Chronic enteropathies are a heterogeneous group of gastrointestinal disorders characterized by gastrointestinal clinical signs that persist for at least 2 weeks. Depending on the study, chronic enteropathies and other diagnoses (eg, IBD) may include a variety of disorders and patient populations, and the inconsistent nomenclature can result in confusing information in the literature. Regardless, achieving a correct diagnosis and classification of chronic enteropathy is essential for proper nutritional management. The most important step in this process is eliminating the possibility of systemic disorders as well as ruling out several primary gastrointestinal diseases, all of which may be less responsive to dietary management. The testing and diagnostic approach have been described elsewhere. The purpose of the information reported here is to provide an overview of dietary management options available to practicing clinicians and the data supporting use of those options for dogs and cats with gastrointestinal diseases.

Hydrolyzed diets

Hydrolysis processing and its effects on allergenicity and antigenicity have been described elsewhere. Briefly, hydrolyzed diets have undergone a process whereby macronutrient structure has been altered to reduce or eliminate allergenic or antigenic potential. A hydrolyzed diet typically contains a single protein source of small polypeptides to reduce allergenicity. There are commercially available veterinary therapeutic hydrolyzed diets with hydrolyzed soy, poultry, and fish protein sources and various carbohydrate sources, including rice, wheat, and starch. On the basis of the current understanding of food allergies, if a food allergy is suspected, the choice of protein source should receive heavy consideration during diet selection. For example, if a chicken allergy is suspected, then it is probably best to avoid feeding a hydrolyzed chicken diet because these diets may not be completely devoid of allergenic potential. Hydrolyzed diets are typically considered highly digestible, in comparison to the digestibility of the parent protein source, and usually have a lower fiber content. These are important factors that, depending on an animal’s needs, may result in improvement or worsening of clinical signs. Criticisms of hydrolyzed diets include effects of hydrolysis on osmotic balance in the gastrointestinal tract and on palatability. Despite concerns about palatability identified in studies of humans, studies of dogs have revealed that palatability of hydrolyzed diets is comparable to that of traditional diets. Hydrolyzed diets for dogs have high osmolarity. In humans, diets with high osmolarity may cause soft feces, osmotic diarrhea, and deleterious effects on enterocytes. These adverse effects are uncommon in dogs and have not been examined in cats.

ABBREVIATIONS
FRD Food-responsive disease
IBD Inflammatory bowel disease
PLE Protein-losing enteropathy
Limited-ingredient diets versus novel-protein diets

A limited-ingredient diet should ideally provide a single carbohydrate and a single protein source. If an animal has not been previously exposed to either of these ingredients, the diet may also be termed a novel-protein diet. To indicate that a diet is novel relies on a comprehensive and accurate diet history. Given the myriad ingredients found in commercially available diets, it is challenging to identify a novel ingredient, especially considering that diets with a claim of limited ingredient sources may contain other ingredients than those listed on the label. Given the paucity of truly novel diets, it may be more realistic to consider these diets as limited-ingredient diets. Anecdotally, limiting the antigen load to the gastrointestinal tract can potentially benefit an animal with food intolerance, even if the diet does not provide novel ingredients.

Fiber content

Fiber is defined as complex, nondigestible carbohydrates of plant origin. Two useful methods for describing fiber sources include fermentability or solubility of the fiber. Fiber is resistant to normal enzymatic digestive processes during passage through the gastrointestinal tract. Fiber undergoes various degrees of fermentation by the intestinal microbiota; the degree of fermentation is dependent on the fermentability inherent to that fiber source (Table 1). Fermentation results in the release of short-chain fatty acids, water, and organic compounds and acidification of the luminal environment. Alternatively, fiber sources can be categorized as soluble or insoluble. Solubility of a fiber is a measure of its ability to disperse in water.

Many diet profiles list crude fiber, despite the fact that total dietary fiber is a more useful descriptor than crude fiber. Total dietary fiber includes all soluble and insoluble sources, whereas crude fiber provides no information regarding soluble fiber (Figure 1). Soluble fiber is typically more readily fermented, which ultimately results in the production of volatile fatty acids that can benefit enterocytes and augment the microbiota. Insoluble fiber is less fermentable and can increase gastrointestinal tract motility and passage of gastrointestinal contents.

Fiber can also serve as a prebiotic (a nondigestible food ingredient that selectively stimulates bacteria to improve host health). Common prebiotics include oligosaccharides and inulin. The by-products of the fermentation of prebiotics serve as nutrients for commensal microorganisms and are not used by the host animal. Investigators have reported beneficial effects of prebiotics in humans and other animals. Fibers that act as prebiotics have yielded mixed results in studies of dogs and cats.

Digestibility of diets

Digestibility of a diet is affected by multiple processes, including mechanical, enzymatic, bacterial, and chemical breakdown of dietary components in the gastrointestinal tract. Breed of dog has an effect on digestion, with larger breeds typically having less

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Table 1—Solubility and fermentability of various dietary sources of fiber.

<table>
<thead>
<tr>
<th>Fermentability</th>
<th>Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Fructose, galactans, mannan, mucilages, apple pectin, citrus pulp, guar gum, gum arabic, soy fiber, apple pomace, carrot pomace, and citrus pectin</td>
</tr>
<tr>
<td>Moderate</td>
<td>Pectin and flaxseed</td>
</tr>
<tr>
<td>Low</td>
<td>—</td>
</tr>
</tbody>
</table>

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Figure 1 Schematic depiction of the relationship of total dietary fiber, crude fiber, insoluble fiber, and soluble fiber.
ability to digest foods, compared with that for smaller breeds.\textsuperscript{23–25} Digestibility is a complicated process that is influenced by the animal that ingests the diet as well as by the diet itself (ingredients, processing technique, or both).\textsuperscript{25} Highly digestible diets are frequently reported to have total digestibility $>80\%$ and digestibility of major macronutrients $>90\%$. However, because multiple factors are involved in calculating digestibility, there is no standard definition for a highly digestible diet. Each component of a highly digestible diet can be altered to affect digestibility, which results in the lack of a consistent phenotype of a highly digestible diet. However, there are numerous commercially available highly digestible diets.\textsuperscript{26–27}

**Fat content**
Commercially available diets include a variety of animal and plant fats to provide a source of calories, essential fatty acids, and fat-soluble vitamins and to enhance palatability. Commercially available veterinary therapeutic low-fat diets\textsuperscript{28–32} provide between 1.7 and 2.6 g of fat/100 kcal. These diets can be useful to maintain adequate dietary fat for animals with chronic enteropathies that appear to be responsive to a lower fat content.

In an animal with physiologically normal digestive function, dietary fat is considered easily digestible (digestibility commonly is $>90\%$).\textsuperscript{25} However, if digestion of dietary fat is disrupted and an inadequate percentage is digested, the result is that dietary fat passes through the gastrointestinal tract. This can result in augmentation of microbiota as well as production of compounds that promote secretory or osmotic diarrhea.\textsuperscript{27} The role of dietary fat in the management of gastrointestinal tract disease is becoming more commonly recognized, especially for dogs with diseases such as PLE-lymphangiectasia.\textsuperscript{28,29}

Cats appear to have a higher tolerance for diets with a high dietary fat content.\textsuperscript{30} The effect of 2 diets that differed in fat content (high content vs low content) was evaluated in cats with chronic signs of gastrointestinal tract disease.\textsuperscript{31} Both diets resulted in a similar response rate (approx 65%). The effect of fat content in cats with chronic enteropathies is unclear and requires further evaluation. Fat content should not be the primary focus of dietary management for cats with chronic enteropathies.

