Nursing Top Student

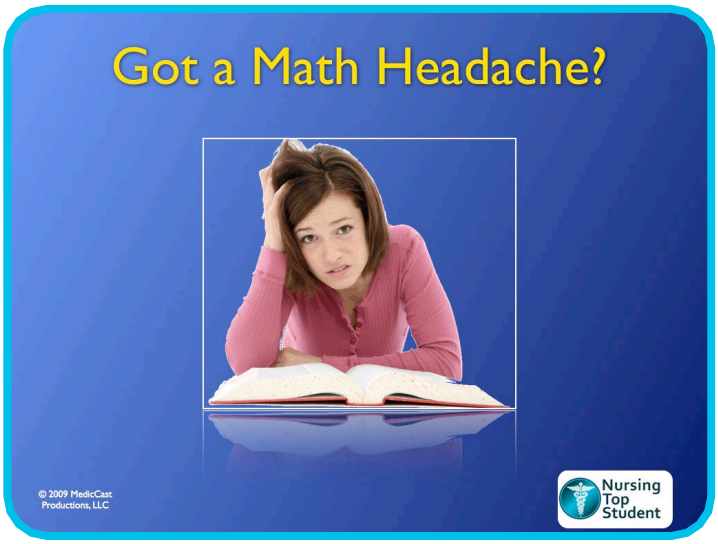
Medication Math Simplified

a Nursing Top Student video slideshow

Hi, I'm Jamie Davis, the Podmedic, host of popular online radio programs such as "The Nursing Show" and "MedicCast Podcast." I wanted to personally welcome you to this educational disc or online course because I think that this an important topic for all of us to review from time to time.

You have purchased this video series because you are struggling with successfully computing medication math problems. Whether you are a nurse, physician, paramedic, or other medical professional, medication and drug calculations are a necessary part of your job. Patient safety depends on you calculating correctly each and every time.

This eBook is part of a video tutorial series that includes both video and audio segments, slides of the presentations, and student handouts. It is designed to review and refresh medication math for medical professionals at all levels from EMTs and paramedics on the street to nurses, physicians and others. We'll take the basic concepts and break them down, simplifying them for you (and me).



Math Phobia?

•Does math drive you nuts?

•Does it take you what seems like hours to complete your calculations?

ME, TOO!

I know that a lot of people who listen to my shows online think I'm some kind of genius paramedic or nurse to do what I do. No, I work hard to produce the materials, research the facts, and when it comes to math, fall back on tried and true techniques to make it easier for me.

Still think you can't do it?

I think you can and I'll tell you why . . .

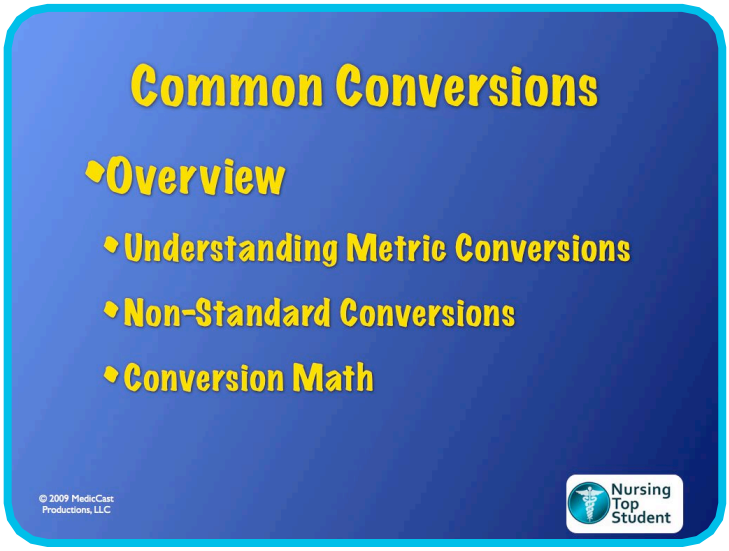
If you can learn and master the steps of a basic assessment, then I am confident that you can learn the methodical steps to become a confident medical mathematician!

