

EDUCATIONAL OBJECTIVES

After participating in this activity pharmacists and pharmacy technicians will be able to:

- Discuss the increasing numbers of veterinary prescriptions being filled in pharmacies with an emphasis on cats and dogs
- Discuss ways in which companion animals' needs differ from those of human patients
- Outline safe medication use in dogs and cats
- Identify methods to ensure that each prescription is appropriate for the companion animal and owners are well informed
- Acquire reputable references for pharmacy staff and companion animal owners



The University of Connecticut School of Pharmacy is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education.

Pharmacists and pharmacy technicians are eligible to participate in this knowledge-based activity and will receive up to 0.2 CEU (2 contact hours) for completing the activity, passing the quiz 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



Patient Safety: When the Patient is a Companion Animal

ABSTRACT: Increasingly, pharmacists and pharmacy technicians are processing prescriptions for animals. Animals are not small humans, and providing care and medication to them requires training and education to keep them safe and avoid medication misadventure. This continuing education activity clarifies differences in pharmacokinetics and pharmacodynamics in animals, and spells out the implications for medications, their doses, and their dosage forms. It also reviews drugs, foods and other substances that are toxic to animals, and animal poison control help. It discusses common diseases in the America's favorite companion animals: cats and dogs. Finally, it identifies references that are helpful to pharmacy staff and pet owners.

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INTRODUCTION

Pet owners often visit the veterinarian's office for routine check-ups and acute or chronic medical problems, and traditionally most pet owners received the medication they needed from the vet. The number of pet prescriptions seen in community pharmacies has increased for several reasons. In some cases, the driver is cost. Veterinarians can save inventory carrying costs for rare, seasonal, compounded, or expensive medications by forwarding prescriptions to pharmacies instead of stocking them. This frees extra funds for better diagnostics and surgical equipment.¹ In addition, state legislatures also allow pet owners to request written prescriptions in lieu of receiving the medication from the vet. This may lower the pet owner's costs, especially with the use of discount cards and supplementary insurance that veterinary offices may not accept.² This continuing education activity introduces the general principles of veterinary pharmacy, and focuses on Americans' favorite companion animals: cats and dogs.

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Figure 1. Classification of Pets^{2,4,5}

PART 1: Let's Start at the Beginning: ANIMAL CATEGORIES

Three general categories of pet animals exist: companion, food animals, and exotic animals, described in **Figure 1**. Researchers and healthcare providers understand domestic/companion animals and those raised for food better than exotic animals, such as pet reptiles, rodents, birds, and fish. Livestock, or farm animals, may fall in both the food and exotics categories. Approximately 1.1% of U.S. households consider chickens, ducks, geese, and other poultry as pets (and not a food source), classifying them as exotics in these cases.³

Our understanding of pharmaceutical care is better for companion animals and food animals than for exotics. As of 2016, 13% of U.S. households had exotic pets.³ Exotic animals require special care, rendering treatment difficult. Most generally consider very small exotic pets, like mice and hamsters, to be expendable. However, some pet owners take great measures to keep them alive.⁵

biotics to treat and prevent illness from spreading to the rest of the herd/flock, and nonsteroidal anti-inflammatory drugs (NSAIDs). The U.S. Food and Drug Administration (FDA) has established strict guidelines that prohibit the use of certain drugs in food animals. The regulations prevent antimicrobial resistance and contamination of food people consume. They also regulate medication timing with respect to when the animal will be consumed.⁶

Exotics and companion animals also use antibiotics frequently, receiving both human and veterinary-use-only antibiotics (e.g., enrofloxacin, marbofloxacin). Certain species, such as ferrets, often require treatment with gastrointestinal medications due to a high occurrence of ulcers. Guinea pigs often need vitamin C injections to treat scurvy.⁵ Exotic animals' unique ailments and differing metabolisms and sizes demand extensive knowledge. Veterinarians and pharmacists need appropriate training to help these distinct animals, especially with their rise in popularity and periodic fads during which people purchase trendy species (sugar gliders, prairie dogs, and the like).

The most common medications used in food animals are anti-



PAUSE AND PONDER: Do you know which of your customers have cats? How many of them have diabetes? Thyroid disease? Renal failure?

What questions do you generally ask when a customer presents a prescription for a cat?

drugs approved in humans as extra-label under specified circumstances. The extra-label drug must be safe to use in animals, but the FDA has specific restrictions about extra-label use of drugs in food-producing animals (discussed in greater detail below).^{5,9,10}

The Elephant in the Room: Cross-Species Bioavailability Differences

Drug bioavailability differs greatly between animal species. Pharmacokinetics (what the body does to the drug)—absorption, distribution, metabolism, and elimination—can differ due to an animal's dietary habits (herbivore vs. carnivore, ruminant [mammals that are able to acquire nutrients from plant-based food by fermenting it in a specialized stomach prior to digestion] vs. non-ruminant). Species evolve to develop enzymes with variable mutations depending on their survival needs.¹¹ Pharmacodynamics (what the drug does to the body) also varies among species.

Tramadol is a drug with large cross-species bioavailability variation. Dogs metabolize tramadol into inactive opioid metabolites and eliminate any active drug rapidly, while cats metabolize tramadol into an active metabolite. Although frequently prescribed, tramadol is a relatively ineffective analgesic for dogs unless administered at high doses (15 mg/kg). Cats require a significantly lower dose (1-2 mg/kg). It is nearly impractical to treat cats with tramadol due to a lack of a drug formulation that delivers such low doses.⁵

Some species differences in bioavailability and metabolism also exist due to mutations in enzymes that metabolize drug products, creating rapid-, ultra-rapid, or slow metabolizers. For example, Beagles have a CYP2D15 mutation that affects their ability to metabolize celecoxib compared to other dog breeds.^{12,13} Other factors include renal function, physiological state, body size, and age. These factors explain why dogs respond to different NSAIDs than humans.⁵

Due to variability in weight, doses vary tremendously from one species to another. Imagine treating a horse or cat with metronidazole for an infection. Cats require an oral dose of 15 mg/kg every 12 hours. