Healthcare Math:
Calculating Dosage

Industry: Healthcare

Content Area: Mathematics

Core Topics: Applying medical abbreviations to math problems, using formulas, solving algebraic equations

Objective: Students will be able to accurately calculate the dosage of medication in the correct form to fill a doctor's prescription

Materials included:
Instructor's notes
Scenario: Pharmacy Technician
Student worksheets
Handouts
Quiz
Answer Keys

Industry Overview:
According to the U.S. Department of Labor, the healthcare industry is expected to generate over 20% of all new jobs created in the U.S. economy between 2012 and 2022.* The healthcare industry is comprised of a vast array of jobs, ranging from nursing assistants to physicians. Mathematics and literacy skills are essential for students who plan to pursue a career in this field. Healthcare professionals, including pharmacy technicians, need to understand medical terms, abbreviations, and metric measurements. They must also have the ability to use formulas to calculate the correct dosage of medication for patients.

* Source: http://www.bls.gov/news.release/ecopro.t06.htm

Instructor's notes:

- The purpose of this module is to help students develop and apply math skills in a healthcare workplace setting. The learning activities were designed to be incorporated throughout multiple instructional periods as math concepts are taught in a healthcare context.

- After completing the module, students should be able to:
    o Interpret the essential information contained on a prescription
    o Apply medical abbreviations to solve mathematical problems
    o Use a formula to calculate the correct dosage of medication to fill prescriptions

- **Setting the stage:** Provide students with background information about the typical responsibilities of a pharmacy technician. You may want to have students use the occupational outlook handbook, O*NET and/or other relevant websites to research the job responsibilities, educational/training requirements, salary, etc. for this position. In addition, you could have students view YouTube videos depicting the typical responsibilities of a pharmacy technician. (See links below)

    Bureau of Labor Statistics – Occupational Outlook Handbook:
    http://www.bls.gov/ooh/

    Occupational Information Network (O*NET)
    http://www.onetonline.org/link/summary/29-2052.00

    Pharmacy Technician videos:
    http://www.youtube.com/watch?v=DW81Hd2YENY

    http://www.youtube.com/watch?v=E_cBkSiaQD8

- **For Activity 1: Prescription Abbreviations** Have students work individually, or in pairs, to review and study common prescription abbreviations listed in the scenario. You may want students to make flash cards to quiz each other on the terms. Have students complete **Worksheet 1**.

- **For Activity 2: Decoding Prescriptions** As a class, review the sample prescription and decode the information. Using copies of **Worksheet 2**, have students practice translating the information on several prescriptions. **Handouts 2A, 2B, & 2C** have some sample prescriptions, or you may want to use others of your own choosing.

- **For Activity 3: Calculating Dosage** Explain the dosage formula to students. As a class, practice putting the information into the formula and calculating the dosage. One example is contained in the scenario. You may want to provide additional examples for students. Have students complete **Worksheet 3A** and **Worksheet 3B**.

- **Assessment: Quiz - Calculating Dosage**

Workplace Scenario: Pharmacy Technician

Maria is a pharmacy technician at a local pharmacy. Working under the supervision of a pharmacist, she fills a variety of prescriptions for customers each day. Currently, you are a pharmacy technician student receiving on-the-job training from Maria.

Activity 1: Prescription Abbreviations

Maria tells you that filling prescriptions accurately is extremely important, even one small error could cause great harm, or even death to a patient. The first step in filling any prescription is to understand all the information contained on the prescription form, including the medical abbreviations. Maria gives you the following chart to help you learn some common abbreviations used on prescriptions. She then asks you to complete **Worksheet 1**.

