Obesity is one of the most common health problems affecting the pet dog and cat population, with an estimated 53% of dogs and 30-57% of cats being overweight or obese. Obesity contributes to infertility, altered immunity, increased joint wear, insulin resistance, increased cardiovascular work, increased anesthetic risk and shorter lifespan. Unfortunately, it can be very difficult to reverse the obese state. Obesity in all species is more easily prevented than treated and the veterinarian plays an important role in educating clients before the pet becomes obese.

One of the easiest ways to help prevent obesity and properly address overweight animals is to keep accurate records of body weight and body condition scores. All patients should be weighed at every visit (every time the owner brings the pet to the clinic for any reason, even just as a companion to another pet) and the weight entered into the permanent medical record. Additionally, all veterinarians and technicians should familiarize themselves with a body condition scoring system. The two most common systems used are a 9 point and a 5 point system. Either system can be utilized, but the 9 point allows for more precise estimates. On a 5 point scale, 3 is ideal for both dogs and cats, with 1 being emaciated and 5 obese. On the 9 pt scale, 4-5 is considered ideal for dogs, depending on size and breed, with 1 being emaciated and 9 morbidly obese. For cats, a 5 is ideal and 1 and 9 are the same as in dogs. Each number on the 9 pt scale represents a change of 10-15% of body weight. Handouts on body condition scoring are available and can be given to clients who can be taught how to score their own pets. Body condition scoring posters can also be hung on exam room walls and often serve as conversation starters when owners inquire about them.

Starting young
A discussion of body weight, body condition and feeding is an important part of the initial puppy and kitten visits. New pet owners should be given specific instructions regarding feeding amounts and body condition goals.

**Puppies**
Puppy owners should be instructed to meal feed their puppies to an ideal body condition, rather than free-feeding or simply following the package feeding directions regardless of how the puppy looks. It is particularly important for large breed puppies to be kept lean throughout the growing period. A BCS of 4/9 has been shown to be ideal for large breed puppies such as Labradors. All owners should be advised that energy requirements often decrease after spaying or neutering while food intake tends to increase. Therefore, the amount of food that maintained a puppy at an ideal body condition before surgery will likely need to be adjusted to keep that puppy at an ideal body condition after surgery. A change in energy requirements of up to ~20% is possible. Puppies that are spayed or neutered younger than 6 months should be monitored particularly carefully for weight gain. Rather than switching to an adult food, a lower calorie puppy food should be obtained for an “easy keeper”.

**Kittens**
While free-feeding young kittens (< 4 months) is generally recommended, owners should transition to limited feeding (i.e. measured amount per day) and/or meal feeding as the time for spay and neuter approaches. Many cats become overweight or obese before their first birthday, setting up a lifetime of health concerns. Risk factors for obesity in cats include spaying and neutering, indoor lifestyle, multiple cat households and ad libitum feeding. As the first three are common and often desired in our pet cats, diet and feeding method become the most important factors that can be controlled. It has been shown that estrogen suppresses appetite in cats of both sexes. One study in ad libitum fed cats showed that food intake increased by 12% immediately after neutering, leading to average weight gains of 28% in 36 weeks after surgery. Energy requirements also decrease. These studies underscore the importance of limiting the amount of food fed after spaying and neutering cats.

**Yearly wellness visits**
At every yearly visit, pet owners should be counseled about their pet’s body weight and condition. Pets that are starting to become overweight (BCS 5.5-6/9) can be addressed while it is still relatively easy to adjust food portions. The yearly visit is also a good time to make sure that all pets are eating appropriate diets for their lifestyle [i.e. not too many treats or too much table food (<10% of daily calories), balanced diets, appropriate amounts].

**Weight loss plans**
Formal weight loss plans are recommended for all animals with BCS of 7 or greater on a 9 pt scale (4 or greater on 5 pt scale). For most pets, a veterinary therapeutic diet formulated for weight loss should be used. Simply restricting the amount fed of over-the-counter maintenance (including “weight control” type) diets runs the risk of restricting essential nutrients in addition to calories, which can lead to muscle loss and alterations in metabolism that can further complicate weight loss.
Dogs

It is ideal to obtain a complete diet history from the client and use it as a basis for a weight loss plan. All food items fed (including treats and table food) should be included to allow for an accurate estimate of daily caloric intake. If current intake can be estimated, then calories should be restricted to 80% of current intake to encourage weight loss. If current intake cannot be determined, caloric restriction should start out initially at the calculated resting energy requirement (RER; \(70 \times BW(kg)^{0.75}\)) for the estimated ideal weight and then be adjusted accordingly. If the ideal weight is not known (i.e. documented from an earlier time in the record) or can’t be accurately estimated, then the RER for the current weight can be used. Regardless of the amount of initial calories fed, adjustments will likely be needed to obtain and maintain steady weight loss.

Diet selection

For an otherwise healthy animal, a weight loss diet should be selected that contains at least 30% of calories from protein on a metabolizable energy (ME) basis (8.5 g/ 100 kcal). Over the counter “light” or “weight management” diets are often not appropriate for weight loss as they usually do not contain adequate amounts of protein and other essential nutrients when restricted to the amounts necessary to achieve weight loss in many animals. Veterinary therapeutic weight loss diets have varying fiber amounts and types, moisture, caloric density and protein concentrations. The selection of a diet for a particular pet should take into account the owner’s lifestyle, pet’s preferences, and diet availability. Ideally, practices should stock at least two therapeutic weight loss diets in canned and dry forms that have differing nutrient profiles (e.g. one higher fiber and one lower) so that the most appropriate diet for each individual pet can be selected.

If owners are used to giving treats, it is helpful to reserve up to 10% of the total desired daily calories as treats. The USDA publishes caloric information for human foods (http://www.nal.usda.gov/fnic/foodcomp/search/). Caloric information for commercial treats may be available from the manufacturer. If the manufacturer cannot provide caloric information, then the product should be avoided.

Weight loss goals

For dogs without additional systemic disease eating a veterinary therapeutic diet designed for weight loss, the weight loss goal is 1-2% of initial BW per week. All dogs should be weighed every two weeks and the amount of food adjusted as needed to maintain the goal rate of weight loss. Usually adjustments of 10-15% of calories are made at a time unless the pet actually gains weight from the last weigh-in, in which case a 20% reduction is likely appropriate. It is important that owners realize that weight loss can be a long process but that even a loss of 10% of body weight can make a big difference in their pet’s health. It is not uncommon for pets to initially lose weight but then hit a plateau. It is important not to be discouraged and to adjust the food and reweigh the patient two weeks later.

For dogs with systemic disease or those who must eat a specific diet that is less than ideal for weight loss (e.g. a limited antigen diet for a dog with food allergies, or an obese patient with copper associated hepatopathy on a liver diet), a more gradual rate of weight loss can be attempted if it is determined that weight loss is an important part of the patient’s overall treatment plan. A goal of 0.5% BW per week may allow for weight loss with less than ideal diets without leading to overt nutrient deficiencies.

Exercise

For dogs that are able, exercise is an integral part of a weight loss program. Owners should be encouraged to increase their pet’s activity gradually as the pet becomes more fit. Brisk walks over increasing distances and swimming can be great activities for sedentary, overweight dogs. For dogs with orthopedic disease, there are an increasing number of veterinary physical rehabilitation services available that may be able to design an appropriate exercise program to improve strength and mobility while limiting the risk of further injury.

Cats

Cats are not small dogs! Although weight loss plans can be frustrating in dogs, they tend to be even more difficult in cats. Cats tend to be more sensitive to dietary change than dogs and often are very persuasive [annoying!] beggars. Cats often decrease their energy requirements significantly when faced with caloric restriction and it is not at all uncommon to have a cat that is maintaining or even gaining weight on an amount of calories that seems implausible (e.g.120 kcal per day for a 10# cat). Additionally, there is the added concern of the development of hepatic lipidosis in overweight cats that refuse to cooperate with the new diet plan. It is also common for the owners of overweight and obese cats to have little knowledge of how much food is being fed daily. As for dogs, if current intake can be quantified, then the calories should be restricted by 20%. If current intake cannot be determined, then the starting point should be 80% of the calculated RER at the ideal weight, using the same equation as in dogs. It cannot be stressed enough that this amount is a starting amount only and will need to be adjusted.

