Lesson 1: Things to memorize: weights, measures, thermometry, and abbreviations

Anyone going into the practice of pharmacy will recognize that there is a lot of memorization involved. Memorization of basic conversions will be your first step toward mastery of pharmaceutical calculations. By the end of this lesson you will be ready to move on to problems where you will use the facts you have memorized to solve problems that will arise in daily practice.

Measurement systems

There are four kinds of measurement systems that are used in the world of pharmacy: metric, apothecaries', avoirdupois, and "common" systems of measurements.

Metric system. You are probably pretty familiar with metric measurements from primary and secondary school. In pharmacy, you will be dealing with metric measurements of length/height, volume, and weight. These will be the meter (m), liter (L), and gram (g), respectively. It is highly likely that you know the prefixes that represent multiples or fractions of these measurements, but in case you are a bit rusty, here are the ones you will likely encounter in clinical practice:

prefix (abbreviation): meaning	example
kilo (k): one thousand	kilogram(kg): drug dosing commonly needs the patient weight to be in kg
deci (d): one-tenth	deciliter (dL): some drug concentrations are reported as g/dL
centi (c): one-hundredth	centimeter (cm): patient heights often have to be converted from inches to cm
milli (m): one-thousandth	milliliter (mL): most injectable drug amounts are in mL
micro (mc or μ): one-millionth	microgram (μg or mcg): some drugs have low serum concentrations e.g., μg/L
nano (n): one-billionth	nanogram (ng): some drugs have very low serum concentrations e.g., ng/L
pico (p): one-trillionth	picogram (pg): a few drugs have barely detectable concentrations e.g., pg/L

Apothecaries' system. As you can guess from the name, this system was used by the old time apothecaries—forerunners to today's pharmacists and pharmacy technicians. In this system, one troy pound was made up of 5760 grains. The troy (apothecary) pound was divided into 12 ounces, each of these ounces (symbol: ℥) into 8 drachms (pronounced "drams" and contemporarily spelled as such; symbol: ʒ), each drachm into 3 scruples, and each scruple into 20 grains. There was also a fluid measure in this system. Here one gallon was divided into 4 quarts, each quart into 2 pints, each pint into 16 fluidounces, each fluidounce into 8 fluidrachms, and each fluidrachm into 60 minims. Although your first reaction to this may be "yuck!" you will nonetheless recognize some of the volume components as familiar if you cook.

Avoirdupois system. This system is Roman in origin, has a French name, and was adopted by the English as a standard for weights in commerce. An avoirdupois (pronounced ah-vwor-doo-pwuh') pound is divided into 16 avoirdupois ounces. One avoirdupois ounce is made of 437.5 grains. You will notice that the number of ounces in a pound is different in this system, compared to the apothecaries' system, as is the number of grains (7000 grains per pound in the avoirdupois system versus 5760 grains per pound in the apothecaries' system). The common measure between the two systems is the grain, such that a grain in the avoirdupois system has the same weight as a grain in the apothecaries' system.

Common or Household system. These combine bits of both the apothecary and avoirdupois systems and also throws in a couple of measures found in neither system. This is the system that is used commonly in the United States. Although it is being replaced by the metric system, this is occurring at a pace so painfully slow that it is unclear whether our children's children will not still be learning both metric and common systems of measurement, at least when *they* cook. The basics of this system are outlined below, although it is likely that you know these already.

1 gallon (gal)	=	4 quarts
1 quart (qt)	=	2 pints
1 pint (pt)	=	2 cups
1 cup	=	8 fluidounces
1 fluidounce (oz)	=	2 tablespoonfuls*
1 tablespoonful (T or tbsp)	=	3 teaspoonfuls* (tsp)
1 pound (lb)	=	16 ounces (oz)
1 yard (yd)	=	3 feet
1 foot (ft or ')	=	12 inches (in or ")

*if you have more than one of these you will add the s to the end of the word. For example, "teaspoonfuls" is correct while "teaspoonsful" is incorrect.

Measurement system trivia (amaze your friends! impress your preceptor!)

- In Medieval times, the merchants came to the people, rather than the people coming to the merchants. Merchants would thus travel the countryside spending a day or more at each regional fair, returning periodically to the port cities or craftsmen to restock their wares. Some cities were large enough to have "great fairs" which drew merchants and traders from many countries. One such city was Troyes, in the Champagne region of France, home to a great fair in the 700-800s. It is likely that the apothecary "Troy" pound came from the name of this city, where a standard weight of coinage for metals, jewels, and medicines was determined that ended up being adopted all over Europe. Troy weight is still used in the jewelry industry. In England, a Troy pound of silver became a measure of currency and eventually gave its name to the sterling pound.
- A grain weight originated from the weight of a dried grain of wheat (France) or barleycorn (England), pulled from the middle of the ear (that's the wheat or barleycorn ear, not the measurer's…).
- The reason that the standard English measurement system has a French name is that at the time of adoption, French was the language spoken by the English court. Avoirdupois has been roughly translated into "heavy goods," "goods of weight," and "to have weight."
- The story about the connection between the scruple as a measure of weight and a scruple as a moral principle that keeps people from doing wrong is an interesting one. It seems that the Medieval apothecaries' apprentices were supposed to use weights in order to measure out the correct amount of medication for a prescription. Because the amount in a scruple was so small, however, (about 1.3 g: around the weight of a quarter teaspoonful of salt) some of the apprentices would just take a pinch of the ground substance for each scruple and add it to the drug mixture they were concocting, rather than go through the laborious process of using the scruple weight and balance to make sure they had the right amount. If the apothecary (who was both physician and pharmacist in Medieval times) didn't see the scruple weight laid out, they would ask the apprentice, "have you no scruples?" This phrase became first associated with carelessness or an unconcern for accuracy and in time changed to mean a lack of principles or moral integrity; individuals with these attributes came to be described as "unscrupulous."
- The metric system was created in France with the groundwork for the system laid, several hundred years ago, by scientists and astronomers. They chose a basic unit of length as being 1/10,000,000 part of the earth's quadrant (the distance from one of the poles to the equator): a meter. There were six other standards chosen as basic units for mass (gram), time (second), amount of a substance (mole), thermodynamic temperature (kelvin), electric current (ampere), and luminous intensity (candela). These were all based on the meter; for example, the basic unit for weight is the gram, which is the weight of one cubic centi*meter* (cm^3) of water at 4°C, measured at sea level. Other units such as area (m^2), volume (m^3), and temperature degree (C) were all derived from the basic units. In 1960, this measurement system was adopted as the official measurement system worldwide, and is called *the Système International d'unite*s (International System of Units) and is abbreviated as "SI units".
- The abbreviation for ounce, oz., is probably derived from the Italian word for ounce, "onza."

