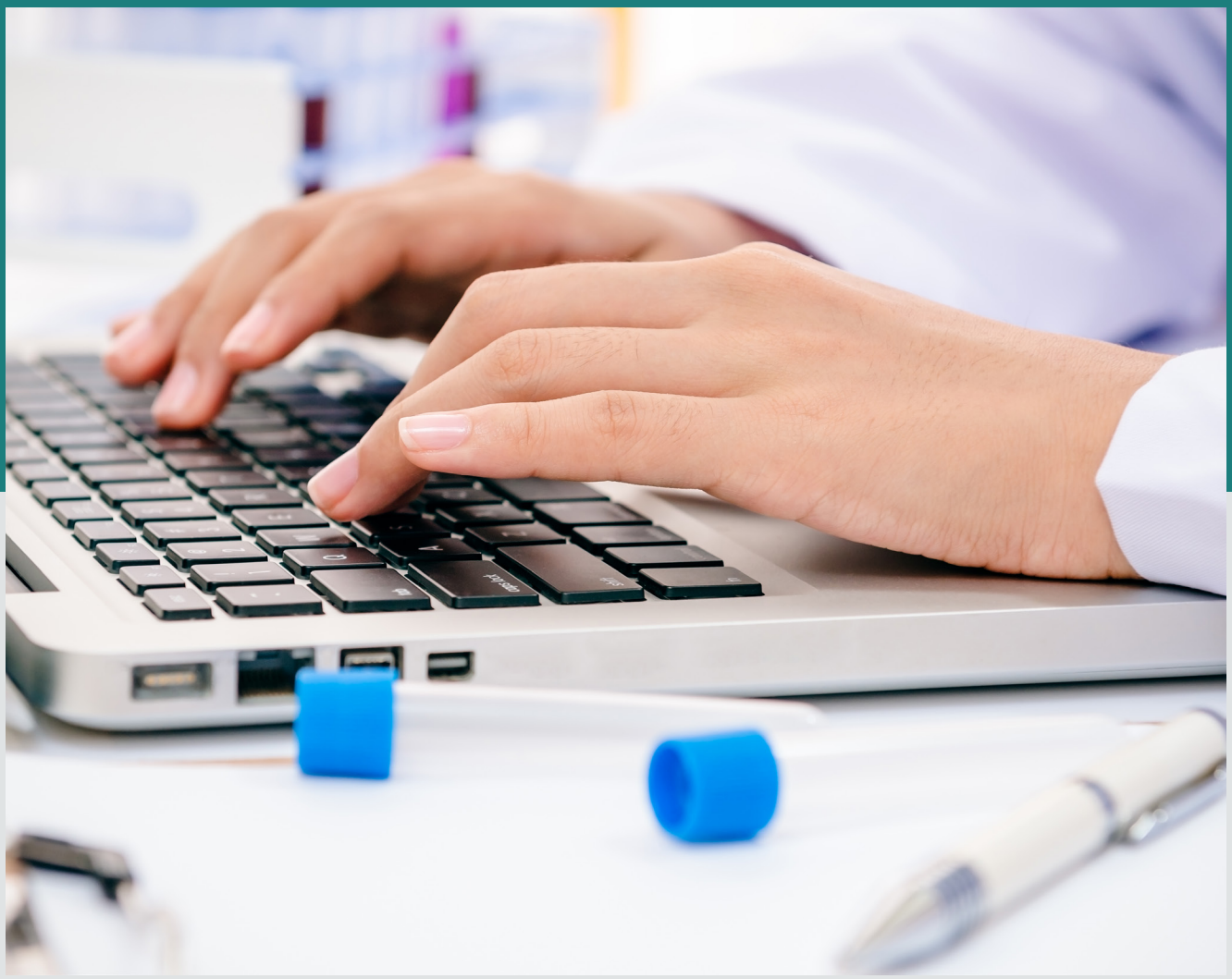
VetTechPrep

Common Calculations in Vet Med: A Guide for Vet Tech Students



MAY 2021

Whether you love it or hate it, math will be an everyday part of your life as a vet tech. The calculations that you learn to perform as a student aren't just for the VTNE® or your class exams; they're also a necessary component of working in this field!

Veterinary calculations may range from simple drug dosage calculations to complicated math related to constant rate infusions. Let's walk through some common veterinary calculations, and how you might apply these calculations to small animal cases.

Calculating a Patient's Drug Dose

Almost every medication prescribed in a veterinary clinic is dosed based on weight. While the vet may calculate many drug dosages, you may also find yourself in situations in which you are expected to calculate a patient's medication or dose. Whether it's an oral medication or an injection, you need to be comfortable doing this math.