Diet selection

The appropriate type of diet to use for feline weight loss plans is a subject of much controversy. It is commonly suggested that higher carbohydrate diets lead to obesity in cats and that low carbohydrate diets are more effective for weight loss. However, experimentally, high fat diets have been shown to be more of a concern for obesity development than high carbohydrate diets when free-fed. Luckily, there are both higher carbohydrate/lower fat and lower carbohydrate/higher fat [canned] weight loss diets available for cats. In general, low carbohydrate dry foods are not recommended for weight loss even if formulated with appropriate nutrient levels as these foods...
are so calorically dense (e.g. 480 kcal/cup and 592 kcal/cup) that feeding amounts will likely need to be measured in tablespoons, individual kibbles or grams, likely leading to decreased cat and owner compliance.

For cats on a weight loss plan that require significant caloric restriction, it is imperative that a veterinary therapeutic diet formulated for active weight loss be used. Feline diets used for weight loss in otherwise healthy cats should contain around 40% or more protein, ME (11.1 g/100 kcal). As in dogs, diet selection should take cat and owner lifestyles, texture preferences, cat behavior (e.g. begging) and any additional health problems (e.g. history of constipation) into account. Canned diets may hold an advantage over dry diets in that the water content may encourage satiety and owners tend to be more aware of how much is being fed.

**Weight loss goals**

Although weight loss rates of 1-2% of body weight are safe in cats when appropriate diets are used, rates of 0.5% -1% BW per week are more realistic. As with dogs, cats should be weighed at least every two weeks on the same scale and the amount of food fed should be adjusted by 10-15% at each weigh-in until the desired rate of weight loss is obtained. It is recommended that clients purchase a baby scale to allow for weekly weighing at home to minimize stress in cats that do not enjoy travel.

Exercising cats tends to be more difficult than exercising dogs. Options include food dispensing toys, feeding multiple small meals in different parts of the house, hiding kibble around a room or throwing it down a hall to be fetched, feather toys, laser pointers, electronic mice and cat wheels (hamster-type wheels popular with Bengal cat enthusiasts).

**Helping your clients (and patients) succeed**

Weight loss plans can be very frustrating for clients and veterinarians can assist by encouraging clients. Assigning a technician or two to be “weigh-loss czars” to help support and motivate clients as well as handling weigh-ins can be helpful. Consider setting up a Biggest Loser or Weight Watchers-type program at your practice to encourage client compliance. Reminder calls can be made for weigh-ins. Visual aids such as line graphs of weight loss over time (easily made as a template in Excel) and before and after pictures can be displayed in the reception area with client permission and can help to motivate clients. Ribbons, small prizes, or discounts can also be offered as incentives for owners that are successful in getting their pets to lose weight.

**Cited references**

Many clients whose pets are being treated for cancer are interested in potential benefits from nutritional modifications. Some owners blame a diet for causing the cancer while others want to home-cook so they can feel like they are actively contributing to their pet’s care. Still another group has done “research” online and in various books and would like to modify or supplement their pet’s diet in the hope that these changes will help cure their pet.

Despite large volumes of information in lay sources touting various nutrients, diets, or supplements for treating cancer in pets and humans, there is little published research addressing nutrition and cancer in dogs and virtually none in cats. The goal of this presentation is to discuss some of the commonly recommended nutritional strategies for dog cancer patients and to review the evidence to support these recommendations.

It should be stressed to clients that the most important nutritional goals for managing dogs with cancer are to maintain an appropriate caloric intake and ensure that all essential nutrient needs are met. These goals can be accomplished with a commercial diet or a home-cooked diet, but the latter requires much more careful planning and institution to ensure nutritional balance. It is important to keep in mind and stress to clients that there is absolutely nothing wrong with simply continuing cancer patients on the diet that they have been doing well on, provided they will eat an appropriate amount to maintain weight and the diet is properly cooked, nutritionally adequate, and made by a reputable company with a long history of good quality control.

Low carbohydrate
One of the most prevalent recommendations, online and within the veterinary community, is that pets with cancer should be fed as low a carbohydrate diet as possible because carbohydrates “feed” the cancer. It has been known for over 50 years that cancer cells obtain most of their energy via anaerobic fermentation of glucose to lactate rather than via aerobic respiration as in most normal cells and it has been reported that dogs with lymphoma have higher insulin and lactate levels than normal dogs. Thus, the suggestion has been made that dogs with cancer may do better on lower carbohydrate diets. However, this theory has not been proven in-vivo.

The only published study that investigated the use of high carbohydrate (55% of calories) versus low carbohydrate (7.5% of calories) diets in dogs with lymphoma did not show a difference in remission times (survival time was not assessed and statistics were not performed) or energy requirements. The author is unaware of any additional published studies in dogs. There continues to be a need for well-designed controlled clinical trials to further investigate the role of dietary carbohydrates in cancer treatment of dogs. Despite the current lack of evidence to support benefits of low carbohydrate diets, this recommendation continues to be enthusiastically embraced by clients and veterinarians alike.

As a whole, low carbohydrate diets (not to be confused with “grain free” diets which can be quite high in simple carbohydrates) are generally quite high in fat and calories and may lead to weight gain if calories are not closely monitored, and pancreatitis (dogs) or gastrointestinal disturbance in sensitive animals; a slow transition from the current diet may be helpful. Low carbohydrate diets are typically contraindicated in pets with kidney disease, severe liver dysfunction, urate or cystine uroliths.

In summary, if low carbohydrate diets are already being fed and are well-tolerated, there is no evidence to suggest that they are harmful to otherwise healthy animals; however, there is little evidence at this point to suggest a clinical benefit of switching a pet with cancer from a balanced diet with a more typical carbohydrate concentration to a low carbohydrate diet.

Amino acids
There has been increasing interest in potential anti-neoplastic benefits of certain amino acids. A commonly discussed amino acid is arginine. Arginine, via its conversion into nitric oxide, has been shown to have both pro-neoplastic and anti-neoplastic properties at the molecular level. In-vivo data in humans and animals with neoplasia are still inconclusive; one controversial veterinary study showed longer disease free interval and survival times in dogs with presumed stage III lymphoma fed a diet supplemented with arginine in addition to omega-3 fatty acids than a similar diet without either addition. Unfortunately, the study design was not ideal and potential benefits of arginine cannot be separated from those of omega-3 fatty acids.
**Omega-3 fatty acids**

Omega-3 polyunsaturated fatty acids (PUFAs) have been demonstrated to have anti-inflammatory effects in numerous species, including dogs. They are increasingly being investigated for potential anti-neoplastic activity as well. Clients are likely to be interested in supplementing or already supplementing various omega-3s when their pet is diagnosed with cancer.

There are two main sources of omega-3 fatty acids: terrestrial plants and marine algae and fish. Flaxseed is an excellent source of alpha-linoleic acid (ALA, 18 carbon, 3 double bonds; 18:3), a short chain omega-3 fatty acid. The two other well-known omega-3s, docosahexaenoic acid (DHA, 22:6) and eicosapentaenoic acid (EPA, 20:5) are only found in marine algae and the cold water marine fish that eat it. Although ALA can theoretically be converted to EPA and then DHA through enzymatic means, a sizable percentage of dietary ALA intake is oxidized for energy and the conversion rates in mammals are generally poor. Cats, for example, are not thought to have clinically relevant conversion of ALA to EPA.

The literature is ambiguous when it comes to benefits of ALA for neoplasia, despite the enthusiastic embrace of this fatty acid on the internet (i.e. Budwig cancer diet). Research in human breast and prostate cancers, mostly correlation studies, has suggested both positive and negative associations between ALA intake and tissue concentration and cancer.

The evidence for potential benefits for EPA and especially DHA is more impressive in humans and animal models, although not strong enough to make supplementation the standard of care in human oncology. Hundreds of studies are currently on-going to more accurately discern the potential anti-neoplastic effects of long chain omega-3 fatty acids in humans and laboratory animals as well as to determine the appropriate doses to optimize these effects in-vivo.

Only one controlled study has investigated a diet high in EPA and DHA on outcome in dogs with cancer. This study looked at dogs with Stage IIIa and IVa lymphoma fed a diet supplemented with fish oil and arginine or a similar diet with no fish oil or added arginine as mentioned above. Overall disease free interval and survival time were not different between the diets, although when the dogs were divided by stage, stage III dogs eating the supplemented diet had longer disease-free interval and survival time. Many aspects of this study have been criticized, including the post hoc subgroup analysis and the method of initial staging.