Converting between measurement systems

The most basic calculations you will do in pharmacy will consist of converting between the metric system and the other measurement systems. It is these conversions that you will need to memorize.

Length. Patient heights are often relayed to you in feet and inches, but calculation of body surface area or some nutrition calculations will require the measurements to be in centimeters.

1 inch = 2.54 cm

It is unlikely that you will need to convert between centimeters and feet or meters and feet in the practice of pharmacy. If you do, then it is pretty easy to use the relationship between inch and centimeter in a proportional calculation to determine what you want to know.

Volume. You will frequently work with volumes—of total product, of dose, and as the denominator in a concentration.

Total volumes of liquid drugs prescribed by physicians will be conveyed as ounces (e.g., 8 ounces of a cough syrup) or in milliliters (e.g., 200ml of an antibiotic suspension). If ordered in ounces, the physician will really mean the apothecaries' fluidounce, but practically no one uses the term "fluidounce" anymore – everyone just refers to it as an ounce. The relationships that you will need to memorize are:

1 pint = 473ml

1 fluidounce = $\overline{3}$ (symbolically) = 29.6ml. It is permissible to round this to 30ml

Volumes you will encounter most frequently in doses are teaspoonfuls, which physicians will still represent symbolically as 3. The conversion is:

1 teaspoonful = 3 (symbolically) = 5ml

If you are a mathematically nimble person, you may be saying, "Now just hold on a minute! If there are 8 drachms (3) in one fluidounce ($\overline{3}$), then 29.6ml ÷ 8 should mean that there are 3.7ml in each fluidram (3)." Although you are absolutely correct here, in real practice it's not interpreted that way. When a physician or pharmacist writes 3 on a prescription, he or she *always* means "one teaspoonful" and so you *must* interpret it as 5ml.

One final volume that you should know about, even if it may not be useful, is the dropper. The "official" dropper contains 20 drops/ml (of water). You, however, will always need to calibrate the dropper if a need for accuracy exists, since the "official" dropper is probably the only type of dropper never available..... Fortunately, droppers that accompany commercially-available prescription and over-the-counter medications will be pre-calibrated for you.

Weight. The most important weight conversions will be between ounces and grams usually for total volumes of solid dosage forms, and between pounds and kilograms, since patients will tell you their weight in pounds but dosage recommendations will be based on kilogram weight. The conversions are:

1 kg = 2.2 lb

1 ounce = 28.35g ≈ 28.4g

When converting between ounces and grams, realize that when rounding 28.4g, 30g is too far off for reasonable accuracy, when you are compounding. It is best if you memorize the conversion to the nearest tenth of a gram (i.e., 28.4g), but if you must round to the nearest whole number, please round to 28g, rather than to 30g.

Since the use of grains as a measure of weight has almost gone by the wayside in the medical profession (most health care practitioners think of grains as a way to obtain fiber in the diet, rather than as a unit of weight), you will rarely encounter their use. Because you will occasionally see them, however, you will need to memorize the conversion. It is

1 grain = 64.8mg; it is permissible to round this number to 65mg

Summary of measurement systems: you will need to memorize this list

1. length
a) 1 inch = 2.54 cm

2. volume:
- 1 pint = 473ml = 16 fluidounces
- 1 fluidounce = 29.6ml = ℥ (symbolically) = approximately 2 tablespoonfuls (30ml OK)
- 1 fluidram = ʒ = 5ml = one teaspoonful
- 1 tablespoonful = 15ml
- 2 cups = 1 pint
- 8 pints = 1 gallon

3. weight
a) 1 grain = 64.8mg (65mg OK)
b) 1 kg = 2.2 lb
c) 1 ounce = 28.4g

Body Surface Area

"BSA" stands for "body surface area" and the units are always m^2. Body surface area is sometimes used in medication dosing, rather than weight alone, particularly for chemotherapy drugs. A universal equation for calculating BSA of both children and adults is:

$$\text{BSA in } m^2 = H^{0.3964} \times W^{0.5378} \times 0.024265$$

where height is in centimeters and weight in kilograms. All other BSA equations work for *either* kids *or* adults, but have not been validated in all ages.

The most commonly-used equation for adults is the Dubois and Dubois method. Corresponding calculations for children and neonates (babies between birth and 1 month of age) are shown here:

for adults	*for children > 1 mo ~ 3 yrs)*	*for neonates (birth – 1 mos)*
BSA in $m^2 = H^{0.725} \times W^{0.425} \times 0.007184$	BSA in $m^2 = (0.1)(W^{0.67})$	BSA in $m^2 = (0.103)(W^{0.67})$

where height is in centimeters and weight in kilograms.

A final easier-to-remember equation that works for adults is:

$$\text{BSA in } m^2 = \sqrt{\frac{(H)(W)}{3600}}$$ where height is in centimeters and weight in kilograms, or

$$\text{BSA in } m^2 = \sqrt{\frac{(H)(W)}{3131}}$$ where height is in inches and weight in pounds.

Adult BSAs are usually rounded to the nearest tenth of a m^2, whereas infants, toddlers, and children are rounded to the nearest one-hundredth of a m^2.

Whatever BSA you calculate, you should get a number for:
a) an adult that is in the ballpark between 1.4 m^2 and 2.4 m^2 (a range of BSA for a 100 pound, 5' 0" person and a BSA for a 240 pound, 6'2" person. Please double check these with your own calculator using the universal equation; now recheck both numbers using the Dubois equation – did you get the same answers? Notice that the discrepancies between the equations are more noticeable when the patient is large).
b) a child in the range of 0.27 m^2 to 1.35 m^2 (i.e., range between an average 3-month old and a 12-year old child).

c) a newborn of around 0.22 m^2 or even lower.
The important thing to take away from this paragraph is that if you calculate a number that is quite different from these ranges (e.g., higher than 2.4 m^2 – and the patient isn't overly large) then you should feel completely confident that you messed up somewhere. Redo the calculation.

