Dosage Calculations Packet

Unit I – Basic Mathematics Review

This unit will review Arabic and Roman numerals, fractions, decimals, percentage, and ratio and proportion.

ARABIC AND ROMAN NUMERALS

Arabic and Roman numerals are used interchangeably to express quantity or degree of measure. Roman numbers are formed by combining the following letters according to the rules stated below:

Arabic numbers	Roman numbers
½	ss
1	I
5	V
10	X
50	L
100	C
500	D
1000	M

1. To repeat a Roman number doubles its value. I =1; II=2
2. To place a letter to the right of a Roman number adds its value to that number. V=5; VI=6.
3. To place a letter to the left of a Roman number decreases the value of that number by the amount of the number added. V=5; IV=4.

Practice Problems

Write the Arabic numbers for the following:

1. III_____ 2. XVI _____ 3. XXXIX _____

4. VI_____ 5. CM______ 6. XXIV _____

Write the Roman numbers for the following:

7. 2 ______ 8. 14 ______ 9. 40 ______ 10. 69 _______

11. 80 ______ 12.150 ______ 13. 99 ______ 14. 19 _______

Answers:

1. 3	2. 16	3. 39	4. 6	5. 900	6. 24
7. II	8. XIV	9. XL	10. LXIX		
11. LXXX	12. CL	13. IC	14. XIX		

FRACTIONS

Definition: A fraction is a part of a whole number. A fraction has 2 parts, the top number is called the numerator and the bottom number is called the denominator.

Example: ½ = 1 is the numerator and 2 is the denominator.

There are 4 types of fractions:

1. Proper fractions – the numerator is less than the denominator. Example: ½.

2. Improper fractions – the numerator is greater than the denominator. Example: 6/5.

3. Complex fractions – the numerator or denominator may be either a fraction or a whole number.

   Example: $\frac{1/2}{2}$ or $\frac{1/2}{3/4}$

4. Mixed number – there is a whole number and a fraction combined. Example: 3 ½.

To change a mixed number to an improper fraction, you must multiply the whole number by the denominator and add the numerator. Example: 3 ½ = 7/2.

Practice Problems

Reduce the following fractions to the lowest terms

2/4=______	10/20= ______	2/8 = ______
3/6=______	15/20= ______	8/12=______
3/9=______	2/10= ______	5/10=______
4/6=______	3/12= ______	3/15=______

Answers:

1. ½	2. ½	3. 1/4	4. ½	5. ¾	6. 2/3
7. 1/3	8. 1/5	9. ½	10. 2/3	11. ¼	12. 1/5

Change the following improper fractions to mixed numbers

1. 6/4=______	2. 7/5=______	3. 15/8= ______
4. 3/2=______	5. 7/3=______	6. 11/10=______

Answers:

1. 1 ½ 2. 1 2/5 3. 1 7/8 4. 1 ½ 5. 2 1/3 6. 1 1/10

Change the following mixed numbers to improper fractions

1. 3 ½= ______	2. 6 ½=______	3. 10 ½=______
4. 33 1/3= ______	5. 8 ¾=______	6. 9 3/5=______

Answers:

1. 7/2 2. 13/2 3. 21/2 4. 100/3 5. 35/4 6. 48/5

Adding Fractions With Like Denominators:

1. Add the numerators.
2. Place the answer over the denominator.
3. Reduce the answer to the lowest term by dividing the numerator and the denominator by the largest number that can divide them both.

Example: 1/8 +1/8 =2/8

Divide the numerator and denominator by 2 and 2/8 becomes ¼.

Adding Fractions With Unlike Denominators:

1. Determine the smallest number that the denominators of each fraction divide into evenly. This is called the least common denominator(LCD).
2. Divide the denominator into the LCD and multiply the results by the numerator.
3. Add the new numerators and place over the new denominator.
4. Reduce to lowest terms.

Example:1/2 + 1/3 (2 and 3 will divide evenly into 6)

6 divided by 2 = 3 x 1 = 3

6 divided by 3 = 2 x 1 = 2

$\frac{3+2}{6} = \frac{5}{6}$ This is reduced to the lowest terms.

Subtracting Fractions With Like Denominators:

1. Subtract the numerators.
2. Place the difference over the denominator.
3. Reduce to the lowest terms.

Example: $\frac{7}{8} - \frac{3}{8} = \frac{4}{8}$ This reduces to ½.

Subtracting Fractions With Unlike Denominators:

1. Find the LCD and convert fractions.
2. Subtract the numerators.
3. Place the difference over the LCD.
4. Reduce to the lowest terms.

Example: $\frac{1}{2} - \frac{1}{3}$ (Find the LCD) = $\frac{3}{6} - \frac{2}{6} = \frac{1}{6}$

This answer is reduced to the lowest terms.

Multiplying Fractions:

1. Multiply the numerators.
2. Multiply the denominators.
3. Reduce to the lowest terms.

Example: $\frac{3}{4} \times \frac{2}{3} = \frac{6}{12}$ Reduced = $\frac{1}{2}$

Dividing Fractions:

1. Invert the divisor (2/3 would become 3/2).
2. Change the division sign to multiplication.
3. Multiply the numerators.
4. Multiply the denominators.
5. Reduce to the lowest terms.

Example: $\frac{1}{3}$ divided by $\frac{1}{2}$ = $\frac{1}{3} \times \frac{2}{1}$ = $\frac{2}{3}$

This answer is reduced to the lowest terms.

Practice Problems for Fractions:

1. 1/4 + ¼ = ______
2. 1/3 + 2/3 = ______
3. 2/5 + 2/5 = ______
4. 3/4 + ¼ = ______
5. 1/6 + 3/12 =______
6. ¼ + ½ = ______
7. 5/8 + ¾ = ______
8. 2/3 + 3/5 = ______
9. 2/3 – 1/3 = ______
10. 5/8 – 3/8 = ______
11. ¾ - ½ = ______
12. 7/10 –1/20 =______
13. 7/12 – 1/6 = ______
14. 7/9 – 1/3 = ______
15. 2/3 X 1/8 = ______
16. 1/3 X 1/6 = _____
17. ¾ X ½ = ______
18. 9/25 X 4/32 = ______
19. 5/6 X 2/3 = ______
20. ¾ divided by 2/3 =______
21. 1/9 divided by 3/9 =______
22. 1/8 divided by 2/3 =______
23. 1/5 divided by ½ =______
24. 3/8 divided by 3/8 =______

Answers:

1. ½
2. 1
3. 4/5
4. 1
5. 5/12
6. ¾
7. 1 3/8
8. 1 4/15
9. 1/3
10. 1/4
11. 1/4
12. 13/20
13. 5/12
14. 4/9
15. 1/12
16. 1/18
17. 3/8
18. 9/200
19. 5/9
20. 1 1/8
21. 1/3
22. 3/16
23. 2/5
24. 1

Please see Nursing Faculty if you need further homework.

DECIMALS:

Adding Decimals:

Align the decimals and add.

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Example:    0.21
            6.093
     +     12.90
          134.04
          ------
          153.24
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Subtracting Decimals:

Align the decimals and subtract.

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Examples:    2.56         6.00
           - 0.83       - 0.90
           ------       ------
             1.73         5.10
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Multiplying Decimals:

1. Multiply as whole numbers.
2. Count the number of decimal places in each number.
3. Count from right to left in the answer and place the decimal point.

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Examples:     3.34         12.67
           x   0.8       x   .25
           -------       -------
             2.672          6335
                           2534
                          ------
                          3.1675
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Dividing Decimals:

1. Change the dividing number to a whole number by moving the decimal point to the right.
2. Change the number being divided by moving its decimal point the same number of places to the right.
3. Divide as usual.
4. Place the decimal point in the answer directly above the decimal point in the dividend.
5. Carry out the answer to 3 decimal places before rounding off to 2 places.