**Home-prepared diets**
Home-prepared diets are growing in popularity for a variety of reasons, including improving the human-animal bond and providing medical benefits.\textsuperscript{32} From a medical perspective, a home-prepared diet can be used to create ultra–low-fat diets ($<17$ g of fat/Mcal; 1.7 g/100 kcal) or to create novel-ingredient diets when none are available. It is crucial to consult with a board-certified veterinary nutritionist to ensure that the recipe provides complete and balanced nutrition because recipes of many home-prepared diets found online can be imbalanced or deficient in essential nutrients.\textsuperscript{33}

### Nutritional Management of Selected Chronic Enteropathies

Chronic enteropathy represents a heterogeneous group of diseases. Information is available on nutritional management for animals with FRD, PLE-lymphangiectasia, food allergies, gluten enteropathies, and chronic large bowel disease\textsuperscript{34–52,bb,cc} (Table 2).

**FRD**
Inflammatory bowel disease is characterized by sustained inflammation of the gastrointestinal tract

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<table>
<thead>
<tr>
<th>Dietary strategy</th>
<th>Species</th>
<th>Indication</th>
<th>Evidence level</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
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<td>Canine</td>
<td>Chronic enteropathy</td>
<td>4</td>
<td>34, bb</td>
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<td></td>
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<td>Chronic enteropathy</td>
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<td>35</td>
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<td>Chronic enteropathy</td>
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<td>38</td>
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<td>39</td>
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<td>40</td>
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<td>Chronic enteropathy</td>
<td>2</td>
<td>41</td>
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<td>2</td>
<td>37</td>
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<tr>
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<td>Chronic enteropathy</td>
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<tr>
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<td>Feline</td>
<td>Colitis</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>Fiber modification</td>
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<td>Colitis</td>
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</tr>
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<td>Colitis</td>
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<td>45</td>
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<tr>
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<td>Feline</td>
<td>Colitis</td>
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<tr>
<td>Highly digestible diet</td>
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</tr>
<tr>
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<td>Colitis</td>
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<tr>
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<td>Chronic enteropathy</td>
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</tr>
<tr>
<td>Fat restriction</td>
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<td>PLE</td>
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<td>28</td>
</tr>
<tr>
<td></td>
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<td>PLE</td>
<td>3</td>
<td>29</td>
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<tr>
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<td>Canine</td>
<td>PLE</td>
<td>4 or 5</td>
<td>49–52, cc</td>
</tr>
</tbody>
</table>

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*Evidence-based medicine levels are as follows: 1, high-quality randomized trial; 2, lesser-quality randomized trial or prospective comparative study; 3, case-control study or retrospective comparative study; 4, case series; and 5, expert opinion.*
in response to a variety of genetic, microbial, immune, and environmental factors. The purpose of dietary modification is to minimize inflammation in the intestinal environment through a reduction of antigenicity. Approximately 66% of dogs with chronic enteropathy and 60% of cats with chronic enteropathy respond to nutritional management and are classified as having FRD. Dogs with FRD are more likely to be younger, have less severe clinical signs, and have signs predominantly of large bowel diarrhea. However, a diagnosis of FRD is possible regardless of these factors and should be based on the response to dietary trials.

Information in multiple case reports and proceedings has supported the use of limited-ingredient and hydrolyzed diets for management of FRD in dogs and cats. High-level evidence in studies has supported these concepts. In a prospective study of 65 dogs, 39 responded to a veterinary limited-ingredient diet in a 10-day feeding trial. The response rate of 60% for that study is similar to the general dietary response rate of 66% detected in other studies. In a retrospective study of 131 dogs with FRD, 73 received a limited-ingredient diet, whereas 58 received a hydrolyzed diet and 2 received home-prepared diets. In a study conducted to determine the role of probiotics in dogs with FRD, 2 groups (total of 21 dogs) were fed a veterinary limited-ingredient diet. All dogs of that study had improvements in the canine IBD activity index after the 4-week dietary trial, although the effects were not attributable to the probiotics.

Hydrolyzed diets have reduced antigenicity, provide (in some cases) novel protein sources, and have high digestibility, which make them valuable for treating FRD. In 1 study, 58 of 131 dogs with FRD were successfully treated with a hydrolyzed diet. In another study, 26 dogs with small intestinal IBD were fed a highly digestible control diet with multiple protein sources or a highly digestible hydrolyzed soy protein diet and monitored over the course of 3 years. Both diets achieved control of most clinical signs at 3 months. However, whereas all dogs fed the hydrolyzed test diet remained free of clinical signs, only 2 (25%) dogs and 1 (12%) dog fed the control diet had no clinical signs at 6 and 12 months, respectively. Clinical resolution was reported for dogs with FRD fed a hydrolyzed diet in a study conducted to examine duodenal histopathologic changes.

In a study of 8 cats with small intestinal IBD that were fed a hydrolyzed soy protein diet, clinical signs resolved in all cats within 4 to 8 days. When exposed to their original diet 2 months later, all cats had a relapse of clinical signs; however, reintroduction of the hydrolyzed soy protein diet resulted in resolution of clinical signs in 7 of the 8 cats. In another study, investigators determined a response rate of 40% to 67% for cats with chronic gastrointestinal signs fed various easily digestible diets. In a more recent study, investigators found that cats had a positive response to 2 easily digestible diets.

These data indicate that limited-ingredient, hydrolyzed, and easily digestible diets can be useful for treating FRD. Comparative studies to determine the relative efficacy of diet types in both dogs and cats with chronic enteropathies are needed because there is only limited noncomparative evidence to support the use of these nutritional management strategies. Regardless of whether a limited-ingredient, hydrolyzed, or easily digestible diet is chosen for an initial dietary trial of a dog or cat with a chronic enteropathy, we believe that when there is no response, it may be beneficial to attempt another dietary approach before ruling out FRD. For example, when a dog with chronic enteropathy fails to respond to a hydrolyzed diet, there may still be benefit in the use of a novel-ingredient diet in a secondary dietary trial. Comparative crossover studies will be needed to determine the benefit of testing a series of diets before definitive recommendations can be made.

Food intolerance and food allergy

The distinction between food allergy and food intolerance is not made in many studies. Thus, the literature is often confusing, which results in misunderstandings in the classification, diagnosis, and nutritional management of FRD and food allergies. Diet selection should be based on a thorough clinical and dietary history, wherein the diet provides novel protein and carbohydrate sources, a hydrolyzed protein, or both. Substitutions for the protein and carbohydrate sources can cause major impacts on overall macronutrient profiles of diets. For example, different carbohydrate sources can have variable amounts of dietary fiber, which potentially can impact disease management. These nuances emphasize the need for a complete examination of dietary choices when prescribing specific diets for gastrointestinal disease management.

Food allergies differ mechanistically from food intolerance. (Figure 2) The exact percentages of dogs and cats with a true immunologic food allergy are unknown. Prevalence estimates are limited to studies in which there has been a dietary challenge exposure and presumptive diagnosis. Approximately 21% of dogs in a study ultimately relapsed when challenge exposed to their initial food, and 29% of cats in another study relapsed when challenge exposed to their initial food; these animals were presumptively considered to have a food allergy. Importantly, FRD was initially diagnosed in the dogs and cats of these studies, and food allergy was subsequently diagnosed on the basis of the dietary challenge exposure. Larger studies should be performed to investigate differences between the clinical syndromes FRD and food allergy and should include an evaluation of the underlying immune response.

Most proteins and, potentially, other macronutrients can be antigenic; however, only a limited number have been demonstrated to be antigenic.
The antigenic properties of a macronutrient are not a species-specific characteristic. The most commonly identified allergens of dogs are beef, dairy products, and wheat, and the most commonly identified of cats are beef, dairy products, and fish.

Animals with food allergies can exhibit a wide variety of clinical signs; however, vomiting and small bowel diarrhea with concurrent dermatologic signs are a common clinical manifestation. A presumptive diagnosis is based on elimination of other differential diagnoses, response to a dietary trial, and relapse in clinical signs after reintroduction of the offending ingredient. Both molecular diagnostic analysis and endoscopic allergy testing have been used to evaluate food allergies; however, the diagnostic performance has limited the use of either of these approaches.

