CALCULATE DOSAGES USING THE DESIRED/AVAILABLE METHOD	=	USE REASONING TO SOLVE EQUATIONS

Program Task: 800 Health Care Provider Skills

Task: 834 Demonstrate medication administration to a client ensuring the use of placebos

Program Associated Vocabulary:
PROPORTIONS, EQUATIONS, FRACTIONAL RELATIONSHIPS, DOSAGE

Program Formulas and Procedures:
Many medications are used in health care. In order to assure patient safety, these medications must be calculated correctly. What you desire to administer to your patient may not be how the medication is available. Therefore, the "Desired/Available Method" must be used to ensure the correct dosage.
Lasix (furosemide) is a medication commonly given to reduce edema. Lasix is available 20mg po.
Sometimes a patient requires a dosage higher than 20mg. Students must realize that a direct proportion must be used. As the dosage the patient is to receive (desired) increases, so will the number of pills that must be administered. This information can be used to set up the following proportion commonly referred to as the "Desired/Available Method"
"Desired" is the amount the patient needs.
"Available" is the amount in each pill/caplet/capsule.
A patient needs 40 mg of Lasix. Lasix is available in pill form at 20mg po. What is the dosage required for this patient?

Example 1: $Desired = 60mg \rightarrow Available = 20mg / pill$

$$\frac{60mg = x}{20mg = 1\ pill}$$

Then, cross-mulitply and solve:
$$20(x) = 60 \times 1$$
$$20x = 60$$
$$x = 3\ pills$$

Example 2: Lanoxin is supplied to your unit labeled 0.5mg per 2cc. Mrs. Smith is to receive 0.25mg daily. How many cc's will you give her?

$$\frac{0.25}{0.5mg} = \frac{x}{2cc} \rightarrow 0.5mg(x) = 0.25(2)mg / cc$$
$$x = 0.5mg \div 0.5mg / cc \rightarrow x = 1cc$$

PA Core Standard: CC.2.2HS.D.9

Description: Use reasoning to solve equations and justify the solution method.

Math Associated Vocabulary:
INVERSE, RECIPROCAL, PROPORTION, CROSS MULTIPLICATION, RATIO, CONSTANT

Formulas and Procedures:

Direct Proportions
Two quantities, A and B, are directly proportional if by whatever factor A changes, B changes by the same factor.

Example 1: Take the formula distance = rate x time. If the rate remains constant, 30 miles per hour, then the time and distance are directly proportional.
$d = 30t$
when t = 2, d = 60
when t = 4, d = 120

> *Note that when the time doubles, so does the distance.

Example 2: If speed is directly proportional to distance and a car can travel 100 miles at 50 miles per hour. How far can that car travel during the same time if it travels 70 mph?

$Step\ 1: Set\ up\ proportion$

$$\frac{50mph}{70mph} = \frac{100mi.}{x}$$

$Step\ 2: Cross\ multiply\ and\ divide\ to\ solve$

$$50x = 70(100) \rightarrow 50x = 700 \rightarrow x = 140\ miles$$

Indirect Proportions
Two quantities, A and B, are inversely proportional if by whatever factor A changes, B changes by the multiplicative inverse, or reciprocal of that factor.

Example 1: Take the formula distance = rate x time. If the distance is constant, 100 miles, then as the rate increases the time decreases
100=rt
When r=, t=1
When r=50, t=2

> *Note that when the rate doubles, time is halved.

Example 2: If the time needed to complete a job is inversely proportional to the number of people working, how long would it take 4 people to paint a room if 1 person needs 8 hours?

Step 1: Set up the proportion   Step 2: Invert (flipA) one ratio

$$\frac{1\ person}{4\ people} = \frac{8\ hours}{x\ hours} \qquad \frac{1\ person}{4\ people} = \frac{x\ hours}{8\ hours}$$

$Step\ 3: Cross\text{-}multiply\ and\ divide\ to\ solve$

$$4x = 8,\ x = 2 \qquad 4\ people\ can\ paint\ the\ room\ in\ 2\ hours$$

Teacher's Script - Comparing and Contrasting
Students must be able to use proportions for a variety of measurements and conversions. One of the most common uses in health care is the calculation of medication dosages. The student needs to be able to recognize the proportional relationship when using the "Desired/Available Method" to determine the correct dosage.
By setting up this proportion and cross multiplying, as in any other algebraic problem, the proper dosage can be precisely and efficiently calculated

Common Mistakes Made By Students:
When students compare Direct and Inverse Proportional relationships, they may become confused and have difficulty differentiating one from the other. One way to keep them straight is to:

1. Set up one pair of values on the same line (see example below).
2. Beneath that line, place the other pair of values.
3. Cross multiply (24 times 100) and (12 times x), but first determine if you have to invert one ratio.
4. If you have to invert one ratio, then it is an inverse proportion.
5. If need be, set up the problem and do it both ways to see which answer makes sense! We know in problem #9, for example, that it won't take 5 rabbits more time than it took 1 rabbit to eat 20 carrots, so it must be an inverse proportion.

$$\frac{12"}{24"} = \frac{100 lbs}{x lbs}$$

Lab Teacher's Extended Discussion
Medication administration is a task performed by many licensed health care professionals. It is imperative that dosages are calculated correctly to ensure patient safety. Students are always permitted to have the formula.

