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AN ONGOING CE PROGRAM
of the University of Connecticut School of Pharmacy and Pharmaceutical Sciences

EDUCATIONAL OBJECTIVES

After completing the continuing education activity, pharmacists and pharmacy technicians will be able to

- List food items that may be harmful to certain pets
- Identify additives that should not be used in veterinary compounding
- Determine when veterinary compounding is acceptable
- Recognize federal laws pertaining to veterinary compounding
- Explain labeling requirements for veterinary compounds

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Pharmacists and pharmacy technicians are eligible to participate in this application-based activity and will receive 0.2 CEU (2 contact hours) for completing the activity, passing the post-test with a grade of 70% or better, and completing an online evaluation. Statements of credit are available via the CPE Monitor online system and your participation will be recorded with CPE Monitor within 72 hours of submission

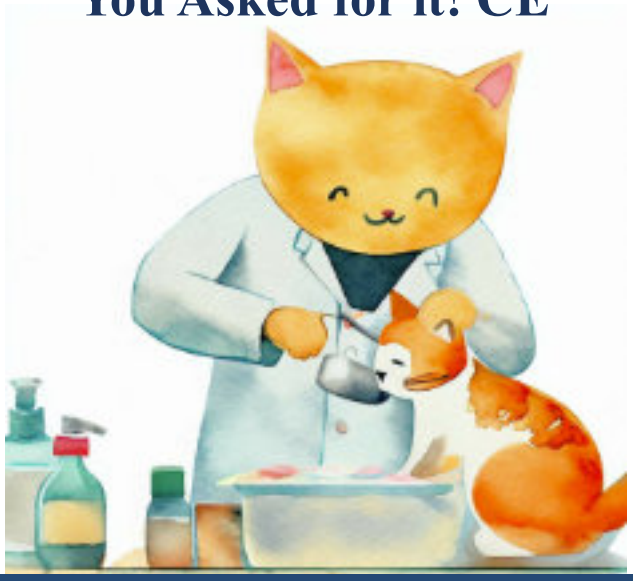
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You Asked for it! CE



Fur, Feathers, and Formulations: Veterinary Compounding Essentials

TARGET AUDIENCE: Pharmacists and pharmacy technicians with an interest in sterile compounding

ABSTRACT: Veterinary compounding can address medication needs when available products are unsuitable for an animal's dose, dosage form, or administration requirements. However, ingredients used safely in humans may be harmful to pets, and toxicity varies among species. This activity reviews common food and medication hazards, factors influencing toxicity, and considerations for selecting flavorings, sweeteners, preservatives, and other excipients. It explains appropriate veterinary compounding and examines applicable federal requirements and FDA guidance. Documentation, ingredient sourcing, adverse-event reporting, and labeling are also addressed. Pharmacists and pharmacy technicians will gain practical knowledge to recognize unsafe ingredients, support appropriate compounding decisions, and collaborate with veterinarians and pet owners to promote safer medication preparation, dispensing, and administration for companion animals.

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FACULTY DISCLOSURE: The author has no financial relationships with an ineligible company.

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INTRODUCTION

For many people, pets are a major part of everyday life. They become part of their households and are like family, but like children, none of them come with true owner's manuals. Sure, there are many books on the subject, but who do you trust? And who has the time to read all that stuff? What happens if or when they become sick or injured and need medication?

As a somewhat reticent parent of a very large Weimaraner (OK, my husband and daughter bought him without my knowledge), I was forced to learn rather quickly about the ins and outs of pet ownership. Still, he arrived, and we needed to

determine what's best for this 99-pound dufus, who amazingly survived eating an entire box of oatmeal raisin cookies. It wasn't pretty, but that story is reserved for a different CE.

At the University of Connecticut School of Pharmacy and Pharmaceutical Sciences, advanced compounding students are trained in some veterinary compounding, but most pharmacy schools do not teach it. This is a bit upsetting since people spend millions of dollars on pets every year. An estimated 65.1 million households are home to dogs, and another 46.5 million households have cats in the United States (U.S.). With pet ownership comes the responsibility of caring for them. The average cost of veterinary care for a dog is $730 per year, with cats averaging $253 per year. The U.S. pet market is estimated to reach 165 billion in 2026.[1]

Increasingly, pharmacy staff need to know some basics about companion animals and their health issues. Pet owners can request a paper prescription from the veterinarian and fill it at community pharmacies. The American Veterinary Medical Association (AVMA) incorporated prescription guidelines into their 1991 bylaws. It states that "a veterinarian shall honor a client's request for a prescription or veterinary feed directive in lieu of dispensing but may charge a fee for this service."[2] What do you do when a pet owner brings a prescription to your pharmacy?

People's perceptions about feeding human food to dogs and cats are surprising. An old wives' tale, passed from generation to generation, tells us that dogs can eat just about anything, including bones. Most of us now know that sharp bone shards can penetrate the soft tissues at the back of the throat, they can lodge in the esophagus, or they can pierce the intestines. It is also possible for a piece of bone to lodge in the trachea (windpipe), interfering with a dog's ability to breathe.[3] The controversy still continues today, but no pet owner wants their pet to have broken teeth, mouth injuries, or intestinal blockages if they can avoid it. If cooked bones are out, what else is bad for them? Certain foods create a risk for most pets, so compounders must not use these items as ingredients in their compounds. **Table 1** contains a list of some human foods that should be avoided in pets.

Items like alcohol, tobacco, caffeine, and chocolate make sense. Alcohol and tobacco affect dogs and cats as they do humans, but our pets are much smaller, so it takes significantly less alcohol or tobacco to cause catastrophic events such as breathing problems, vomiting, diarrhea, coma, or even death. Dogs are curious, and a tobacco or marijuana "cigarette" on the ground might be pretty tasty. The average tobacco cigarette contains 10 to 12 milligrams of nicotine. A toxic dose of nicotine for a pet is 0.5 to 1 milligram

Table 1. Human Foods That Should Not Be Given to Pets[4]

