

Module B Basic Math for Pharmacology

- Basic math skills:
- Addition
- Subtraction
- Multiplication
- Division
- Fractions
- Decimals
- Percents

Math Diagnostic Evaluation

- Study Chapter 1 in text.
- Do your own work to review skills.
- Math tutors are available if you need help with basic math.

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Symbols and Abbreviations

- Learn the common medical abbreviations inside the cover of text.
- This is critical to your success.
- Start today and review every day
- Some changes:
- Delete qd, qod, hs, U, and write it out.

Equivalents

- Learn equivalents listed inside text cover.
- Some changes:
- Must have a leading 0 before a decimal.
- No trailing 0.
grains i = 60mg 1 cup = 240 ml

Remember these are equivalents, not exact measurements. You can not figure all of them out, must MEMORIZE them.

Metric System

- An international decimal system of weights and measures. Based on divisions and multiples of 10.
- A lot of math may be done by decimal movement.
- Move decimal 3 places to the right to convert a larger unit of measure to the next smaller unit of measure. This is the same as multiplying by 1000.
- Move decimal 3 places to the left to convert a smaller unit of measure to the next larger unit of measure. This is the same as dividing by 1000.

Basic units of measure in Metric System

- Gram - weight
- Liter - volume
- Meter - length

Metric Weights

- Gram is the basic unit of measurement
- The abbreviation is g. (may see GM)
 - g = 1000 milligrams (mg)
 - mg = 1000 micrograms (mcg)
 - mcg = one millionth of gram
 - kg = 1000 grams (g) = 2.2 pounds

Metric Volume

- Liter (L) is the basic unit of measurement.
- 1 Liter (L) = 1000 ml (milliliters).
- 1 milliliter (ml) = 1 cubic centimeter (cc).

Metric Lengths

- 1 centimeter (cm) = 10 millimeters (mm)
- 1 millimeter (mm) = 0.1 cm
- 2.5 centimeters = 1 inch

Metric System Rules

1. Arabic numbers are used to express quantities.
2. Parts of a unit or fractions are expressed as decimals.
3. The quantity is always written before the abbreviation or symbol.
4. Use a leading 0 to emphasize units of less than one to help avoid errors.

APOTHECARY SYSTEM

- One of the oldest systems of measurements still being used in this country.

Apothecary System Basic Units of Measurement

- Weight
 - Grain – basic unit of measurement for weight.
 - Dram (symbol) – is also a unit of weight.
 - 1 dram = 60 grains.
 - Ounce (symbol) abbreviation - oz.
- Volume
 - Minim (m) basic unit of volume. 1 m = 1 gtt.
 - Dram and ounce also measure volume.
 - Pint (pt) and quart (qt).

Household System

- The household system is used for home medications.
- There are no standard rules.
- Some units for liquid measure are the same as the apothecary system. (qt. and pt.)
- Standard cookbook abbreviations are used.
- Arabic numbers and fractions are used.
- The basic unit of measurement is the drop.

Common Household Measurements

- Drop (gtt) Drops vary in size and are not an accurate measure for drugs unless a calibrated dropper is used. You can not substitute droppers for medications.
- Teaspoon (t)
- Tablespoon (T)
- Cup (C)
- Pint (pt)
- Quart (qt)

EQUIVALENTS

Metric	Apothecary	Household
1 g (gram)	15 grains	
1 kg = 1000g		2.2 lbs (pounds)
1g = 1000 mg		
1 mg = 1000 mcg		
60 mg	1 grain	
1 L (liter)=1000 ml 500 ml =	1 qt (quart)=32oz 1 pt (pint) =16oz	1 qt, 2 pt, 4 cups
	1 minim	1 gtt (drop)
1 ml	15-16 minims	15-16gtts, 60mcgtts
5 ml	1 dram	1 t (teaspoon)
30 ml	1 oz	2 T (tablespoons)
15 ml	0.5 oz	1 T
120 ml	4 oz	1/2 cup
240 ml	8 oz	1 cup
2.5 cm (centimeter)		1 inch

Units and Milliequivalents

- Some drugs are measured in units (U) and others are measured in milliequivalents (mEq).
- Both of these measures indicate a strength or potency for that particular drug and there is no conversion necessary.
- Ex. A unit of penicillin G is equal to a unit of penicillin G.
- Ex. A mEq of KCL is equal to a mEq of KCL.