Despite the lack of definitive evidence for benefit of EPA and DHA supplementation in dogs or cats with cancer and the lack of a defined appropriate dose, the sum total of the human and animal literature is suggestive of a benefit, and it is therefore very reasonable to feed a diet high in EPA and DHA or to supplement a low omega-3 commercial diet with these fatty acids. Although appropriate doses have yet to be determined, the author generally starts with a total daily dose of 300 g EPA and DHA (1 regular strength human fish oil capsule) per 10 pounds body weight. There is minimal evidence at this point to support a benefit of flax (ALA) supplementation as a source of omega-3 fatty acids in dogs with cancer, and it should not be used as a source of omega-3 fatty acids for cats. Clinicians should keep in mind that there is an upper limit to how much omega-3s can be safely supplemented because adverse events can be seen, although it remains rather undefined.

**Antioxidants**

Antioxidant supplementation is controversial in cancer patients, both human and animal. While there is evidence that some antioxidants may help prevent certain types of cancers, there is also evidence that some antioxidants increase the risk of certain cancers (e.g. beta carotene and lung cancer). Studies in humans with active tumors have shown variable results from high-dose antioxidant supplements including beneficial, no observable, and detrimental effects. Common recommendations in humans include avoiding antioxidant supplements within a few days of chemotherapy and throughout a course of radiation. These recommendations apply to antioxidant supplements, rather than antioxidants naturally occurring in whole foods (or commercial diets for our pets). The author recommends avoiding unnecessary supplementation of antioxidants during active cancer treatment with chemotherapy or radiation.

### Maintenance of body condition

Maintenance of an ideal body condition during cancer treatment can be important to ensure the best prognosis. While obesity has been linked to cancer development and even a worse prognosis in some human cancers, there are few known associations so far in dogs or cats and it is unclear at this time whether being overweight confers a worse prognosis for pets with common cancers. For pets that are overweight enough (> 7/9 body condition score) that it poses quality of life or mobility issues, it may be beneficial to institute a weight loss plan geared towards modest decrease in body weight (10-15% loss) rather than focusing on obtaining an ideal body condition score.

For underweight dogs and cats, the emphasis should be on distinguishing muscle loss (cachexia), which is not easily reversed, from fat loss, which will respond to increasing the daily calorie intake. Cachexia is much more common in cats with cancer than dogs and is associated with a worse prognosis. Some pets with cancer (such as those with oral masses) may require assisted feeding utilizing a feeding tube to maintain an appropriate body weight. These strategies should be instituted early on when weight loss is first noted and may be more easily reversed, rather than only as a last ditch attempt in an emaciated animal.
Summary
The best evidence supports feeding pets with cancer commercial or home-cooked diets designed to meet both their energy and essential nutrient requirements. There is no “magic cancer” diet, despite passionate claims to the contrary. Low carbohydrate diets remain unproven; supplementation with EPA and DHA should be considered. Supplementation of arginine remains equivocal. Antioxidant supplementation is controversial and until it becomes less ambiguous, it is likely best to avoid exogenous supplementation outside of the levels provided by a well-balanced diet, especially during chemotherapy or radiation. Some pets may require assisted feeding to maintain an optimal body weight and condition.

References
Nutritional Management of Common Gastrointestinal Diseases
Callin Heinze, MS, VMD, DACVN
Cummings Veterinary Medical Center at Tufts University
North Grafton, MA

First things first - fiber
Fiber is probably one of the most enigmatic nutrients, however, it can play an important role in gastrointestinal disease management and prevention. Although technically a carbohydrate due to its composition of sugar molecules, it is indigestible to mammals. The difference between digestible carbohydrates (sugars and starches) and fiber is mainly how the monosaccaride units are linked to each other. Depending on the species, hindgut/colonic or rumen microbes can break down the bonds and extract energy from different types of fibers even though the animal lacks endogenous enzymes to break down fiber.

Most fiber sources are derived from plants and represent structural components of the plant cell walls (cellulose, lignin, hemicellulose, pectins) or compounds found intracellularly (gums, fructans, mucilages). The two main functional groups for fibers are insoluble fibers and soluble fibers. Insoluble fibers include cellulose and hemicelluloses while soluble fibers are pectins, gums, fructans [including fructoligosaccarides (FOS); inulin] and mucilages.

Insoluble fibers basically enter and exit the body virtually unchanged and are not soluble in water (e.g. wheat bran will never dissolve in water). Soluble fibers will dissolve in water and form viscous gels if in the right proportions (pectins are used to make jam). Both types of fiber can have very different effects in the gastrointestinal tract.

Fibers can also be categorized on the basis of the speed and degree to which they are fermented in the colon by intestinal bacteria to produce short chain fatty acids (SCFA: butyrate, propionate, and acetate) that supply colonocytes with nutrition. Generally, the more soluble the fiber source, the more rapidly and completely fermentable it is. While the ability to be fermented by microbes overall can provide health benefits to enterocytes, too much highly fermentable fiber can interfere with digestion and can lead to excessive production of gas and associated GI discomfort.

It can be very difficult to compare the amounts of each type of fiber or even total fiber in commercial pet foods. The fiber amount listed in the guaranteed analysis is “crude fiber”, which includes most, but not all, insoluble fibers, but does not include any soluble fibers. Another type of analysis, total dietary fiber (TDF), measures soluble fiber and the most common types of insoluble fibers in pet foods. The TDF analysis (commonly used for human foods) is more time-consuming and considerably more expensive than crude fiber measurement. Because of these limitations and because it is not required of pet food companies, TDF is rarely available for commercial pet foods. It is wise to keep in mind that many canned diets have more soluble fiber than insoluble and many dry diets have similar amounts of soluble and insoluble fiber, thus the total fiber in the diet may be twice the crude fiber value or even higher, but there is no way to know without a measurement of TDF.

| Table 1. General properties of soluble vs insoluble fibers |
|---------------------------------|-----------------|-----------------|
| Property                        | Soluble         | Insoluble       |
| GI Motility/transit time         | Slows transit time | Increases transit speed |
| Interaction with water           | High, binds and forms a gel | Some water binding |
| Fecal volume (dry matter)       | Mild increase   | Increased       |
| Frequency of defecation          | +/-             | Increased       |
| Fermentability                   | Usually moderate to high | Low |

There are a number of options for higher fiber diets as well as supplements to add to lower fiber diets. While it is very popular, please note that canned pumpkin is not a very concentrated source of fiber – 1 tablespoon of pumpkin puree has 0.4 grams of fiber compared to 4.5 grams in a tablespoon of psyllium husk powder (generic unflavored Metamucil) and 1.5 g in a tablespoon of wheat bran.

Prebiotics and probiotics
Pre- and probiotics are popular buzzwords right now in both human and animal nutrition. Probiotics are live, non-pathogenic bacteria that are capable of colonizing the gut and producing beneficial effects whereas prebiotics are compounds that feed the growth of beneficial bacteria. Most prebiotics are soluble, fermentable fiber sources like FOS. Promoting the growth of beneficial commensal bacteria can improve GI health as they can out-compete potential pathogenic organisms (e.g. Clostridium) for resources in the gut. Commensal bacteria may also play a role in immunoregulation and are currently being investigated for immune benefits that extend well beyond the gastrointestinal tract.

Both pre- and probiotics are becoming more common as additives in commercial pet foods. Probiotic inclusion in pet food is more controversial as there are many questions regarding the viability of various bacterial species as part of the food matrix (they are usually added to kibble after cooking). For a probiotic to have beneficial effects it must survive the hostile environment of the stomach and colonize the large intestine and there is little evidence to support that probiotic strains included in commercial pet foods.
accompany this goal. One Canadian study showed that of 19 diets investigated that were marketed as containing probiotics, none of them had all of the strains or amounts reported on the label when the products were cultured. The study concluded that diets that purport to contain probiotics contained low numbers of organisms that often did not correspond with the information on the label.

Separate probiotic supplements may be more efficacious than probiotics incorporated into food; however, there are still many questions regarding viability, appropriate dose, etc. Although much more research is needed to determine the appropriate bacterial strains, doses and methods of administration, the commercially available veterinary products from reputable companies appear to be safe for most animals and can be considered as adjunct therapy for animals with gastrointestinal signs, especially diarrhea secondary to antibiotic administration. Even among these products, however, there is great variability in bacterial strains and numbers.

An interesting aside to the probiotic/prebiotic discussion is some recent interest in trying to repopulate the gut entirely with a new, healthier microbiome. This can be accomplished with fecal transplantation (aka “repoopulation”) and anecdotal success in improving or even curing even long-standing diarrhea or other chronic GI issues has been reported in people and animals. Thus, this technique may become more widespread if results continue to be promising.