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Example:            73.
              0.03. 2.19.        The answer is 73
                    2 1
                      09
                       9
                      0
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Example:            81.1
              0.05. 4.05.5       The answer is 81.1
                    4 0
                      05
                       5
                       05
                        5
                        0
```

Rounding Decimals:

1. Determine at what place you are going to round.
2. If the number to the right of the place you are going to round is greater than or equal to 5, round up to the next number.
3. If that number is less than 5, delete the remaining number or numbers.

Practice Problems

1. 2.03 + .009 + 12.9 =_____ 2. 3.33 + 0.6 + 4.00 = _____

3. 12.009 - .89 = _________ 4. 3.90 – 2.02 = _________

5. 4.32 X .9 = ___________ 6. 0.980 X 0.2 = _________

7. 24 divided by 1.2 = _____ 8. 0.75 divided by 0.5 = ___

Round the decimal to the tenth place:

9. 0.75 =______ 10. 0.23 =_______

11. 0.98 = ______ 12. 0.36 =_______

Round the decimal to the hundredth place:

13. 1.086 =_____ 14. 0.456 = ______

15. 12.234 =______ 16. 19.014 = _____

Answers:

1. 14.939	2. 7.93	3. 11.119	4. 1.88
5. 3.888	6. 0.196	7. 20	8. 1.5
9. 0.8	10. 0.2	11. 1.0	12. 0.4
13. 1.09	14. 0.46	15. 12.23	16. 19.01
14. 0.46	15. 12.23		

Please see Nursing Faculty if you need further homework.

PERCENTAGE:

A percentage is a part of 100.

Changing Percent to Fractions:

1. The numerator will be the number in front of the % sign.
2. The denominator will always be 100.
3. Divide as usual.
4. Reduce to the lowest terms.

Example: 25% = $\frac{25}{100}$ = (25 divided by 100) = ¼

Changing Fractions to Percent:

1. Divide the numerator by the denominator.
2. Multiply the answer by 100.

Example: ¼ = 1 divided by 4 = 0.25 X 100 = 25%

Changing Percent to a decimal:

1. Remove the % sign.
2. Divide by 100 (or move the decimal 2 places to the left).

Example: 25% = $\frac{25}{100}$ = .25

Practice Problems:

Change to fraction:	Change to %:	Change to decimal:
1. 10% = ______	2. ½ = ______	3. 10% = ______
4. 45% = ______	5. 1/3 = ______	6. 45% = ______
7. 75% = ______	8. ¼ = ______	9. 75% = ______
10. 25% = ______	11. 4/5 = ______	12. 25% = ______

Answers:

1. 1/10	2. 50%	3. 0.1	4. 9/20
5. 33%	6. 0.45	7. ¾	8. 25%
9. 0.75	10. ¼	11. 80%	12. 0.25

RATIO and PROPORTION:

Ratio:

Definition: A ratio expresses the relationship of one quantity to another. When solving dosage calculations, a ratio is composed of two numbers that are separated by a colon.

Examples: 2:4 or 4:16 or 1:50

Proportion:

Definition: A proportion shows the relationship between two ratios that are equal.

Examples: 1 : 2 :: 2 : 4 or 2 : 8 :: 5 : 20

The first example is read like this: 1 is to 2 as 2 is to 4. You can see that these two ratios are equal. The way to demonstrate this mathematically is to multiply the two outer numbers together and the two inner numbers together. The answers will be equal to one another.

Example: 2 : 8 :: 5 : 20
2 x 20 = **40** (outer numbers multiplied together)
8 x 5 = **40** (inner numbers multiplied together)

Ratio and proportions are used to solve dosage calculation problems when you do not know one of the four numbers. This is called solving for "X" or solving for the unknown.

<u>Solving for "X":</u>

1. Multiply the outer numbers.
2. Multiply the inner numbers.
3. Place the answer that contains the "X" to the left of the equals sign and solve the equation by diving the entire equation by the number before the "X".

Example: 3 : 5 :: 15 : X
3X = 75 (divide the equation by 3)

$$\frac{3X}{3} = \frac{75}{3} \qquad X = 25$$

To check your work, put the answer into the equation and multiply the outer numbers and the inner numbers and they should be equal.

Example: 3 : 5 :: 15 : 25
3 x 25 = **75** (outer numbers multiplied together)
5 x 15 = **75** (inner numbers multiplied together)

Practice Problems

Find the value of x:

1. 2 : 3 :: 8 : x
2. x : 5000 :: 10 : 500
3. 2/3 : ¾ :: x : 21/24
4. 5 : x :: 20 : 30
5. 0.125 : 1 :: 0.25 : x
6. 2.2 : 6 :: x : 140
7. 12 : 6 :: 24 : x
8. x : 1/150 :: 1 : 1/100

Answers:
1. 12
2. 100
3. 7/9
4. 7 1/2
5. 2
6. 51.33
7. 12
8. 2/3

Unit II – Systems of Measurement and Conversion

Nurses have the legal responsibility for administering the appropriate amount of medications. They must be able to interpret dosage instructions from manufacturers and doctors to administer doses accurately. They must also be able to provide client education regarding home administration. There are three primary systems of measure that are currently used in medication administration: the metric system, the apothecary system, and the household system.

THE METRIC SYSTEM

The metric system is widely used in dosage calculations. It uses powers of 10 and the basic units of measure are the gram, liter, and meter. A **gram** measures weight, a **liter** measures fluid, and a **meter** measures length

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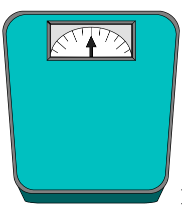
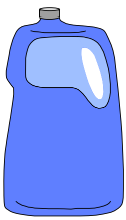
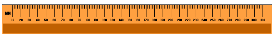
Gram:  measures weight.
Gram may be written G, g, Gm or gm.

Liter:  measures liquid.
Liter may be written L or l

Meter:  measures length. Meter may be written m.

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The metric system also uses prefixes to describe how much of the basic unit:

Kilo =1000 times the basic unit.
Centi =1/100 of the basic unit or 0.01.
Milli = 1/1000 of the basic unit or 0.001.
Micro =1/1,000,000 of the basic unit or 0.000001.

Commonly seen units are the Kg (kilogram), ml (milliliter), and mcg (microgram).

The metric system contains the following rules:

1. Arabic numbers are used (i.e. 150)
2. The symbol of measure is placed after the number (i.e. 150 **ml**)
3. Fractions are written as decimals (0.25)

METRIC BASIC EQUIVALENTS

1 Kg. = 1000 Gm.
1 Gm. = 1000 mg.
1 mg. = 1000 mcg.
1 ml. = 1 c.c.
1 L. = 1000 c.c. or 1000 ml.

Practice Problems

Abbreviate the following metric notations:

1. Five grams ________________
2. Seven hundred fifty milliliters ________________
3. One and one-half kilograms ________________
4. Two hundred micrograms ________________
5. One- half milligram ________________
6. Five-hundredths of a gram ________________
7. Six hundred milligrams ________________
8. Three-tenths of a gram ________________

Answers: 1. 5 gm 2. 750 ml 3. 1 ½ kg 4. 200 mcg
5. 0.5 mg 6. 0.05 gm 7. 600 mg 8. 0.3 gm

Using Ratio and Proportion Within the Metric System

As stated earlier, nurses use ratios (1:2) to make comparisons, and proportions to show that two ratios are equal (1 : 2 :: 2 : 4). This principle is used to exchange weights within the metric system.