The problem with most students whom I've met is when they look at math, their eyes cross. Seriously! It's as if everything starts to swim around and before they know it everything just becomes a big jumble of numbers and signs. If only they had a step by step plan, a way of doing things that would allow them to be successful and safe when calculating patient doses and other medical math like metric conversions.

This program is a road map to med math success for you. No one goes on a trip to a destination by just randomly driving and expecting to get there, or at least get there in a reasonable time frame. You DO NOT want to be arriving at medication dosages by accident!

Since accidental dosing is not a desired patient outcome, we need to come up with a better way, together to get the job done. Here's what we're going to do. We're going to take things step by step - plan our approach so that every calculation becomes the same. We'll follow the same steps and complete the problem, the same way, every time. We'll start out with a review of some common conversions needed for medical calculations. Then we'll get into the Med Math Simplified plan for every formula. Finally, we'll touch on some of the tricks and short cuts that are out there and why it's not a good idea to become too reliant on them all of the time.

SECTION 1: MEASUREMENT CONVERSIONS



In these initial segments, we'll review the common measurement conversions out there and take a look at some of the non-standard ones, too. The most important conversions involve converting metric units to larger and smaller units. Next we'll look at non-standard unit conversions like converting pounds to kilos and some of the old apothecary weights and measures. Finally we'll look at setting up the math conversion problems to make sure we get the correct answer.

The METRIC SYSTEM!!!!

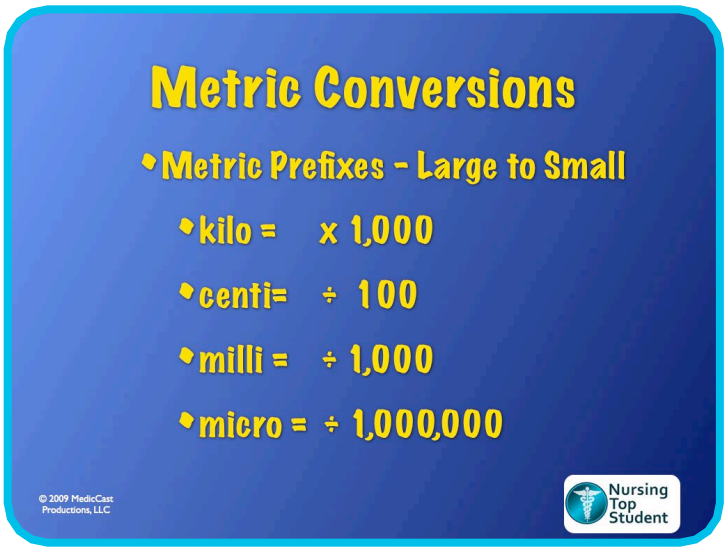
Ok, maybe that's a bit much, but this is really important. For some of you, this may be an easy review, for others, this may be the basis of you med math challenges. The important part is to stick around and review this info together so we can move forward. This is the basis of everything that follows.

The metric system is easy because it is entirely based on units of ten. If you can count by tens and hundreds then the numbers are easy in the metric system. I have found, though, that the base units and prefixes tend to mix people up so we'll spend most of our time focusing on those. Just remember that the next higher or lower units of measure are either bigger or smaller by a factor of 10. Simply add or subtract a zero, or move a decimal point to convert the number to the next unit of measure.

Metric base units:

•**Meter** is a unit of length or in really big lengths - distance. If you measure a pencil, it is a simple length measurement but measure how far it is to the next town, and it is better thought of as a distance. Still, it all is based on the meter as the root term. A meter is roughly equivalent to a yard in english measure or 3 feet. For reference, a man is about 2 meters tall.

•**Gram** is a unit of weight or mass. Depending on the thing being measured, it will either be a really big number (something heavy) or small number (lightweight). A gram is about the weight of paper clip. So it is pretty small - about .35 ounces each in english measures.