Nutritional management of gastrointestinal disease

Acute gastroenteritis

Gastroenteritis generally presents as vomiting and/or diarrhea and has a number of causes including dietary indiscretion, infectious causes, inflammatory bowel disease, outflow obstruction and extra-GI causes such as renal and vestibular disease. Appropriate diagnostics and supportive care with fluids and medication as appropriate should always be provided. Nutritional management is similar for cases where an inciting cause cannot be precisely determined and eliminated.

Generally a highly digestible diet is recommended once active vomiting stops and the diet is continued until several days after vomiting and diarrhea resolve before transition to the patient’s normal diet. Highly digestible diets include most veterinary therapeutic foods marketed for gastrointestinal health. These diets generally contain low amounts of insoluble fiber and varying amounts of fermentable soluble fiber such as FOS as well as other ingredients that are easily broken down and assimilated.

Highly digestible diets are often referred to as “bland diets”, but this terminology is vague and misleading as most people think of “bland” as meaning lacking flavor and many of these diets are quite palatable. Another misnomer is that these diets are all low in fat. The fat actually ranges pretty dramatically, from 16% of calories (18 g/1000 kcal) to 51% of calories (58 g/1000 kcal) for dogs. For cat diets, the range is from 30% fat (35 g/1000 kcal) to 52% (61 g/100 kcal).

If pancreatitis is suspected, especially in a dog, then a low fat diet should be offered (<25 g/1000 kcal). In addition to concerns over pancreatitis, high fat diets can prolong gastric emptying time. When in doubt, it is generally safest to use a lower fat diet rather than a higher fat diet for initial re-feeding.

Not all of the highly digestible therapeutic diets are appropriate for puppies and kittens, however, so care should be taken to ensure that the diet selected provides adequate nutrition for growth. Although it may seem unimportant if the diet is intended for only a few days, it is not uncommon for a few days to stretch to a few weeks or even longer and as appropriate diets are readily available, it makes sense to preferentially use them.

Many veterinarians advise clients to feed boiled chicken or ground beef and rice to dogs and cats with gastroenteritis. While chicken breast (baking is just as good as boiling) and white rice are highly digestible and low in fat, ground beef can vary in fat content quite dramatically but will usually be moderate to high in fat. Data on the effect of boiling beef on fat content is lacking. Both options are deficient in multiple essential nutrients and it is imperative that clients be advised that these diets are not to be fed for more than a week or two in adult animals to avoid the risk of nutrient deficiency and that clients be given appropriate amounts to feed to meet calorie needs (1 cup of chicken or beef and rice is typically a lot lower in calories than 1 cup of most dog foods). If clients desire to feed a home-cooked diet long-term, then they should be referred to a board certified veterinary nutritionist to have a custom diet formulated so ensure that all essential nutrient needs are met.

Adverse reactions to food

The most common types of adverse food reactions are hypersensitivity (“food allergy”) and intolerance. Food hypersensitivity usually involves an immune response to a protein in the food and can manifest as gastrointestinal signs (vomiting, diarrhea) or as cutaneous signs (pruritus, secondary infections), or both. Food intolerance is a non-immunologic adverse response to a diet (e.g., lactose intolerance in humans and animals) and usually manifests as only gastrointestinal signs.

The “gold standard” for diagnosis of both food allergy and intolerance is a strict elimination diet and re-challenge with the original diet. If clinical signs improve dramatically on the elimination diet but then recur when the previous diet is reintroduced, then the diagnosis is made. A positive elimination trial does not distinguish between hypersensitivity and intolerance, or determine which ingredient(s) are the offenders. Elimination diets should contain one protein and one carbohydrate source to which the animal has not previously been exposed, or should be made from proteins which have been chemically digested (i.e. hydrolyzed) to reduce them to a size unlikely to provoke an immune response.

389
There are multiple veterinary therapeutic diets available for diet trials; a thorough diet history is critical as these diets may not be novel or appropriate for a particular patient. It is very important to counsel owners (and veterinary staff?) that no treats or flavored medications, flavored toys, toothpaste, etc should be used during the elimination trial. Even medication in gel capsules made from beef gelatin could be enough to promote a reaction in a beef-allergic dog.

If the patient with the suspected adverse food reaction is a growing kitten or puppy or a pregnant or lactating bitch or queen, care should be taken to select a diet that is appropriate for growth. Many commercial novel and hydrolyzed diets are not appropriate for growth, especially for large breed puppies, and none of them have been specifically tested for reproduction and so these diets could potentially cause harm in the 4-12 weeks that a typical food trial lasts. Although feeding a diet appropriate for growth may limit diet options significantly, it is important to the long term health of the animal.

Blood and saliva based allergy tests, while often performed, are notoriously unreliable for diagnosis of food allergies and are poor substitutes for a strict elimination trial. To determine which ingredient is the problem, the animal should be returned to the elimination diet after the re-challenge phase of the trial until clinical signs resolve, and then each ingredient in turn should be added to the elimination diet one at a time, waiting 1-2 weeks before each new ingredient and watching for recurrence of clinical signs. It is important to keep in mind that different cooking methods (processing) can alter antigens and thus it is possible that a dog allergic to chicken in a dry pet food may not be allergic to canned chicken or home-prepared chicken. If commercial diets fail to relieve clinical signs yet a food allergy or intolerance is still strongly suspected, a home-cooked diet can be considered. It is very important that this diet be formulated by a veterinary nutritionist if it is to be used for longer than 2-3 weeks as nearly all home-cooked diet recipes designed by owners or found online or in books are deficient in essential nutrients.

According to the most cited review, the most common food allergens in dogs are beef, dairy, wheat, chicken and egg. For cats, beef, dairy and fish have been the most commonly reported. This report likely reflects ingredient prevalence in commercial diets over the past three decades rather than increased inherent antigenicity of these foods. There is no evidence to support an animal being allergic to “all grains” or “all meats” and grains are typically less antigenic than meat proteins, despite this increasingly widespread belief among pet owners and even some veterinarians. There is the potential for cross-reactivity between various proteins (e.g., between duck and chicken) but this concept remains unproven in veterinary medicine.

Once it is determined which ingredients are not tolerated or promote an allergic reaction, an attempt can be made to find a commercial diet lacking in these ingredients or the animal can remain on the elimination diet long-term (assuming that it is nutritionally balanced).

**Inflammatory bowel disease (IBD)**

IBD has multiple etiologies and thus there is no one nutritional strategy that works for every patient. For some patients, nutritional modification can be a valuable adjunct to medical management and can reduce the amounts of medications needed whereas some patients require intense medical management and seem completely refractory to dietary change.

Common nutritional strategies for managing IBD include the use of novel ingredient and/or hydrolyzed diets (as for adverse reactions to food) or highly digestible diets. Additionally, colonic IBD may benefit from increasing fiber (especially soluble) to promote the production of SCFAs. Finding the best diet for a pet with IBD typically involves some trial and error aided by information on how the pet did on previous diets with varying characteristics.

**Lymphangiectasia**

Lymphangiectasia, or dilation of the intestinal lymph vessels, can be seen as a primary condition or in conjunction with IBD. This condition can lead to marked loss of both albumin and globulins (protein losing enteropathy; PLE) and can be greatly exacerbated by high fat diets. Nutritional management of lymphangiectasia involves feeding a low fat diet (typically < 24 g/1000 kcal or 20% fat on a metabolizable energy basis; ME), preferably highly digestible, ± novel ingredient or hydrolyzed diet if concurrent IBD is evident. Every pet is different and some may require more dramatic fat restriction than others. Unfortunately, there are currently no commercial hydrolyzed or limited ingredient diets available with less than 24 g/1000 kcal fat, so often an educated guess as to which condition is of biggest concern must be made (there are several dry options less than 32 g/1000 kcal or 27% ME, but these may be too high in fat for many animals). Alternatively, a veterinary nutritionist can be consulted for an ultra-low fat or low fat, novel ingredient home-cooked diet recipe.

**Feeding after GI surgery**

Traditionally, animals were fasted for several days after gastrointestinal surgery but newer data suggests that early return to feeding can promote better gut healing. Highly digestible liquid or solid diets should be introduced in small amounts as soon as the pet is awake enough to swallow appropriately. For pets with no appetite, a nasogastric tube can be used to provide nutrients to the gut as well as some calories. It seems to be less important to meet all calorie needs within 2-3 days after surgery than it is to at least start getting food into the gut (so called “trophic” feeding). Adjustments in pain medications and use of anti-nausea and pro-kinetic drugs
may facilitate earlier return to feeding. Feeding amounts should be increased over 2-4 days, depending on the level of debilitation and appetite until calorie needs are being met.

