The importance of developing a nutritional plan for patients ranging from healthy to the critically ill cannot be underestimated. More clients are taking an active role in developing a nutritional plan for their pets, and many are choosing unconventional diets (e.g., raw, holistic, organic, all meat, etc.). The veterinary team can have a strong influence on the nutritional choices clients make for their pets. Clinical nutrition is not a static process. Nutritional requirements change over time or in the presence of disease states. Life stage nutrition is the concept of providing a diet designed to meet the optimal nutritional needs of a patient at a specific age or physiologic state. The nutritional needs of an 8-week-old puppy, 15-year-old geriatric dog, or pregnant dog are not the same. Understanding the differences in nutritional needs as a patient ages is one example of this concept. Unfortunately, a thorough review of life stage nutrition is beyond the scope of this review.

Malnutrition, a disorder of inadequate or unbalanced nutrition that is associated with either nutritional deficiency or excess, is another key factor that plays a role in health and disease. Although often overlooked, obesity is the primary example of malnutrition in Western society. Another example is simple starvation. This occurs in normal, healthy patients denied adequate caloric intake. In order to maintain lean body mass, changes occur in the body to reduce energy requirements and decrease metabolic rate. Stress starvation occurs during illness or injury. Unlike simple starvation, counter-regulatory hormones (e.g., glucagons, epinephrine, cortisol) and inflammatory mediators are released, which prevent a decrease in metabolic rate. A catabolic state results with loss of lean body mass and a negative nitrogen balance. These patients have compromised immune function, reduced wound healing, and a decreased overall prognosis. A nutritional plan should address any aspect of malnutrition in an attempt to reverse this process and restore normal balance.

Where do we start in this endeavor? Patient assessment is the first area to focus on in developing a nutritional plan. The primary goal is to establish the patient’s nutritional needs based on its physiologic condition. Review of the patient’s history and medical record will help determine the nutritional status at that moment. Particular attention should address 1) species, 2) breed, 3) age, 4) gender, 5) reproductive status, 6) activity level, and 7) environment. A complete history should also include questions about the pet’s weight, current diet, treats and supplements consumed, and an accurate description of the current feeding plan. Ongoing treatment for disease conditions that may affect appetite, nutrient metabolism, or both should also be noted.

Next, physical examination can help define nutritional status. It may also identify an ongoing disease process that may alter nutritional requirements. Areas to address include body weight in relation to previous examinations and body condition scoring (BCS). BCS is utilized to assess a patient’s fat stores and, to a lesser extent, muscle mass. Fat coverage is evaluated over the ribs, down the topline, around the tailbase, and along the ventral abdomen. Descriptors have been developed for different species (e.g., dogs and cats) to aid in this evaluation. Methods of BCS often involve a 1–5 or 1–9 grading scale. The author utilizes a 1–5 grading system, with 1 being very thin, 5 grossly overweight, and 3 ideal condition. This system, when incorporated repeatedly, provides a reasonable estimation of body composition. Studies assessing the accuracy of this system for repeatability and variation between scorers demonstrated agreement between 80–90% of the measurements. It is recommended to include BCS in the medical record along with body weight every time a patient is evaluated. A change in BCS as little as 1 point indicates a 15–20% change in body composition. This piece of information may be the earliest indicator of malnutrition or an underlying disease process in the patient.

Laboratory tests and ancillary diagnostic procedures cannot directly assess a patient’s nutritional status. However, they may provide additional information regarding an underlying condition that could alter nutritional requirements. Health status of patients may also play a role in nutritional management. A routine wellness check-up for a patient in ideal BCS is unlikely to require nutritional intervention. A hospitalized patient being treated for an underlying disease process that has been anorectic for several days may require immediate attention regarding nutritional status. Systematically reviewing the medical history, physical exam findings, diagnostic test results, and health status will help in the initial formulation of a nutritional plan.

Feeding protocols should be developed to meet the nutrient requirements of each individual based on patient assessment. Nutrients are divided into six basic categories. Water, minerals, and vitamins are essential nutrients to
support life. However, the focus of this discussion will involve the energy-supplying nutrients, including carbohydrates, fats, and proteins.

Carbohydrates play important roles in health maintenance. Simple sugars and starches provide energy in the form of glucose to the body. In general carbohydrates supply 3.5 kcal/g of energy. Certain organs and tissues in the body require glucose for their energy source. Examples include the brain and red blood cells. Complex carbohydrates, better known as fiber, can be classified as soluble or insoluble. Soluble fibers tend to be rapidly fermentable. Fermentation produces short chain fatty acids that provide a direct source of nutrients to the large intestine and help maintain a healthy, intact gastrointestinal mucosal barrier. Fermentation also promotes the growth of normal gastrointestinal bacterial flora and inhibits growth of pathogenic bacteria. Insoluble fiber tends to be slowly fermentable. It helps promote normal mechanical function of the gastrointestinal tract by increasing bulk and water content in the stool.