Ratio and Proportion

- Ratio – is used to indicate a relationship between two numbers. These numbers are separated by a colon. Example – 3:4
- The colon indicates division. Therefore a ratio is a fraction and the numbers or terms of the ratio are the numerator and denominator.
- The numerator is always to the left of the colon and the denominator is to the right.
- Ex. 3/4

Proportion

- Definition – an equation of 2 ratios of equal value. The terms of the first have a relationship with the terms of the second ratio.
- A proportion may be written in any of these formats.
- $3:4 :: 6:8$
- $3:4 = 6:8$
- $3/4 = 6/8$

Means and Extremes

- The means are the inner or middle numbers and the extremes are the outer or end numbers.

Proving Ratios are Equal and Proportions are True

- In a proportion the product of the means is equal to the product of the extremes.
- The answer is obtained by multiplying the means and the extremes.
- Ex. $3:4 :: 6:8$
- $3 \times 8 = 24$
- $4 \times 6 = 24$
- $24=24$

Solving for X Using Ratio and Proportion

- $3:4 :: 6:X$ Multiply means & extremes
 - $3X=24$
 - $\frac{3X}{3} = \frac{24}{3}$ Divide both side by the number in front of X.
 $X = 8$ Answer - to prove it is correct substitute answer for X and multiply.
- $3:4 :: 6:8 \quad 24=24$

Solving for X in proportions involving decimals

- $25:5 :: 1.5:X$
- $25X=7.5$
- $\frac{25X}{25} = \frac{7.5}{25} = 0.3$
- Check answer: $25:5 :: 1.5:0.3$
- $7.5 = 7.5$

Proportions with unknowns that involve fractions

1. Multiply the means and extremes.
2. Divide both sides by the number in front of X. Division of two fractions: invert the second fraction and multiply.
3. Multiply the numerators and the denominators.
4. Divide the final fraction to solve for X.

Example

- $1/5 : 1 :: 1/2 : X$
- $1/5X = 1/2$
- $1/5x = 1/2$
 $1/5 \quad 1/5$
- $X = 1/2 \times 5/1 = 5/2 = 2.5$

- Proof: $1/5 : 1 :: 1/2 : 5/2$
 $1/5 \times 5/2 = 5/10 = 0.5$
 $1 \times 1/2 = 1/2 = 0.5$

Converting Within and Between Systems Using Ration and Proportion

- 1. State the known equivalent first.
- 2. Add the incomplete ratio on the other side of the equal sign or semicolon in the same sequence.
- 3. Label all terms in the proportion including X. Labels are ignored when multiplying and dividing.
- 4. Solve the problem by using principles of ratio and proportion. (product of means = product of extremes).
- 5. The final answer for X should be labeled with the appropriate unit of measurement. Always look at what X is labeled in problem and label your answer.

Remember

- 1. Conversions between systems involve equivalents and not exact measurements.
- 2. 10% Rule - no more than a 10% variation should exist between the dose ordered and the dose given. Ex. 0.9 tablets = 1 tablet.
- 3. Capsules can not be divided. Never open, crush or empty contents as it can result in all of a time release medication being released at once.
- 4. The maximum dose of most capsules or tablets given at one time USUALLY would not exceed 3.
- 5. Each tablet of capsule contains a specific amount of drug.
- 6. There are measures for which there are no equivalents such as mEq and units.