References
Nutritional Management of Diabetes:
It’s Not Just All About Carbs
Callin Heinze, MS, VMD, DACVN
Cummings Veterinary Medical Center at Tufts University
North Grafton, MA

Diabetes mellitus is a common endocrine disease in dogs and cats. Proper attention to nutrition can help maintain appropriate body weight, ensure that all essential nutrient requirements are met, and (in conjunction with medical management) maximize diabetic control. There is no one nutritional strategy that benefits all diabetic pets; species, body condition, feeding preferences and co-morbidities need to be taken into account when considering dietary modification.

Dogs
The vast majority of dogs have insulin-dependent diabetes (IDDM), similar to human type 1 disease. Regardless of diet, dogs will require insulin; however, some modifications in diet composition and feeding practices have been shown to be beneficial to maximize diabetic regulation.

The most important nutritional concept for managing diabetes in dogs is consistency. Dogs can often be well-controlled on a wide variety of diets as long as the same amount of diet is fed at the same times every day. Therefore, it is typically not necessary to immediately change the diet of a diabetic dog unless there are other concerns with the diet other than just the diabetes. Dogs should be fed their total daily food allotment divided evenly into two meals that correspond with insulin administration. Controlled amounts of certain treats (low sugar, ideally lean meats or vegetables) can also be fed, but it is important to keep the type, amount, and timing of treats consistent from day to day.

Rather than changing the diet at the time of diagnosis when many dogs are ill and feeling poorly, if there are no substantial comorbidities, the author recommends to first attempt to obtain glycemic control using insulin and allow the owner to get used to the changes that come with living with a diabetic pet while continuing the dog’s normal diet. If it is difficult to maintain satisfactory control, than a dietary change, such as to a higher fiber diet, can be considered once other medical conditions that can contribute to insulin resistance are ruled out.

There is currently minimal experimental evidence to support a recommendation of low carbohydrate diets for dogs with diabetes. One study showed no difference in diabetic control of dogs fed canned diets that differed in carbohydrates by a factor of 9.1 Regardless of diet, dogs rarely go into diabetic remission and insulin will not be able to be discontinued. While in an otherwise healthy dog low carbohydrate diets are unlikely to be harmful, they do tend to be very high in calories (especially dry diets) and fat and are contraindicated for overweight, hyperlipidemic, or fat-sensitive dogs.

There is no evidence that canned or dry diets are better for diabetic control in dogs; however, semi-moist diets (e.g., dry diets with chewy chunks or diets with moisture higher than 10% but lower than 65%) should be avoided as these diets often use simple sugars such as corn syrup to help maintain the moist texture. While uncommon, table sugar can be found in some canned and dry foods and should also be avoided.

Home-cooked diets are typically less ideal for diabetic dogs because they are difficult to adjust to maintain body weight without altering nutrient levels and because they do not tend to be as consistent as commercial diets. If a home-cooked diet is going to be fed, the author recommends utilizing higher fiber fruits and vegetables as well as carbohydrates from complex (e.g. whole grains) rather than refined sources (white potato, tapioca, white rice) and feeding the exact same recipe for every meal. Diet recipes should be obtained from a board-certified veterinary nutritionist to ensure that all essential nutrients are present in appropriate amounts as most recipes found online and in books are nutritionally unbalanced.2

Weight loss is indicated to enhance insulin sensitivity in overweight dogs. In these cases, a higher fiber/lower energy density veterinary therapeutic weight loss diet may be a good option. As weight loss is a symptom of both caloric restriction and poor diabetic control, diabetic dogs on weight loss plans need to be monitored very closely. There is also a risk of insulin overdose as insulin sensitivity improves with weight loss.
Cats

Unlike most dogs, diabetic cats often present similarly to human type-2 diabetics in that they produce insulin, but are resistant to its effects. Many cats are overweight and may have comorbidities such as osteoarthritis and pancreatitis. It has been suggested that higher carbohydrate diets and/or dry diets may predispose cats to obesity and/or diabetes. However, current experimental evidence does not support these assertions.

Over time, cats with chronic diabetes may lose weight and their ability to produce insulin, thus becoming more similar to dog diabetics and human type-1 diabetics. Most diabetic cats require exogenous insulin therapy and dietary composition can affect the doses required to maintain glycemic control.

The ideal diet composition for feeding diabetic cats remains unknown. There are only a handful of published studies investigating the effects of different dietary composition (protein, fat, fiber and carbohydrates) in naturally occurring diabetes in cats. Most examining lower carbohydrate diets (< 20% of calories, <5.7 mg/100 kcal, from carbohydrate). All of these studies have pretty noteworthy limitations - they did not control for caloric intake or weight loss, used small numbers of cats, compared commercially available diets that differed in more than just the strategy being investigated (e.g. fiber, carbohydrate, and protein), or made clinical decisions (e.g. reducing insulin dose) which may not have been supported by laboratory data. While there are many recommendations out there regarding the appropriate amount of carbohydrates to feed to diabetic cats (e.g. “<12% of calories”, “< 7% (units unknown)”), these numbers are based on opinion rather than well-designed studies looking at dose-response.

The net take home from the available studies is that both higher fiber and low carbohydrate diets may have some benefit in the regulation of feline diabetes, although low carbohydrate diets look more promising. With all of the talk and support for low carbohydrate diets among both veterinarians and pet owners, many may be surprised to learn that from an evidence-based medicine perspective, the data supporting low carbohydrate diets as a mainstay for diabetic cats are far from definitive. In fact, a recent systemic review of factors associated with diabetic remission in cats concluded that “dietary carbohydrate reduction might be beneficial, but requires further study”.

Despite the lack of strong literature evidence of benefit, many clinicians feel that they see clinical benefits with low carbohydrate diets. As such, low carbohydrate diets in controlled amounts can certainly be considered for diabetic cats, but it is important to keep in mind that they are not ideal for all cats. Some cats will not eat canned diets and dry low carbohydrate diets are often excessively high in fat and calories (> 450 kcal/cup), making them poor choices for hyperlipidemic, overweight, or even normal weight cats with low energy requirements (such as some cats that were overweight before they developed diabetes). Furthermore, most low carbohydrate diets, whether canned or dry, are also quite high in protein and are thus contraindicated in cats with kidney disease or other causes of protein intolerance.

It is important that diet recommendations for diabetic cats are tailored to the individual cat, taking into account cat body condition, comorbidities, owner factors, and food preferences. Regardless of the type of diet chosen, as for dogs, feeding a consistent daily diet is important. Unlike dogs, it is less important to feed cats only two meals exactly 12 hours apart. Many cats, particularly those treated with insulin such as Lantus, can likely be allowed to free feed (if not overweight) or eat multiple meals throughout the day.

For overweight feline diabetics, weight loss should be a high priority once the diabetes is reasonably well regulated. Many overweight cats have very low energy requirements and low carbohydrate dry diets are likely to be too high in calories and too low in other nutrients. A canned lower carbohydrate veterinary therapeutic weight loss diet is recommended. For cats with low energy needs unwilling to eat a canned diet, an appropriate low calorie dry weight loss diet should be used (which may not necessarily be low in carbohydrates). All diets should be fed at amounts necessary to induce weight loss of 0.5-1% body weight per week; however, reducing a diet not designed for active weight loss to less than 75% of the manufacturer’s recommended feeding amounts for the cat’s ideal weight can lead to nutrient deficiencies and related health concerns.

It is important to keep in mind that cats can be transiently diabetic and weight loss will often increase insulin sensitivity and decrease insulin requirements. Thus, diabetic cats, especially those newly diagnosed and those on weight loss plans, should be monitored carefully to prevent hypoglycemia.

The lack of commercial options that may meet all desired nutritional goals for diabetic cats (e.g. low calorie, higher protein, lower carbohydrate and high nutrient density) may lead some pet owners and veterinarians towards home-cooked or even raw diets for diabetic cats. Raw diets are a poor recommendation for any diabetic cat due to concerns with immunosuppression and because of public health concerns. Home-cooked diets can be utilized, but are time- and often cost-intensive if they must be adjusted for weight loss and often are not palatable for cats used to eating commercial foods.