Food Item	Type of Pet	Toxicity/Reasoning
Alcohol	Dogs, cats, chickens, rabbits	Alcohol poisoning
Tobacco	Dogs, cats	Nicotine
Onions, chives, garlic (Allium family)	Dogs, cats, chickens, rabbits	Sulfates, disulfides
Avocado	Dogs, cats, chickens, horses, cows, pet birds	Persin
Salt	Dogs, cats, chickens	Fluid imbalance
Spicy foods	Dogs	Gastrointestinal upset
Grapes, raisins	Dogs, cats, rabbits	Kidney failure
Caffeine	Dogs, cats, rabbits	Methylxanthines
Chocolate	Dogs, cats, horses, rabbits	Theobromine and caffeine
Citrus fruits	Cats, chickens	Citric acid, essential oils
Cinnamon	Dogs, cats	Mouth and throat irritant
Nutmeg	Dogs, cats	Myristicin
Macadamia nuts	Dogs, cats	Toxicity unknown
Mushrooms	Dogs, cats	Mycotoxins
Green tomatoes, raw potatoes	Dogs, cats, chickens, horses, rabbits	Solanine
Raw bread dough, raw yeast, bread	Dogs, cats, horses, rabbits	Gastrointestinal upset, bloating, empty calories
Rhubarb	Chickens, rabbits	
Dairy items, ice cream	Dogs, cats, chickens, horses, rabbits	High sugar, high fat, lactose intolerance. Adult cats become lactose intolerant
Sugar free gum and sugar free candy	Dogs	Xylitol
Seeds and pits	Dogs, cats, chickens, horses, rabbits	Cyanide
Turkey skin, chicken skin, ham	Dogs, cats, rabbits	High fat content, can cause acute pancreatitis
Marijuana	Dogs, cats, horses, rabbits	Tetrahydrocannabinol (THC)

per pound, and a 4-milligram dose per pound can be lethal.[5] Doing some quick math, consuming as little as three or four cigarettes could be fatal to a 10-pound dog.

Vaping has become extremely popular, which has caused an increase in nicotine poisoning. An average 6 mL, 5% nicotine e-cigarette can contain up to 300 mg of nicotine. Pets can be subjected to nicotine poisoning by secondhand smoke, through spillage on skin, and by drinking vaping liquid. Consider this: a 40-pound dog would only need to be exposed to a 1 mL dose for it to become poisoned.[5] Nicotine is not the only toxin in e-cigarettes. They also contain volatile organic compounds, heavy metals (e.g., cadmium, copper, lead, nickel, tin) and they contain propylene glycol. All of these components are harmful to pets.

Those other "cigarettes" can be pretty tasty too. Marijuana use is on the rise in the U.S. and as of September 9, 2026, it is legal in 42 states and the District of Columbia. "Recreational drugs, including marijuana, remain among the ASPCA Animal Poison Control Center's top 10 categories of substances involved in pet poisonings. The two major components of marijuana are cannabidiol (CBD) and delta-9-tetrahydrocannabinol (THC). THC is responsible for the characteristic marijuana toxicosis and products containing THC can cause clinically significant poisoning; CBD products can also pose risks, particularly because composition and THC contamination/concentration may vary. CBD is widely advertised for human and pet use, but consumers must read labels carefully. Most CBD products are not entirely pure. They contain small amounts of THC.[6]

Although secondhand smoke and consuming raw marijuana leaves can be toxic, the most reported intoxication comes from pets eating infused edibles. Edibles–like brownies, cookies or gummies–are made with concentrated THC infused oils or THC-infused butter. They tend to be a more significant threat since most edibles also contain chocolate or xylitol.[7] If pets exhibit any symptoms, they should be taken to a veterinarian. THC poisoning closely mimics the signs of antifreeze poisoning which is fatal and an antidote needs to be given as quickly as possible.[6,7]

Symptoms of marijuana intoxication can become visible within 30 to 60 minutes after ingestion. Pets may stumble and cross their feet, walking as if they were drunk, they may have enlarged pupils, become lethargic and flinch in reaction to sudden movements. Pets with severe cases of intoxication may vomit, have tremors, shake uncontrollably and in extreme cases become comatose. Roughly 50% of dogs develop urinary incontinence and dribble urine uncontrollably (which might make the drug less popular if this happened in humans).[7]

Some medications contain significant amounts of alcohol. If unsecured, a dog or cat could consume them. Certain formulations of diphenhydramine (Benadryl, Sominex), guaifenesin with codeine (Cheracol Plus), dextromethorphan, guaifenesin, pseudoephedrine combinations (Dimetane,



Robitussin, Triaminic, Vicks), hydrocodone and pseudoephedrine combinations (Novahistine), and certain multivitamin liquids (Geritol) contain alcohol. Some remedies can contain up to 25% alcohol, which can harm pets (and children).[8] Alcohol is sweet tasting to dogs, so they will not stop drinking it until it is all gone.

Caffeine and chocolate ingestion should also be taken seriously. Caffeine contains methylxanthines, which can cause bronchodilatory and stimulatory effects in humans. In animals, they can also cause vomiting, diarrhea, hyperactivity, seizures, and cardiac arrhythmias. Chocolate, derived from the roasted seeds of *Theobroma cacao*, contains methylxanthine theobromine and caffeine. The theobromine content in chocolate is three to ten times that of caffeine. Cats do not have taste buds that can detect sweetness, but dogs do have a sweet tooth and love the taste of chocolate. One ounce (28 grams) of chocolate could be a lethal dose in a small dog. Theobromine has a half-life of two to three hours in humans, but it is longer in dogs. The half-life of theobromine in dogs is 17.5 hours.[9,10] The **SIDEBAR** on page 4 provides more information about chocolate toxicity in dogs.

Excess salt (sodium chloride) can cause fluid imbalances which could lead to seizures and spicy foods can cause painful vomiting, diarrhea, or stomach ulcers. Dogs, cats, and even birds are very sensitive to salt, so pet owners and compounders should be aware of common items that contain large amounts of salt. For example, sea water, baking soda, homemade play dough, and driveway deicer all contain high concentrations of salt. Sodium chloride poisoning in dogs are most often caused by pet owners who use salt to induce vomiting after the dog has ingested a different toxin. It is important to consult with a veterinarian or pet helpline before administering any type of antidote.[12]

Even seemingly harmless spices can be harmful. Cinnamon can cause mouth irritations and nutmeg, which contains myristicin, can cause hallucinations in smaller animals. Mushrooms contain

How Much Chocolate is Too Much?