Calculating Oral Dosages

- Always read question carefully and identify known and unknown factors. Eliminate unnecessary information.
- Step 1: Make sure everything is stated in the same unit and system before calculating. You may need to make conversions. It is usual and safer to convert what is ordered to what is available.
- Step 2: Estimate what the approximate or reasonable answer would be prior to working the problem.

Oral dosages continued:

- Step 3: Set up the proportion – label all terms including X. State the known ration first – what is available. State the terms of the ratio in the same sequence. Label the value for X.
- Step 4: Work the problem disregarding labels. When you complete the problem, label your answer whatever X is labeled.

Notes:

- Keep your work neat.
- Be deliberate with decimals.
- Be careful when transferring numbers that you do not change them.
- Circle answer in your work.
- Do not forget the math rules when rounding your final answer.
- Think! Is this answer logical.
- Check your answers. (After complete test).

Oral Dose Example

- ❑ Order: 0.5 g
- ❑ Available: 250 mg/tablet
- ❑ Step 1: Convert g to mg.
 $1000\text{mg} : 1\text{g} :: X\text{mg} : 0.5\text{g}$
 $X = 500\text{mg}$
- ❑ Step 2: State known first, then unknown.
 $250\text{mg} : 1\text{ tablet} :: 500\text{mg} : X\text{ tablet}$
 $\frac{250X = 500}{250 \quad 250} = 2\text{tablets}$
- ❑ Proof: $250\text{mg} : 1\text{tablet} :: 500\text{mg} : 2\text{ tablets}$
 $500=500$

Example

- Order: 1.25mg/kg/day PO ever 6 hours in equally divided doses.
- Available: 5 mg/ 2 ml
- Patient weighs 48 pounds.
- Step 1: Convert pounds to kg.
 $2.2 \# : 1\text{ kg} :: 48 \# : X\text{ kg}$
 $\frac{2.2 X = 48}{2.2 \quad 2.2} = 21.81 = 21.8\text{kg}$

Continued:

- Step 2: Calculate mg/day
 $1.25\text{ mg} : 1\text{ kg} :: X\text{ mg} : 21.8\text{ kg}$
 $X = 27.25\text{ mg/day}$
- ❑ Step 3: How many doses will you give in a day? 4
- ❑ Step 4: Calculate number of mg/dose
 $27.25\text{ mg} : 4\text{ doses} :: x\text{ mg} : 1\text{ dose}$
 $\frac{4X=27.25}{4 \quad 4} = 6.81\text{mg/dose}$
- ❑ Step 5: Calculate ml/dose
 $5\text{ mg} : 2\text{ ml} :: 6.81\text{ mg} : X\text{ ml}$
 $\frac{5X=13.62}{5 \quad 5} = 2.72\text{ ml} = 2.7\text{ml}$

Converting Temperatures from Celsius to Fahrenheit

- Formula: Fahrenheit = $1.8C + 32$
- Example: Convert 36.3 Celsius to Fahrenheit
 $1.8 X 36.3 = 65.34 + 32 = 97.34 = \underline{97.3 F}$

Converting Temperatures from Fahrenheit to Celsius

- Formula: Celsius = $\frac{F - 32}{1.8}$
- ❑ Example: Convert 101.6 F to Celsius
 $101.6 - 32 = \frac{69.6}{1.8} = 38.66 = \underline{38.7 C}$

Converting Minutes to Hours and Hours to Minutes

- To convert minutes to hours: Divide the number of minutes by 60.
- Example: 15 minutes = _____ hr.
 $\frac{15}{60} = 0.25\text{ hr}$
- ❑ To convert hours to minutes multiply by 60.
- ❑ Examples: $0.25\text{ hr} X 60 = 15\text{ minutes}$
 $1.5\text{ hr} X 60 = 90\text{ minutes}$

Calculating Calories in Lipids

- A gram of lipids (fat) contains 9 calories.
- 10% lipids contain 10g/100ml (0.9or 1 cal/ml)
- 20% lipids contain 20g/100ml (1.7or 2 cal/ml)
- 30% lipids contain 30g/100ml (2.7or 3 cal/ml)
- To determine calories use the manufacture's label for the number of calories per ml.
The manufactures usually round to the nearest whole.