In summary:

1. While many clinicians feel that low carbohydrate diets are quite beneficial to cats with diabetes, experimental evidence is rather weak and the ideal type and amount of carbohydrates for diabetic cats remains unknown.
2. Instead of a one-size-fits-all approach, it is important to assess the individual cat – comorbidities such as obesity, owner factors, and strong cat preferences should be taken into account when nutritional recommendations are made.
What every veterinarian should know about carbohydrates in pet food

When it comes to carbohydrates in pet foods, the most common thing that most veterinarians do not realize is that they are not directly measured. Carbohydrates are not part of the “Guaranteed Analysis” on the label and are not required to be measured at all in pet foods. In fact, manufacturers are discouraged from making any claims regarding carbohydrate content.

Whereas we can look on a Nutrition Facts label for a human food and see the total carbohydrate broken down into fiber and sugar, we cannot do that for pet food. There is no standardized assay for measuring carbohydrates in pet foods. The most common way currently used is to estimate the “nitrogen free extract” or NFE. The NFE is what is left after the fat, fiber, moisture, protein, and minerals from the food are removed. The amounts of each of these compounds from the food analysis are added up and then subtracted from 100 to get the amount of “carbohydrates”. This means that all the error and variation in all analyses end up in the “carbohydrate” fraction.

Contributing to the imprecision of this estimate is the fact that there is A LOT of error in crude fiber, which underestimates total dietary fiber by as much as 3 fold or more. If fiber is underestimated, then digestible carbohydrate amounts in foods that have much higher total dietary fiber than crude fiber can look higher than in foods that have less total dietary fiber but similar crude fiber. So, the amounts of carbohydrate/NFE in pet foods should be considered a rough estimate at best, yet many veterinarians and pet owners worry about small differences in carbohydrates between diets when it comes to feeding diabetic pets.

Another big issue is that not all carbohydrates are the same. We intuitively know that 20 grams of sugar are not the same as 20 grams of oats, but we have minimal data on the effect of different types of carbohydrates on the post-prandial blood glucose response of dogs and cats. We can’t assume that it will be exactly how it is in people. To further complicate factors, most pets are eating complex commercial diets, so even if one ingredient has more of an effect on blood glucose on its own, it can be hard to predict the result when it’s mixed with all the other ingredients found in commercial diets such as added fibers, meats, etc.

So what is a clinician to do? Clinical response (and hopefully more well-designed diet studies) is going to be much more valuable than the precise amount of carbohydrates in the diet (which is likely not available, anyway).

Take home messages
- We don’t have all the answers yet
- Current studies leave big gaps and don’t include dose response info for various nutrients (such as protein, carbs)
- Only a handful of diets have been tested in clinical trials
- Carbohydrate data for pet food should be considered an estimate only and may have a large margin of error
- Type of carbohydrate is likely as important as amount, but this has not been assessed in any studies
- There is little data to support common recommendations for specific carbohydrate amounts in foods for dogs or cats with diabetes

References
Renal Diets: What to Feed and When to Start
Callin Heinze, MS, VMD, DACVN
Cummings Veterinary Medical Center at Tufts University
North Grafton, MA

Renal disease is one of the medical conditions in veterinary medicine that is most amenable to dietary management. Research in both dogs and cats has demonstrated that specially formulated diets for renal disease help prevent uremic episodes, slow disease progression, and can double survival time. Dietary modifications for chronic kidney disease (CKD) are designed to help mitigate many of the metabolic changes that occur secondary to decreased renal function. Most “renal diets” are restricted in phosphorus, reduced in protein and sodium, +/- supplemented with potassium, alkalinizing, and enriched with B-vitamins and often omega-3 fatty acids.

Phosphorus
The most critical nutritional modification in renal disease is phosphorus restriction. Numerous well-designed studies have shown that controlling blood phosphorus concentration through dietary modification slows the progression of CKD. Reduced glomerular filtration rate (GFR) in CKD leads to decreased renal excretion of phosphorus. Hyperphosphatemia in turn leads to increased secretion of parathyroid hormone, leading to increased release of calcium and phosphorus from bone. This combination can cause mineralization of soft tissue, advances renal damage, and may lead to marked bone loss (“rubber jaw”).

The International Renal Interest Society (IRIS) has published guidelines on phosphorus management for renal patients at www.iris-kidney.com/pdf/IRIS_2009_Treatment_Recommendations_Summary.pdf. It is important to note that the target serum phosphorous concentrations are all in the lower end to middle of most laboratory reference intervals. This is because increased concentrations of parathyroid hormone can occur when serum phosphorus is still within the reference intervals. As renal disease advances, it often becomes impossible to keep phosphorus concentrations within the IRIS guidelines using diet alone. In these cases, phosphate binders should be used in addition to the lowest phosphorus diet that is appropriate for the patient. Commercial renal diets range from 0.5 – 1.2 and 0.8 - 1.28 g/1000 kcal phosphorus in dog and cat diets, respectively. The Association of American Feed Control Officials (AAFCO) minimums for dog and cat maintenance are 1.4 and 1.25 g/1000 kcal phosphorus, respectively. Therefore, all diets with a “formulated to meet AAFCO nutrient profiles” statement on the bag (predominantly OTC diets) will be inappropriate for dogs with renal disease, while the vast majority will be inappropriate for cats with renal disease, by definition.

Protein
Reduction of dietary protein is probably the best known and most controversial nutritional modification for patients with renal disease. As many publications point out, there is no evidence that high protein diets are harmful to the kidneys per se. However, many of the toxins that build up in the bloodstream when GFR is markedly compromised by advanced tubulointerstitial disease are nitrogenous compounds. Reducing dietary protein can improve quality of life in these patients by reducing the effects of these toxins on other systems. Additionally, the limiting factor in phosphorus restriction in diets is often the animal protein content as most meats are high in phosphorus. It is best to determine the appropriate degree of protein reduction necessary based on the individual patient’s laboratory values and the need to balance protein intake with adequate phosphorus restriction and other nutritional modifications. Protein reduction, when appropriate, should be done by maximizing the quality of the protein to ensure that the physiologic requirements for protein are being met without adding excess amounts that will quickly be metabolized into uremic toxins.

In contrast to the situation for CKD without proteinuria, for animals with evidence of a significant protein losing nephropathy (with or without concurrent tubular disease), protein reduction may be as critical, or even more critical, to slowing disease progression than phosphorus restriction. It has been shown in many species that increasing dietary protein exacerbates glomerular protein loss. Albumin is toxic to the tubules, leading to accelerated degradation of the entire kidney. Therefore, although it may seem counterintuitive, most animals with PLN respond to lower dietary protein with lower urine protein:creatinine ratios (UPC) and higher serum albumin. Unfortunately, there is no known dose-response data to serve as a guideline for what amount of protein should be used. For most patients, it is likely appropriate to switch to a commercial renal diet [12-15% and 20-27% protein calories metabolizable energy (ME): 33 - 39 g/1000 kcal and 55 – 77 g/1000 kcal, for dogs and cats, respectively], even if azotemia is not present. For dogs or cats that were consuming particularly high protein/phosphorus diets (such as many grain free and low carbohydrate diets, raw diets and/or lots of meat based treats) at diagnosis, reduction of protein and phosphorus down to around AAFCO minimums [-18 and 23% protein ME (51 and 65 g/1000 kcal) and 1.4 and 1.25 g/1000 kcal phosphorus, respectively for dogs and cats] may be a good initial step. Further dietary modification can then be based on laboratory and clinical response.
Sodium
The vast majority of commercial pet foods contain sodium well in excess of physiological requirements. Due to mainly theoretical concerns regarding blood pressure and water balance, excess sodium is generally avoided in diets for patients with renal disease. The sodium concentration in all commercial renal diets for both dogs and cats is well above AAFCO minimums, but less than the sodium concentrations of most OTC diets.

Potassium
Serum potassium values can vary dramatically both among patients and between dogs and cats. Dogs with CKD are more likely to have hyperkalemia, especially those on ACE-inhibitors for glomerular disease, while cats with CKD are more likely to have hypokalemia. Commercial renal diets also vary in their potassium concentrations, with feline diets generally being higher than canine diets. The wide range of potassium concentrations in canine diets allows for selection of the diet most appropriate for the individual patient. For the rare cases that are hyperkalemic on the lowest potassium commercial renal diet, a home-cooked diet may be helpful if medications cannot be altered.

Acid-base
One of the many roles of the kidney is acid-base balance. The kidney regulates the excretion of hydrogen ions and bicarbonate regeneration; consequently, animals with renal impairment often become acidemic. Commercial renal diets are thus designed to be relatively alkalinizing to help counteract these changes. In cats, this is significantly different from OTC maintenance diets which are generally acidifying due to both ingredient composition and specific intention to help prevent struvite-related urinary problems.