Different cocoa beans and chocolate products contain various amounts of methylxanthines. Compounders and veterinary care providers must consider the dog or cat's weight and the amount of chocolate consumed.[10,11]

Methylxanthine doses of 15 mg/kg (7.5 mg per lb) or less should not harm a dog. This is equivalent to one square of dark chocolate for a 3 kg (6 lb.) dog or seven squares of chocolate for a 15 kg (33 lb.) dog. One square of chocolate is approximately 6 grams (0.21 oz). This formula calculates the dose consumed:

- Theobromine dose = concentration in type of chocolate x amount eaten/weight
- Caffeine dose = concentration in type of chocolate x amount eaten/weight
- Theobromine + caffeine = total methylxanthines

The caffeine and theobromine amount in the specific type of chocolate may be on the label, and **Table 2** provides some information about common products.[10] However, in emergencies, healthcare providers can use calculators on the Internet that perform this calculation quickly and efficiently. This is not to say that cats never get into chocolate and get sick. There are also cat chocolate toxicity calculators online in case of emergency.

Table 2. Methylxanthines in Chocolate[10]

Product	Methylxanthines per 1 gram chocolate	mg methylxanthines /ounce of chocolate
Dry cocoa powder	28.5 mg	800 mg
Unsweetened bakers chocolate	16 mg	450 mg
Milk chocolate bar	2.3 mg	64 mg
Dark chocolate bar	5.7 mg	150 - 160 mg
Cocoa bean hulls (mulch)	9.1 mg	225 mg
White chocolate	Negligible	

mycotoxins which can also cause hallucinations, diarrhea, vomiting, or kidney failure and in extreme cases, liver failure.[4]

Although it is more toxic to cats than dogs, onions, chives, garlic, and all members of the allium family of herbs contain sulfoxides and disulfides, and an oxidant called n-propyl disulfide. These can cause fatal anemia, called oxidative hemolysis, which affects dogs, cats, rabbits and chicken. Signs of anemia may take several days to appear.[4,17,18] If a dog is fed a little garlic once in a while it should not be a problem, but garlic should not be intentionally used as a veterinary compounding ingredient or supplement without veterinary direction. It was once believed that garlic supplements given to dogs could help to repel fleas and ticks, but this has now been proven to be ineffective.[13]

Other problematic vegetables include green tomatoes, raw potatoes, and avocado. The tomato plant's green parts, its stems and leaves, and raw potatoes contain solanine. Solanine is poisonous, even to humans. It has pesticide-like properties and is part of the plant's natural defenses. Solanine can be found in green potatoes and potato tubers (eyes).[14] It is also found in other members of the nightshade family (e.g., eggplant skin).

Avocado is only slightly dangerous to dogs and cats, but extremely dangerous to birds and large animals such as cows, goats, sheep and horses. The bark, leaves, skin, pits and fruit of the avocado contain persin, which is a fungicidal toxin. Persin is an oil soluble compound that seeps into the fruit from the large seed inside. It is similar in structure to a fatty acid, and is harmless to humans, but toxic to most animals. Symptoms of persin toxicity range from edema and mastitis to respiratory distress and heart failure.[15,16]

Chickens, which are increasingly popular in backyards, are sensitive to many food items. They should not be fed most human foods, but especially avoid feeding them citrus fruits, uncooked rice and uncooked dried beans, fruit seeds and pits, tomato leaves, green potatoes, and rhubarb.[17] Rhubarb's high oxalic acid content binds to minerals and can form kidney stones. Although high in calcium and phosphorus, certain dried beans are acidic and contain hemagglutinin. Certain dried beans contain hemagglutinins, plant lectins that can bind to intestinal cells and interfere with normal gastrointestinal function, potentially causing vomiting, diarrhea, and other signs of toxicity.

Rabbits, guinea pigs, and most herbivores have similar dietary restrictions. Fruit seeds and pits contain small amounts of cyanide, which can be a concern to smaller animals. Cabbage, cauliflower, other gassy vegetables and iceberg lettuce must be avoided. Iceberg lettuce contains lactucarium. Lactucarium (also called lettuce opium), a milky fluid excreted near the base of the lettuce plant, has sedative properties. Rabbits and other herbivores should stick to darker greens.[18]

Factors That Influence Toxicity

Each species of animal reacts to toxins differently due to variations in absorption, metabolism, or elimination. The dose of toxin per body weight is a major concern. Other factors include the animal's age, size, nutritional status, stress level, and overall health. For example, most young animals do not have a fully developed system of metabolism, which may cause a toxin to remain in their system longer, causing more harm. Horses, rabbits, and small rodents do not have the ability to vomit, which means that they may be poisoned at a lower dose.[19]

One must also consider the chemical nature of a food, drug, or poison that is consumed. If the drug or toxin dissolves in water easily, it will spread throughout the body easier. If there are substances added to an active ingredient, such as a binding agent or outer coating, or if it is a sustained release product, it will

affect absorption.[19] Overall, pharmacists should become familiar with species-specific toxins and the factors that affect the risk of toxicity. Animals absorb, distribute, metabolize, and eliminate medications and toxins differently from humans, and the interspecies differences are also notable. See the **SIDEBAR** for a list of the top ten toxic items.

Evolution has influenced species-specific diets. Dogs have evolved to become opportunistic gorgers, while cats are very picky. A dog will eat every bit of chocolate once he starts, which is the reason why dog poisonings are more common. Cat poisoning is less common and are usually the result of intentional harm by human beings.

Pause and Ponder: Have you tried to give a dog a tablet or capsule? Did you wrap it in some meat or cheese? How did you get that cat to take his dose?

When to Compound

Pharmacists should consider compounding veterinary products under three conditions:

1. **When a commercial product is unavailable**. This could be due to drug recalls, drug shortages, or because a commercial product has yet to be developed. In some cases, rapid changes in disease state management create an urgent need for medication.
2. **When an approved drug needs to be modified**. This would include an increase or decrease in dosage due to a lack of appropriate dosage size, or a lack of formulation for a desired route. For example, making a dilution, adding flavoring, or changing the form of the drug. A popular compounding task is changing a tablet into a suspension.
3. **When the likelihood of nonadherence is high**. Owners' adherence is greater when they can administer one combination product instead of two or three. For example, combining two injectable vaccines or allergy medications into one syringe for ease of use would be helpful to the pet owner. Of course, it is also more beneficial to the animal, since it will minimize harm and stress, which will lead to a better prognosis. Our students have recently formulated a compound of ketoconazole, gentamicin sulfate, and mometasone furoate all in one for a dog with an external ear bacterial yeast infection.