Trying to memorize any of the equations for BSA may be an exercise in frustration, but you should choose the equation(s) that you feel most comfortable with to keep with you when at a clinical practice site, particularly if you work at all with medications for children or for cancer patients.

Thermometry

You need to be able to convert back and forth between the centigrade/Celcius and Fahrenheit temperature scales. These are both used in the clinical setting for reporting patient temperatures. Some institutions/clinics will report Fahrenheit, others centigrade, or, more commonly, the patient will report a temperature in Fahrenheit but your dosing guide for medications will give guidelines using the centigrade scale; it is imperative that you can move comfortably back and forth between them.

$$°F = \frac{(°C \times 9)}{5} + 32 \quad \text{or} \quad °F = (°C \times \frac{9}{5}) + 32 \quad \text{or} \quad °F = (°C \times 1.8) + 32$$

$$°C = \frac{(°F - 32)}{9} \times 5 \quad \text{or} \quad °C = (°F - 32) \times \frac{5}{9} \quad \text{or} \quad °C = (°F - 32) \times 0.56$$

Some students have used the equations 9C = 5F – 160 and 5F = 9C + 160; you will find these are another version of the same equations above.

Temperatures should be rounded to the nearest tenth of a degree (both Fahrenheit and centigrade e.g., 98.6°F, 37.0°C).

If you were to insert thermometers in several of your major orifices at the same time, you would find (besides feeling like a porcupine) that they would not give you the same exact reading. Rectal temperatures are around 1°F (0.5°C) greater than oral temperatures. Oral temperatures are around 1°F (0.5°C) greater than axillary (i.e., armpit) temperatures.

If dosing directions for a medication are based on temperature, which site do you use to determine temperature for a patient? Generally, for individuals aged 5 years and older, you will use an oral temperature, and for children younger than age 5 you will use a rectal temperature, in order to determine whether to give a fever-reducing agent. You will always have to adjust an axillary temperature since recommendations for dosing of fever-reducing medications are never based upon an axillary temperature.

You will need to memorize the Fahrenheit-centigrade and centigrade-Fahrenheit conversion equation that you like best, and memorize the conversion between oral, rectal, and axillary temperatures.

Abbreviations used on prescriptions

Why do you need to learn information about abbreviations used on a prescription, for a pharmacy calculations class? The main reason is that you need to evaluate every dose for every patient to determine whether or not you think it is the right dose for that patient. The first step in evaluating the dose is to be able to *read* the prescribed dose on the prescription, which will usually be communicated in a series of symbols and abbreviations. You will need to know how to interpret these in order to select the correct medication, as well as check the dose, and translate the directions into something that the patient will understand. This is going to involve some tedious memorization. The most common abbreviations that you will use will be summarized here in a format similar to the way you would need to consider them when reading a prescription.

Drug names. First, after you have confirmed that you have the correct name and contact/location information for the patient, you will need to determine the drug name. Prescribers may abbreviate the names of some drugs (this doesn't mean that it is the correct thing to do, but you will see it done). The following are common abbreviations used:

abbreviation	meaning
5-FU	fluorouracil
APAP	acetaminophen
ASA	aspirin
AZT	zidovudine (chemical name: azidothymidine)
CE	conjugated estrogens
CPZ	chlorpromazine
D5-1/2NS	5% dextrose and half-normal saline (0.45% sodium chloride) in water (this is an intravenous infusion solution)
D5W	5% dextrose in water (this is an intravenous infusion solution)
EES	erythromycin ethylsuccinate
EPO	erythropoietin
HCTZ	hydrochlorthiazide
INH	isoniazid
LR	lactated Ringer's solution (this is an intravenous infusion solution)
MOM	milk of magnesia
MPA	medroxyprogesterone acetate
MS	morphine sulfate
MVI	multivitamin
NS	normal saline (0.9% sodium chloride in water)
NTG	nitroglycerin
PB	phenobarbital
PCN	penicillin
PPD	purified protein derivative (this means a tuberculin skin test)
TMP/SMX	trimethoprim + sulfamethoxazole
TPN	total parenteral nutrition

Prescribers will also use standard chemical abbreviations for electrolytes and other substances, e.g., KCl, NaCl, $MgSO_4$, but you will already know these if you have taken general chemistry courses.

You will also see classes of drugs abbreviated, most commonly NSAIDs (nonsteroidal antiinflammatory drugs), OCs (oral contraceptives), and TCAs (tricyclic antidepressants), but rarely will these abbreviations appear on a prescription.

Drug allergies. You will now need to look at the patient's profile to determine if the patient has any history of allergy or intolerance to this drug. The following abbreviations are commonly used when reporting drug allergies:

abbreviation	meaning
NKDA	no known drug allergies
NKA	no known allergies
sulfa	refers to any of a class of medications containing a $–SO_2$ constituent
ADR	adverse drug reaction – used when the reaction is not allergic in nature but is nonetheless uncomfortable for the patient

Strength. The prescriber may indicate after the drug name the strength of the medication to be dispensed. There are only two times when this may not be done. If the drug comes in only one strength then the prescriber will often not note the strength. The other time the prescriber may omit the strength is if he or she writes "Dose per pharmacy" on the prescription, indicating that the pharmacist may determine the correct dose for the patient. At all other times, you should see a prescribed strength on the prescription. If it's missing and there are multiple strengths, you have no

choice but to contact the prescriber to consult about the strength. Strengths will usually be given as a number with an abbreviation after it. You will need to read the abbreviation correctly.

abbreviation	**meaning**
%	g/dL
g	gram
gr	grain
IU	international units
mg	milligram
u or U	unit (but please write out the full word when *you* use this term)

Drug form. If the drug comes in more than one form, the prescriber will need to identify the desired form.

