2meq</th>
<th>20 meq</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ml</td>
<td>X mls?</td>
</tr>
</tbody>
</table>

How much Potassium Chloride will be added to the bag? X=
Reading and Interpreting Oral Medications

Technicians must learn to interpret orders properly

Steps to follow…
 1. Read carefully
 2. Determine what kind of answer you are looking for i.e. how many pills, how many mls, for one dose or several doses
 3. Recalculate for accuracy.

Oral Medications

Oral medications come in solid forms, such as tablets and capsules, and liquid forms.
Variations of these solid forms include powders and granules
Safest and most frequently used route of administration
Calculations are needed to determine the amount of dose/dosage to be given to a patient

Oral medications

1. A physician orders Penicillin V 325,000 units qid po. The concentration for the medication on hand is Penicillin V 400,000 units/5 mL. What volume of medication should be given to the patient with each dose? ___________

2. How many mls should be dispensed if the prescription is for 7 days? ___________

Oral Medication Calculations

\[ X = \frac{325,000 \text{ units}}{400,000 \text{ units/mL}} \times 5 \text{ mL} \]

\[ X = 4.06 \text{ mL} \]

16.4 mLs x 7 days =

A physician’s order calls for 400 mg of Amoxicillin tid for 3 days. The pharmacy has a stock concentration bottle of 150 mg/5 mL. What volume, in milliliters, of the medication is needed to fill the prescription?

\[ X = \frac{400 \text{ mg}}{150 \text{ mg/mL}} \times 5 \text{ mL} \]

\[ X = 13.33 \text{ mL} \]
1. What is the volume needed for one dose?

\[
\begin{array}{|c|c|}
\hline
150 \text{mg} & 400 \text{mg} \\
\hline
5 \text{ml} & 3 \text{mls} \\
\hline
\end{array}
\]

\[\text{X=}\]

2. How many mls are needed to fill the prescription for 3 days?

\[\text{Remember*** The doctor ordered the medication to be given tid (3 times a day) for 3 days}\]

\[13.3 \text{mls} \times 3 = 40 \text{mls in one day}\]

\[40 \text{mls} \times 3 \text{ days=}\]

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**Things to Remember**

- Always place unit endings on all mathematical equations
- Physically look to find the concentration of medication on the bottle. Read carefully. Never assume!
- When conducting ratio and proportion equations, the left side is EQUAL to the right side
- Always divide by X

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**References**