•**Liter** is a unit of volume or displacement. It is roughly equal to a quart in English measure.

Let's move on to the metric prefixes. Remember each is a multiple of 10's so you are just adding or subtracting zeroes, or moving the decimal a number of places to the right or left.

Common Metric Prefixes:

•**Kilo** is the largest measurement prefix we'll be using. You will most commonly see this in measures of weight where you are estimating a patient's weight or converting from pounds to KILOgrams. Kilo signifies one thousand times the base unit so a kilogram is one thousand grams.

•**Centi** moves the base unit smaller, reducing the base unit by 100. You will most commonly see this in describing wounds or short distances on a body: for instance, the wound was 2 cm across and was 5 cm to the left of the patient's midline. A centimeter is 1/100 of a meter. You will most likely only use this in terms of length or distance and not for weights or volume.

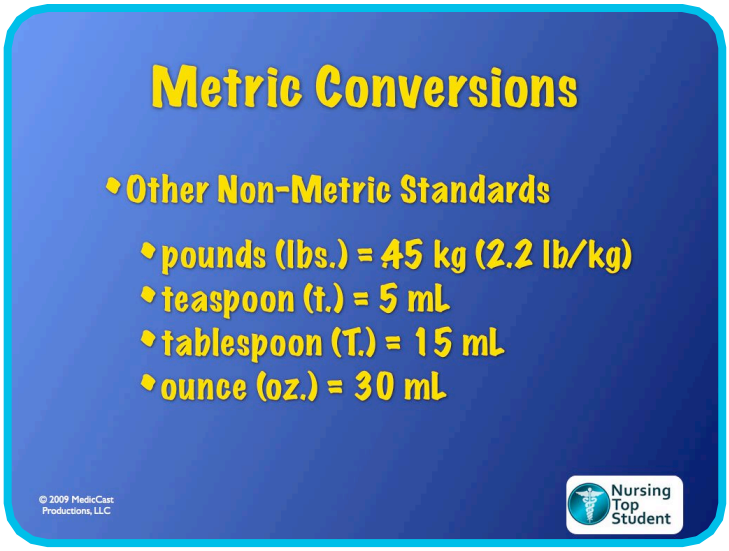
•**Milli** makes the base unit one thousand times smaller. It is going to be the most commonly seen prefix in medication math as it refers really small divisors of the base units. For instance 1 mg is 1/1,000 of a gram (that's 1/1,000 of that paperclip). This is useful for volume measurement as well, since a liter is so large, a mL is a much easier unit of measurement for dosing medications in solutions.

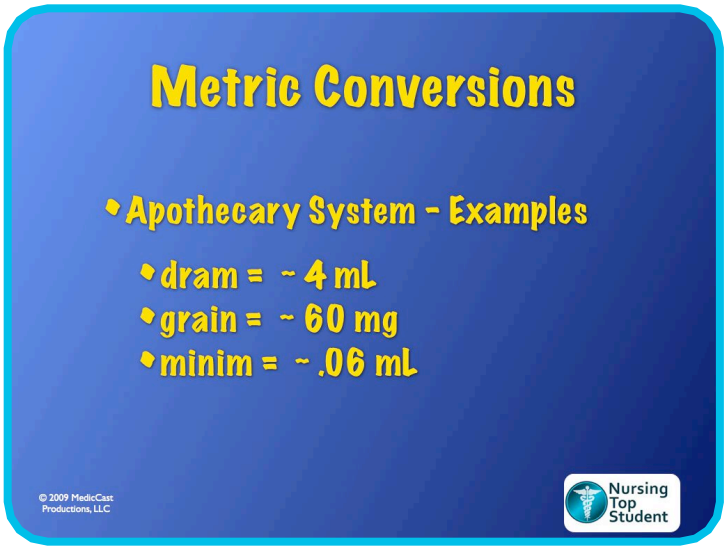
•**Micro** reduces the base unit one million times and will most commonly be used in weights in micrograms. This is really small but it is important to note the difference and be very careful. If you mistake a microgram measurement for a milligram measurement, you will give the patient one thousand times their normal dose!