abbreviation	**meaning**
B/S or B&S	bite and swallow
cap or caps	capsules
crm	cream
elix	elixir
gtts	drops
MDI	metered dose inhaler
nebs	solution for nebulization
NPO	nothing by mouth; not a drug form but means the patient is not to receive any medications administered by the oral route
PO or po	by mouth, orally, or swallowed
PR	suppository (this is the meaning when written after the drug name)
SL	sublingual form
sol or soln	solution
supp	suppository
susp	suspension
syr	syrup
tab or tabs	tablets
ung	ointment

Total amount of drug. Next, you will need to interpret the total amount of drug that needs to be dispensed, if the prescriber has indicated this on the prescription. Sometimes the prescriber may not indicate the total amount and will instead leave it up to you to determine what that amount should be. More information on how to determine this will be provided in lesson four. Most of the time, the total amount will be written as a standard number, with a # sign in front of it, e.g., #30 or #60. This will be easy for you to interpret (e.g., 30 capsules, 60 tablets). A few prescribers still write the quantity in Roman numerals: some of these are included below in case you're rusty. The only other symbols which may be unrecognizable to you is the number of ounces prescribed, if a prescriber uses the ounce symbol (℥). These are also included below for commonly prescribed drug amounts.

abbreviation	**meaning**
disp	dispense
mL*	milliliter
qs	add a sufficient quantity to make...
℥ ii	2 ounces
℥ iii	3 ounces
℥ iv	4 ounces

ʒ vi	6 ounces
ʒ viii	8 ounces
I or i	1
IV or iv	4
V or v	5
X or x	10
L or l	50
XC or xc	90
C or c	100

*please note that while a large L is the correct abbreviation for liter, most people use a small l in the abbreviation e.g., ml, µl. Don't let this bother you.

As a final commentary on prescribed amounts, it is optimal if on a controlled substance prescription the prescriber also indicates in parentheses the number of the tablets, capsules, or other total amount to be dispensed, written out e.g., #20 (twenty). When the number is written out with alphabet numbers like this it is much harder for people to alter the amount of tablets prescribed on the prescription. This really helps to protect you from the heartache of filling a forged/altered prescription and you can pass this request on to prescribers to enable them to better protect the number of tablets dispensed to their patients.

Interpreting the directions. The following abbreviations have to do with the directions, which are often indicated on the prescription by the abbreviation "sig," a latin abbreviations that basically means "directions:"

The directions written on a prescription by a prescriber will contain abbreviations in the dose, the route, the frequency, and in frequency modifiers which the prescriber may specify.

Directions: dose. In addition to the drug form mentioned above, which may be contained in the directions, the prescriber may also use the following abbreviations.

abbreviation	**meaning**
ʒ	teaspoonful or teaspoonfuls
aa or a͞a	of each
cc	milliliter (actually means cubic centimeter, but 1 cc = 1 ml)
gtt	drop
i	1
ii	2
ss or s͞s	one-half
t	teaspoonful or tablet; this is dangerous as it is confusing; avoid using it yourself
tbsp	tablespoonful
TKO or KVO	"to keep open" or "keep vein open;" an IV rate of 42 ml/hr
tsp	teaspoonful

Directions: route. This refers to how the drug enters the body. Sometimes route is used to indicate a drug form.

abbreviation	**meaning**
ad	right ear
as	left ear
au	each ear
IM	intramuscularly
IV	intravenously
IVP	intravenous push

IVPB	intravenous piggyback
od	right eye
os	left eye
ou	each eye
po	by mouth *or* orally
PR	rectally
PV	vaginally
SC or SQ	subcutaneously
SL	sublingually; “under the tongue” is a more patient-friendly translation
top	topically

Directions: frequency. As you can probably guess, this is how often the patient takes the drug.

abbreviation	**meaning**
alt	alternating
BID	twice a day *or* twice daily
BIW	twice weekly
CID	5 times a day
HS	bedtime
q	every
q12h	every 12 hours
q24h	every 24 hours *or* once daily
q4-6h	every 4-6 hours
q4h	every 4 hours
q6h	every 6 hours
q8h	every 8 hours
qAM	every morning *or* daily in the morning
qd	daily or once daily
qHS	bedtime *or* daily at bedtime
QID	4 times a day
q5min	every 5 minutes
qOd	every other day
qPM	every evening *or* daily in the evening
q week	once weekly
TID	three times daily
TIW	three times weekly

Directions: frequency modifiers and miscellaneous.

abbreviation	**meaning**
Δ	change
ac	before meals
ASAP	as soon as possible
ATC	around the clock
BS, FBG	blood sugar, fasting blood glucose
c or c̄	with
max	maximum

min	minutes or minimum (depends upon context)
MR	may repeat
NR	no refills
NTE	not to exceed
OTC	over-the-counter
pc	after meals
prn	as needed, if needed, when needed; use “as needed for” if there’s an indication present
s or $\bar{s}$	without; lay individuals use the abbreviation w/o
stat	immediately
ut dict or ud	as directed
WA	while awake
x or X	times
x 1	one time
x 2	two times
x 3	three times or up to three

Indications. This outlines why the patient is receiving the drug or warns of a reason to alter intake of the drug if an adverse event occurs (e.g., hold pain medication if respiratory rate less than 12). Pharmacists love indications, but usually have to guess at them. Only the most common ones are noted here

abbreviation	**meaning**
BP	blood pressure
CHF	congestive heart failure
COPD	chronic obstructive pulmonary disease; includes emphysema and bronchitis
CP	chest pain
HTN, HBP	hypertension, high blood pressure
HR	heart rate
MI	myocardial infarction: a heart attack
N/V	nausea and/or vomiting
temp	temperature
RR	respiratory rate
sz	seizures
UTI	urinary tract infection

Abbreviations of prescriber. The final thing you should see on a prescription is the signature of the prescriber, followed by his or her degree. Because authority to prescribe varies from state to state, do not be surprised if one or more of the following professionals cannot write prescriptions in your state.

abbreviation	**meaning**
ARNP	Advanced Registered Nurse Practitioner
CNM	Certified Nurse Midwife
DDS	Doctor of Dental Surgery; a dentist
DPM	Doctor of Podiatric Medicine; a foot physician
DO	Doctor of Osteopathy; an osteopathic physician
DVM	Doctor of Veterinary Medicine
MD	Medical Doctor; a physician
ND	Doctor of Naturopathy; a naturopathic physician