RULES OF PROPORTION

1. Units of ratios must correspond within the same proportion. Correct = Gm. : Kg. :: Gm. : Kg.
2. No more than 2 different units of measure can be used within the proportion.
3. Label all numbers with the appropriate unit of measure.

Example: 0.5 Kg. = __?___gm.

First, find the basic equivalent in the previous chart.
This would be, 1 Kg. = 1000 Gm. Now you know 3 of the 4 numbers in the equation. Solve for "X" as you were taught in Unit I and utilize the above rules of proportion.

Set the problem up: 1 Kg. : 1000 gm. :: 0.5 Kg. : X gm
X = 500

Remember, you multiply the outside numbers and then the inside numbers and then divide. In this example, it was not necessary to divide.

What label comes after 500? Look up at your problem, it would be 500 gm. The label will always be what follows the unknown "X".

Practice Problems

Solve for "X":

1. 250 Gm. = X Kg.	6. 3.5 L. = X ml.
2. 2500 mcg. = X mg.	7. 154 c.c. = X L.
3. 15 mg. = X mcg.	8. 0.25 L. = X ml.
4. 4 ml. = X c.c.	9. 2000 mg. = X gm.
5. 3 Kg. = X Gm.	10. 250 mg. = X Gm.

Answers: 1. 0.25 kg   2. 2.5 mg   3. 15000 mcg
4. 4cc   5. 3000gm   6. 3500 ml   7. 0.154 L
8. 250 ml   9. 2 gm   10. 0.25 gm

Please see Nursing Faculty if you need further homework.

THE APOTHECARY SYSTEM

The Apothecary System is another method of expressing units of measure. It is an old system and is not used exclusively because it is not standarized. That means that each measure is an approximate amount, not an exact amount. But, some doctors still order medicines using this system, and some labels contain this system as well. It is different from the metric system in the following ways:

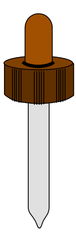
1. It uses Roman numerals (ss = 1/2, i = 1, iv = 4, v = 5, ix =9, x = 10)
2. The unit is written before the amount (gr i, gr ss, gr iv)
3. Fractions are written as common fractions (gr. 1/150). The only exception is ½, which is written as is.

The basic units of measure that are commonly used are the grain, ounce, dram, and minim.

Grain:  measures weight and is written gr.

Ounce:  measures liquid amounts and is written like a cursive ʒ but with an extra hump on top =

Dram:  Used to measure smaller amounts of liquid medicine. It is written just like a cursive ʒ.

Minim:  Tiny amount of liquid medicine. A minim equals a drop. It is written like a cursive m and sometimes it has a long tail.

Apothecary measures for dry weight are infrequently used. Therefore, the word “fluid” is generally dropped when referring to the dram or ounce. The table below reflects apothecary measures for volume.

APOTHECARY BASIC EQUIVALENCES		
60 minims	=	1 fluid dram
8 fluid drams	=	I fluid ounce
16 fluid ounces	=	1 pint
2 pints	=	1 quart
4 quarts	=	1 gallon

Practice Problems

Solve for “X” using ratio and proportion:

1. m. 30 = dram X
2. dram iv = ounce X
3. ounce 32 = qt. X
4. qt. 2 = pt. X
5. ounce xvi = qt. X
6. dram iv = m. X
7. m. xxx = dram X
8. 0 ss = ounce X
9. 15 pt. = qt. X
10. ounce ss = m. X

Answers:

1. ½ dram 2. ½ oz 3. 1 qt 4. 4 pts 5. ½ qt
6. 240 m 7. ½ dram 8. 1/16 oz 9. 7.5qt 10. 240 m

HOUSEHOLD MEASURE

The Household Unit of Measure is the most commonly recognized by laypeople in America. It includes drops, teaspoons, tablespoons, and cups. **Drop** is written gtt, **teaspoon** is written tsp or t., **tablespoon** is written Tbsp, tbsp or T and **cup** is written C. This system is not standardized either, it utilizes approximate measures.

HOUSEHOLD EQUIVALENTS

60 drops (gtts.)	=	1 teaspoon (t.)
3 teaspoons	=	1 Tablespoon (T.)
2 Tablespoons	=	1 ounce
8 ounces	=	1 cup (C.)

Practice Problems

Solve for "X" using ratio and proportion:

1. 5 T. = X t.
2. 3 c. = X ounce
3. 150 gtts. = X t.
4. 4 ounce = X T.
5. 2 ounce = X t.
6. 24 ounce = X c.
7. 9T. = X ounce
8. 5 t. = X gtts.

Answers: 1. 15 t 2. 24 oz 3. 2.5 t 4. 8 T
5. 12 t 6. 3 c 7. 4 ½ oz 8. 300 gtts

Nurses must learn all three units of measure (metric, apothecary and household) because medicines are ordered or labeled using the metric system or apothecary system, and we tell patients how much medicine to take using the household system.

LEARNING the BASIC EQUIVALENCES

In order to calculate dosage amounts you must first **memorize** these basic equivalences:

BASIC EQUIVALENCES COMMONLY USED

1 g (gram) = 1000 mg (milligrams)	60 mg = gr 1 (grain)
1 kg (kilogram) = 1000 g	1 dram = 4 ml
1 kg = 2.2 lb (pounds)	
1 L. (liter) = 1000 ml (milliters)	30 ml = 1 oz (ounce)
1 ml = 1 cc (cubic centimeter)	1 T = 3 tsp (teaspoon)
1 mg = 1000 mcg. (micrograms)	1 C (cup) = 8 oz
2 T (tablespoon) = 1 oz	1 T = 15 ml
15 – 16 gtt (drop) = 1 ml	1 tsp = 5 ml

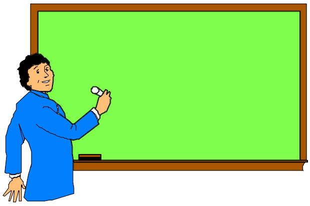
Conversion Between Systems

Now that you know the equivalences, it is time to learn how to convert values between systems. Keep your charts of equivalences handy and refer back to them often.

Many times the physician will order a medication in one strength but the pharmacy stocks the medication in a different strength. By using ratio and proportion that you were taught in Unit I, you can determine how much of the medication that the pharmacy stocks will be needed to equal the amount ordered by the physician.

Always set up your problem in the following manner:

KNOWN UNIT OF MEASURE	:	KNOWN EQUIVALENT UNIT OF MEASURE	::	DESIRED UNIT OF MEASURE	:	UNKNOWN EQUIVALENT (X)



Example: How many grams are there in 500mg?
(The known ratio is 1000 mg = 1 gm)

KNOWN UNIT OF MEASURE	:	KNOWN EQUIVALENT UNIT OF MEASURE	::	DESIRED UNIT OF MEASURE	:	X
1000 mg	:	1 gm	::	500 mg	:	X gm

1000 X = 500

$$X = \frac{500}{1000}$$

X = 0.5 gm (Remember to check your answer)

Example: 20 mg is equal to how many grains?
(The known ratio is 60 mg = 1 gr)

Use the above formula:

60 mg : 1gr :: 20 mg : X gr

60 X = 20

$$X = \frac{20}{60}$$

X = 1/3 grain (Remember to check your answer)

Practice Problems

1.	¼ gr	= ______	mg	13.	2500 mg	= ______	gm
2.	120 mg	= ______	gm	14.	30 kgs	= ______	lbs
3.	0.05 gm	= ______	gr	15.	12 oz	= ______	cc
4.	55 lbs	= ______	kg	16.	0.003	= ______	mcg
5.	250 mcg	= ______	mg	17.	1000 ml	= ______	pts
6.	0.3 ml	= ______	m	18.	165 lbs	= ______	kg
7.	4 drams	= ______	ml	19.	1.5 tsp	= ______	cc
8.	45 ml	= ______	oz	20.	3 gr	= ______	mg
9.	1.25 L	= ______	ml	21.	1 1/3 oz	= ______	tsp
10.	20 ml	= ______	tsp	22.	0.006 gm	= ______	mg
11.	1 ½ gr	= ______	gm	23.	10 ml	= ______	tsp
12.	0.2 mg	= ______	gr	24.	3 C	= ______	cc

Answers:

1. 15 mg	13. 2.5 gm
2. 0.120 gm	14. 66 lbs
3. 0.75 gr	15. 360 cc
4. 25 kg	16. 3 mcg
5. 0.25 mg	17. 2 pts
6. 5 m	18. 75 kg
7. 16 ml	19. 7.5 cc
8. 1 ½ oz	20. 180 mg
9. 1250 ml	21. 8 tsp
10. 4 tsp	22. 6 mg
11. 0.1 gm	23. 2 tsp
12. 1/300 gr	24. 240 c

Please see Nursing Faculty for further homework.

UNIT III – Simple Dosage Calculations