Some common abbreviations found on prescriptions

Abbreviation	Meaning
ac	before meals
bid	twice a day
cap	capsule
d	day (24 hours)
Exlir.	liquid or syrup
g	gram – dry measure used in tablets
gr	grains – dry weight of medication
gt	drop
h	hour
hs	at bedtime
IM	Intramuscular
mg	milligram – dry weight measure
mL	milliliter – liquid volume measure
po	by mouth
pc	after meals
pil	pill
prn	as needed
q	every
q2h	every 2 hours
qd	every day
qh	every hour
Sig	patient instructions
qid	4 times a day
Supp.	medications inserted rectally
T̈	One tablet
tab	tablet
tid	3 times a day
U	Unit

Directions: Put the letter of the definition next to the correct medication abbreviation

1. qid   _____   A. by mouth or orally

2. hs   _____   B. liquid or syrup

3. bid   _____   C. every day

4. g   _____   D. three times a day

5. mg   _____   E. medication inserted rectally

6. po   _____   F. milligram

7. qd   _____   G. four times a day

8. gr   _____   H. every 6 hours

9. U   _____   I. milliliters

10. tid   _____   J. as needed

11. Elix. _____   K. grain

12. Supp. _____   L. Unit

13. q6h   _____   M. at the hour of sleep; bedtime

14. mL   _____   N. gram

15. prn   _____   O. twice a day

Activity 2: Decoding Prescriptions

Maria wants you to learn how to accurately interpret the information contained on a typical prescription. This includes the name of the medication, the dosage and form of the medication, the amount to be taken, the method of administration, and the frequency and duration the medication will be taken. As a pharmacy technician, you need to read the prescription very carefully. Many medications have similar names or come in more than one form. For example, an older adult may take the capsule or tablet form of a medication, while a young child might be prescribed an elixir, the liquid form of a medication. She gives you the following sample prescription and asks, "How would you translate this information?"

Patient Name: John Smith
Address: 400 E 3rd Street
                     Duluth, MN 55804

Rx   Amoxicillin 250 mg tablets   # 42
         TT tablets p.o. T.i.d. X 7 days

Do Not Refill ___X___   (Sign) _____ M.D.
Refill _____ Times   D.E.A. Number _____
Date 10/3/00   Print Last Name Johns

Maria explains:

The first part of a prescription is the name of the drug; it can be a brand name or generic. On this prescription, the drug name is Amoxicillin. The next part—250 mg—denotes the strength of the drug. In this case, it's 250 milligrams in the form of tablets. "TT" stands for two tablets. The "po" means the medication is taken by mouth "tid" or three times a day. The 'x' indicates this prescription is to be taken for a period of 7 days. Two tablets x 3 times a day for 7 days = 42, the total number of tablets to be dispensed.

Maria gives you several prescriptions and asks you to complete all the information on **Worksheet 2** for each prescription.

Worksheet 2: Decoding Prescriptions   **Name:** _____

Directions: On your own paper, record the following information for each prescription your instructor gives you.

The patient's full name	
The date	
The drug name in manufacturer or generic format	
The doctor's order for dosage amount (how much medication)	
The administration route (by mouth, IV, injection)	
The frequency with which the patient is to take the medication	
The duration, the number of days that the patient is to take the medication	
The total quantity or amount that the pharmacist is to dispense	
A check-off or box allowing a generic substitute (if provided)	
The physician's name	
The physician's DEA number	

Handout 2A: Sample Prescriptions

Phone 123-456-7890   DEA# 012345678

Patty Street, MD

Pediatrician

Pt. name Tim Jones   Age 10   Date Aug. 30, 2014

Address: 2 Joyce Road, Anyway, IL 62000

R$_X$ Ceclor 10 mL bid x 10 d

Refill: 0   _X_ Generic and/or equivalent allowed

Physician's Signature _____*PStreet*_____

    Pediatric Center

    123 Abbey Road

    Anyway, IL 62000

Phone 123-456-7890   DEA# 012345678

Sarah Jean, MD

Pt. name <u>Mary Brown</u>   Age <u>47</u>   Date <u>Sept. 20, 2014</u>

Address: <u>789 6th Street,</u>

R$_X$ <u>Darvon 1 g tab. p.o. q4h for 3 days</u>

Refill <u>Ø</u>   Generic and/or equivalent allowed

Physician's Signature _____*SJean*_____

    SJMedical Associates

    23South Street

    Anytown, IL 62222

Handout 2B: Sample Prescriptions

Phone 123-456-7890   DEA# 012345678
Sarah James, MD

Pt. name Jeff Howard   Age 53   Date Sept. 20, 2014
Address: 1234 5th Street,
R_X Ampicillin 250mg po qid x 10 days
Refill Ø   Generic and/or equivalent allowed
Physician's Signature   *S James*