OD	Doctor of Optometry
PA	Physician's Assistant; often called a Medex

Other common abbreviations used in health care
Abbreviations of health care professionals. In addition to the prescriber's initials, you will also see other health care practitioners' qualifications after their notes in the chart. This list outlines degrees of people who are not prescribers, but who still are health care professionals.

abbreviation	**meaning**
BSN	Bachelor of Science in Nursing
CNA or NAC	Certified Nursing Assistant; also called a nurse's aide
CPT	Certified Pharmacy Technician
DC	Doctor of Chiropractic
HCP	health care professional; not a degree but used often enough to warrant mention
LMT	Licensed Massage Therapist
LPN	Licensed Practical Nurse
MHA	Masters of Health Care Administration
MPH	Masters of Public Health
MSW	Masters of Social Work
MT or MLT	Medical Technologist or Medical Laboratory Technologist
OT	Occupational Therapist
PharmD	Doctor or Pharmacy*
PhD	Doctor of Philosophy
PT	Physical Therapist
RD	Registered Dietition
RN	Registered Nurse
RPh	Registered Pharmacist*
RT or RRT	Respiratory Therapist or Registered Respiratory Therapist

* Pharmacists can sometimes prescribe medications under prescriptive authorities established with a prescriber. This stipulates the conditions under which independent prescribing can occur.

Some of these people (e.g., RNs, RPhs, RRTs, MSWs) may write an order for a medication, but only if told to do so by the physician. In this case they will sign the prescription using the abbreviations v.o. for voice order, or t.o. for telephone order, to indicate how the order was communicated to them, then sign the prescriber's name and degree, followed by a slash and then their name and degree. For example:

v.o. W. Harrison, MD/T. O'Sullivan, RPh

Laboratory values. You may need to convert between laboratory value measurement systems; there will be more on this in lesson two. For now, you need to be able to recognize the units before you can begin to convert. A few abbreviations from commonly-ordered laboratory tests are also included here.

abbreviation	**meaning**
dL or dl	deciliter (100ml)
µL or mcL or µl	microliter (1/1000 of a ml)
µg or mcg	microgram (1/1000 of a mg)
pg	picogram (1/1000 of a ng)
Cr or SCr	serum creatinine; you will use this for calculating kidney function
BUN	blood urea nitrogen; used to calculate if a patient is dehydrated
K	potassium

Na	sodium
Cl	chloride
glu	serum glucose
Ca	calcium
PO4	phosphate
alb	albumin; a serum protein
CBC	complete blood count
C/S	culture and sensitivities
Hgb or Hb	hemoglobin; this may also be used when calculating a dose of IV iron
Hct	hematocrit; this may be used when calculating a dose of IV iron
ng	nanogram (1/1000 of a μg)

You will learn more laboratory abbreviations during your therapeutics courses.

Composing the label instructions

Once you have deciphered the information on the prescription, you will need to translate them into instructions that a patient can understand. Complete prescription sentences generally:

- start with a command (e.g. take, place, insert, unwrap and insert, apply, inhale),
- follow with a command modifier (e.g. by mouth, rectally, sparingly),
- then note the dosage number and form/unit (e.g. 2 tablets, 1 capsule, 1 teaspoonful),
- follow with the dosing frequency (e.g. twice daily, every 4-6 hours),
- and finish with a frequency modifier (e.g. as needed for pain, on an empty stomach, with food, for blood pressure, with a full glass of water, for 10 days).

Some examples of the use of abbreviations and symbols

written on a prescription	**What you would type on a label**
Tylenol #3 disp. 30 i po q4-6h prn pain	Tylenol #3 #30 Take 1 tablet every 4-6 hours as needed for pain.
APAP 5gr supp #10 i PR prn temp>101	Acetaminophen 325mg Supp. #10 Unwrap and insert rectally 1 suppository as needed when temperature is higher than 101°F.
Cheracol ℨ iv ℨ ii po q4h prn cough	Cheracol 4oz. Take 2 teaspoonfuls every 4 hours as needed for cough.
gentamicin ophth soln 5ml i gtt ou q4h WA x 5 days	Gentamicin 0.3% 5ml Place in each eye one drop every 4 hours while awake for 5 days.
Ampicillin 250mg #40 i po ac & HS	Ampicillin 250mg #40 Take 1 capsule 4 times a day: before meals and at bedtime.

Lesson 1 Appendix: A few summaries and some fun facts

Symbols used in pharmacy

All of these have already been addressed, but the most common symbols used in pharmacy are summarized here so you can see them all together. You will need to memorize these.

symbol	meaning
ʒ	one teaspoonful or 5ml or one fluidram
℥	one ounce *or* one fluidounce *or* two tablespoonfuls *or* 30ml
āā	of each
ss	one-half
c̄	with
s̄	without
Δ	change

Note: if you see either the ounce or the teaspoonful symbol followed by lower case roman numerals (e.g. ii, iii, iv), this indicates the *number* of either teaspoonfuls or ounces desired, e.g., ʒ ii = 2 teaspoonfuls, ℥ viii = 8 oz. If the symbol itself is *not* followed by the lower case roman numerals, then you should automatically assume only one teaspoonful or ounce.

Apothecaries' System of Measurement

fluid measures

1 fluidram (fl ʒ)	=	60 minims		
1 fluidounce (fl ℥)	=	8 fluidrams	=	480 minims
16 fluidounces	=	1 pint		
32 fluidounces	=	1 quart	=	2 pints
4 quarts	=	1 gallon	=	8 pints

solid measures

20 grains (gr)	=	1 scruple (℈)		
60 grains	=	3 scruples	=	1 dram (ʒ)
480 grains	=	8 drams	=	1 ounce (℥)
5760 grains	=	12 ounces	=	1 pound

Avoirdupois System of Measurement

437.5 grains	=	1 ounce (oz)
16 ounces	=	1 pound (lb)

Notice how we use this definition of 16 ounces/pound in our American system. This is also the grain definition we use in the grain:ounce conversion seen at the beginning of this lesson. Since you know that 1 ounce = 28.35g, then 437.5 grains would equal 28,350 mg, which simplifies to 1 grain = 64.8 mg (please double check this with your calculator).