The focus of this unit is learning to interpret physician orders and read medication labels correctly. In addition, the administration of safe dosages of oral and parenteral medication will be discussed.

INTERPRETING PHYSICIAN ORDERS

In order to administer medications safely and correctly the nurse must first be able to interpret the physicians order.

Example: Ambien 10 mg p.o. q h.s. p.r.n. sleep.

What is the name of the medication? Ambien
What is the prescribed dosage? 10 mg
What is the route of administration? p.o. (by mouth)
When is the drug to be administered? h.s. (hr of sleep)
Why is the drug to be administered? to help pt sleep

Practice Problems

For each of the MD orders interpret the following:

a. Medication name?
b. Prescribed dosage?
c. Route of administration?
d. Time of administration?
e. What other directions, if any, are given?

1. K-Lor 20 mEq p.o. in 120 cc orange juice b.i.d.
2. Valium 5 mg p.o. q 4 hr p.r.n. anxiety.
3. Tylenol gr X p.o. q 4 hr p.r.n. temp > 101.
4. Demerol 75 mg I.M. q 4 hr p.r.n. pain.

Answers:

1. a. K-Lor
   b. 20 mEq
   c. po (by mouth)
   d. 2 times a day
   e. mix in 120 cc orange juice

2. a. Valium
   b. 5 mg
   c. po
   d. every 4 hours as needed
   e. give as needed for anxiety

3. a. Tylenol
   b. grain 10
   c. po
   d. every 4 hours as needed
   e. give if temp > 101

4. a. Demerol
   b. 75 mg
   c. IM (intramuscular)
   d. every 4 hours as needed
   e. give as needed for pain

INTERPRETING MEDICATION LABELS

Medication label information varies from one medication to another. However, most all labels contain the following information; brand name, generic name, dosage, route of administration and manufacturer. If a medication has to be reconstituted, the label will contain information regarding suitable diluents, amount of diluents to be added, concentration of medication after it is reconstituted and its stability. The label of a medication to be administered IV should tell what IV fluids are compatible with the medication. If the medication is in a multi-dose package it will give the total amount of the medication contained.

Practice Problems

Identify the following for each of the medication labels:

a. Generic name c. Route of administration or form

b. Trade name d. Dosage

1.

2.

3.

4.

Answers:

1. a. ramipril b. Altace c. capsules d. 2.5 mg/cap
2. a. cefotaxime b. Claforan c. IM/IV d. 1 gm
3. a. phenobarbital b. none c. tablets d. 15 mg/tab
4. a. epoetin alfa b. Epogen c. 1 ml vial d. 3,000 u/ml

CALCULATION OF ORAL DOSAGES

Oral dosage forms of medications include tablets, capsules, suspensions, lozenges, powders, emulsions, solutions, tinctures, syrups and elixirs. The liquid forms of oral medications are generally calculated to be administered in millimeters, cubic centimeters teaspoons, tablespoons and sometimes minims.

RULES FOR ORAL DOSAGES

1. Only scored tablets can be divided accurately.
2. Administer the least number of tablets, capsules, etc. possible to obtain the correct dosage.
3. If the ordered medication specifies a number of pills without a designated strength, the order can only be carried out if the drug is manufactured in a single strength.
4. There can only be a 10% margin of difference between the **ordered** and the **administered** dosage to be considered within a safe range.

To calculate oral dosages you will use the previously discussed method of ratio and proportion. Set the problems up just as you did in Unit II.

Example: ORDERED: Amoxicillin 500 mg p.o.
AVAILABLE: Amoxicillin 250 mg tablets

250 mg : 1 tablet :: 500 mg : X tablets

250 X = 500

$X = \frac{500}{250}$ X = 2 tablets

Check your answer: 250 mg : 1 tab :: 500 mg : 2 tab

250 x 2 = **500**

1 x 500 = **500**

Example: ORDERED: Nembutal 30 mg p.o.
AVAILABLE: Nembutal scored tablets gr. I

Since the ordered form of the medication and the available form of the medication are values from different systems of measurement, you must first change the ordered form of the medication to the available form of the medication. **This type of a problem is always going to require 2 steps.**

Step 1:
(The known ratio is 60 mg = 1 grain)

60 mg : 1 grain :: 30 mg : X grain

60 X = 30

$X = \frac{30}{60}$ $X = \frac{1}{2}$ grain or 0.5 grain

Step 2:
Now put this answer into an equation and determine how many tablets you should administer.

1 grain : 1 tablet :: 0.5 grain : X tablet

X = 0.5 You would administer ½ of a tablet.

CALCULATION OF PARENTERAL DOSAGES

Parenteral means injection of drugs into the tissue or fluids of the body. The various routes for this include; Intradermal (I.D.), Subcutaneous (S.C. or sq), Intramuscular (I.M.) and Intravenous (I.V.). The calculation of these dosages is no different from oral dosage calculations. You will use ratio and proportion to solve the problems. Keep your conversion charts handy!

Practice Problems

Calculate the correct amount of oral or parenteral medications to be administered:

1. Order : Demerol 20 mg IM
   Available: Demerol 50 mg per cc

2. Order: Scopolamine gr 1/300 IM
   Available : Scopolamine 0.4 mg per ml

3. Order : Amoxil 0.5 gm p.o.
   Available: Amoxil 250 mg per 5 ml

4. Order: Prozac liquid 40 mg p.o.
   Available: Prozac liquid 20 mg per 5ml

5. Order: Nitrostat 1/100 gr p.o.
   Available: Nitrostat 0.3 mg per tablet

6. Order: V-Cillin K 800,000 units p.o.
   Available: V-Cillin K 400,000 units per tablet

7. Order: Cylert 75 mg. p.o.
   Available: Cylert 18.75 mg per tablet

8. Order: Neupogen 0.3 mg sq
   Available: Neupogen 300 mcg per ml

9. Order: Fentanyl 45 mcg I.M.
   Available: Fentanyl 0.05 mg per ml

10. Order: K-Lor 60 mEq p.o.
    Available: K-Lor 20 mEq per 5 cc

1. 0.4cc 2. 0.5ml 3. 10 ml 4. 10 ml 5. 2 tabs
6. 2 tabs 7. 4 tabs 8. 1 ml 9. 0.9ml 10. 15 cc
Please see Nursing Faculty if you need further homework.

Practice Problems

Calculate the correct amount of medication to administer.
Interpret the labels to determine the available dosage.

1. Order: K-Tab 1.5 gm po bid with meals.

2. Order: Heparin 8000 units sq q 12 hr.

3. Order: Primaxin 0.5 gm IM q 12 hr.

4. Order: Infergen 12 mcg sq q day.

Answers: 1. 2 tabs 2. 0.8 ml 3. 2 ml 4. 0.4 ml

Please see Nursing Faculty if you need further homework

UNIT IV – ADVANCED DOSAGE CALCULATIONS

This unit will cover the following topics; reconstitution of powered drugs, insulin administration and calculating safe pediatric dosages of medications.

<u>RECONSTITUTION OF POWERED DRUGS</u>

Reconstitution of powered drugs involves the addition of a sterile diluent, usually distilled water or normal saline, to a drug that is in the form of a powder. The pharmacist usually carries out this task, but in many areas of the hospital the task becomes that of the nurse's. The package insert or the container will contain the directions for reconstituting a particular drug. The diluent, as well as instructions for storage will be included. If the vial is a multi-use vial it is the nurse's responsibility to date and time the container.