B-vitamins
B-vitamins are water-soluble and with rare exception (B-12) are not stored in the body. They are, however, needed daily for nearly all metabolic pathways. Most commercial renal diets for both dogs and cats are fortified with additional B vitamins to ensure adequate amounts despite the potential for increased renal losses secondary to polyuria.

Omega-3 fatty acids
Research in dogs has shown potential reno-protective effects of supplementation with long chain omega-3 fatty acids from fish oil (eicosapentaenoic acid; EPA; and docosahexaenoic acid; DHA). However, there is some conflicting evidence and a clear dose response has not been determined for dogs. There is no published prospective information regarding omega-3 fatty acid supplementation in cats with renal disease. Flax, which is a good source of the short chain omega-3 fatty acid alpha-linoleic acid (ALA), has not been investigated to see whether it is beneficial. As its endogenous conversion to DHA and EPA is poor in dogs and essentially non-existent in cats, it should only be used as a last resort when supplementation with fish oil is not feasible.

Many commercial renal diets already contain added fish oil, but the amounts vary. The author tends to use a dose of around 300 mg total DHA + EPA per 10 pounds of body weight. This amount can be supplemented on top of a commercial diet that is not already supplemented, or the total intake from the diet alone can be calculated and fish oil added to attain the final desired dose. For many patients, liquid fish oil may also be a palatability enhancer.

When should a renal diet be started?
In the absence of proteinuria, initial dietary modifications for early asymptomatic CKD (IRIS Stage 1 or when CKD is suspected but not confirmed) should be geared towards reducing phosphorus. There are a handful of commercial diets (a few OTC and veterinary therapeutic diets made by Hill’s and Iams Veterinary Formulas Early Stage Renal canine) with phosphorus below 1.5 g/1000 kcal and moderate protein which can be considered. These diets will be higher in protein than renal diets and may not have the other modifications that have been previously discussed. Once CKD progresses to the end of stage 2, or if significant proteinuria is evident, most patients should be fed only a commercial renal diet.

What about concurrent diseases?
Common concurrent disease processes that can make it difficult to find an appropriate renal diet include food allergies and fat intolerance (hyperlipidemia, history of pancreatitis). Recently, two new dry diets from Royal Canin have been introduced that combine hydrolyzed soy with low phosphorus and protein, which may be good options for dogs and cats with food allergies and kidney disease. Some patients with early CKD and confirmed or suspected food allergies/intolerances may be able to be fed a commercial lower protein and phosphorus limited-antigen diet, such as some of the Hill’s Prescription Diet d/d line. Alternatively, it is recommended to trial a few of the regular renal diets to see if they are tolerated. For confirmed allergies to ingredients that cannot be avoided in the renal diets or for fat intolerance, home-cooked diet formulations may be required.
What if the pet will not eat a renal diet?

There are more than a dozen reduced phosphorus and protein diets (including canned and dry options) that may be options for dogs with various stages of CKD. A slow transition from the previous diet is recommended whenever possible. Low protein palatability enhancers such as fish oil, homemade low sodium meat broths, honey, pancake syrup, applesauce and some human enteral products can be added to the diet to increase interest, depending on whether a dog or cat is being treated. Meats and other foods high in protein, phosphorus, and sodium should be avoided as they have the potential to negate the benefits of the diet and actually make the patient feel worse in the short term. It is common for pets with later stage disease to have cyclical appetites where they may not be interested in eating the same food every day. Rotating between several appropriate diets may help overcome this issue. Appetite stimulants rarely result in consistent consumption of enough food to meet energy requirements.

Home-cooked diets may be more palatable to dogs with CKD than commercial diets. However, the vast majority of the recipes in books and online are unbalanced and may not be appropriate for renal patients despite assertions to the contrary. Clients wishing to try a home-cooked diet should obtain a custom recipe from a board-certified veterinary nutritionist, usually through a veterinary teaching hospital nutrition service. Some balanced (but not customized) recipes for home-cooked renal diets can also be obtained by veterinarians for their clients from BalanceIT.com.

There are more than a dozen potential commercial options for cats with various stages of renal disease (including canned and dry options). Unfortunately, cats tend to be notoriously picky about switching foods and transitioning them to a renal diet can be very challenging. However, the potential to double their survival time and improve their quality of life should serve as a powerful motivator to clients to persevere. Cats also seem more likely than dogs to go through a prolonged period of wasting as their appetite decreases and their intake does not meet their energy requirements. Unlike in dogs, appropriate home-cooked diets are rarely more appealing to cats than commercial diets. Palatability enhancers such as homemade, low sodium meat broths, fish oil and animal fats can be used to encourage intake. Clinicare RF may be palatable to some cats and can be used to supplement their food consumption.

Assisted feeding

Assisted (tube) feeding should be considered for patients with renal disease that are not able to maintain an appropriate body condition via voluntary intake of an *appropriate* diet for their stage of disease. Esophagostomy (E) tubes are the most commonly used and can make a huge difference in the quality of life for both owner and pet. An E-tube allows for an appropriate diet (i.e. a blenderized canned renal diet) to be fed in appropriate amounts to maintain body weight and often reduces the stress surrounding mealtimes for both pet and owner. Many medications as well as oral fluids can be administered via the tube, which can also enhance quality of life for the entire family.

Feeding tubes are best placed prior to the animal becoming significantly debilitated, rather than as a last-ditch attempt to prolong the life of an emaciated, anorexic, severely uremic animal. For this reason, the author often discusses feeding tubes as an option with clients long before the pet requires it, even at the first or second visit after the renal disease is diagnosed. Clients are advised to consider that at some point a feeding tube may be appropriate and encouraged to decide as a family how they would handle the situation if it arose. In the authors’ experience, these types of emotional decisions are best made when the pet is not in immediate danger and the clients have ample time to consider all the implications. It is often helpful to keep a list of good clients who have successfully used feeding tubes and are willing to talk to other clients about their experiences.

References

Consumers have increased access to nutrition information, both accurate and misleading, and many pet owners are becoming increasingly concerned about what they feed their pets. Many of our clients view their pets as members of the family and want to feed them using similar criteria to that which they use to feed themselves. Thus, popular human diet trends such as gluten-free, vegetarian, vegan, and natural are being more commonly applied to pets and have been embraced by pet food manufacturers. On the other side of the spectrum, others desire to feed their dogs or cats more like their wild relatives and feel strongly that raw, “evolutionary” diets offer superior nutrition. It is important for veterinarians to understand the pros and cons of various alternative feeding strategies so that they can appropriately advise their clients.

**Home-cooked diets**

While still representing a small proportion of pet owners, home-cooking is becoming more popular, especially in the wake of a few high profile pet food recalls in the past 10 years. Many pet owners opt to cook for their pets due to distrust of commercial pet food, a desire to have more control over ingredients, or because they feel that their pet prefers home-cooked meals. A smaller segment of pet owners end up cooking for their pets because medical conditions limit the available commercial options.

Many owners simply chose ingredients that their pet likes and mix them together with or without a vitamin or mineral supplement. These diets are invariably deficient in essential nutrients, even with added popular human or pet supplements, neither of which are designed to fill in the gaps in home-cooked pet diets. Other pet owners seek out published recipes for home-cooked diets from lay books, magazines, newsgroups, and on the internet. With few exceptions, the diets resulting from these recipes are deficient in multiple essential nutrients and contain vague preparation and supplementation instructions. Even with a well-designed recipe, ingredient variation and modifications (both inadvertent and intentional) to the recipe by pet owners can lead to imbalances or nutrient deficiency or toxicity.

While in theory a home-cooked diet can be a healthy alternative to commercial diets, there is currently no evidence that home-cooked diets have any nutritional benefits over commercial diets for healthy pets and the risks of nutrient deficiencies and other imbalances are much increased when a home-cooked diet is fed. Home-cooked diets are of particular concern for growing animals as these diets are commonly deficient in nutrients such as calcium that are essential for normal growth. All pet owners desiring to home-cook for their pets should be referred to appropriate sources for recipes such as a board-certified veterinary nutritionist (www.acvn.org).

**Vegetarian/vegan**

Vegetarian and vegan lifestyles are becoming more mainstream. These lifestyles are often adopted for ethical reasons, but many people also choose to eat this way for both perceived and demonstrated health benefits. Both of these motivations can drive pet owners to want to feed their pets in a similar manner.