Example: Patient receives 60 ml of 20% lipids.

- Calculate the number of calories:
 - Step 1: 20% lipids = 2 calories/ml.
 - Step 2: 2 cal : 1 ml :: X cal : 60 ml
 - Step 3: X = 60 x 2 = 120 calories

Calculating Calories in Glucose Solutions

- Each gram of glucose contains 4 calories.
- 5% glucose solution contains 5g/100ml.
- 10% glucose solution contains 10g/100ml.
- 25% solution contains 25g/100ml or 1cal:1ml.
- To determine the number of calories first determine the number of grams of glucose received.
- Next determine the total number of calories in the grams of glucose received.

Example: Patient received 550ml of D5W.

- Calculate the number of calories received.
 - Step 1: 5 g : 100 ml :: X g : 550 ml
$$\frac{100 X = 2750}{100 \quad 100} = \underline{27.5 \text{ g}}$$
 - Step 2: 1g : 4 cal :: 27.5 g : X cal
 - X = 27.5 x 4 = 110 cal

Example: Patient receives 430 ml of 10% glucose.

- Calculate the calories.
 - Step 1: 10 g : 100 ml :: X g : 430 ml
$$\frac{100 X = 4300}{100 \quad 100} = 43 \text{ g}$$
 - Step 2: 4 cal : 1 g :: X cal : 43 g
 - X = 4 x 43 = 172 calories

Example: Patient receives 550 ml of 25% TPN.

- Calculate the number of calories:
 - Step 1: 1 cal : 1 ml :: X cal : 550 ml
 - Step 2: X = 550 calories
 - Just remember that with 25% solutions there is one calorie per ml and you do not have to calculate.

Calculating Parenteral Medications

- Calculate parenteral medications exactly like oral medications.
- Read label and determine the dosage strength in a certain amount of solution.
- Determine the type of syringe needed.
- Determine if everything is in the same system and unit of measure. Make conversions if needed.
- Think what would be a logical answer.
- Use ratio and proportion to solve for X.
- Remember to use math rules to round your final answer.

Example

- Order: grains 1/200 atropine IM
- Available: Atropine 1 mg/2ml
- How many ml (s) will you give? ____
- Step 1: Convert grains to mg
 $60 \text{ mg} : 1 \text{ grain} :: X \text{ mg} : \text{grain } 1/200$
 $X = 60/200 = 6/20 = 0.3 \text{mg}$
- Step 2: $1 \text{ mg} : 2 \text{ ml} :: 0.3 \text{ mg} : X \text{ ml}$
 $X = 0.6 \text{ ml}$
- Proof: $1 \text{ mg} : 2 \text{ ml} :: 0.3 \text{ mg} : 0.6 \text{ ml}$
 $0.6 = 0.6$

Heparin Calculations

- Heparin is a potent anticoagulant . Miscalculation can be life-threatening. Validate dosages with another nurse.
- PTT is test used to determine dosages.
- Heparin comes in many strengths and preparations. The bottles look the same.
- Read labels carefully to determine correct strength.
- Heparin can be given subcutaneously or IV, never IM.
- TB syringe is used to measure doses of less than 1 ml.
- The abdomen is the site used for SC injection.
- Round to nearest 100th using a TB syringe.
- THINK what a logical answer would be.