Lesson 1 practice questions

1. 1gr aspirin = _____ mg If a doctor told you to recommend a product that would give a patient "a grain per day of aspirin," which product would you dispense?

a) Bayer Children's Aspirin, 81mg chewable tabs
b) Halfprin, 165mg enteric-coated tablets
c) Ecotrin (enteric-coated aspirin) 325mg
d) Generic enteric-coated aspirin, 650mg

2. 1/200 gr nitroglycerin SL = _____ mg

You get a prescription for the above. Which product will you dispense?

a) Nitrostat 0.3mg (nitroglycerin)
b) Nitrostat 0.4mg (nitroglycerin)
c) Nitrostat 0.6mg (nitroglycerin)
d) Nitrobid 2.5mg capsules (nitroglycerin)

3. 5gr ferrous gluconate = _____ mg

A patient tells you her doctor wanted her to take one of these every day. Which product would you recommend?

a) ferrous sulfate 324mg tablets
b) ferrous fumarate 324mg tablets
c) ferrous gluconate 240mg tablets
d) ferrous gluconate 325mg tablets

4. A patient has been receiving penicillin 1,000,000 units IV q6h while in hospital. He is now to be sent home. You need to convert him to an oral form of this drug. The bottle of penicillin tells you that 250mg = 400,000 units. What dosage regimen will you recommend for this patient?

a) penicillin VK 250mg po QID
b) penicillin VK 500mg po QID
c) penicillin VK 500mg po BID

5. Convert the following patient weights to their metric equivalent:

e) 120 lb = _____ kg
f) 150 lb = _____ kg
g) 183 lb = _____ kg
h) 330 lb = _____ kg
i) 93 lb = _____ kg
j) 25 lb = _____ kg
k) 7.5 lb = _____ kg
l) 5 lb, 9oz = _____ g
m) 3lb 4.5oz = _____ g
n) 1lb 5.2oz = _____ g

Rule of thumb for rounding when you are performing weight calculations:

a) for adults and children over 25 pounds, round to the nearest whole kilogram e.g., 70 kg
b) for children between 6 and 25 pounds, round to the nearest tenth of a kilogram e.g., 6.8 kg
c) premature infant weight is expressed in g. Round to the nearest whole gram e.g., a 4-pound preemie would be 1818 g

6. Calculate the metric heights of the following patients:

a) 5' 10" = _____ cm
b) 4' 6" = _____ cm
c) 5' 4" = _____ cm
d) 6' 4" = _____ cm
e) 36" = _____ cm

7. Convert the following:

a) 1 mg/L = _____ µg/ml
b) 1.6 ng/ml = _____ mg/L
c) 100 mg/dl = _____ mg/ml
d) 60 mg/dL = _____ g/L
e) 2 ng/ml = _____ µg/L
f) 20 mg/dL = _____ mg/L
g) 20 pg/ml = _____ ng/L
h) 50 µg/ml = _____ mg/dL

8. Calculate the following BSAs:

a) a 160 lb, 5'8" patient = _____ m^2
b) a 218 lb, 6'1" patient = _____ m^2
c) a 98 lb, 5'0" patient = _____ m^2
d) your body surface area, using your weight and your height (you can use either your real or driver's license measurements) _____ m^2

9. Working with temperatures:

a) "Normal" oral body temperature is 98.6°F. What is this temperature in °C? _____ °C
b) You see on a patient's chart that he has an oral temperature of 39.6°C. What is the Fahrenheit equivalent? ____ °F
c) Calculate the Fahrenheit equivalent of an oral temperature of 36.2°C. _____ °F
d) A pediatric patient has a rectal temperature of 102.4°F. Calculate the oral equivalent of this temperature in both °F and °C. _____ °F _____ °C
e) A preemie registers an axillary temperature of 99.6°F. What would this be equivalent to if it were taken rectally? _____ °F

10. Now work with some of those symbols:

a) You have a plastic amber prescription fluid vial which reads ʒ iv . How many ounces is this? _____ oz How many ml? _____ ml
b) A physician has written ʒii po TID on a prescription. What would you type on a label? Take _____ by mouth three times a day. What would be an alternate way of interpreting this sig? Take _____ by mouth three times daily.
c) A prescription lists two inhalers and the directions are ii puffs āā QID. This prescriber means for the patient to inhale 2 puffs _____ four times a day.
d) A prescriber has written for HCTZ 25mg with the following directions: s̄s̄ tab po qd. You will type on the prescription label: Take _____ tablet by mouth every day.
e) A prescription reads: i po BID. Take c̄ food. You will type: Take one tablet twice daily _____ food.

11. Consider the following sigs (shorthand directions found on the prescription that the patient brings in from the prescriber) and write out the directions that you would place on the prescription label for the patient:

f) Septra DS #20: i po BID x 10 days

Your label directions:_____

g) Kaolin-Pectin 8oz: ʒ i-ii po q loose stool

Your label directions:_____

h) Nitroglycerin 0.4mg #100: i SL prn CP. MR q5min x 2

Your label directions:_____

_____

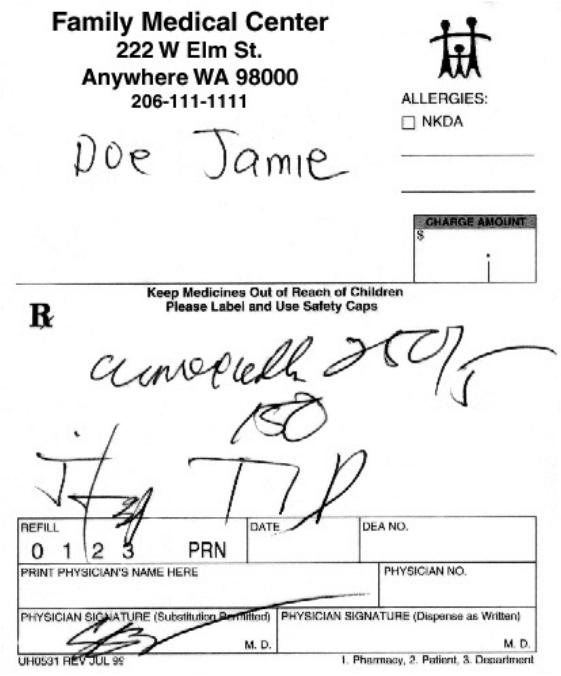
i) Ventolin Syrup 4oz: ʒ i po TID prn SOB, wheezing

Your label directions:_____

j) Amoxicillin 125mg/5ml 100ml: 2.5ml po TID x 10 days

Your label directions:_____

Bonus fun: test your prowess! The following prescriptions were written in haste by a prescriber. Can you tell what they are for? (hint: both drug names appear in this lesson) What prescription directions would you type on the label?