Most studies regarding novel-ingredient or hydrolyzed diets for food allergies pertain to dogs with dermatologic signs with or without gastrointestinal signs. Hydrolyzed diets can be effective in up to 80% of dogs with experimentally induced or naturally occurring food allergies. Hydrolyzed diets have similar efficacy to novel-ingredient diets for clinical patients with naturally occurring food allergies.

**PLE-lymphangiectasia**

The most common causes of PLE include IBD, lymphangiectasia, infections (eg, histoplasmosis), and gastrointestinal lymphoma. Definitive diagnosis of each of these conditions requires examination of an intestinal biopsy specimen or use of targeted diagnostic testing and impacts whether dietary treatments may be beneficial. Empirically, dietary fat restriction is considered a primary consideration for management of PLE, most notably for lymphangiectasia, on the basis of the fact that dietary fat increases lymphatic flow, which may aggravate gastrointestinal loss of protein and clinical signs.

Initial data on dietary fat restriction for the treatment of PLE originated primarily from case reports of animals managed with low-fat diets. Most of the reported success was with low-fat diets, although diets were sometimes also high in dietary fiber, which can reduce fat absorption. Because such data represent weaker evidence-based medicine, they do not definitively support or refute the use of these strategies. The efficacy of feeding low-fat diets to dogs with PLE was reported for 24 dogs, 19 of which responded to dietary fat restriction. Treatment in that study included both an ultra–low-fat diet (home-prepared chicken breast and potato) and a veterinary therapeutic low-fat diet, with dogs fed the ultra-low-fat diet maintaining a significantly higher serum albumin concentration. Use of a low-fat diet limits the amount of circulating lipid in chymal lymphatic fluid, which decreases lacteal pressure and reduces protein loss. The higher serum albumin concentration detected in dogs fed the ultra-low-fat diet provides indirect support of this mechanism. The investigators of the study did not control for immunomodulating medications, which limits the interpretation of the exact role of diet.

Yorkshire Terriers with PLE had a short-term response to feeding of low-fat diets without concurrent use of immunomodulating drugs. Limitations to that study were that it was a small number of dogs of a single breed without a control population. Nonetheless, it strongly indicated a role for fat restriction. Although it was not designed to evaluate dietary impact, another study of 30 Yorkshire Terriers with PLE revealed benefits of concurrent management with immunomodulating drugs and a limited-ingredient or low-fat diet.

These studies provide preliminary evidence to support the effect of dietary fat restriction in animals with noninfectious and nonneoplastic PLE, which makes it the primary dietary objective when treating dogs with PLE despite the fact that additional studies are required. In addition, PLE is less common in cats, and dietary fat restriction is not considered important in this species because it appears that cats tolerate fat better than do dogs. If results for examination of biopsy specimens are consistent with IBD, dietary

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**Figure 2**—Schematic depiction of immunologic and nonimmunologic reactions to dietary macronutrients. (Adapted from Roudebush P, Guilford GW, Jackson HA. Chapter 31: adverse reactions to food. In: Hand MS, Thatcher CD, Remillard RL, et al, eds. Small animal clinical nutrition. 5th ed. Topeka, Kan: Mark Morris Institute, 2010:609–635. Reprinted with permission.)
management should also take into account the aforementioned recommendations for FRD.

**Gluten enteropathy**

Celiac disease is a result of an animal reacting to gluten proteins. Because of its notoriety in humans, owners more frequently inquire about it as a cause of clinical signs in dogs and cats. The prevalence of gluten sensitivity in dogs is unknown, and the disease is not recognized in cats. In veterinary medicine, a disease process similar to that for celiac disease in humans has been identified in genetically related Irish Setters. Clinical signs and histopathologic findings are similar to those for IBD, and resolution occurs when dogs are fed a gluten-free diet. Recently, a multisystemic form of gluten sensitivity has been reported in Border Terriers. Although it currently is considered an uncommon chronic enteropathy, it should remain as a differential diagnosis, especially for specific breeds.