Example: calculating heparin

- Order: Heparin 2000 units SC bid.
- Available: Heparin 10,000 units/ml
- How many ml (s) will you give? ____
- $10,000 \text{ units} : 1 \text{ ml} :: 2000 \text{ units} : X \text{ ml}$
 $\frac{10,000 X = 2000}{10,000 \quad 10,000}$
 $X = 2/10 = 0.2 \text{ ml}$

Example: Calculating heparin

- Order: Heparin 3200 units SC bid.
- Available: Heparin 5000 units/ml
- How many ml (s) will you give? ____
- $5000 \text{ units} : 1 \text{ ml} :: 3200 \text{ units} : X \text{ ml}$
- $\frac{5000X = 3200}{5000 \quad 5000}$
- $X = 32/50 = 0.64 \text{ ml}$

Calculating Insulin Dosages

- Insulin is a hormone used to treat Diabetes.
- Insulin is necessary for the body to utilize glucose.
- Errors in calculating insulin dosages can be life-threatening. Validate doses.
- Insulin is measured in units and administered with special insulin syringes that are measured in units.
- There are different types of insulin, be sure to read labels carefully.

Types of Insulin

- Animal sources: beef and pork
- Human sources: recombinant DNA or semi-synthetic form made by altering the amino acid structure of the pork insulin to the structure of human insulin.
- Less allergy to human forms.

Types of Insulin

insulin type	onset of action	peak	duration
Humalog			
Novalog ultra-short	15 min	½ - 1hr	3-4hr
Regular rapid acting	30-60min	2-4hr	5-7hr
NPH intermediate	1-4 hr	6-12hr	18-28hr
70/30 mixed	30 min	4-8hr	up to 24hr
Lantus long acting	~1 hr	none	24 hrs

Insulin Labels

- Trade name with letter to indicate type.
- Exp. Date
- Concentration (100 units/ml)
- International symbols that indicate type.
- Be very careful that you are giving the type ordered.
- Store open bottles at room temp for 30 days.

Insulin Orders

- Insulin is usually ordered bid or twice a day.
- This means usually means 30 minutes before breakfast and 30 minutes before dinner.
- Order should contain type or types to be given and when it is to be given. (as above)
- Doses are based on body weight and the patient's blood glucose levels.
- HbA1c or glycosylated hemoglobin– lab test that reflects the past 3 months of glucose control. 7or less is the goal for adults.

Coverage Orders or Sliding Scale Orders

- Usually used when patient is ill or cannot take their regularly scheduled doses or it may be in addition to regularly scheduled doses.
- Usually ordered 4 times a day. Every 6 hours or 4 times a day, before meals and at bedtime.
- The nurse checks the patient's blood glucose and administers regular insulin according to the ordered scale.

Example of Coverage Orders

- Humulin R insulin SC before meals and at bedtime on sliding scale.
- Blood glucose Units

0-149	0
150-199	2
200-249	4
250-299	6
300 or >	8 and call MD

Drawing up Insulin and Mixed Insulin

- You will be responsible for drawing up insulin.
- Learn procedure from text book or lab skills book.
- Practice these skills because it is not easy.

Injection Sites

- The abdomen (fastest absorption) is the site of choice.
- SC tissues of deltoid, thigh and hip may be used.
- Insulin is absorbed differently from different sites.
- Because of this, I usually give it where the patient usually takes it for more consistent blood glucose levels.
- Rotate sites.

Giving Insulin in Minims using a TB Syringe

1. What is the available concentration of insulin? 100 units/ ml
2. What is the conversion for ml to minims?
15-16 minims = 1 ml
3. Determine the number of ml(s) the dose would be.
4. Convert the ml(s) to minims.
5. Remember to round to the nearest whole minim.

Reconstitution of Medications

- Powdered Drugs – packaged in powder form because they are unstable in liquid forms.
- Once diluted they are stable for a limited time.
- Label will specify how to reconstitute:
- Type and amount of solvent or diluent.
- Follow directions carefully, KEEP STERILE.
- Common diluents: tap water, sterile water for injection, sterile normal saline, D5W, bacteriostatic water for injection.

Label Information

- Type of diluent
- Amount of diluent (remember total volume will be greater than the amount of diluent added).
- Length of time stable after reconstitution
- Storage instructions
- Strength or concentration after mixing
- If any of this information is not on label, check with pharmacy or PDR.

Multi-dose containers or containers with multiple directions for mixing.