What drug do you think this is?

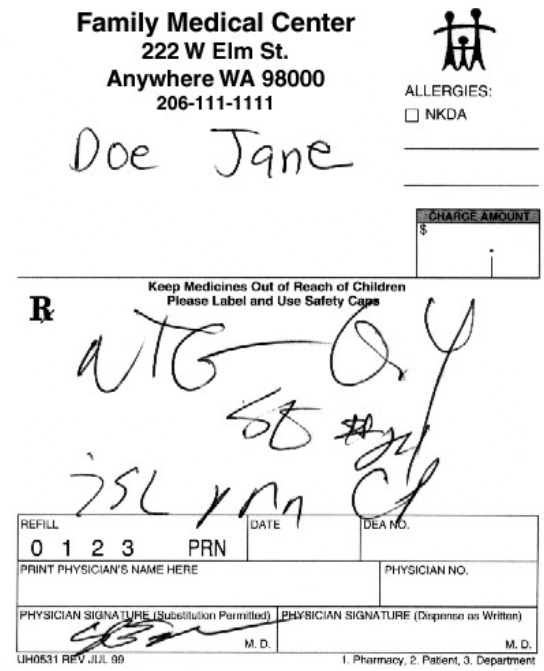
_____

What directions would you type on the label?

_____

_____

_____



What drug do you think this is?

_____

What directions would you type on the label?

_____

_____

_____

Answers to Lesson 1 practice questions

1. 1gr aspirin = **65 mg**

If a doctor told you to recommend a product that would give a patient "a grain per day of aspirin," which product would you dispense?

a) Bayer Children's Aspirin, 81mg chewable tabs *(note: no 65mg available so use closest dosage form available)*
b) Halfprin, 165mg enteric-coated tablets
c) Ecotrin (enteric-coated aspirin) 325mg
d) Generic enteric-coated aspirin, 650mg

2. 1/200 gr nitroglycerin SL = 0.325 mg

Which product will you dispense?

a) Nitrostat 0.3mg (nitroglycerin)
b) Nitrostat 0.4mg (nitroglycerin)
c) Nitrostat 0.6mg (nitroglycerin)
d) Nitrobid 2.5mg capsules (nitroglycerin)

3. 5gr ferrous gluconate = _____ mg

A patient tells you her doctor wanted her to take one of these every day. Which product would you recommend?

a) ferrous sulfate 324mg tablets
b) ferrous fumarate 324mg tablets
c) ferrous gluconate 240mg tablets
d) ferrous gluconate 325mg tablets *(note that the first two choices are the wrong salt and the third is the wrong strength)*

4. A patient has been receiving penicillin 1,000,000 units IV q6h while in hospital. He is now to be sent home. You need to convert him to an oral form of this drug. The bottle of penicillin tells you that 250mg = 400,000 units. What dosage regimen will you recommend for this patient?

a) penicillin VK 250mg po QID
b) **penicillin VK 500mg po QID** *(note 500mg is closest dosage form available)*
c) penicillin VK 500mg po BID

5. Convert the following patient weights to their metric equivalent:

a) 120 lb = **55 kg**
b) 150 lb = **68 kg**
c) 183 lb = **83 kg**
d) 330 lb = **150 kg**
e) 93 lb = **42 kg**
f) 25 lb = **11.4 kg**
g) 7.5 lb = **3.4 kg**
h) 5 lb, 9oz = **2528 g**
i) 3lb 4.5oz = **1491 g**
j) 1 lb 5.2oz = **602 g** *(note: you may actually see a preemie this size – almost small enough to fit in the palm of your hand. We live in amazing times.)*

6. Calculate the metric heights of the following patients:

a) 5' 10" = **178 cm**
b) 4' 6" = **137 cm**
c) 5' 4" = **163 cm**
d) 6' 4" = **193 cm**
e) 36" = **91 cm**

7. Convert the following:

a) 1 mg/L = **1 µg/mL**

b) 1.6 ng/ml = **0.0016 mg/L**

c) 100 mg/dl = **1 mg/ml**

d) 60 mg/dL = **0.6 g/L**

e) 2.0 ng/ml = **2.0 µg/L**

f) 20 mg/dL = **200 mg/L**

g) 20 pg/ml = **20 ng/L**

h) 50 µg/ml = **5 mg/dL**

8. Calculate the following BSAs:

a) a 160 lb, 5'8" patient = **1.9 m^2**

b) a 218 lb, 6'1" patient = **2.3 m^2**

c) a 98 lb, 5'0" patient = **1.4 m^2**

d) your body surface area, using your weight and your height (you can use either your real or driver's license measurements) **1.4 - 2.3 m^2**, **depending upon whether you are short or tall, single-serving or economy-sized**

9. Working with temperatures:

a) "Normal" oral body temperature is 98.6°F. What is this temperature in °C? **37.0 °C**

b) You see on a patient's chart that he has an oral temperature of 39.6°C. What is the Fahrenheit equivalent? **103.3°F**

c) Calculate the Fahrenheit equivalent of an oral temperature of 36.2°C. **97.2°F**

d) A pediatric patient has a rectal temperature of 102.4°F. Calculate the oral equivalent of this temperature in both °F and °C. **A thermometer placed in the mouth at the same time would register an oral temp of 101.4 °F or 38.6 °C**

e) A preemie registers an axillary temperature of 99.6°F. What would this be equivalent to if it were taken rectally? **101.6°F**

10. Now work with some of those symbols:

a) You have a plastic amber prescription fluid vial which reads ℥ iv . How many ounces is this? **4 oz** How many ml? **118.4 ml or 120ml - either is OK**

b) A physician has written ℥ii po TID on a prescription. What would you type on a label? Take **2 teaspoonfuls** by mouth three times a day. What would be an alternate way of interpreting this sig? ? Take **10 ml** by mouth three times a day.

c) A A prescription lists two inhalers and the directions are ii puffs āā QID. This prescriber means for the patient to inhale 2 puffs **of each inhaler** four times a day.

d) A prescriber has written for HCTZ 25mg with the following directions: s̄s̄ tab po qd. You will type on the prescription label: Take **one-half** tablet by mouth every day.

e) A prescription reads: i po BID. Take c̄ food. You will type: Take one tablet twice daily **with** food.