SJMedical Associates
23South Street
Anytown, IL 62222

March 5, 2005
John Smith, MD
555 5th Ave
Anywhere, USA 12345
(555)555-5555
For: Jane Doe

Rx: Lasix 20 mg. P.O., Daily

Disp: #30
Refills: 2

                                    MD signature
                                    Provider number

Generic

Handout 2C: Sample Prescriptions

I.M. Doctor, MD
Primary Care Associates
123 Wellness Road, Anytown, Canada, (123) 456-7890

Name: Priscilla Reed   Date: July 2, 2008
Address: 265 Logan Avenue   Age/Wt: 63 years, 72 kg

Rx: Metoprolol 50 mg tablet
Sig: Take ½ tablet po bid
M: 30 tablets
Refills: 1

A. Resid, PGY2
A.Resident CPSO # 98765

J.Q. Physician, M.D.
1234 Any Street
Austin, Texas 78701
(512) 123-4567

Name: M.Y. Patient   Date: 6/15/02

Address: 789 Happy Dr., Austin, TX

A generically equivalent drug product may be dispensed unless the practitioner hand writes the words 'Brand Necessary' or 'Brand Medically Necessary' on the face of the prescription.

Procardia 10mg
#30

1 daily in a.m.

Brand Necessary

Refill _2_ times   *J.Q. Physician*
                                   Signature

Activity 3: Calculating Dosage

Maria says you are now ready to learn the dosage formula used to calculate the amount of medication needed to fill a prescription.

Dosage Formula:

Doctor's Order (D)   x   quantity(Q) = individual dosage to be administered
Supply on Hand (H)

      Short version**:**   **$\dfrac{D}{H}$ x Q = one dose**

The formula can be read as: The <u>doctor's order</u> (the numerator) divided by the <u>supply on hand</u> (the denominator), multiplied by <u>the quantity</u> equals <u>the amount of one dose of medication</u>.

Understanding the parts of the Dosage Formula

Doctor's Order (D) is the name and amount of the medicine prescribed by the doctor

Supply on Hand (H) is the amount per item of the medication that is available in the pharmacy

Quantity (Q) is the form of the medication, such as tablet, capsule, or milliliter.

Dosage is the amount of medication to be given in one dose

Important: The doctor's order and the supply on hand must be in the same unit of measure, such as grams (g), milligrams (mg), and milliliters (mL). Answers must include the correct unit notation.

Maria gives you the following example: Dr. Smith has prescribed 30 mg of medicine for her patient. The drug label on the medicine indicates that the medicine is supplied in 60 mg per tablet. We will use the dosage formula to calculate the correct amount of medication for one dose.

<u>(D) 30 mg</u> x (Q) 1 tablet = <u>0.5 mg</u>. Therefore, one dose will be one half (1/2) tablet
(H) 60 mg

Important: In the medical field, any decimal number that is not greater than 1 should have a 0 in front of the decimal point. Thus, the correct form for the dosage in this example is 0.5 mg, **not** .5 mg

Worksheet 3A: Calculating Dosage   Name_____

Maria gives you several prescriptions for you to practice using the formula to calculate the dosage. Make sure you include the correct form (g, mg, mL, etc.) when making your calculations. The first one has been set up for you. Note: If the quantity (Q) is larger than 1, you may want to simplify (cancel) before multiplying.

Dosage formula: $\dfrac{D}{H}$ **x Q = one dose**

1. Order: 500 mg   (D) 500 mg   x (Q) 1 tablet = _____
   Supply on hand: 250 mg per tablet   (H) 250 mg

2. Order: 1 g
   Supply on hand: 0.5 g per capsule

3. Order: 50 mg
   Supply on hand: 25 mg per 5 mL

4. Order: 1000 mg
   Supply on hand: 2000 mg per scored tablet

5. Order: 500 mg
   Supply on hand: 125 mg per caplet

6. Order: 250 mg
   Supply on hand: 125 mg per capsule

7. Order: 25 mg
   Supply on hand: 100 mg per 20 mL

8. Order: 75 mg
   Supply on hand: 5 mg per 20 mL

9. Order: 5 mg
   Supply on hand: 32 mg per 8 mL

10. Order: 500 mg
    Supply on hand: 50 mg per 2 mL

Worksheet 3B: Filling Complete Prescriptions   **Name** _____

Maria now wants you to calculate the individual dose, the daily dose, and the total amount needed to fill the complete prescription for several patients. Refer to your abbreviations list to help you decode the prescription information, if needed. Remember to write the form of medication in your answer.

