Nutrition Math 101: Important Calculations

Ed Carlson, CVT, VTS (Nutrition)
VetBloom, Woburn, Massachusetts

Abstract

Nutrition, the fifth vital assessment, is essential to the health of veterinary patients. Pet owners look to the veterinary healthcare team for nutritional recommendations. Learning a few basic nutritional calculations, such as how to calculate the caloric requirement of dogs and cats, allows veterinary nurses to provide excellent nursing care to patients and to better educate clients.
Optimal veterinary nursing care requires the ability to perform calculations. Veterinary nurses routinely calculate drug doses, fluid rates, and constant-rate infusion rates; however, basic nutrition calculations are sometimes overlooked. This article explains how to easily perform common and important nutrition calculations.

**CALCULATING ENERGY (CALORIC) REQUIREMENTS**

Establishing whether a patient is currently eating enough or too much involves determining its resting energy requirement (RER). However, many other factors also go into calculating a patient’s energy needs, including growth, desired weight loss or gain, and activity level.

**Resting Energy Requirement**

RER is a function of metabolic body size and represents the energy requirement of the patient while at rest at a controlled temperature.

There are several formulas for calculating RER based on body weight in kilograms (BW kg):

- $30 \times (\text{BW kg}) + 70 = \text{RER}$
- $70 \times (\text{BW kg})^{0.75} = \text{RER}$
- $\sqrt[3]{(\text{BW kg} \times \text{BW kg} \times \text{BW kg})} \times 70 = \text{RER}$

The formula $30 \times (\text{BW kg}) + 70 = \text{RER}$ is commonly used in many veterinary hospitals and may be used for patients weighing more than 2 kg and less than 45 kg. For patients weighing less than 2 kg or more than 45 kg, the formulas $70 \times (\text{BW kg})^{0.75} = \text{RER}$ and $\sqrt[3]{(\text{BW kg} \times \text{BW kg} \times \text{BW kg})} \times 70 = \text{RER}$ provide a more accurate estimate of caloric requirements.

The difference in estimates when $30 \times (\text{BW kg}) + 70$ is used can be seen by looking at 2 patients, Max and Tiny. Max weighs 20 kg (44 lb) and Tiny weighs 1.36 kg (3 lb).

Using the formula $30 \times (\text{BW kg}) + 70 = \text{RER}$, Max and Tiny have the following RERs:

- **Max**: $30 \times 20 = 600 + 70 = 670 \text{ kcal/day}$
- **Tiny**: $30 \times 1.36 = 40.8 + 70 = 110.8 \text{ kcal/day}$

Using the formula $70 \times (\text{BW kg})^{0.75} = \text{RER}$, their RERs are:

- **Max**: $70 \times (20)^{0.75} = 662 \text{ kcal/day}$
- **Tiny**: $70 \times (1.36)^{0.75} = 88.2 \text{ kcal/day}$

The difference between the 2 results is only 8 kcal/day for Max, but for Tiny, the first equation overestimates RER by 22.6 kcal per day. For this reason, it is preferable to use the formula $70 \times (\text{BW kg})^{0.75}$ or $\sqrt[3]{(\text{BW kg} \times \text{BW kg} \times \text{BW kg})} \times 70$ to calculate RER for all patients.

**Daily Energy Requirement**

Once the patient’s RER has been determined, the next step is to calculate the patient’s daily energy requirement (DER). DER is calculated by multiplying RER by a coefficient based on the patient’s life stage and body condition. Coefficients for common life stages are listed in **TABLE 1**.

**Example**: Sandy is a dog weighing 30.45 kg (67 lb). She is overweight with a body condition score of 4 out of 5. Follow the below steps to calculate her DER for weight loss.

**RER**: $70 \times (30.45)^{0.75} = 907 \text{ kcal/day}$
Then, using the weight loss coefficient from TABLE 1, calculate her DER:

\[ \text{RER} \times 1 = \text{DER} \]

**DER:** \(907 \times 1 = 907 \text{ kcal/day}\)

It is important to remember that all caloric calculations are estimates of the patient’s energy needs; actual caloric intake may vary between individuals depending on the patient’s age, lifestyle, activity level, body condition score, and other factors. However, the above RER and DER calculations are an excellent starting point for every nutritional recommendation.

**CALCULATING AMOUNT TO FEED**

Once the patient’s DER is known, the amount of food needed to meet it can be calculated. The first step is to find the caloric content per can or cup of the food the patient is going to be fed. The caloric content of any food (and some treats) can be easily found on the product packaging or obtained from the manufacturer’s website or product guide. The caloric content of most “people” food that patients eat can be found on the product packaging or manufacturer website.

The number of calories in a can or cup of the selected food is simply divided into the patient’s DER. To continue with Sandy as an example:

The dry food the owner is feeding Sandy contains 363 kcal/cup.

\[ 907 \text{ kcal/day} \div 363 \text{ kcal/cup} = 2.5 \text{ cups/day} \]

Sandy could eat 2.5 cups of this food per day if she is not fed any canned food or treats.

However, the owner wants to include some canned food and treats in Sandy’s diet. The canned food contains 369 kcal/can, and the treats contain 34 kcal/treat. Treats should make up no more than 10% of a pet’s daily calorie intake; therefore, Sandy’s daily treat allowance should be no more than 90 kcal.

**Treat allowance:** \(90 \text{ kcal} \div 34 \text{ kcal/treat} = 2.6 \text{ treats} \)

For ease, Sandy can have 2.5 treats/day, totaling 85 kcal/day (34 \( \times \) 2.5 = 85).