Dogs and cats can be very particular, and their sense of smell will give that medication away every time. This means that compounding must be creative. The most popular forms of medications for veterinary consideration include capsules, transdermal medications, flavored liquids, tablets, chews, or treats. Oral formulations can be difficult to give, but devices such as droppers, mechanical pill injectors, oral syringes, and oral pastes and gels can mask medications. Pill pockets—soft, flexible treats—can be molded around a tablet or capsule. Medicated oral pastes and gels, when placed on a cat's paw, are an ingenious way for the cat to lick his medicine up. Compounders

SIDEBAR: ASPCA Poison Control: Top 10 Pet Toxins of 2025[20]

Each year, ASPCA Poison Control reviews exposure data to identify the substances pets most commonly encounter. In 2025, ASPCA Poison Control received calls about more than 376,000 potentially toxic items to which pets were exposed." In 2025, the top 10 categories were:

1. **Over-the-counter medications and supplements** — 16.9% of exposures; vitamins, supplements and skin care products were the most common.
2. **Food and drink** — 16.4%; common exposures included grapes, raisins, xylitol-containing gum, onions, and garlic
3. **Human prescription medications** — with cardiac medications most prevalent
4. **Chocolate** — 13.6% of exposures; ASPCA received approximately five calls per hour regarding chocolate.
5. **Veterinary products** — 9.1%; up from #7, flavored chewable products were a common source
6. **Plants and fungi** — 7.5%
7. **Rodenticides** — 6.5%
8. **Household products** — 6.4%; cleaners and paints were common exposures
9. **Insecticides** — 3.8%
10. **Recreational drugs** — 1.9%; including marijuana, psychedelic mushrooms, and increasingly, kratom (up 400%)

make a variety of products from hairball pastes and pectin gels, used for diarrhea, to dental licks and probiotic powders which are placed on a cat's fur.

Human compounding caters to the customer, and the same is true for pets. Tuna or salmon flavoring attracts cats; beef or chicken flavoring may fool dogs; and birds love seeds. Other ingredients can be rather generic. Compounders can choose from a myriad of thickeners, sweeteners, and preservatives. Choosing the correct excipient could be crucial.

PAUSE AND PONDER: Take another look at the list of forbidden foods. Which items on your pharmacy compounding shelf could be harmful to pets?

Ingredients for veterinary compounding

In human compounding we tend to lean toward avocado or grapeseed oil to soothe and treat the skin, which are lighter than other oils. We use alcohol, propylene glycol, polysorbate 80 (Tween 80), and essential oils in compounds and peanut butter quite often for dog treats. These may not be the best choices in some veterinary situations. Let's look at what is safe and what should not be used for pets.

Sweeteners

Sugar substitutes are game changers for people who have diabetes or are on low calorie diets. Xylitol is a current human favorite, occurring naturally in small amounts in berries,

SIDEBAR: POOR MIMI[23]

In 2020, Mimi, a pet poodle passed away after receiving gabapentin. The veterinarian prescribed gabapentin oral solution, for ease of use and medication adherence for Mimi's seizures. The owner administered the dose and Mimi's seizures increased, so the owner called the veterinarian, who increased the dose of medication to be given. Within 24 hours Mimi was gone.

How could this happen?

Many veterinarians are unfamiliar with the added ingredients in human formulations. Also, drug manufacturers may change sweeteners without notice. A retail pharmacist filled her prescription for gabapentin oral solution with the commercially available product, which contained xylitol. When the dog's owners went to the pharmacy to investigate, they found several factors which caused the problem.

- They were told that the pharmacist did not know that the solution contained xylitol and he was also unaware that xylitol was harmful to dogs.
- The pharmacy had no drug utilization review processes in place for veterinary drugs.
- The existing built-in computer software was not programmed to issue alerts for xylitol or other veterinary toxins.
- The pharmacy did not have a veterinary drug reference book, for example, *Plumbs Veterinary Medicine*, or a veterinary drug formulary. Unfortunately, the majority of state boards of pharmacy do not require pharmacies to carry a veterinary drug reference book.

Pharmacists and pharmacy technicians need to be aware of additives in human drug formulations that can be harmful to pets. Mimi's death could have been avoided.[23]

cauliflower, corn, mushrooms, oats, plums, and pumpkins. In industrial production, the purest form is extracted from raw biomass materials such as hard and soft wood, and especially from the birch tree. More economical processing uses hydrolyzed, purified agricultural corn, wheat, and rice waste. Economists expect xylitol production to become a $1.4 billion industry by 2025.[21] Why the increase in popularity? Xylitol contains two-thirds of the calories of sucrose and has a mildly increased saliva effect. Unfortunately, xylitol is extremely toxic to dogs.

When dogs consume xylitol, it is quickly released into the bloodstream, causing an immediate and potent release of insulin from the pancreas. This leads to severe hypoglycemia, with onsets that can occur anywhere from 10 to 60 minutes after ingestion. Without treatment, the dog may develop liver failure, have seizures, or become comatose.[22]

Products that contain xylitol are ubiquitous. It's found in foods such as barbeque sauce, candy, gum, jam, ketchup, low calorie maple syrup, and peanut butter (meaning that compounders who use peanut butter need to check labels carefully; xylitol may be listed as 1,4-anhydro-d-xylitol, anhydroxylitol, birch bark extract, birch sugar, D-xylitol, Xylite, xylitylglucoside, or zylatol). In fact, sugar-free gum is the most common source of xylitol poisoning in dogs. For example, one piece of gum or one breath mint can be fatal to a 10-pound dog. The Pet Poison Helpline responded to 5,846 xylitol poisoning cases in 2020.[22]

Xylitol can also be found in many pharmaceuticals and personal care products: cough syrup, deodorant, digestive aids, gummy vitamins, laxatives, mouthwash, nasal sprays, shampoo, skin care products, sleep supplements, toothpaste, and especially orally dissolving tablets. Small traces of xylitol can even be found in prescription medications.[22] Gabapentin tablets and capsules do not contain xylitol, but gabapentin oral solution contains xylitol. The **SIDEBAR** discusses one xylitol poisoning case.

PAUSE AND PONDER: Have you heard of birch sugar?