- After reconstituting any multi-dose medication, the nurse must indicate the following on the label:
- Initials of nurse mixing
- Date and time of reconstitution
- Date and time of expiration
- Strength and concentration

Example:

The HCP orders Amoxicillin 750mg IM q8h. You have a vial of powdered Amoxicillin 1g. The directions state add 2.6ml of sterile N/S to obtain a total vol. of 3ml. How many ml(s) will you give? _____

- Step 1: Convert mg to g.
 $1000\text{mg}:1\text{g}::750\text{mg}:X\text{g}$
 $1000X=750$
 $X = \frac{750}{1000} = 0.75\text{g}$
- Step 2: What is the available concentration?
1g:3ml
- Step 3: 1g:3ml :: 0.75g:Xml
 $X = 2.25\text{ml} = 2.3\text{ml}$

Vials with more than one direction for mixing

- Some vials have multiple mixing options
- Use judgment to determine which option to use.
- Usually use the one nearest to the dose ordered.
- Indicate on the vial by circling the option used.

Pediatric Dosage Calculations

- Methods used:
 - According to weight
 - According to age
 - Drug dosage per kg of body weight
 - Body surface area (BSA)

Body Surface Area

- Usually calculated by MD for burn patients or in critical care situations.
- BSA can be determined by using a calculation formula or a nomogram scale.
- West Nomogram : To use the scale draw a straight line from the patient's height in the far left column to his weight in the far right column.
- The intersection of the line with the surface area column is the estimated BSA.
- There is a column for estimating BSA for infants and children of normal height for weight using weight alone. * Must be sure they are in the normal values.

Clark's Rule Based on weight

- Formula:
 $\frac{\text{Weight in \#s}}{150\# (\text{avg. adult weight})} \times \text{Adult dose} = \text{Child's dose}$
- Ex: Adult dose is 10mg. What is the dose for a child weighing 15#?
 $\frac{15\#}{150\#} \times \frac{10\text{mg}}{150} = \frac{150}{150} = 1\text{mg}$

Fried's Rule Based on age in months (infants)

- Formula:
 $\frac{\text{Age in Months}}{150 \text{ months}} \times \text{Adult dose} = \text{Child's dose}$
- Ex: Adult dose is 100mg. What is the dose for a 5 month old infant?
 $\frac{5 \text{ mo.}}{150 \text{ mo.}} \times \frac{100\text{mg}}{150} = \frac{500}{150} = \frac{50}{15} = 3.33\text{mg}$

Young's Rule Based on child's age in years

- Formula:
$$\frac{\text{Age of child} \times \text{Adult dose}}{\text{Age of child} + 12} = \text{Child's dose}$$
- Ex: Adult dose is 60 minims. What is the dose for a 3 year old child?
$$\frac{3 \times 60 \text{ minims}}{3+12=15} = \frac{180}{15} = 12 \text{ minims}$$

Critical Care Calculations

- Critical care patients often require potent drugs that can cause rapid changes in vital signs – BP, respirations and heart rate.
- These patients require close monitoring by the nurse.
- The calculation of these doses are critical as an error can quickly adversely effect the patient.

Points to Remember

- An infusion pump should be used.
- A microdrip (60gtts=1ml) is used when a pump is not available. When using a microdrip set drops/minute = ml/hr.
- Be sure weight is accurate since dose is based on weight.
- Have another nurse calculate dose for accuracy.
- Think what a logical answer would be before calculating.
- Use Ratio and Proportion to solve the problems.

Order: Epinepherine @ 30ml/hr.
Available: Epi 2mg/250ml D5W.