Example: Ordered: Primaxin 750 mg IM.
Available: Primaxin 750 mg vial. Dissolve in 3ml of 1% lidocaine HCl solution.

How many ml of diluent should you add? 3ml
What amount of the medication will you administer? All that is in the vial. (The whole vial = 750 mg).

Example: Ordered: Mandol 250 mg IM.
Available: Mandol 1 gm vial. Add 3 ml of normal saline to obtain a concentration of 1gm per 4 cc.

How many ml of diluent should you add? 3 ml
What amount of medication will you administer?
1000 mg : 4 cc :: 250 mg : X cc
1000 X =1000 **X = 1cc**

Practice Problems

Solve the following reconstitution problems. Determine what amount of the medication you will administer.

1. Order: Cefobid 750 mg IM.
   Available: Cefobid 1 gm vial. Add 2.6 ml of sterile water to obtain a concentration of 250 mg/ml.

2. Order: Pipracil 1.5 gm IM
   Available: A 2 gm vial of Pipracil. Add 4 ml of normal saline to obtain a concentration of 1 gm /2.5 ml.

3. Order: Claforan 1 gm IM
   Available: A 2 gm vial of Claforan. Add 5 ml normal saline to obtain a concentration of 330 mg/ml.

4. Order: Lorabid 400 mg p.o.
   Available: Bottle containing Lorbid 1 gm powder. Add 25cc water to obtain a concentration of 200 mg/ 5cc.

5. Order: Librium 25 mg IM.
   Available: Librium 100 mg ampule. Add 2 ml of enclosed diluent to obtain a concentration of 100 mg/ 2ml.

6. Order: Kefzol 300 mg IM.
   Available: Kefzol 500 mg vial. Add 2 ml normal saline to obtain a concentration of 225 mg/ ml.

Answers: 1. 3 ml 2. 3.75 ml 3. 3 ml
4. 10 cc 5. 0.5 ml 6. 1.3 ml

Please see Nursing Faculty if you need further homework.

INSULIN ADMINISTRATION

Insulin is a natural hormone produced by the pancreas to maintain the body's blood sugar within the normal range of 80-120 mg/dL. You will learn much more about this during lecture. The purpose of this unit is to teach you how to safely calculate and administer insulin to patients.

The insulin that is used for replacement therapy is obtained from animal and human sources. This is important for the nurse to know because the patient needs to remain on the same source of insulin between home care and hospitalization. The label on the insulin bottle will tell whether the insulin is from an animal source or human source.

In addition to various sources of insulin, there are different categories of insulin. The categories are short, intermediate, and long acting insulin and the bottles will be labeled accordingly. This means that the effect the insulin has on the body varies in terms of time. Once again, this will be taught in detail at a later time in the curriculum. The nurse needs to use caution that he/she is giving the correct type of insulin because a patient may be receiving more than one type of insulin at various times throughout the day.

Insulin is measured by a standard that is called USP units. It is supplied in concentrations of **100 units per milliliter.** (Memorize this!) This is true for all sources and all categories of insulin.

An insulin syringe can only be used for measuring insulin. Units are not interchangeable. A unit of insulin is not the same as a unit of penicillin. Do not use a Tuberculin syringe to measure insulin. Insulin syringes are designed with less dead space in the hub of the syringe.

POINTS TO REMEMBER WHEN ADMINISTERING INSULIN

1. When mixing categories of insulin in the same syringe, always draw up the short-acting (it's clear in appearance) first. (Clear to cloudy).
2. Gently roll the bottle of insulin to mix it before drawing up the dose. Do not shake the bottle vigorously.
3. Always have another nurse verify that you have drawn up the correct amount and type of insulin.
4. Only Regular (short acting) insulin can be given intravenously.
5. If not given correctly, insulin can be a lethal drug.

Because insulin is supplied as 100 units/ml and the insulin syringe is measured in units/ml, there is no calculation required for insulin administration. If the order states 5U Humulin Insulin R, you would administer 5 units of regular insulin via a 1 ml insulin syringe.

Many times the patient will receive a long-acting insulin once or twice daily, as well as a short acting insulin every 4 hours depending upon his blood sugar. To determine the amount of the short-acting insulin to administer, the nurse will have to refer to the physician's sliding scale order.

Example: Order: Regular insulin sq q 4 hr according to sliding scale below.
The patient's blood sugar was 235. How much insulin will the nurse administer?

Blood Sugar (mg/dL)	Regular Insulin
0 – 150	No insulin
151 – 200	2 units
201 – 240	4 units
241- 280	6 units
281 – 330	8 units
over 330	Call MD

Based on the above sliding scale, you administer 4 units.

Practice Problems

Use the sliding scale above to determine how much Regular insulin should be administered based on the following blood sugar results:

1. 265 mg/dL = ______________________
2. 212 mg/dL = ______________________
3. 199 mg/dL = ______________________
4. 75 mg/dL = ______________________
5. 241 mg/dL = ______________________
6. 345 mg/dL = ______________________
7. 300 mg/dL = ______________________
8. 35 mg/dL = ______________________

Answers:
1. 6 units
2. 4 units
3. 2 units
4. 0 units
5. 6 units
6. call MD – blood sugar **too high**
7. 8 units
8. 0, call MD – blood sugar **too low** (remember the normal 80 – 120)

Are you beginning to feel like a nurse? Now we are getting into the fun stuff! If you are feeling overwhelmed, please see a member of the Nursing Faculty for one-on-one assistance!

CALCULATING SAFE PEDIATRIC DOSAGES

Infants and children require smaller quantities of drugs than adults. Their medications are commonly ordered in milligrams or micrograms per kilogram of body weight. Below are the steps to determine a safe pediatric medication dosage:

1. Weigh the child
2. Convert pounds to kilograms as you did in Unit II.
3. Calculate the ordered dose using ratio and proportion.
4. Determine if the dose is safe according to the manufacturers safe dosage range.

Example: Order: Demerol 1.5 mg/kg IM. The child weighs 20 pounds.

Step 1: Convert pounds to kilogram

2.2 lb : 1 kg :: 20 lb : X kg

2.2 X = 20

X = 9.0909 (Round to the hundredth place for children)

X = 9.09 kg

Step 2: Calculate the ordered dose of Demerol.

1 kg : 1.5 mg :: 9.09 kg : X mg

X = 13.635 (Round to the hundredth place for children)

X = 13.64 mg Demerol