Prescription	Single dose	Daily dose	Complete prescription
Ampicillin 500 mg po qid x 5 d On hand: 250 mg capsules	_____	_____	_____
Digoxin elixir 150 mcg po tid x 10 d On hand: 50 mcg/mL	_____	_____	_____
Codeine sulfate 60 mg po q4h x 7 d On hand: 30 mg tablets	_____	_____	_____
Clondine 0.4 mg po bid x 3 d On hand: 0.1 mg tablets	_____	_____	_____
Amoxicillin 250 mg po qid x 10 d On hand: 125 mg capsules	_____	_____	_____
Lasix 40 mg po qd x 30 d On hand: 20 mg tablets	_____	_____	_____
Ampicillintrihydrate 250 mg po qid x 10 d On hand: 125 mg per 5 mL	_____	_____	_____

Quiz: Calculating Dosage   Name _____

For each of the following doctor's orders, calculate the individual dose of medication.

1. Dr. Jones prescribed Plendil 7.5 mg. The drug label reads: Plendil 2.5 mg tab.

2. The doctor ordered Dilaudid 1.5 mg IM from a vial that is labeled 0.6 mg per mL

3. Dr. Sam prescribed 20 mg of a medication. You have 10 mg per 5 mL.

4. The physician ordered Procardia XL 60 mg. The drug on hand is Procardia XL 30 mg tablets.

5. Dr. Garza prescribed 30 mg of Phenobarbital. The pharmacy has 15 mg capsules available.

For each of the following prescriptions, calculate the individual dose, the daily dose, and the total amount needed to fill the complete prescription.

	Single dose	Daily dose	Total amount
6. Amoxicillin 500 mg capsule po tid x 10 d On hand: 500 mg/1 capsule	_____	_____	_____
7. Prednisone 40 mg po bid x 3 d On hand: 10 mg tablet	_____	_____	_____
8. Ciprofloxin 750 mg po qd x 10 d On hand: 500 mg scored tablet	_____	_____	_____
9. PenVK 250 mg po qid x 10 d On hand: PenVK 250 mg/1 tsp	_____	_____	_____
10. Acetaminophen 500 mg tab po q4h x 5 d On hand: 250 mg/1 tablet	_____	_____	_____

Worksheet 1: Prescription Abbreviations <u>Answer Key</u>

1. qid <u>G</u>   A. by mouth or orally

2. hs   <u>M</u>   B. liquid or syrup

3. bid <u>O</u>   C. every day

4. g   <u>N</u>   D. three times a day

5. mg   <u>F</u>   E. medication inserted rectally

6. po   <u>A</u>   F. milligram

7. qd   <u>C</u>   G. four times a day

8. gr   <u>K</u>   H. every 6 hours

9. U   <u>L</u>   I. milliliters

10. tid <u>D</u>   J. as needed

11. Elix. <u>B</u>   K. grain

12. Supp. <u>E</u>   L. Unit

13. q6h <u>H</u>   M. at the hour of sleep; bedtime

14. mL   <u>I</u>   N. gram

15. prn <u>J</u>   O. twice a day

Worksheet 2: Decoding Prescriptions   <u>**Answer Key**</u>

Answers will vary depending on the prescriptions used for this activity

The patient's full name	
The date	
The drug name in manufacturer or generic format	
The doctor's order for dosage amount (how much medication)	
The administration route (by mouth, IV, injection)	
The frequency with which the patient is to take the medication	
The duration, the number of days that the patient is to take the medication	
The total quantity or amount that the pharmacist is to dispense	
A check-off or box allowing a generic substitute (if provided)	
The physician's name	
The physician's DEA number	