- Calculate: a. mg/hr _____
b. mcg/hr _____
c. mcg/min. _____
- a: 2mg:250ml::Xmg:30ml
$$250X = 60$$

$$X = \frac{60}{250} = \frac{6}{25} = 0.24\text{mg}$$

Con't

- b. Mcg/hr:
$$1000 \text{ mcg} : 1 \text{ mg} :: X \text{ mcg} : 0.24 \text{ mg}$$

$$X = 240 \text{ mcg/hr}$$
- c. Mcg/minute:
$$240 \text{ mcg} : 60 \text{ minutes} :: X \text{ mcg} : 1 \text{ minute}$$

$$60X = 240$$

$$X = \frac{240}{60} = \frac{24}{6} = 4 \text{ mcg/minute}$$

Order: Aminophylline 0.25g/500ml D5W
over 8 hours

- Calculate: mg/hr
mg/minute
- Step1: Convert g to mg
$$1000 \text{ mg} : 1 \text{ g} :: X \text{ mg} : 0.25 \text{ g}$$

$$X = 250 \text{ mg}$$
- Step 2: Available = 250 mg/500ml
- Step 3: Calculate ml/hr
$$500 \text{ ml} : 8 \text{ hr} :: X \text{ ml} : 1 \text{ hr}$$

$$8X = 500$$

$$x = \frac{500}{8} = 62.5 = 63 \text{ ml/hr.}$$

Con't

- Step 4: Calculate mg/hr.
250 mg : 500 ml :: X mg : 63 ml
 $500X = 15750$
 $X = \frac{15750}{500} = 31.5 \text{ mg/hr}$
- Step 5: Calculate mg/minute
31.5 mg : 60 min. :: X mg : 1 min.
 $60X = 31.5$
 $X = \frac{31.5}{60} = 0.525 \text{ mg/ min.}$

Order: Pitocin 4ml/hr
Available: Pitocin 20units/1000ml D5W

- How many miliunits will be infused per hour?
- Step 1: Available = 20units/1000ml
- Step 2: Calculates units/hr
20 units : 1000ml :: X units : 4 ml
 $1000 X = 80$
 $X = \frac{80}{1000} = 0.08 \text{ units}$
- Step 3: Calculate miliunits/hr.
1 unit : 1000miliunits :: 0.08 units : X miliunits
 $X = 1000 X 0.08$
 $X = 80 \text{ miliunits}$

Order: Nipride 3mcg/kg/min.
Available: Nipride 50mg/500ml D5W
Pt. weight – 60 kg

- Calculate: ml/hr
- Step 1: Calculate dose for patient:
3 mcg : 1kg :: X mcg : 60 kg
 $X = 180 \text{mcg/minute}$
- Step 2: Convert mcg to mg:
1000 mcg : 1 mg :: 180 mcg : X mg
 $1000 X = 180$
 $X = \frac{180}{1000} = 0.18 \text{ mg}$
- Step 3: Calculate mg/hr: 0.18mg:1 min. :: X mg:60 min
 $X = 10.8 \text{ mg/hr}$
- Step 4: Calculate ml/hr: 50mg : 250ml :: 10.8mg : Xml
 $50X = 2700$
 $X = \frac{2700}{50} = 54 \text{ml/ hr.}$

Order: Nitroglycerine 5 mcg/min.
Available: Nitroglycerine 50mg/500ml D5W

- Calculate ml/hr:
- Step 1: Calculate mcg/hr
5 mcg : 1min :: X mcg : 60min
 $X = 300 \text{ mcg/hr}$
- Step 2: Convert mcg to mg:
1000mcg : 1mg :: 300mcg : Xmg
 $1000 X = 300$
 $X = \frac{300}{1000} = 0.3 \text{mg/hr}$
- Step 3: Calculate ml/hr:
50mg : 500ml :: 0.3mg : Xml
 $50X = 150$
 $X = 3 \text{ ml/hr}$

Order: Heparin 10units/minute IV
Available: Heparin 25,000 units/500ml D5W

- Calculate ml/hr:
- Step 1: Calculate units/hr
10 units : 1 min. :: X units : 60 min.
 $X = 600 \text{ units/hr}$
- Step 2: Calculate ml/hr
25,000 units : 500ml :: 600 units : X ml
 $25,000 X = 300,000$
 $X = \frac{300,000}{25,000} = 12 \text{ ml/hr}$

Intravenous Fluid Administration

- It is important to calculate IV fluids accurately.
- Some patients are more susceptible to fluid overload than others. IV pumps should always be used on these patients.
- IV fluids are always sterile.
- Bags or bottles should be checked for clarity, and expiration dates.
- Read the label carefully for the type of fluid.
- The nurse is responsible for monitoring initiating and monitoring infusions.