Now that you know how to determine the amount of medication to administer based on weight, you need to learn how to determine if that dose is within the safe range. Drug manufacturers will include the safe pediatric ranges for medications. You have to insert the dosage for your pediatric patient into the equation and use ratio and proportion, to determine if it is a safe dose. If it is, you administer the drug. If it is not, you call the ordering physician. Many times a range will be given rather than one specific safe dosage amount.

Example: Order: Tegretol 400 mg po BID. The recommended dose is 15 – 20 mg/kg. The child weighs 55 lbs. Is the ordered dose a safe dose?

Step 1: Convert pounds to kilograms

2.2 lb : 1 kg :: 55 lbs : X kg

X = 25 kg

Step 2: Calculate to determine if the dose is safe.

1 kg : 15 mg :: 25 kg : X mg

X = 375 mg **and**

1 kg : 20 mg :: 25 kg : X mg

X = 500 mg

This tells you the safe range per dose is 375 – 500 mg. As stated above, the MD ordered 400 mg. Since 400 falls within the safe range, you would determine that 400 mg is a safe dose. If, for example, the MD had ordered 600 mg Tegretol then you would determine that not to be a safe dose and you would notify the ordering physician.

Another variation of this principle, is that the nurse may have to determine if a dose is safe in terms of a 24 hour period. Some medications will list a 24-hour safe dose range and the nurse has to determine if the number of doses of a medication to be given in 24 hours falls within that range.

Example: Order: Erythromycin 62.5 mg, po q6 hr for an infant that weighs 11 lbs. Safe dose range is 30 – 50 mg/kg/24 hrs.

Step 1: Convert lbs to kg

2.2 lb : 1 kg :: 11 lbs : X kg

X = 5 kg

Step 2: Determine safe dose range for 24-hr period.

1 kg : 30 mg :: 5 kg : X mg

X = 150 mg

1 kg : 50 mg :: 5 kg : X mg

X = 250 mg

Safe dosage range for 24-hr period = 150 mg – 250 mg

Step 3: Determine if the ordered dosage for the 24-hr period is safe.

The ordered medication is ordered every 6 hours. The nurse determines that the child will receive 4 doses in a 24-hr period.

62.5 mg X 4 doses = 250 mg of Erythromycin in a 24-hr period. The nurse determines this to be a safe 24-hr period dose by comparing this number to the safe range in step 2.

Let’s try some practice problems! These will be a little bit different from what you have had so far. They will require you to think about what the question is asking.

Practice Problems

1. Order: Tylenol elixir 10 mg/kg po.
   Child weight is 10 pounds.
   Available: Tylenol elixir 160 mg/ 5ml.

   How much Tylenol will you administer?

2. Order: Amoxicillin 100 mg po q6 hr.
   Child weighs 15 lbs.
   Safe range is 25 – 30 mg/kg/24 hr.

   a. What is the safe 24-hr range?
   b. Is the ordered dose safe for a 24-hr period?

3. Order: Ferrous Sulfate 9 mg po tid.
   Child weighs 13 lbs. The safe dosage is
   3 –6 mg/kg/24 hrs.

   a. What is the safe 24-hr range?
   b. Is the ordered dose safe for a 24-hr period?

4. Order: Lanoxin 18 mcg po bid.
   Child weighs 7 lbs. The safe range is
   10 – 12 mcg/kg/24 hrs.

   a. What is the safe 24-hr range?
   b. Is the ordered dose safe for a 24-hr period?
   c. If the medication is supplied 50 mcg/ml, how many ml will you administer per dose

5. Order: Dilantin 40 mg po q 8 hr.
   Child weighs 27 lb. The safe range is 8–10 mg/kg/24 hr

   a. What is the safe 24-hr range?
   b. Is the dose safe for a 24-hr period?
   c. If the medication is supplied 125 mg/5 ml, how many ml will you administer per dose?

6. Order: Prednisone 150 mg po bid.
   Child weighs 21 lb. The safe range is 0.5-40 mg/kg/24hr

   a. What is the safe 24-hr range?
   b. Is the dose safe for a 24-hr period?
   c. If the medication is supplied 5 mg/ml, how many ml will be required for a 24 hour period?

7. Order: Ceclor 180 mg po q 8 hr.
   Child weighs 10 lb. The safe dose is 15 mg/kg/dose.

   a. What is the safe dose for this child?
   b. Is the ordered dose safe?
   c. If the medication is supplied 125 mg/ 5 ml, how many ml will you administer?

Answers:

1. 1.42 ml
2. a. 170.5 – 204.6 mg b. no 100 X 4 = 400 mg
3. a. 17.73 – 35.46 mg b. yes 9 X 3 = 27 mg
4. a. 31.8 – 38.16 mcg b. yes 18 X 2 = 36mcg c.0.36ml
5. a. 98.16 – 122.7 mg b. yes 40 X 3 =120mg c. 1.6ml
6. a. 4.78 - 382 mg b. yes 150 X 2 = 300mg c. 60 ml
7. a. 68.25 mg b. no c. Don't administer dose call MD

Please see Nursing Faculty if you need further homework.

UNIT V – Intravenous Preparation with Clinical Calculations

Intravenous fluids are used in health care settings to rehydrate patients or to give medicines. Calculation of IV flow rates ensures that fluids do not infuse too fast, which could overload the patient or too slowly, delaying treatment. This unit will explain how to calculate and administer IV fluids and medications. The topics to be discussed include; calculating flow rates for electronic and manual IV flow regulators, calculating hourly IV heparin dosages and calculating IV flow rates in order to administer a specific concentration of a medication per minute or hour.

ELECTRONIC IV FLOW REGULATORS

Electronic pumps are used in all health care settings. In some instances, it is mandatory policy to use these devises. Such is the case when administering narcotics, heparin or various heart medications via continuous IV drip. In addition, very small amounts of fluid can be infused over an extended period of time by using these electronic pumps.

The key concept to **memorize** about these electronic pumps is that they are designed to infuse the IV fluid/medication in **milliliters per hour** (some of the newer pumps can be set to administer tenths of a milliliter per hour). The physician will order the flow rate in milliliters (cc) per hour or specify the amount of time necessary to infuse the IV fluid/medication.

When the physician orders the specific ml per hour, the nurse simply hangs the correct IV fluid/medication and sets the pump to the ordered flow rate. There are NO calculations!!!

However, if the physician only specifies the duration of time to take to infuse an amount of IV fluid/medication and does not order ml per hour, the nurse must calculate the flow rate. You will use ratio and proportion to calculate the flow rate.

Example: Order: 1000 cc NS IV to infuse over 8 hrs.

8 hr : 1000 cc :: 1 hr : X cc

8X = 1000

X = 125 cc/hr   This is the flow rate!

Shortcut: Actually all you have to do is divide the total amount of fluid by the number of hours.

If the infusion time is not in whole hours, you must calculate using 60 minutes rather than 1 hour.

Example: Order: Zofran 10 mg in 100 cc NS IVPB q 8 hr.
Infuse over 30 minutes.

30 min : 100 cc :: 60 min : X cc

30 X = 6000

X = 200 cc/hr

The nurse sets the electronic pump to deliver 200 cc/hr and after 30 minutes the 100 cc of medication would have been infused.

Here's another example similar to the one above:

Order: Ampicillin 500 mg in 100 cc NS IVPB q 8 hr.
Infuse over 20 minutes.