Worksheet 3A: Calculating Dosage   <u>**Answer Key**</u>

Dosage Formula: $\dfrac{D}{H}$ x Q = **drug dose**

1. Order: 500 mg
   Supply on hand: 250 mg per tablet   <u>2 tablets</u>

2. Order: 1 g
   Supply on hand: 0.5 g per capsule   <u>2 capsules</u>

3. Order: 50 mg
   Supply on hand: 25 mg per 5 mL   <u>10 mL</u>

4. Order: 1000 mg
   Supply on hand: 2000 mg per scored tablet <u>½ tablet</u>

5. Order: 500 mg
   Supply on hand: 125 mg per caplet   <u>4 caplets</u>

6. Order: 250 mg
   Supply on hand: 125 mg per capsule   <u>2 capsules</u>

7. Order: 25mg
   Supply on hand: 100 mg per 20 mL   <u>5 mL</u>

8. Order: 75 mg
   Supply on hand: 5 mg per 20 mL   <u>300 mL</u>

9. Order: 5 mg
   Supply on hand: 32 mg per 8 mL   <u>1.25 mL</u>

10. Order: 500 mg
    Supply on hand: 50 mg per 2 mL   <u>20 mL</u>

Worksheet 3B: Filling Complete Prescriptions   <u>**Answer Key**</u>

<u>Prescription</u>	<u>Single dose</u>	<u>Daily dose</u>	<u>Complete prescription</u>
Ampicillin 500 mg po qid x 5 d			
On hand: 250 mg capsules	<u>2 capsules</u>	<u>8 capsules</u>	<u>40 capsules</u>
Digoxin elixir 150 mcg po tid x 10 d			
On hand: 50 mcg/mL	<u>3 mL</u>	<u>9 mL</u>	<u>90 mL</u>
Codeine sulfate 60 mg po q4h x 7 d			
On hand: 30 mg tablets	<u>2 tab</u>	<u>12 tab</u>	<u>84 tab</u>
Clondine 0.4 mg po bid x 3 d			
On hand: 0.1 mg tablets	<u>4 tab</u>	<u>8 tab</u>	<u>24 tab</u>
Amoxicillin 250 mg po qid x 10 d			
On hand: 125 mg capsules	<u>2 tab</u>	<u>8 tab</u>	<u>80 tab</u>
Lasix 40 mg po qd x 30 d			
On hand: 20 mg tablets	<u>2 tab</u>	<u>2 tab</u>	<u>60 tab</u>
Ampicillintrihydrate 250 mg po qid x 10 d			
On hand: 125 mg per 5 mL	<u>10 mL</u>	<u>40 mL</u>	<u>400 mL</u>

Quiz: Calculating Dosage   <u>**Answer Key**</u>

For each of the following doctor's orders, calculate the individual dose of medication:

1. Dr. Jones prescribed Plendil 7.5 mg. The drug label reads: Plendil 2.5 mg tab.

    3 tab

2. The doctor ordered Dilaudid 1.5 mg IM from a vial that is labeled 0.6 mg per mL

    2.5 mL

3. Dr. Sam prescribed 20 mg of a medication. You have 10 mg per 5 mL.
    10 mL

4. The physician ordered Procardia XL 60 mg. The drug on hand is Procardia XL 30 mg tablets.

    2 tab

5. Dr. Garza prescribed 30 mg of Phenobarbital. The pharmacy has 15 mg capsules available.
    2 capsules

For each of the following prescriptions, calculate the individual dose, the daily dose, and the total amount needed to fill the complete prescription.

	Single dose	Daily dose	Total amount
6. Amoxicillin 500 mg capsule po tid x 10 d On hand: 500 mg/1 capsule	1 capsule	3 capsules	30 capsules
7. Prednisone 40 mg po bid x 3 d On hand: 10 mg tablet	4 tabs	8 tabs	24 tabs
8. Ciprofloxin 750 mg po qd x 10 d On hand: 500 mg scored tablet	1 ½ tabs	1 ½ tabs	15 tabs
9. PenVK 250 mg po qid x 10 d On hand: PenVK 250 mg/1 tsp	1 tsp	4 tsp	40 tsp
10. Acetaminophen 500 mg tab po q4h x 5 d On hand: 250 mg/1 tablet	2 tabs	12 tabs	60 tabs