Many companies now list xylitol as birch sugar. Xylitol was first discovered and reported in 1891 by the German Nobel Prize winning chemist Emil Fischer. Fischer named the new compound xylit (the German word for xylitol), which is believed to stem from the Greek word xylon, whose English translation is xylem. Xylem constitutes the woody element of higher plants, such as the beech wood from which Fischer first isolated xylitol. Xylitol is a polyol sugar alcohol and is referred to as birch sugar because it can be produced from birch. Natural sources of xylitol include plums, strawberries, and raspberries. It may also be listed as birch sugar, or birch bark extract[24]

Many other sugar substitutes are considered safe to use in veterinary compounding. Erythritol, a sugar used mainly in keto desserts and baked goods, is safe in small amounts. Stevia and aspartame are also considered safe to use, although pets may experience stomachaches or slight diarrhea. Saccharin (Sweet-n-Low), sucralose (Splenda), or monk fruit, a newer sweetener, are all considered safe in pets.[25] Dogs have more of a sweet tooth than cats, but in general, sweeteners should be kept to a minimum.

Flavors

Using an optimal flavor profile helps mask the active ingredient's taste and will promote animal adherence. Compounders should use only flavorings that are intended for compounding use. They shouldn't use meat-flavored bouillon cubes or bouillon powders for compounding since they contain high amounts of salt, onion powder, and other harmful spices. **Table 3** lists common flavorings and the species that find them enjoyable.

Preservatives and Additives

The Food and Drug Administration (FDA) maintains a list of additives generally recognized as safe (GRAS) for use in pet foods.

Manufacturers must submit food additives used in their pet foods for FDA review, which if approved, are added to the GRAS list.[27]

Still, many excipients should not be used for veterinary compounding [28,29,32]

- Butylated hydroxyanisole (BHA)
- Butylated hydroxytoluene (BHT)
- Ethoxyquin
- Propylene Glycol
- Polysorbate 80 (Tween 80)

BHA and BHT are preservatives that are added to oils and rendered fats in certain pet foods and treats. They have been found to be carcinogens and can cause liver and kidney damage in rats, but the FDA has cleared them for use in small amounts in pet foods and treats. Ethoxyquin, a preservative, is used as a hardening agent. It is also used in pesticides and rubber and is illegal for human use, yet the FDA has ruled the additive "may be safely used in animal feeds" when used according to regulations.[27] Which is the best preservative to use? The answer is to stick to more natural preservatives. Vitamin C and E are great choices, as are lemon, except for use in cats and chickens, and honey. Honey is packed with vitamins A, B, C, D, E, and K and also contains potassium, calcium, magnesium, copper, and antioxidants. Giving a pet a small amount of honey can even help to build immunity from some allergens, such as pollen.[30]

Propylene glycol is a controversial excipient used as a humectant, or moisturizing agent, in many pharmaceutical formulations. Propylene glycol is frequently used as a substitute for ethylene glycol in low toxicity, environmentally friendly automotive antifreeze. Small amounts may be used in dog formulations, but it is extremely toxic to cats. Extended exposure to propylene glycol over several years has been shown to cause seizures and possible blood disorders in both dogs and cats.[29]
Cats may develop Heinz body hemolytic anemia, which can lead to death.

Cats and dogs are also extremely reactive to essential oils. Popular essential oils (e.g., eucalyptus oil, peppermint oil, tea tree oil) can be found in some natural flea repellents, perfumes, and aromatherapy products. These are safe to use in humans and can be found in many topical preparations; using these oils in topical preparations for dogs or especially cats (since they are continual groomers), can be harmful. Signs of toxicity are lethargy, depression, ataxia, tremors, seizures, or death.[31]

Polysorbate 80 (Tween 80) is a surfactant used in soaps and as a lubricant in eye drops. It is also used as an excipient quite often to stabilize aqueous formulations of lipophilic drugs for vaccines and for parenteral administration. Many Chinese herbal injectable medications contain high amounts of polysorbate 80. When dogs are given intravenous (IV) medications that contain high levels of polysorbate 80, for example vitamin K, it causes systemic histamine release, which causes allergic reactions and tachycardia and may lead to an anaphylactic reaction.[32]

Corn syrup is a cheap humectant, sweetener, and flavoring agent all-in-one, but it can increase blood sugar significantly in dogs. A vegetable-based glycerin, such as coconut glycerin is a better choice.[33]

Food dyes and colorants should be used sparingly when compounding. Blue dye #2, red #40, yellow #5 and #6 can cause hypersensitivity or allergic reactions in some pets. Also, caramel color 4-methylimidazole (4-MIE) is under investigation as a possible carcinogen in pets.[33] In actuality, pets do not care about the color of the compound. Artificial coloring only appeals to the pet owner.

General Recommendations for Compounding

Under the Federal Food, Drug, and Cosmetic Act (FD&C Act), the FDA permits compounding of animal drugs when the source of the active ingredient is a finished FDA-approved drug, and not a bulk drug substance (BDS), unless certain exceptions, described

Table 3. Common Flavorings for Pets[17,26]

Animal	Flavor	Reasoning
Birds	Banana, grape, orange, raspberry, tangerine, tutti-frutti, pina colada	Birds prefer sweet and fruity flavors
Dogs	Bacon, beef, liver, chicken, turkey, cheese, peanut butter, molasses, caramel, anise, marshmallow, raspberry, strawberry, honey	Dogs prefer meats and sweets
Cats	Fish, liver, tuna, cod liver oil, sardines, mackerel, salmon, beef, chicken, cheese, bacon, molasses, peanut butter, butterscotch, marshmallow	Cats have little preference for sweetness but strongly dislike bitterness
Gerbil	Banana cream, orange, peach, tangerine, tutti-fruiti	Gerbils like sweet and fruity flavors
Iguana	Banana, cantaloupe, kiwi, orange, tangerine, watermelon, other melons	Iguanas and most reptiles, rely on their sense of smell more than taste, so it must smell good
Rabbits	Banana cream, carrot, celery, lettuce, parsley, pineapple, vanilla, butternut	Find their favorite vegetable or fruit and use it
Poultry	Cantaloupe, corn, meal, milk, vanilla, butternut, watermelon	Birds are more visually oriented. The color red appeals to them, berries are a good choice. Research is ongoing to determine the sense of taste in chickens

When to Call a Professional

When should pet owners or concerned pharmacy staff call a professional for a suspected pet poisoning? The sooner the better. The first call should be to the pet's veterinarian, but national hotlines are also available for emergencies 24/7 for a fee.