11. Consider the following sigs (shorthand directions found on the prescription that the patient brings in from the prescriber) and write out the directions that you would place on the prescription label for the patient:

a) Septra DS #20: i po BID x 10 days; Your label directions: **Take 1 tablet twice daily for 10 days.**

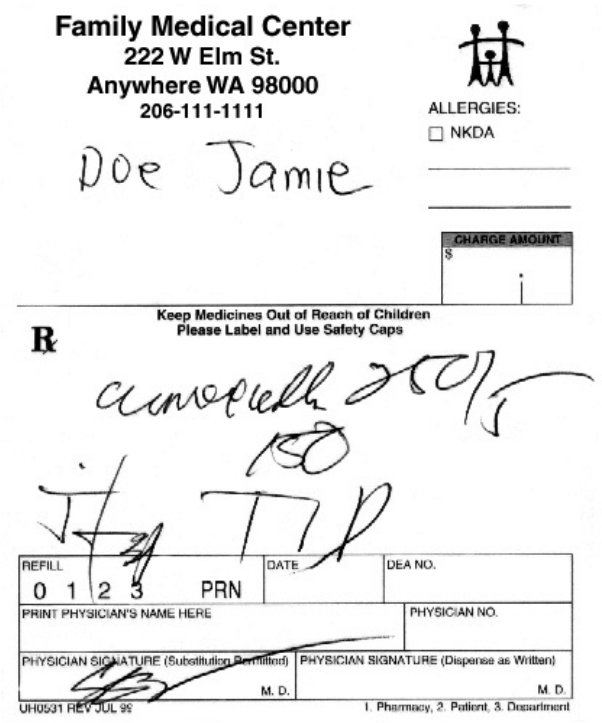
b) Kaolin-Pectin 8oz: ℥ i-ii po q loose stool; Your label directions: **Take 2-4 tablespoonfuls after each loose stool.**

c) Nitroglycerin 0.4mg #100: i SL prn CP. MR q5min x 2; Your label directions: **Dissolve under the tongue one tablet as needed for chest pain. May repeat every 5 minutes if pain persists, to a maximum of 2 additional doses.**

d) Ventolin Syrup 4oz: ℥i po TID prn SOB, wheezing; Your label directions: **Take 1 teaspoonful up to 3 times a day as needed for shortness of breath or wheezing.**

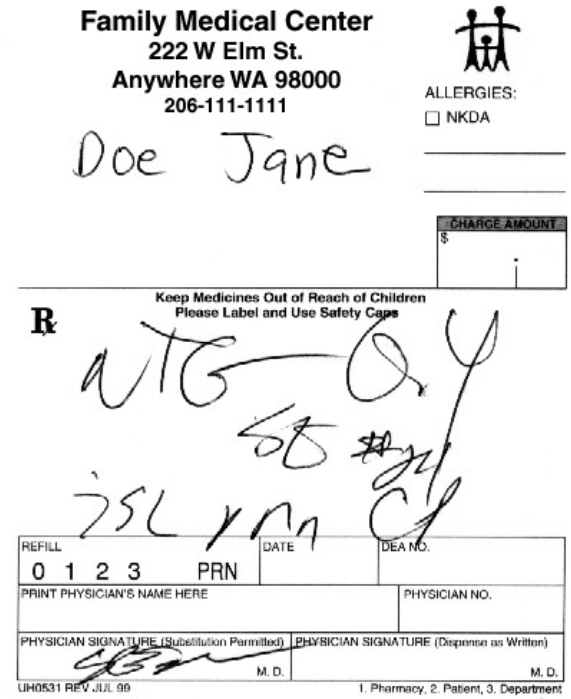
e) Amoxicillin 125mg/5ml 100ml: 2.5ml po TID x 10 days; Your label directions: **Take 1/2 teaspoonful (2.5 ml) 3 times a day for 10 days.**

Bonus fun:


Family Medical Center
222 W Elm St.
Anywhere WA 98000
206-111-1111
ALLERGIES:
☐ NKDA
Doe Jamie
CHARGE AMOUNT
$
Keep Medicines Out of Reach of Children
Please Label and Use Safety Caps
Rx
REFILL
0 1 2 3 PRN
DATE
DEA NO.
PRINT PHYSICIAN'S NAME HERE
PHYSICIAN NO.
PHYSICIAN SIGNATURE (Substitution Permitted)
M. D.
PHYSICIAN SIGNATURE (Dispense as Written)
M. D.
UH0531 REV JUL 99
1. Pharmacy, 2. Patient, 3. Department

What drug do you think this is?
Amoxicillin 250mg/5ml susp, 150ml

What directions would you type on the label?
Take one teaspoonful three times a day for 10 days.


Family Medical Center
222 W Elm St.
Anywhere WA 98000
206-111-1111
ALLERGIES:
☐ NKDA
Doe Jane
CHARGE AMOUNT
$
Keep Medicines Out of Reach of Children
Please Label and Use Safety Caps
Rx
REFILL
0 1 2 3 PRN
DATE
DEA NO.
PRINT PHYSICIAN'S NAME HERE
PHYSICIAN NO.
PHYSICIAN SIGNATURE (Substitution Permitted)
M. D.
PHYSICIAN SIGNATURE (Dispense as Written)
M. D.
UH0531 REV JUL 99
1. Pharmacy, 2. Patient, 3. Department

What drug do you think this is?
Nitroglycerin 0.4mg SL tabs

What directions would you type on the label?
Dissolve under the tongue one tablets as needed for chest pain.