20 min : 100 cc :: 60 min : X cc

20 X = 6000

X = 300 cc/hr

In this example, the nurse sets the electronic pump to deliver 300 cc/hr, and after 20 minutes the 100 cc of medication would have been infused.

Note: The mg of medication has nothing to do with calculating the flow rate. Don't be confused and try to use this number in your calculation!

Practice Problems:
Calculate the flow rate when using an electronic pump:
1. Infuse 1500 cc NS over 24 hours.
2. Infuse1000 cc D5W over 15 hours.
3. Infuse 1000 cc NS over 10 hours.
4. Infuse 600 cc LR over 3 hours.
5. Infuse 2000 cc ½ NS over 24 hours.
6. Infuse Tagamet 300 mg IVPB mixed in 100 cc NS over 45 minutes.
7. Infuse Unasyn 500 mg IVPB mixed in 50 cc NS over 10 minutes.
8. Infuse Kytril 20 mg IVPB mixed in 75 cc NS over 45 minutes.
9. Infuse Ampicillin 500 mg IVPB mixed in 50 cc NS over 30 minutes.
10. Infuse 30 cc of 3% NS IVPB over 15 minutes.

Answers: 1. 63 cc/hr 2. 67 cc/hr 3. 100 cc/hr
4. 200 cc/hr 5. 83 cc/hr 6. 133 cc/hr 7. 300 cc/hr
8. 100 cc/hr 9. 100 cc/hr 10. 120 cc/hr
Please see Nursing Faculty if you need further homework

MANUAL IV FLOW REGULATORS

Nurses are using fewer and fewer manual IV flow regulators to administer IV fluids/medications in the health care setting. Another term used to describe these regulators is gravity drip IV infusions. This describes how manual flow regulators work. The rate of infusion is dependant upon the gravity of the bag of IV fluid/medication. The rate of these infusions will always be calculated in **drops(gtts) per minute.** (There will not be a pump!)

In order to calculate the accurate rate of infusion, the nurse must know the type of tubing or administration set to be used. Each type of administration set has a drop chamber with either a **macro** drop set that delivers 10, 15 or 20 drops per milliliter while the **micro** drop set always delivers 60 drops per milliliter. This is referred to as the drip factor. To prevent errors in calculating the infusion rate, always check the manufacturer's label to verify the drip factor of the administration set.

The nurse will have to manually regulate the flow of IV fluid/medication when using the above administration sets. There are two steps to this process. The first step is that the nurse must calculate the drop rate, which will always be gtts/min. The second step is that the nurse will adjust the roller clamp on the IV tubing and count the drops to insure accurate infusion. This type of infusion will have to be monitored frequently because kinked tubing or a change in arm position can slow or increase the rate of flow.

There are various formulas to use to calculate the flow rates for manual IV regulators. The following formula needs to be **memorized**:

$$\frac{\text{Amount of fluid} \times \text{Drip factor}}{\text{Time (always in minutes)}}$$

Example: Order: 3000 cc NS IV over 24 hrs.
Drip factor of tubing: 15 gtts/cc.

$$\frac{3000\ cc \times 15\ gtts/cc}{24\ hr \times 60\ min} = \frac{45000}{1440} = 31.25 = 31 gtts/min$$

This number will have to be rounded to a whole number because a manual IV flow regulator cannot deliver a portion of a drop.

If the infusion time is less that one hour, you simply put this amount of time as the denominator.

Example: Order Ampicillin 500 mg IVPB in 100 cc NS to infuse over 30 min. Drip factor: 10 gtts/cc.

$$\frac{100\ cc \times 10\ gtts/cc}{30\ min} = \frac{1000}{30} = 33.33 = 33 gtts/min$$

Example: Order: Vancomycin 1 gm IVPB in 250 cc NS to infuse over 1 ½ hrs. Drip factor: 20 gtts/cc.

$$\frac{250\ cc \times 20\ gtts/cc}{1.5\ hr \times 60\ min} = \frac{5000}{90} = 55.56 = 56 gtts/min$$

Practice Problems

Determine the infusion rate for the following:

1. Order: 1000 cc NS to infuse in 8 hours.
   Drip factor of administration set: 15 gtts/cc.

2. Order: 1000 cc NS to infuse in 6 hours.
   Drip factor of administration set: 20 gtts/cc.

3. Order: 1000 cc NS to infuse in 10 hours.
   Drip factor of administration set: 15 gtts/cc.

4. Order: 500 cc NS to infuse in 4 hours.
   Drip factor of administration set: 15 gtts/cc.

5. Order: 85 cc NS to infuse in 1 hour.
   Administration set is a micro set.

6. Order: 1500 cc D5W to infuse in 10 hours.
   Drip factor of administration set: 15 gtts/cc.

7. Order: 1000 cc NS to infuse in 8 hours.
   Drip factor of administration set: 20 gtts/cc.

8. Order: Pepcid 40 mg IVPB mixed in 100 cc NS to infuse over 30 minutes. Drip factor: 20 gtts/cc.

9. Order: Vibramycin 200 mg IVPB mixed in 100 cc NS to infuse over 30 minutes. Drip factor: 10 gtts/cc.

10. Order: Dextran 40 mg IVPB in 250 cc to infuse over 45 minutes. Drip factor: 15 gtts/cc.

Answers:
1. 31 gtts/min
2. 56 gtts/min
3. 25 gtts/min
4. 31 gtts/min
5. 85 gtts/min
6. 38 gtts/min
7. 42 gtts/min
8. 67 gtts/min
9. 33 gtts/min
10. 83 gtts/min

Please see Nursing Faculty if you need further homework.

CALCULATING HOURLY IV HEPARIN DOSAGES

The administration of continuous IV heparin is a common practice in the hospital setting. It is vital that the nurse know how to calculate an accurate infusion rate since the margin is very small and can easily result in death. IV heparin will always be administered via an electronic pump, thus it will be calculated in milliliters per hour. The dosage of heparin is measured in units. Ratio and proportion are used to calculate the dosage.

Example: Order: Heparin 800 units/hr via continuous IV infusion. Medication comes mixed from pharmacy: Heparin 25,000 units in 250ml NS.

25,000 units : 250 cc :: 800 units : X ml

25,000 X = 200,000

$X = \frac{200{,}000}{25{,}000} = 8$ ml/hr

Example: Order: Heparin 1200 units/hr via continuous IV infusion. Medication comes mixed from pharmacy: Heparin 10,000 units in 250 ml NS.

10,000 units : 250 cc :: 1200 units : X ml

10,000 X = 300,000

X = 30 ml/hr

Remember, you can check your answer to verify it is correct: (multiply outside #'s and they will = inside #'s)

10,000 X 30 = 300,000

250 X 1200 = 300,000

Practice Problems

Determine the flow rate (ml/hr) for the following:

1. Order: Heparin 1500 units per hr via IV infusion .
   Medication comes mixed from pharmacy:
   Heparin 25,000 units in 250 cc NS.

2. Order: Heparin 1800 units per hr via IV infusion.
   Medication comes mixed from pharmacy:
   Heparin 20,000 units in 250 cc NS.

3. Order: Heparin 1200 units per hr via IV infusion.
   Medication comes mixed from pharmacy:
   Heparin 25,000 units in 200 cc NS.

4. Order: Heparin 800 units per hr via IV infusion.
   Medication comes mixed from pharmacy:
   Heparin 20,000 units in 100 cc NS.

5. Order: Heparin 1000 units per hr via IV infusion.
   Medication comes mixed from pharmacy:
   Heparin 20,000 units in 150 cc NS.

6. Order: Heparin 1100 units per hr via IV infusion.
   Medication comes mixed from pharmacy:
   Heparin 10,000 units in 100 cc NS.

Answers:

1. 15 cc/hr
2. 22.5 or 23 cc/hr
3. 9.6 or 10 cc/hr
4. 4 cc/hr
5. 7.5 or 8 cc/hr
6. 11 cc/hr

Please see Nursing Faculty if you need further homework.

IV ADMINISTRATION BY CONCENTRATION

Usually IV fluids/medications are ordered to be infused at a certain rate or time period as has already been taught. However, some IV's, especially in the critical care areas, are ordered to be administered with a specific concentration of the medication per hour, per minute or per milliliter. This is a difficult calculation to master, but if you will learn the basic steps of the calculation, and think about what the problem is asking, you will have no problems!

Below are the basic steps to these types of problems. Remember, you may not have to use all of the steps for each problem.

Step 1: Convert pounds to kilograms.

Step 2: Determine the correct dosage based on the patients weight (in kilograms)

Step 3: Convert the ordered unit to the unit you have on hand.

Step 4: Calculate the # of cc/min to administer.

Step 5: Calculate the # of cc/hr to administer. (This usually has to be done because these medications are administered via electronic pump.)

Remember, you may not always have to go through all 5 steps. Think through the problem and determine the steps needed!!!

Example: Order: Bretylol 5mcg/kg/min. Medication comes mixed 0.05 g in 50 cc NS. Patients weight is 187 lbs.

Step 1: Convert lbs to kg

2.2 lb : 1 kg :: 187 lb : X kg
X = 85 kg

Step 2: Determine the correct dosage based on pts weight

1 kg : 5 mcg :: 85 kg : X kg
X = 425 mcg

Step 3: Convert the ordered unit to the unit on hand.

1 g : 1,000,000 mcg :: 0.05 g : X mg
X = 50,000mcg (there are 50,000 mcg in 50 cc NS)

Step 4: Calculate the # of cc/min to administer.

50,000 mcg : 50 cc :: 425 mcg : X cc
X = 0.425 cc/min

Step 5: Calculate the # of cc/hr to administer.

1 min : 0.425 cc :: 60 min : X cc
X = 25.5 cc/hr or 26 cc/hr

Remember, some newer pumps can administer fluids to the tenth of a cc. The nurse must be familiar with the equipment and know whether to set the pump at 25.5 cc/hr or 26 cc/hr.

Example: Order: Nitroprusside 50 mg in 500 cc D5W
at 50 mcg/min. Set the pump at____cc/hr?

Step 1: Convert to kilograms. – NOT NEEDED!!!

Step 2: Determine the correct dosage based on the patients weight. - NOT NEEDED !!!

Step 3: Convert the ordered unit to the unit on hand.
1 mg : 1000 mcg :: 50 mg : X mcg
X = 50,000 mcg (50,000 mcg in 500 cc D5W)

Step 4: Calculate the # of cc/min to administer.
50,000 mcg : 500 cc :: 50 mcg : X cc
X = 0.5 cc/min

Step 5: Calculate the # of cc/hr to administer.
1 min : 0.5 cc :: 60 min : X cc
X = 30 cc/hr

Practice Problems

Determine the **rate (cc/hr)** for the following:

1. Order: Administer Cleocin IV at a rate of 10 mg/min.
   Available: Cleocin 900 mg in 100 cc NS.

2. Order: Administer 10 mEq KCl per hour via IV.
   Available: 50 mEq KCl in 100 cc D5W.
   (Hint: this is already in cc/hr, you will not need to do step 4)

3. Order: Administer Diuril at a rate of 15 mg/min.
   Available: Diuril 350 mg in 50 cc NS.

4. Order: Isuprel 5 mcg/min IV.
   Available: Isuprel 2 mg in 500 cc NS.

5. Order: Lidocanine 2 mg/min IV.
   Available: Lidocaine 1 g in 250 cc D5W.

6. Order: Nitrostat IV 10 mcg/min.
   Available: Nitrostat 8 mg in 250 cc NS.

7. Order: Nipride IV 0.5 mcg/kg/min. Pt. weight = 125 lb.
   Available: Nipride 10mg in 100 ml D5W.

8. Order: Dobutrex 6 mcg/kg/min. Pt. weight = 50 kg.
   Available: Dobutrex 250 mg in 250 cc NS.

9. Order: Intropin 5 mcg/kg/min. Pt. weight = 132 lb.
   Available: Intropin 200 mg in 250 cc NS.

10. Order: Aminophylline 0.5 mg/kg/hr. Pt weight =154 lb
    Available: Aminophylline 500 mg in 1000 cc D5W.

Please see Nursing Faculty if you need further homework.

Bonus Problem: See if you can use what you have learned to solve this problem.

Intropin is infusing at 25cc/hr. The concentration of Intropin is 200 mg in 250 cc D5W. The patient's weight is 143 lb. What is the mcg/kg/min the patient is receiving? (You basically have to work backwards through the steps.)

Answers: If you need further instruction of how to arrive at the answer, please contact one of the Nursing Faculty.

1. 900 mg : 100 cc :: 10 mg : Xcc
   X = 1.11 cc/min (you determined cc/min)
   1 min : 1.11 cc :: 60 min : X cc
   X = 66.6 or 67 cc/hr (you determined cc/hr)

2. 50 mEq : 100 cc :: 10 mEq : X cc
   X = 20 cc/hr (the question was already in cc/hr)

3. 350 mg : 50 cc :: 15 mg : X
   X = 2.14 cc/min

   1 min : 2.14 cc :: 60 min : X cc
   X = 128.4 or 128 cc/hr

4. 1000 mcg : 1 mg :: 5 mcg : X mg
   X = 0.005 mg (you converted to like units)

   2 mg : 500 cc :: 0.005 mg : X cc
   X = 1.25 cc/min

   1 min : 1.25 cc :: 60 min : X cc
   X = 75 cc/hr

5. 1000 mg : 1 gm :: 2 mg : X gm
   X = 0.002 gm (you converted to like units)

   1 gm : 250 cc :: 0.002 gm : X cc
   X = 0.5 cc/min

   1 min : 0.5 cc :: 60 min : X cc
   X = 30 cc/hr

6. 1000 mcg : 1 mg :: 10 mcg : X mg
   X = 0.01 mg (you converted to like units)

   8 mg : 250 cc :: 0.01 mg : X cc
   X = 0.3125 cc/min

   1 min : 0.3125 cc :: 60 min : X cc
   X = 18.8 or 19 cc/hr

7. 2.2 lb : 1 kg :: 125 lb : X kg
   X = 56.82 kg

   1 kg : 0.5 mcg :: 56.82 kg : X mcg
   X = 28.41 mcg (this is the correct dosage based on kg)

   1000 mcg : 1 mg :: 28.41 mcg : X mg
   X = 0.0284 mg (you converted to like units)

   10 mg : 100 cc :: 0.0284 mg : X cc
   X = 0.284 cc/min

   1 min : 0.284 cc :: 60 min : X cc
   X = 17.04 = 17 cc/hr

8. 1 kg : 6 mcg :: 50 kg : X mcg
   X = 300 mcg (this is the correct dosage based on kg)

   1000 mcg : 1 mg :: 300 mcg : X mg
   X = 0.3 mg (you converted to like units)

   250 mg : 250 cc :: 0.3 mg : X cc
   X = 0.3 cc/min

   1 min : 0.3 cc :: 60 min : X cc
   X = 18 cc/hr

9. Convert lb to kg = 60 kg

1 kg : 5 mcg :: 60 kg : X mcg
X = 300 mcg (this is the correct dosage based on kg)

1000 mcg : 1 mg :: 300 mcg : X mg
X = 0.3 mg (you converted to like units)

200 mg : 250 cc :: 0.3 mg : X cc
X = 0.375 cc/min

1 min : 0.375 cc :: 60 min : X cc
X = 22.5 or 23 cc/hr

10. Convert lb to kg = 70 kg

1 kg : 0.5 mg :: 70 kg : X mg
X = 35 mg (this is the correct dosage based on kg)

500 mg : 1000 cc :: 35 mg : X cc
X = 70 cc/hr (the order was written per hr)

Bonus Question:
Convert lb to kg = 65 kg

1 mg : 1000 mcg :: 200 mg : X mcg
X = 2000,000 mcg (you converted to like units)

250 cc : 200,000 mcg :: 25 cc : X mcg
X = 20,000 mcg (you determined mcg/hr)

60 min : 20,000 mcg :: 1 min : X mcg
X = 333.33 mcg (you determined mcg/min)

65 kg : 333.33 mcg : 1 kg : X mcg
X = 5.128 = **5.13 mcg/kg/min**

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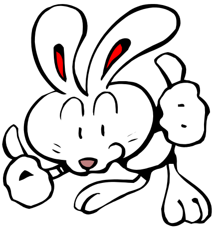
GREAT JOB!!!



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