- ASPCA Animal Poison Control
  https://www.aspca.org/pet-care/animal-poison-control
  888-426-4435
  Free access to website
  $110.00 fee for hotline service
  *90% of the fee is covered with ASPCA insurance
- Pet Poison Helpline
  http://www.petpoisonhelpline.com
  855-746-7661
  Free access to the website. $89.00 fee for hotline service

below, are followed. A "bulk drug substance" is a substance used to make a drug that becomes an active ingredient in the drug's finished dosage form.[34] Most pharmacists would recognize that as an active pharmaceutical ingredient (API).

A commercially available drug may not always be available or appropriate for veterinary use. For example, an FDA-approved drug may contain excipients or preservatives that are unsuitable for a particular species, the available strength may be inappropriate, or the dosage form or flavor may make administration difficult. When no medically appropriate FDA-approved, conditionally approved, or indexed drug can be used, and an FDA-approved drug cannot appropriately serve as the source of the active ingredient, a drug compounded from a BDS may be medically necessary. In 2022, FDA issued Guidance for Industry (GFI) #256, *Compounding Animal Drugs from Bulk Drug Substances*, which describes circumstances in which FDA generally intends to exercise enforcement discretion for animal drugs compounded from BDS.[36] FDA maintains lists of BDS that may be used under specified circumstances for office stock for nonfood-producing animals and for certain preparations for food-producing animals or free-ranging wildlife. These substances are not FDA-approved drugs; rather, their use may fall within FDA's enforcement discretion policy when the conditions described in GFI #256 are met.[36] Compounders must also meet applicable documentation, sourcing, labeling, and adverse-event reporting requirements described in the guidance.

In August 2026, FDA issued draft GFI #256B, *Compounding Animal Drugs from Bulk Drug Substances: Compounding under CGMP in Federally-Registered Facilities*. The draft guidance proposes an enforcement policy for animal drugs compounded from BDS in FDA-registered facilities operating in accordance with current good manufacturing practice (cGMP). It does not apply to ordinary state-licensed pharmacies that are not federally registered or to drugs compounded from FDA-approved animal or human drugs. If finalized, GFI #256B is expected to be combined with GFI #256. Because GFI #256B remains a draft guidance and is not yet for implementation, compounders should monitor FDA updates before changing practice based on its recommendations.

The FDA has composed a checklist for pharmacists regarding veterinary compounding.[35]

1. **Confirm whether patient(s) is a nonfood-producing animal or a food-producing animal**. Make sure that chicken is just a pet! Food-production animals (cattle, chickens, etc.) have an additional set of rules (not discussed here). Check the FDA guidelines for more information.[33]

2. **Follow all state laws and regulations that apply to compounding animal drugs**. Compounders need to check their state regulations. It appears that most states tend to merely restate FDA animal compounding guidance.

3. **Meet USP standards and FD&C Act requirements.** Use FDA-approved drugs or FDA-approved BDS, follow USP guidelines and monographs, if they exist, and follow FD&C Act requirements.

4. **Include all labeling information. S**ee below.

5**. Dispense the compounded drug(s) to the patient's owner or caretaker or the veterinarian who prescribed or ordered it.** A valid veterinarian-client relationship must exist, and a veterinarian must provide a valid prescription.

6. **Report adverse events and product defects associated with the compounded drug to the FDA on Form FDA 1932a**.

7. **Consider other FDA-approved options first.** Check to see if alternative options are available. Compounding is permitted if the active ingredient is a different salt, ester, or other derivative.

8. **Determine if you are compounding a copy of an FDA-approved product.** If the exact form of medication is commercially available, it cannot be compounded.

9. **Obtain a medical rationale and retain it in your records if a copy is needed.** The rationale for the compound must be documented on the prescription.

Other considerations include determining the physical and chemical compatibility of the drugs, the drugs' solubility and stability, and the active ingredients' pharmacodynamics.

Labeling

In addition to including the client's name on the label, the AVMA recommends veterinarians and compounders in veterinary

offices convey the following information to animal owners when prescribing all compounded preparations[38,39]:

- Name, address, and telephone number of veterinarian
- Identification of animal(s) treated, species, and number of animals treated, when possible
- Date of treatment, prescribing, or dispensing of drug
- Name, active ingredient, and quantity of the drug (or drug preparation) to be prescribed or dispensed
- Drug strength (if more than one strength available)
- Dosage and duration
- Route of administration
- Number of refills
- Cautionary statements, as needed
- Beyond-use date (BUD)
- Slaughter withdrawal and/or milk withholding times, if applicable

Per FDA regulations, pharmacies must include the following on the compounded drug's labeling: name and strength or concentration of drug; species and name or identifier of patient(s); name, address, and contact information for the compounding pharmacy and name of the prescribing veterinarian; a BUD; the withdrawal time as determined by the prescribing veterinarian; and the following statements must be included[34]:

- "Report suspected adverse reactions to the pharmacist who compounded the drug and to FDA using online Form FDA 1932a."
- "This is a compounded drug. Not an FDA-approved or -indexed drug."
- "Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian."

CONCLUSION

On June 10, 2021, the FDA finalized GFI #263, (not to be confused with GFI #256 which was mentioned previously) requesting that participating animal drug companies voluntarily transition certain antimicrobials from over-the-counter availability to veterinary prescription within two years. The aim of this guidance is to decrease antibiotic resistance in animals, and the target date to introduce new prescription labels onto the market was June 11, 2023.[39] These include well-known antibiotics such as erythromycin, gentamicin, penicillin, sulfamethoxazole, and tetracycline. This FDA requirement is now in effect for food-production animals and pets, and it may be one reason why many pharmacies have seen an increase in pet prescriptions. Another reason may be that more pet owners trust their local pharmacy to prepare the correct formula for their furry family members.

The field of veterinary medicine is expanding seemingly daily, and it is a field where compounding pharmacies can be instrumental. Veterinary compounding has its challenges, but when collaborating with a veterinarian, the compounder can impart professional judgment to ensure that the compound is safe, effective, and therapeutic. That's a rewarding practice in the end.

Figure 1 (next page) emphacizes key points that will puff-fect your practice.