Non-Standard Units of Measure

Now we'll look at non-standard units of measure including the old apothecary system. This system is being phased out, but you may find an older physician who still prescribes using this system. The apothecary system is based in old, non-standardized weights and measures. This means that depending on your textbook or reference source, you might have two different conversions from drams to milliliters.

The Joint Commission guidelines for medication safety and error reduction would call this a violation of standard practices and I, personally, would not take an order written this way. In cases where I received an order written in non-standard units, I would ask the doctor to rewrite it or a pharmacist to convert it for me.





Conversions from teaspoons is useful for medications in solution for oral administration (pediatric meds particularly). A teaspoon is equivalent to 5 mL. The teaspoon is being phased out because a teaspoon is also the common name for a spoon in your flatware set. These are not standardized in any way so dosing is better with a measuring cup or spoon designed for medications.

The same is true of the tablespoon, since many unknowing parents may just use a bigger spoon like a soup spoon or serving spoon. A tablespoon is three teaspoons or 15 mL.

Here are some samples from the apothecary system. Other non-standard measurements include the ones listed below. These are more important since these are more commonly needed in calculations. Converting from pounds to kilograms happens quite frequently.

pounds (lbs.) = 0.45 kg (2.2 lb/kg)

teaspoon (t.) = 5 mL

tablespoon (T.) = 15 mL

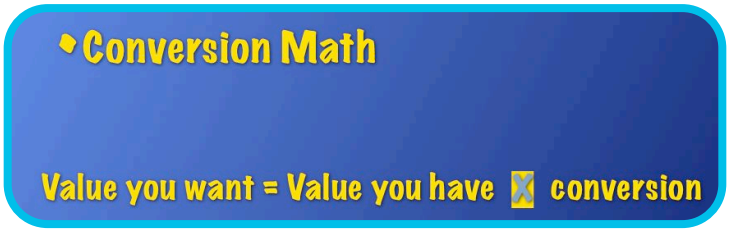
ounce = 30 mL

Conversion Math Formulas

Let's look at conversions between metric measures as well as conversions between metric and the non-standard weights and measures. This requires setting up an equation that you will solve with some basic algebra. Setting up these equations or formulas is the key to correctly figuring med math.

The formula is the most important part of the process so let's look a basic version of the formula first. Formula Layout:

- Figure out **which value you want** (what is the question asking you for?)
- Place that on the **left** side of the equation.
- Figure out the **value(s) you have.**
- Place that on the **right** side of the equation.
- Determine your **conversion values**.
- Multiply the **value you have** by the **conversion values**.



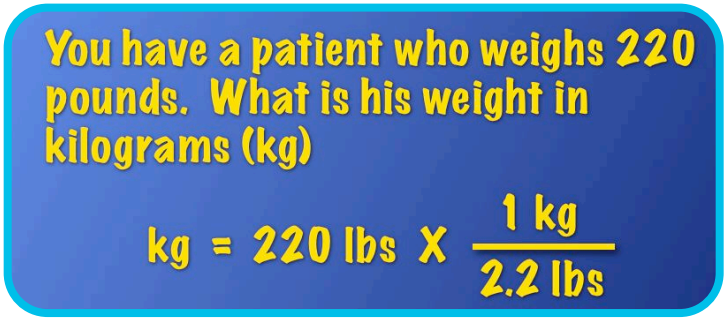
Let's start with a basic conversion you'll be running all of the time - converting pounds to kilograms. Here's the practice problem:

You have a patient who weighs 220 pounds. What is his weight in kilograms (kg)?

Yeah, I know. We can all do this one in our heads. Every adult male is exactly 100 kilos, right? Seriously, though. Get in the habit of setting up these problems correctly from the start. Even on the easy ones.

Look at the question again and follow our steps in laying out the equation for the first time.