Diets based on dairy or egg protein can be nutritionally complete and meet the needs of both dogs and cats if properly supplemented, just like meat-based diets. Vegan diets are much more complicated. Dogs, as omnivores, may adapt better to vegan diets than cats and often appear to do well on carefully designed vegan diets. However, long-term studies of vegan dog diets have not been performed. There are a number of vegan or vegetarian dog foods on the market, including some veterinary therapeutic diets used to treat certain health conditions.

It is recommended to supplement with carnitine and taurine if animal proteins are not being used in a dog diet, as methionine is typically limiting in plant proteins and is used to make both taurine and carnitine. Deficiencies have been reported in dogs eating low protein or predominately plant-protein based diets and can be clinically important (e.g. dilated cardiomyopathy).

Cats, by virtue of their status as obligate carnivores, have high protein needs and also require a number of nutrients that are not readily obtained from plant sources, such as arachidonic acid, preformed vitamin A rather than beta-carotene, and taurine. Vegan diets, whether commercial or home-made, are not recommended for cats and serious nutritional concerns have been demonstrated for many commercial vegan cat diets and pretty much all home-prepared vegan cat diets.

Owners insisting on feeding their dogs a vegan diet should be steered towards veterinary therapeutic diets that are appropriate for long-term feeding of systemically healthy dogs as these diets typically undergo much more extensive testing than typical over-the-counter diets. Alternatively, these clients can be referred to a board-certified nutritionist for a balanced home-cooked diet recipe. These owners should be advised that long-term health effects are not known.

Owners insisting on feeding their cats a vegan diet should be counseled that this diet strategy is not in the cat’s best interest and is likely to lead to serious health concerns.
**Raw diets**

Commercial raw diets are one of the fastest growing market sectors of the pet food industry. The ready availability of glowing testimonials from other pet owners online, as well as recommendations from pet store employees and sometimes veterinarians have increased the number of clients who may consider feeding these diets. The author has also noted a small but increasing percentage of clients who do not realize that they are actually feeding a raw diet, usually because the product has been freeze-dried, or is in the form of a traditional kibble that has then been coated in freeze-dried raw food. More and more companies, many of which never previously sold raw foods, are now offering hybrid diets - mixtures of dehydrated raw and kibble, which can be hard to distinguish from cooked kibble diets.

Nutritional adequacy is a concern with both commercial (mainly the all-raw ones rather than the kibble hybrids) and home-prepared raw diets (often referred to as ‘BARF’ – Bones And Raw Flesh or Biologically Appropriate Raw Food). For commercial products, it may not always be clear to the consumer whether the diet is actually designed to be complete and balanced and even some of those that are intended to be may have apparent nutritional gaps when subjected to increased scrutiny (be especially wary if no concentrated supplements are listed on the ingredient list!). Home-prepared raw diets have similar nutritional adequacy issues to those of home-cooked diets. Commercial raw diets have been associated with pancreatitis (they are usually very high in fat) and both homemade and commercial products have been associated with hyperthyroidism in dogs, as well as constipation, gastrointestinal obstruction and dental fractures.

An additional, significant concern with raw diets is biological contamination. Many producers and promoters of raw diets either deny that their products potentially contain pathogenic bacteria such as Salmonella or E.coli or state in their marketing materials that animals do not get sick from these bacteria. Contamination of meat intended for human consumption has been a serious concern for many years, with major coverage of the issue in well-respected publications such as *The New York Times* and *Consumer Reports*.\(^2,3\) Major raw pet food producers have recalled numerous raw diets due to contamination with *Salmonella* and other pathogens over the years (15 recalls for diets alone in 2015). It is currently both reasonable and safest to assume that all raw meat is contaminated, whether intended for human or animal consumption.

While dogs and cats may be less sensitive to food borne illness than people, there are numerous documented cases of severe and even fatal disease attributed to bacterial contamination of foods\(^4,6\). Additionally, it is likely that many milder cases go undiagnosed as the clinical signs – vomiting, diarrhea, ± fever - are far from pathognomonic. Although some diet manufacturers have started using high pressure processing (HPP) or other non-traditional processes to kill bacteria in raw diets, these techniques are rather new to the pet food industry and efficacy is still unclear. There have been recent recalls of raw diets treated with HPP, which suggests problems with either the technique or the handling of the food and ingredients after the processing step.

Raw food-fed pets have been shown to shed viable pathogenic bacteria\(^7,9\), sometimes asymptptomatically, putting all people in the household at risk. Of particular concern are households with young children, the elderly, or people with weak or suppressed immune systems (such as HIV or cancer patients). The CDC and FDA both have put out strong statements discouraging the use of raw meat diets for pets due to concerns for human health.

In summary, there is so far no scientific evidence to substantiate the majority of the anecdotal benefits of feeding raw versus cooked diets. However, there is clear evidence to suggest that these diets and raw meat treats can cause harm to both pets and their human companions. A recent review outlines what is known about raw diets – both the pros and the cons\(^10\).

**Natural/holistic diets**

AAFCO defines natural as “a feed or ingredient derived solely from plant, animal or mined sources, either in its unprocessed state or having been subject to physical processing, heat processing, rendering, purification, extraction, hydrolysis, enzymolysis or fermentation, but not having been produced by or subject to a chemically synthetic process…” To label a pet food as “natural” requires that no synthetic compounds of any kind be included. However, phrasing such as “natural diet with added vitamins” can be used to acknowledge the fact that many diets contain natural ingredients but are supplemented with synthetic vitamins, amino acids or mineral complexes.

The current definition of natural gives no information about ingredient or product quality. It is important to keep in mind that natural sources of many vitamins, minerals and amino acids used in commercial pet foods are not always practical and many synthetic sources are metabolically indistinguishable from natural forms.

Some commercial diets attempt to provide for all required nutrients using only whole foods. This approach, while emotionally appealing, presents several problems. First, these diets generally contain large numbers of ingredients sourced from many different vendors. Vitamin and mineral contents of ingredients such as fruits, vegetables and kelp (a commonly used iodine source) tend to vary, sometimes substantially, between sources and even by season. Ingredient analysis can be quite expensive, so individual shipments of ingredients may not be thoroughly screened, especially by smaller companies that purchase many different ingredients and lack the ability to do in-house analysis.
Whole food ingredients never provide only one nutrient, thus adding enough of an ingredient to meet one nutrient requirement can result in an excess of another nutrient. Similarly, some nutrients, such as taurine, become less bioavailable with cooking (others become more available); it may be difficult or impossible to provide adequate amounts of these nutrients from whole food sources.

Artificial preservatives are becoming uncommon in pet foods, mostly due to public opinion rather than any documented adverse effects. The most common “natural” preservatives used in pet foods are the antioxidants vitamin C, vitamin E (mixed tocopherols), and rosemary extract. These preservatives may be less effective than their synthetic counterparts and necessitate more attention be paid to setting appropriate expiration dates, proper storage and monitoring for spoilage.

The term “holistic” has no AAFCO definition and the term can be applied to any pet food product.

Cited references
Gray says obesity in animals should be treated with exercise and a healthy, calorie-reduced diet. She says a well-balanced diet is essential. 'If you feed a growing dog a pure-meat diet, such as pork or beef, without any nutritional supplements, it may have abnormal bone development.' Sign up for our Newsletters. Find out more. A meat-only diet can cause a dog's bones to become brittle and prone to breaks. 'I've seen an extreme example of a puppy breaking its legs just by jumping from the sofa,' Gray says. She recommends mid- to premium-range pet food. 'Most [dog food] from [companies such as] Dog and cat reproduction, contraception and artificial insemination: Proceedings of the First International Symposium on Canine and Feline Reproduction. Dublin, Ireland, July 1-2, 1988. Journal of Reproduction and Fertility Supplement 39: 1-323. Current and proposed methods for contraception and termination of pregnancy in dogs and cats. Journal of the American Veterinary Medical Association 198(7): 1214-1225. ISSN: 0003-1488. Battling the Bulge. 02/18/2011. Author: Caroline Coile, PhD. Spaying or neutering has been assumed to lead to increased chance of obesity: A relationship has been demonstrated in cats, but so far no definitive study is available for dogs. Some owners blame obesity on endocrine problems such as hypothyroidism, but in reality, probably less than 5 percent of obesity cases are caused by any kind of disease or drugs. This would seem to make sense, but several studies have found the addition of either soluble or insoluble fiber, at moderate or high levels, has no effect on satiety or feeding behavior in dogs. Include treats in the daily allotted calories, and limit treats to less than 10 percent of daily caloric intake. Make sure everyone in the family follows the diet rules.