Figure 1. Purr-fecting Your Veterinary Compounding Practice

Best

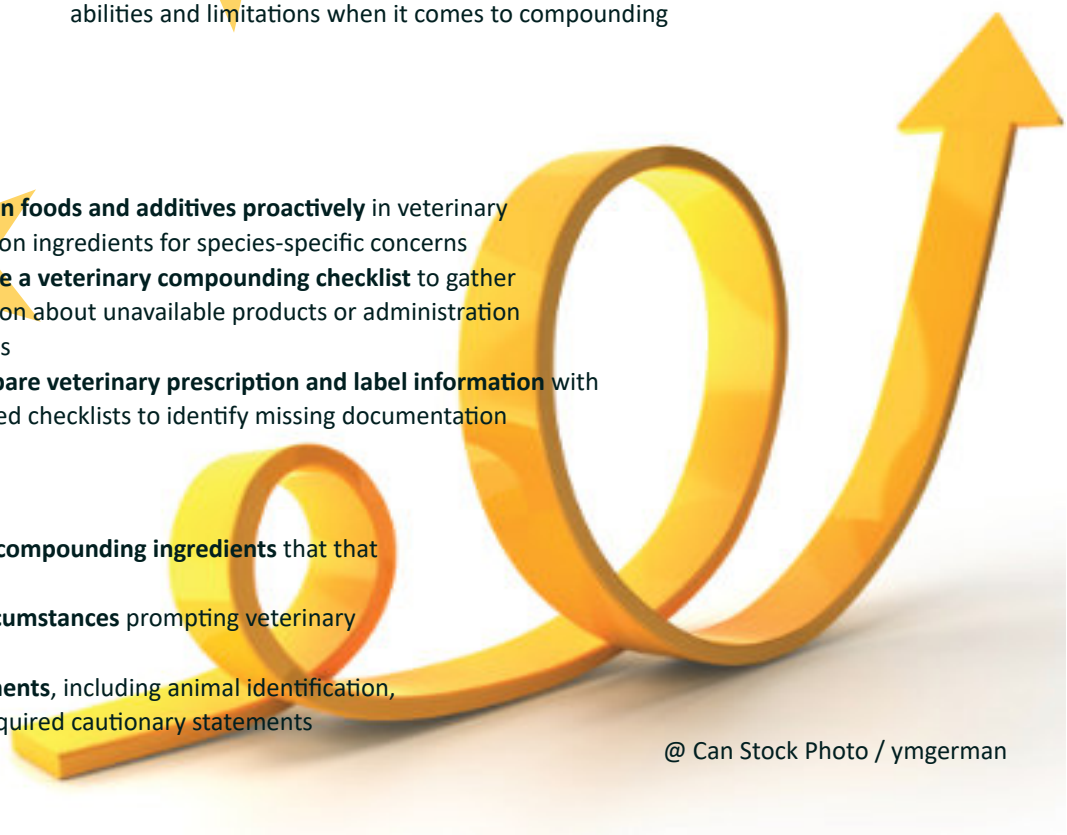
1. **Be COMMUNITY CHAMPIONS** and talk to patients and community groups about the importance of medication for companion animals
2. **Encourage discussion** with patients about consistent use of preventives and appropriate antibiotic use
3. **Collaborate actively with veterinarians** so they know your abilities and limitations when it comes to compounding

Better

1. **Screen foods and additives proactively** in veterinary preparation ingredients for species-specific concerns
2. **Create a veterinary compounding checklist** to gather information about unavailable products or administration difficulties
3. **Compare veterinary prescription and label information** with established checklists to identify missing documentation

Good

1. **Recognize foods and compounding ingredients** that that may harm pets
2. **Identify common circumstances** prompting veterinary compounding
3. **Identify labeling elements**, including animal identification, beyond-use dates, and required cautionary statements



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REFERENCES

1. Megna M. Pet Ownership Statistics,2026. Forbes Magazine. Accessed September 10,2026. https://www.forbes.com/advisor/pet-insurance/pet-ownership-statistics/#

2.Principles of Veterinary Medical Ethics of the AVMA. American Veterinary Association. August 2019. Accessed July 6, 2023 https://www.avma.org/resources-tools/avma-policies/principles-veterinary-medical-ethics-avma

3.Veterinary Centers of America (VCA) Animal Hospitals: Why Bones are not Safe for dogs. By Ryan Llera, BSc, DVM; Robin Downing, DVM, CVPP, CCRP, DAAPM. Accessed 07/04/2023. https://vcahospitals.com/know-your-pet/why-bones-are-not-safe-for-dogs#:~:text=Dogs%20can%20choke.,your%20dog's%20ability%2

4. 20 Foods Dogs Can't Eat, and 13 Foods Safe for your Pup! Dr. Chris Roth DVM, July 21, 2022. Accessed August 5, 2023. https://www.petsbest.com/blog/20-foods-dogs-shouldnt-eat/?utm_source=nmpi&utm_medium=pmax&utm_campaign=max&utm_term=p

5. Brooks, Wendy, DVM,DABVP. Nicotine Poisoning in Pets. Revised January 23, 2023. Accessed August 5, 2023. https://veterinarypartner.vin.com/default.aspx?pid=19239&id=4952080#

6. Chapin . Pets On Pot, Just High or Highly Dangerous? Michigan State College of Veterinary Medicine, December 4, 2018. Accessed August 5, 2023. https://cvm.msu.edu/vetschool-tails/pets-on-pot-just-high-or-highly-dangerous#

7. Johnstone, Gemma, American Kennel Club. Marijuana Poisoning in Dogs. April 10, 2023. Accessed August 5, 2023. https://www.akc.org/expert-advice/health/marijuana-poisoning-in-dogs/.

8. Liquid medicine may contain a high level of alcohol. Use with caution when administering to a child. Consumer Med Safety.org. Accessed August 5, 2023. https://www.consumermedsafety.org/safety-articles/liquid-medicine-may-contain-a-high-level-of-alcohol-use-with-caution-when#:~

9. Myers J. Chocolate toxicosis (Methylxanthine Toxicosis) in Dogs. September 9, 2022. Accessed August 5, 2023. https://vetster.com/en/conditions/dog/chocolate-toxicosis-methylxanthine-toxicosis-in-dogs

10. Gwaltney-Brant SM. Chocolate Toxicosis in Animals. Accessed August 5, 2023. https://www.merckvetmanual.com/toxicology/food-hazards/chocolate-toxicosis-in-animals#:~:text=DVM%2C%20PhD%2C%20DABVT,Modified%20Nov%202022

11. Zaborowska, Ł. Dog Chocolate Toxicity Calculator. Accessed August 5, 2023. https://www.omnicalculator.com/biology/dog-chocolate-toxicity.