Health Occupations (51.0899) T-Chart

Problems	Occupational (Contextual) Math Concepts	Solutions
1. Lanoxin is supplied to your unit labeled 1.5mg per 4cc. Mr. Steve's is to receive 0.5mg daily. How many cc's will you give him?		
2. Amitriptyline comes 100mg per tablet. Your patient is to receive 200mg. How many tablets will you need?		
3. The patient is ordered to receive 0.4mg atropine. The vial is labeled 1.5mg per 2 ml. How much should the patient receive?		

Problems	Related, Generic Math Concepts	Solutions
4. If it takes 12 eggs to make 1 dozen, how many eggs will be needed to make 9 dozen?		
5. The pressure of a gas and its corresponding volume are inversely proportional. If the pressure of 0.24 m3 is 0.5 atm, what would the pressure be of 0.060 m3 of the same gas at the same temperature?		
6. If it takes 26 lbs. of metal to make 10 castings, how many pounds of metal will be needed to make 14 castings?		

Problems	PA Core Math Look	Solutions
7. Given that y and x are **directly** proportional and y = 2 When x = 5, find the value of y when x = 15.		
8. Given that y and x are **inversely** proportional and y = 2 when x = 5, find the value of y when x = 15.		
9. If one rabbit can chew 20 carrots in 15 hours, how long will it take 5 rabbits to chew the same 20 carrots?		

Problems	Occupational (Contextual) Math Concepts	Solutions
1. Lanoxin is supplied to your unit labeled 1.5mg per 4cc. Mr. Steve's is to receive 0.5mg daily. How many cc's will you give him?	$\dfrac{0.5mg}{1.5mg} = \dfrac{x}{4cc} \rightarrow 1.5mg(x) = 0.5(4)mg/cc$ $x = 2mg \div 1.5mg/cc$ $x = 1.33cc$	
2. Amitriptyline comes 100mg per tablet. Your patient is to receive 200mg. How many tablets will you need?	$\dfrac{100mg}{200mg} = \dfrac{1\,tablet}{x} \rightarrow 100mg(x) = 200(1)mg/tab$ $x = 200mg\,tab \div 100mg$ $x = 2\,tablets$	
3. The patient is ordered to receive 0.4mg atropine. The vial is labeled 1.5mg per 2 ml. How much should the patient receive?	$\dfrac{0.4mg}{1.5mg} = \dfrac{x}{2ml} \rightarrow 1.5mg(x) = .4(2)mg\,ml$ $x = 0.8mg \div 1.5mg$ $x = .533ml$	

Problems	Related, Generic Math Concepts	Solutions
4. If it takes 12 eggs to make 1 dozen, how many eggs will be needed to make 9 dozen?	**(Direct)** $\dfrac{12\,eggs}{x\,eggs} = \dfrac{1\,doz}{9\,doz} \rightarrow 1x = 12(9) \rightarrow x = 108\,eggs$	
5. The pressure of a gas and its corresponding volume are inversely proportional. If the pressure of 0.24 m3 is 0.5 atm, what would the pressure be of 0.060 m3 of the same gas at the same temperature?	**(Inverse)** $\dfrac{0.24m^3}{0.060m^3} = \dfrac{0.5atm}{xatm}$ $\dfrac{0.24m^3}{0.060m^3} = \dfrac{xatm}{0.5atm} \rightarrow 0.24(0.5) = 0.060x \rightarrow z = 2atm$ Invert one ratio since, it is an inverse proportion.	
6. If it takes 26 lbs. of metal to make 10 castings, how many pounds of metal will be needed to make 14castings?	**(Direct)** $\dfrac{10\,castings}{14\,castings} = \dfrac{26lbs}{xlbs} \rightarrow 26(14) \rightarrow x = 36.4lbs$	

Problems	PA Core Math Look	Solutions
7. Given that y and x are **directly** proportional and y = 2 When x = 5, find the value of y when x = 15.	**(Direct)** $\dfrac{5}{15} = \dfrac{2}{y} \rightarrow 5y = 2(15) \rightarrow y = 6$	
8. Given that y and x are **inversely** proportional and y = 2 when x = 5, find the value of y when x = 15.	**(Inverse)** $\dfrac{5}{15} = \dfrac{y}{2} \rightarrow 15y = 2(5) \rightarrow y = 0.667$	
9. If one rabbit can chew 20 carrots in 15 hours, how long will it take 5 rabbits to chew the same 20 carrots?	**(Inverse)** $\dfrac{1}{5} = \dfrac{x}{15} \rightarrow 5x = 1(15) \rightarrow x = 3\,hours$	