**Large bowel disease**

Nutritional management of chronic colitis in dogs has been investigated. In 1 study, investigators detected a positive response of 13 dogs to a home-prepared diet of cottage cheese and rice. In that study, 2 dogs had recurrence of clinical signs when switched to a limited-ingredient diet, and 9 dogs had recurrence of clinical signs when switched to the pretreatment diet. In another study, investigators detected a positive response of 11 dogs to a limited-ingredient diet. Concurrent anti-inflammatory medications were used in that study to induce clinical remission; however, 9 of the 11 dogs were ultimately managed by use of diet alone. The effects of 3 diets (low-fat, high-fiber, and hypoallergenic diets) with concurrent anti-inflammatory treatment administered during the initial few weeks were evaluated. In that study, there was a response rate of 85% with the hypoallergenic diet without concurrent medications; the fiber diet was less effective for controlling clinical signs but ultimately was successful in approximately 75% of affected dogs. Dogs fed the low-fat diet had a response rate of 18%. Investigators evaluated the response of 27 dogs with chronic noninflammatory colitis to supplementation of various diets (easily digestible, low-fat, and limited-ingredient diets) with fiber. Overall, an excellent or good clinical response was seen in 26 of 27 dogs, and a small number of dogs were able to consume diets without fiber supplementation. In another study, 19 dogs with chronic colitis that initially failed a low-fat dietary trial responded to a fiber-fortified diet and could be maintained without the use of other concurrent medications. Finally, a complete or partial response was detected in 28 of 30 dogs fed limited-ingredient diets.

Limited information is available on nutritional management of colitis in cats. In 1 study, 6 cats were treated with diet alone (all 6 had a positive response), and 6 were treated with diet in addition to ancillary medications (4 cats had a positive response). Complete resolution was observed in 7 cats, all of which received long-term management with diet alone; another 3 cats had a partial response to dietary management. The diets most commonly used in the study were high in fiber or supplemented with fiber. In another study, response of 6 cats to a home-prepared diet of lamb and rice was evaluated. One cat of that study was concurrently managed by administration of anti-inflammatory medications in the initial few weeks, but ultimately diet alone was sufficient for disease management.

For both dogs and cats, there is limited evidence for the use of easily digestible diets, fiber-supplemented diets, or novel-ingredient or limited-ingredient diets in the management of chronic colitis. However, the aforementioned studies lacked comparative control groups, and the optimal nutritional strategy remains unclear. Therefore, prospective studies to compare the efficacy of various nutritional strategies are needed.

**Clinical Summary**

Chronic enteropathies in dogs and cats can be effectively managed with diet, and nutritional management offers many advantages over long-term administration of antimicrobials or use of immunomodulatory medications. Therefore, it should be a focus during treatment planning for patients with chronic enteropathy. A variety of options exist, and patient factors and clinical signs should guide empirical dietary management choices made by clinicians. Each patient should be evaluated, and diets should be chosen on the basis of the most recent literature to best suit the needs of each patient. Dietary response times have been reported, and there is evidence that indicates multiple dietary trials may be advantageous in patients that fail to respond to initial empirical choices. Establishing control of chronic enteropathies in dogs and cats through the use of dietary modification and proper monitoring can lead to a strong, stable response to treatment.

**Acknowledgments**

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The authors thank Tim Vojt for assistance with creation of the figures.

**Footnotes**

a. Purina Pro Plan Veterinary Diets HA, Hydrolyzed Canine Formula, Nestlé Purina PetCare Co, St Louis, Mo.
b. Purina Pro Plan Veterinary Diets HA, Hydrolyzed Canine Formula, Chicken Flavor, Nestlé Purina PetCare Co, St Louis, Mo.
c. Purina Pro Plan Veterinary Diets HA, Hydrolyzed Feline Formula, Soy and Chicken Flavor, Nestlé Purina PetCare Co, St Louis, Mo.
d. Royal Canin Veterinary Diet Hydrolyzed Protein Adult HP dry dog food, Royal Canin, St Charles, Mo.
e. Royal Canin Veterinary Diet Hydrolyzed Protein Adult HP canned dog food, Royal Canin, St Charles, Mo.
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