Fats are the primary source of energy for dogs and cats, providing 9 kcal/g. They also play an important role in cell membrane structure and lipoproteins. Fatty acids are derived from this nutrient. The most commonly known fatty acids are omega-3 and omega-6. These particular fatty acids are classified as essential because the body cannot synthesize them. Omega-3 fatty acids inhibit the synthesis of inflammatory mediators, which is believed to provide an anti-inflammatory effect in certain disease conditions. Omega-6 fatty acids are utilized for prostaglandin synthesis and some other biologically active molecules. They also have been shown to improve the immune barrier of the skin.

Proteins are molecules composed of amino acids and are the principal structural constituents of body organs and tissues. These complex molecules serve many functions. They are utilized to rebuild and maintain tissues, serve as carrier molecules and message transmitters, and provide enzymes, antibodies, and an energy source. Protein provides 4 kcal/g of energy. Several amino acids require special attention in this discussion, including taurine, arginine, and glutamine. Taurine is an essential amino acid of cats but not dogs. It has many important roles in the body. Taurine is necessary to synthesize bile acids, regulate calcium flux, provide neurotransmission, serve as an antioxidant, and stabilize cell membranes. Deficiencies of this amino acid in cats can result in abnormalities such as retinal degeneration and dilated cardiomyopathy. Arginine is an essential amino acid for kitten, cats, puppies, and dogs. It is necessary to prevent hyperammonemia. Arginine serves as an intermediate in the urea cycle. The urea cycle is the major metabolic pathway that detoxifies nitrogenous waste and prevents the build-up of ammonia in the body. A deficiency of this amino acid produces clinical signs of hepatic encephalopathy (e.g., ataxia, vomiting, abnormal vocalization, hypersalivation, tremors). Most protein sources utilized in commercial pet foods provide an adequate amount of this amino acid. Products utilized for other species such as milk replacers or human enteral solutions should be closely evaluated for arginine levels prior to use. Glutamine is a conditionally essential amino acid. In normal health, adequate levels of glutamine are synthesized, but in certain disease conditions or critical illness, this pathway becomes attenuated. Glutamine is a key energy source for rapidly dividing cells such as enterocytes. It is utilized by the body for nitrogen transport, gluconeogenesis, renal ammoniogenesis, and RNA and DNA synthesis. Supplementation with this amino acid in critical illness has shown mixed results with patient outcome.

Determining the ideal proportions of nutrients for a patient revolves around the initial patient assessment. Certain medical conditions may benefit from dietary therapy that is somewhat altered from general guidelines. A dog with a diagnosis of pancreatitis requires a nutritional plan that minimizes fat content. An understanding of the energy-supplying nutrients will aid in providing appropriate caloric needs to the patient. Calculating energy requirements is necessary to determine the quantity of food to feed to a patient. Initial calculations are based on one of two equations to determine resting energy requirements (RER):

Linear formula (valid for patients >2kg to <30kg)

\[ \text{RER (kcal/day)} = (30 \times \text{BW}_{\text{kg}}) + 70 \]

Or

Exponential formula based on body surface area

\[ \text{RER (kcal/day)} = 70(\text{BW}_{\text{kg}})^{3/4} \]
After determining RER, daily energy requirements (DER) can be calculated by multiplying RER by an appropriate factor. Charts have been developed to determine the appropriate factor for most situations and can be located in any veterinary nutritional textbook.

Determining how to feed your patient becomes easier if it is eating without assistance. Unassisted feeding methods include free choice, food-restricted meal feeding, or time-restricted meal feeding. All of these options have potential advantages and disadvantages, but for strict caloric control, food-restricted meal feeding is probably best. Assisted feeding methods include placement of a supplemental feeding tube. Many options exist for this treatment modality. The decision to use one site over another (e.g., esophagostomy vs. jejunostomy) involves expected duration of nutritional support, need to circumvent certain areas of the gastrointestinal tract, and stability of the patient for anesthesia. The primary goal with nutritional support via a feeding tube is to utilize as much of the gastrointestinal tract as possible. If nutritional support is determined to be necessary and enteral nutrition is not possible immediately, parenteral nutrition should be strongly considered.

Reassessment of the patient is the final step in developing a nutritional plan. Evaluation of the dietary plan should encompass all of the steps listed above. Circumstances that would warrant dietary replacement include an inability to satisfy nutritional requirements, the diet being poorly tolerated (e.g., persistent vomiting), or the patient refusing to eat the food. Depending on the severity of the clinical case, reassessment may occur from every several hours in the critically ill to annually in a healthy patient. This stepwise approach and repetitive process will help determine the appropriateness of the feeding plan no matter how complicated the clinical case.

References/ Suggested Reading