Calculating MI/Hr

- IV fluids are ordered on the basis of ml/hr.
- Infusion pumps are used to deliver ml/hr.
- Rule: Round to the nearest ml/hr.
- To calculate ml/hr you need to know the amount of fluid to be infused and the number of hours it is to be infused over.
- Ratio/proportion can be used to calculate.
- Or, divide total volume to be infused by the number of hours it is to be infused over.

Example: 1000 ml D5W IV q8h per pump

- Using Ratio and Proportion:

$$1000 \text{ ml} : 8 \text{ hr} :: X \text{ ml} : 1 \text{ hr}$$

$$8 X = 1000$$

$$X = \frac{1000}{8} = \underline{125 \text{ ml}}$$
- Dividing total volume by the number of hours to be infused over:

$$\frac{1000}{8} = \underline{125 \text{ ml}}$$

Calculating Drops per Minute

- Calculate gtts/minute when using gravity flow.
- Must know the drop factor of the IV tubing.
- Agencies will use one macro-drop set and a micro-drop set.
- Macro-drop sets drop factors: 10, 15 or 20 gtts/ml.
- Micro-drop sets all deliver 60 gtts/ml. (gtts/minute = ml/hr.)
- Must know the type of macro-drop tubing your agency uses. It is printed on the box.

Calculation gtts/minute

- To calculate gtts/minute, you must know:
 - Volume to be infused
 - Drop factor of the IV tubing or set.
 - Time over which the fluid is to be infused.
- Formula:

$$\frac{V1(\text{vol to be infused})}{T1(\text{time in hrs - \# of hrs. it is to infuse})} \times \frac{V2(\text{drop factor})}{T2(\text{time in min., usually 60, if <60 use \# of min.})}$$

Example: 1000 ml D5W over 8 hr by gravity. Drop factor is 10.

- $\frac{1000 \text{ ml}}{8} \times \frac{10}{60} \frac{(1)}{(6)} = \frac{1000}{48} = 20.8 = 21 \text{ gtts.}$

Example: 100ml D5W with Ampicillin 1 g over 30min. Drop factor 10.

- $\frac{100 \text{ ml}}{1} \times \frac{10}{30} \frac{(1)}{(2)} = \frac{100}{2} = 50 \text{ gtts/min}$

Determining if IV is On Time, Ahead, or Behind

- A gravity infusion may get off schedule due to many reasons.
- Nurse checks to ensure it infuses on time.
- If it is off schedule, the nurse recalculates to infuse it on time.

Example: Order: 1000ml N/S IV q10h.
Drop factor = 15
Started at 6 AM

- What time should it be infused? _____
- How many ml/hr will be infused? _____
- How many gtts/min will be infused? _____
- Nurse checks @ 10AM and 500ml is in the bag. Is it on time, ahead, or behind? _____
- If ahead or behind, how much? _____
- If not on time, recalculate in gtts/min to infuse on time.

Answers to previous questions

- 4 PM
- 1000 ml : 10 hr :: X ml : 1 hr
 $10 X = 1000$
 $X = \underline{100 \text{ ml/hr}}$
- $\frac{1000}{10} \times \frac{15 (1)}{60 (4)} = \frac{1000}{40} = 25 \text{ gtts/min}$
- If it were infusing on time, 400ml should be infused. 500 has infused. So, it is ahead.
- Ahead by 100 ml.
- $\frac{500 \text{ml}}{6} \times \frac{15 (1)}{60 (4)} = \frac{500}{24} = 20.8 = 21 \text{ gtts/min}$