Oral Tablet or Capsule

When calculating the dose of an oral medication to give a particular patient, you will use the following formula:

Patient's Drug Dose (mg) = Dosage Desired (mg/kg) x Patient Weight (kg)

Example: A 21 kg dog is seen at your practice for a skin infection. The vet says "let's send her home with cefpodoxime at 10 mg/kg once daily for 14 days" and then walks into the next room. What dose of cefpodoxime will you send home with the client?

Use the above equation, inserting your desired dose and the patient's weight:

Patient dose = (10 mg/kg) x (21 kg) = 210 mg

Based on this calculation, you determine that the dog needs 200 mg of cefpodoxime daily. Cefpodoxime comes in 200 mg tablets, so you place 14 tablets in a pill vial and print a label that says "Give 1 tablet by mouth once daily for 14 days."

Injectable Medication or Oral Suspension

Liquid medication dose calculations are performed in a similar manner, but they require an extra step. Dosing liquid medication (whether oral or injectable) requires you to factor in the concentration of the liquid formulation.

Example: You are working at a busy emergency clinic, helping the veterinarian juggle multiple cases, when a hit-by-car dog arrives. The vet performs a brief triage exam and determines that the dog is stable. He then asks you to give the dog an injection of 0.1 mg/kg hydromorphone (for pain control) and present the owner with an estimate for diagnostics. The dog weighs 12 kg and the concentration of injectable hydromorphone in your hospital is 2 mg/ml.

How much hydromorphone do you administer?

First, calculate the patient's dose as described above:

Patient dose = (0.1 mg/kg) x (12 kg) = 1.2 mg

Next, divide the patient's dose by the concentration of injectable hydromorphone:

Volume to administer = (1.2 mg) / (2 mg/ml) = 0.6 ml

You will administer 0.6 ml of 2 mg/ml hydromorphone.

Converting Concentrations

Calculating the dosage of an injectable drug is relatively straightforward when the concentration of that drug is given in mg/ml, such as in the previous example. In some cases, however, the concentration of an injectable drug is provided as a % (weight/volume). This makes life a bit more complicated!

When a drug's concentration is provided as a percentage, it means the following:

% weight/volume = (grams of solute) / (100 ml)

Or, in plain English, the % w/v tells you how many grams of the drug are present in 100 ml of solution. You can use this information to convert % concentration to mg/ml.

Example: Your practice is treating a 7 kg dog for suspected scabies. The vet asks you to administer an injection of 0.3 mg/kg ivermectin. You pull the ivermectin bottle off the pharmacy shelf and see that it has a concentration of 1%. How much ivermectin should you administer?

First, you'll want to calculate the dog's required dose of ivermectin:

Patient dose = (0.3 mg/kg) x (7 kg) = 2.1 mg

Next, you'll need to convert the 1% ivermectin concentration to mg/ml, so you can work with it more easily. Begin by converting the % concentration to g/ml, then convert that value to mg/ml:

1% = (grams of ivermectin) / (100 ml) =
(1 g)/(100 ml)
= (1000 mg) / (100 ml)
= (10 mg ivermectin) / (1 ml)
= 10 mg/ml ivermectin

Finally, divide the dog's ivermectin dose by the concentration of ivermectin, to determine how much ivermectin you should administer:

Volume to administer = (2.1 mg) /
(10 mg/ml) = 0.21 ml

You will administer 0.21 ml of 1% ivermectin to this dog.

Fluid Therapy Calculations

Calculating a Maintenance Fluid Rate

The typical maintenance fluid rate for small animal patients is 50-60 ml/kg/day, depending on which reference you consult and your veterinarian's preference. In order to program a fluid pump, however, you must convert that daily fluid rate to an hourly fluid rate. This requires calculating the pet's daily fluid need, then dividing by 24 to calculate the pet's hourly fluid rate.

Example: The vet asks you to place an IV catheter in a 15 kg dog, then start the dog on fluids at a maintenance rate of 60 ml/kg/day. What ml/hr rate should be entered into the fluid pump?

First, calculate the patient's 24-hr requirement:

(15 kg) x (60 ml/kg/day) = 900 ml/day

There are 24 hours in a day, so this fact can be used to convert ml/day to ml/hr:

(900 ml/day) / (24 hrs/day) = 37.5 ml/hr

Therefore, you should enter a fluid rate of 37.5 ml/hr into the fluid pump.

Diluting Drugs in Fluids

In some cases, you may need to dilute a drug in IV fluids. This is the equation that is used when performing drug dilutions:

C1V1 = C2V2

In this equation, C1 and V1 represent the initial concentration and volume, while C2 and V2 represent the final concentration and volume.

Example: You are asked to prepare a 5% dextrose solution for IV fluid administration. You have a 1L bag of LRS and a bottle of 50% dextrose. How much dextrose should you add to the fluid bag, in order to create a bag containing 5% dextrose?

In this example, C1 is the original dextrose concentration (50%), V1 is the dextrose volume to be added (your unknown), C2 is the final desired dextrose concentration (5%), and V2 is the final volume of fluid in the bag (1000 ml).