- What do you want to know? -- The weight in kilograms.
- Place kilogram (kg) on the left side of the equals sign.
- What do you know? -- The weight in pounds.
- Place the weight in pounds on the right side of the equals sign.



- What is the conversion? -- 2.2 pounds per kilograms.
- Multiply the weight in pounds by the conversion value 2.2 pounds per kilogram.

NOTE: As you build the formula you'll need to keep a few rules in mind. You want the value labels to cancel out I'll turn that over though and say it's 1 kilogram per 2.2 pounds. And you need to get in the habit of doing that to make sure you are getting the answers you want. Put the corresponding value you want on top on the opposite side of the equation.

Do the Math

$$kg = 220\ \cancel{lbs} \times \frac{1\ kg}{2.2\ \cancel{lbs}}$$

$$kg = \frac{220\ kg}{2.2}$$

Let's convert this one. First, cancel out the pieces of the equation you can. Remember from your basic algebra classes, you may cancel values or like numbers on a one for one basis from the the top and bottom of the equation. That leaves you with 220 kilograms divided by 2.2. When you do the math and you get 100 kg.

Now this whole time you've been saying, "Jamie, I already know that one. I can do it in my head!" and you are right. But this is about setting up the equation so that you can run the equation the same way each and every time you need to do so.

Let's try one more.

The bag of saline you have is labeled 1 Liter. How many milliliters do you have?

Ok, let's set up the equation again.

- What do you want to know? -- How many milliliters do you have.
- What do you know? -- You have 1 Liter.
- What is the conversion you need to use here? -- 1 Liter is equal to 1,000 milliliters. Remember to put the value you want on the top!
- Let's cancel out the values we can. When you do, you are left with a final answer of 1,000 milliliters.

The bag of saline you have is labeled one Liter. How many milliliters do you have?

$$mL = 1\ L \times \frac{1000\ mL}{1\ L}$$

$$mL = \cancel{1\ L} \times \frac{1000\ mL}{\cancel{1\ L}}$$

$$mL = 1000\ mL$$

Conversion Review

Let's review some key points before we move on to laying out more complex equations.

Understand the underlying relationships of the Metric system. Know the different factors of ten for each of the various prefixes and how they modify the base values.

Non Standard Conversions are out there even as we strive for a universal safe dosing and medication standard. It is important to recognize them and to memorize at least a few of them.

Do the Math. The last part you have to do. Sorry. No tricks here. If you think you need additional resources or a refresher about basic math or algebra, I'd suggest talking to your school about what resources and tutoring they make available.

Quiz # 1 Conversion Math

Convert the following measurements to the indicated value. Round decimal values to the nearest tenth.

1. 80 pounds (convert to kilograms)

2. 3 ounces (convert to milliliters)

3. 2 table spoons (convert to milliliters)

4. 5 teaspoons (convert to milliliters)

5. 135 pounds (convert to kilograms)

Convert the metric system values to the indicated value. Show all decimals values.

6. 1,250 mL (convert to liters)

7. .00052 Liters (convert to milliliters)

8. .0042 Grams (convert to micrograms)

9. .042 Grams (convert to milligrams)

10. 12 milligrams (convert to micrograms)

Note about pounds to kilogram conversions. The values of 2.2 pounds per kilogram and 1 pound equaling 0.45 kg are rounded decimal values. The actual conversions are: 2.2046226 pounds per kilogram or 1 pound equals 0.45359237 kg.

When using the rounded values, you will notice a minor difference if you use one calculation form versus another. This is a negligible difference in dosing calculations. To avoid confusion, for this tutorial series, we will use 2.2 pounds per kilogram as our standard conversion value for all weight conversions from pounds to kilograms.

Answer key Quiz #1
1.) 36.4 kg; 2.) 90 mL; 3.) 30 mL; 4.) 25 mL; 5.) 61.4 kg; 6.) 1.25 Liters; 7.) 0.52 mL; 8.) 4200 mcg; 9.) 42 mg; 10.) 12,000 mcg

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