12. American College of Veterinary Pharmacists. Salt. Accessed August 5, 2023. https://vetmeds.org/pet-poison-control-list/salt/#!form/PPCDonations.

13. Burle A. Can Dogs Eat Garlic? August 4, 2022. Accessed August 5, 2023.. https://www.akc.org/expert-advice/nutrition/can-dogs-eat-garlic/

14. Medline plus, National Library of Medicine. Potato plant poisoning. Accessed August 5, 2023. https://medlineplus.gov/ency/article/002875.htm

15. Oelrichs PB, Ng JC, Seawright AA, Ward A, Schäffeler L, MacLeod JK. Isolation and identification of a compound from avocado (Persea americana) leaves which causes necrosis of the acinar epithelium of the lactating mammary gland and the myocardium. Nat Toxins. 1995;3(5):344-349. doi:10.1002/nt.2620030504

16. Avocado. Pet Poison Helpline. Accessed August 5, 2023. https://www.petpoisonhelpline.com/poison/avocado/# Reviewed/Revised Jun 2021 | Modified Nov 20

17. What not to feed chickens, 33 Foods to Avoid. Backyard chicken project.com. Accessed August 5, 2023. https://backyardchickenproject.com/what-not-to-feed-chickens/

18. Foods Rabbits should never eat. February 15, 2021. Oxbow Animal Health. Accessed August 5, 2023. https://oxbowanimalhealth.com/blog/foods-rabbits-should-never-eat/

19. Factors Affecting the Activity of Poisons. Merck Veterinary Manual. Accessed August 5, 2023.https://www.merckvetmanual.com/special-pet-topics/poisoning/factors-affecting-the-activity-of-poisons#

20. Majority of America's Pet Owners Unprepared for Costly Medical Emergencies, New ASPCA Report Warns. ASPCA. Accessed September 9, 2026. https://www.aspca.org/about-us/press-releases/majority-americas-pet-owners-unprepared-costly-medical-emergencies-new-aspca?utm_source=chatgpt.com

21. Xylitol, Drugs.com. Accessed August 5, 2023. https://www.drugs.com/npp/xylitol.html

22. Xylitol Poisoning in Dogs. VCA. Accessed August 5, 2023. https://vcahospitals.com/know-your-pet/xylitol-toxicity-in dogs#:~:text=What%20is%20xylitol%3F,corn%20fiber%20or%20birch%20trees.

23. Dog Dies After Being Treated with Gabapentin Exposing Flaws in the Divide Between Human and Animal Drugs. Pet Food Safety News and Information. Accessed August 5, 2023. https://www.poisonedpets.com/dog-dies-after-being-treated-with-gabapentin-exposing-flaws-in-the-divide-between-human-and-animal-drugs/.

24. Zacharis C. Xylitol. In: O'Donnell K, Kearsley MW, eds. Sweeteners and Sugar Alternatives in Food Technology. 2nd ed. Wiley-Blackwell; 2012:347-382.

25. Brahlek A. Not-So Sweet Toxic Sweeteners for Dogs: Xylitol and Others. November 21, 2022, Accessed August 5, 2023. https://grubblyfarms.com/blogs/the-flyer/toxic-for-dogs-xylitol

26. Allen, LV Chapter 29, Veterinary Pharmaceuticals. The Art, Science, and Technology of Pharmacy Compounding. 6th edition, American Pharmacists Association, 2020.

27. Current Animal Food GRAS Notices Inventory. U.S. Food and Drug Administration. Accessed August 5, 2023. https://www.fda.gov/animal-veterinary/generally-recognized-safe-gras-notification-program/current-animal-food-gras-notices-inventory

28. Mahaney P. Pet Food: The Good, the Bad, and the Healthy. Accessed August 5, 2023. https://www.petsafe.net/learn/pet-food-the-good-the-bad-and-the-healthy

29. Dog Food Advisor. These 6 Dog Food Preservatives Could Be Toxic to Your Pet. Accessed August 5, 2023. https://www.dogfoodadvisor.com/red-flag-ingredients/dog-food-preservatives/

30. People Foods Dogs Can and Can't Eat. AKC staff. April 3, 2022. Accessed August 5, 2023. https://www.akc.org/expert-advice/nutrition/human-foods-dogs-can-and-cant-eat/

31. Schmid R, Brutlag A. Flint C. DVM Essential Oil and Liquid Potpourri Poisoning in Cats. Accessed August 5, 2023. https://vcahospitals.com/know-your-pet/essential-oil-and-liquid-potpourri-poisoning-in-cats#

32. Qiu S, Liu Z, Hou L, et al. Complement activation associated with polysorbate 80 in beagle dogs. Int Immunopharmacol. 2013;15(1):144-149. doi:10.1016/j.intimp.2012.10.021

32. 10 Ingredients to avoid in dog food. TPLO info. November 12, 2021.

Accessed August 5, 2023. https://tploinfo.com/blog/10-ingredients-to-avoid-in-dog-food/
34. Animal Drug Compounding. U.S. Food and Drug Administration. Accessed August 5, 2023. https://www.fda.gov/animal-veterinary/unapproved-animal-drugs/animal-drug-compounding
35. Check List for Pharmacists: Compounding Animal Drugs. U.S. Food and Drug Administration. Accessed August 5, 2023. https://www.fda.gov/media/157331/download
36. GFI # 256- Compounding Animal Drugs from Bulk Drug Substances. August 2022. U.S. Food and Drug Administration Center for Veterinary Medicine. Accessed August 5, 2023. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/cvm-gfi-256-compounding-animal-drugs-bulk-drug-substances
37. FDA list of Bulk Drug Substances for compounding office stock drugs for Non-food producing animals. Accessed August 5, 2023. https://www.fda.gov/animal-veterinary/animal-drug-compounding/list-bulk-drug-substances-compounding-office-stock-drugs-use-nonfood-producing-animals
38. Compounding: Facts for Veterinarians. American Veterinary Medicine Association. Accessed August 5, 2023. https://www.avma.org/resources-tools/animal-health-and-welfare/animal-health/compounding/compounding-faq-veterinarians
39. Over-the-counter antimicrobials changing to prescription-only. American Veterinary Medicine Association. Accessed August 5, 2023. https://www.avma.org/resources-tools/one-health/antimicrobial-use-and-antimicrobial-resistance/over-counter-antimicrobials-changin