Plugging the numbers we know into the equation gives us:

(50%) x (ml dextrose) = (5%) x (1000 ml)

Next, divide both sides by 50% to rearrange the equation, giving:

ml dextrose = (5%) x (1000 ml) / (50%) = 100 ml dextrose

The only tricky thing to remember here is that you want 100 ml of dextrose in a final volume of 1000 ml. Therefore, you can't just add 100 ml of dextrose directly to the 1L LRS bag; that would give you a final volume of 1100 ml! First, remove 100 ml of LRS, then add your 100 ml of dextrose. This will result in a final volume of 1L of 5% dextrose in the fluid bag.

Constant Rate Infusions

When calculating a CRI, there's no magical equation. Instead, think through the problem in a logical, stepwise fashion. You know the rate at which you want the patient to receive a particular drug. You also know how long the patient's fluid bag will last. Therefore, you can determine how much of the drug should be added to the fluid bag in order to deliver the drug at your desired rate.

Example: A 5 kg dog requires a ketamine CRI at a dose of 0.5 mg/kg/hr. You would like to add this ketamine to a new 1L bag of LRS, which will be administered at a maintenance rate of 11 ml/hr. How much ketamine (100 mg/ml) should you add to the 1L bag of LRS?

First, you need to determine how much ketamine (in ml) the dog needs to receive every hour.

Begin by calculating the dog's hourly dose in mg:

(0.5 mg/kg/hr) x (5 kg) = 2.5 mg/hr

Next, determine the volume of ketamine (in ml) per hour:

(2.5 mg/hr) / (100 mg/ml) = 0.025 ml/hr ketamine

Now, determine how many hours the dog's bag of IV fluids will last:

(1000 ml) / (11 ml/hr) = 90.9 hours

Now you know the bag will last 90.9 hours and you know that the dog needs 0.025 ml/hr of ketamine. What's next? Multiple these two numbers together, to determine how much ketamine is required to provide 0.025 ml/hr for the full 90.9 hours that the bag will last:

(0.025 ml/hr) x (90.9 hrs) = 2.3 ml of ketamine

Therefore, you should remove 2.3 ml of fluids from the bag and add 2.3 ml ketamine. This will ensure that the dog receives 0.5 mg/kg/hr of ketamine when the fluids are given at 11 ml/hr.

Nutritional Requirements

Nutritional calculations are used in a variety of circumstances. Hospitalized pets may need to be fed according to a precise caloric requirement, or the owner of an overweight pet may need help calculating how many calories per day they should feed to promote weight loss.

To calculate a pet's nutritional requirements, you must first calculate the pet's resting energy requirement (RER), according to the following equation:

$$RER = 70 \times (\text{body weight in kg})^{0.75}$$

The RER is then multiplied by 1.0-1.6. The exact multiplier used should be based on the pet's reproductive status and activity level (altered pets < intact pets, lazy pets < active pets).

Example: A 6 kg spayed female dog presents for a new patient exam. During your exam, you note that she has a body condition of 5/9.

Her owner reports that she was underweight when they first adopted her from the animal shelter, so they've been feeding large meals and she's starting to look better. While the owner is excited, you want to ensure that the owner doesn't continue feeding an amount that will lead to weight gain. How many calories per day do you want the owners to feed this dog?

First, calculate the dog's RER:

$$RER = 70 \times (6)^{0.75} = 70 \times 3.83 = 268 \text{ kcal/day}$$

Given that the dog is altered and is prone to gaining weight, the lower end of the multiplication factor range should be used. Therefore, you multiply the dog's RER by 1.2:

$$268 \text{ kcal/day} \times 1.2 = 322\text{k cal/day}$$

Based on these calculations, you recommend that the dog's owner aim to feed approximately 300-320 kcal/day.

Final Tips

When performing calculations, whether in school or in practice, don't be afraid to ask for help. Every veterinary team seems to have one individual who is good at math and who likes performing calculations. Figure out who this individual is and, if you're unsure of things, ask them to perform the calculation to see if you arrive at the same answer. You can also use online calculators and apps as a resource, although it's important to realize that they aren't always accurate or reliable.

Additionally, don't be so rushed that you make careless mistakes. A small math error could have a big impact on your patient. Take your time and check your work, either by working the problem again or by working backwards (use division to check your multiplication, addition to check subtraction, etc.).

By working carefully and using your available resources, you should soon be able to tackle these tricky calculations easily and with confidence!

About the Author

Cathy Barnette is a practicing small animal veterinarian, freelance writer, and contributor to VetPrep and VetTechPrep. She is passionate about both veterinary medicine and education, working to provide helpful information to veterinary teams and the general public. In her free time, she enjoys spending time in nature with her family and leading a Girl Scout troop.