Subtract the treat allowance from Sandy’s DER to determine the amount remaining for canned and dry food.

\[ 907 \text{ kcal/day} – 85 \text{ kcal} = 822 \text{ kcal} \]

The owner wants to feed mostly dry food, so next, determine how many full cups of dry food Sandy can have per day. The dry food contains 363 kcal/cup; therefore, **2 cups of dry food = 726 kcal**.

\[ 822 \text{ kcal} – 726 \text{ kcal} = 96 \text{ kcal left over for canned food} \]

The canned food contains 369 kcal/can. Divide the remaining DER by this number.

\[ 96 \text{ kcal} \div 369 \text{ kcal/can} = 0.26 \text{ or } \frac{1}{4} \text{ can of canned food} \]

The above amounts can be divided by the number of times the patient will be fed per day.

Instructions to the client should be specific and include the name and brand of the food being recommended, the amount to be fed per day and per feeding, how many feedings per day, how many treats, and when the plan may change. To continue with Sandy as an example:

Sandy should be fed 2 cups of the dry food, \( \frac{1}{4} \) can of the canned food, and 2.5 treats per day. The author...
recommends feeding her 1 cup of the dry food and 1/8 of a can of canned food in the morning and the same amounts at night. The 2.5 treats can be given between meals.

Sandy’s owner should be reminded that treats should make up no more than 10% of the total calories Sandy consumes per day. It is recommended Sandy be brought back for a weight check in 2 weeks as her feeding plan may need to be adjusted if she has lost or gained weight.

For many healthy pets being fed a good-quality, complete, and balanced diet manufactured by a reputable company, the above calculations may be the only ones required. Online calculators also exist to help with these computations (BOX 1). However, there are many others veterinary nurses can use in their role as a veterinary nutrition advocate.

AS-FED VERSUS DRY MATTER BASIS

Ingredients are listed on the label as percentages on an “as-fed” basis; essentially, this means that the moisture content is included. Dry and canned pet food both contain moisture, but in different amounts. To be compared between different foods, especially when comparing canned food to dry kibble, each nutrient must be converted from as-fed to dry matter basis (DMB).

One method of estimating the crude moisture in a pet food is to subtract the percentage of moisture listed in the guaranteed analysis section on the label from 100% and then divide the percentage of each nutrient listed in the guaranteed analysis by this number.³

Example: A canned-food label lists the moisture content as 75% and protein as 10% (as-fed basis).
- 100% – 75% moisture = 25% DMB
- 10% protein + 25% DMB = 40% protein

This food is 40% protein DMB.

Example: A dry-food label lists the moisture content as 10% and protein as 18% (as-fed basis).
- 100% – 10% moisture = 90% DMB
- 18% protein + 90% DMB = 20% DMB

This food is 20% protein DMB.

Note that before conversion from as-fed to DMB, the canned food in this example appeared to contain less protein than the dry food; however, it actually has more.

A simpler, perhaps not quite as accurate, method is to multiply the percentages of nutrients listed in the guaranteed analysis by 1.1 for dry foods and by 4 for canned foods.

Example: A dry-food label that lists the protein content as 18% × 1.1 = 19.8% protein DMB.

Example: A canned-food label that lists the protein content as 10% × 4 = 40% protein DMB.

Both of these calculations provide an estimated amount of nutrients on a dry matter basis. If the actual amount is required, it can be obtained from the pet food manufacturer.

COMPARISON ON A CALORIC BASIS

The simple method described above can be useful to help clients understand that comparisons are not as easy as simply reading pet food labels. However, comparing nutrients on a caloric (or energy) basis as grams per 1000 kcal provides a more useful, more accurate comparison and is often preferred.

For this comparison, locate the caloric density (kcal/kg) and the percentage of the nutrient to be compared on the product label. For protein, add 1.5% to the minimum listed on the label, and for fat, add 1%.⁴

Example: A dry diet that contains 26% protein with 3450 kcal/kg.
Ed Carlson

Ed is the director of veterinary nursing education for VetBloom. He is also the treasurer of the New Hampshire Veterinary Technician Association and secretary of the Massachusetts Veterinary Technician Association. Ed has served on multiple NAVTA committees and was the 2021 NAVTA president. He obtained his VTS (Nutrition) in 2014 and lectures frequently at local, regional, national, and international veterinary conferences on a variety of topics. Ed received the NAVTA Technician of the Year award in 2019.

### NUTRITION NOTES

**• 26% protein + 1.5% = 27.5%**

**• 3450 kcal/kg ÷ 10 000 = 0.345**

**• 27.5% ÷ 0.345 = 79.7 g/1000 kcal**

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**Example:** A canned diet that contains 9.2% protein with 1202 kcal/kg.

**• 9.2% protein + 1.5% = 10.7%**

**• 1202 kcal/kg ÷ 10 000 = 0.12**

**• 10.7% ÷ 0.12 = 89.2 g/1000 kcal**

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**CALCULATING ESTIMATED CARBOHYDRATE CONTENT**

Guaranteed analyses do not list the amount of carbohydrate in a pet food; however, this amount is easily estimated. Start by converting the protein, fat, fiber, and ash contents to DMB (as explained above). Add these percentages together and subtract the total from 100%. This is the estimated carbohydrate content of the food.³

**Example:** A diet that contains the following contents as DMB.

- **Protein:** 32% DMB
- **Fat:** 20% DMB
- **Fiber:** 6% DMB
- **Ash:** 12% DMB
- **Total:** 70%

100% – 70% = 30%. This food contains approximately 30% carbohydrate.

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**SUMMARY**

These basic nutrition calculations are important when veterinary nurses are developing nutritional recommendations and plans for patients and educating clients on the importance of nutrition. **TVN**

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**References**


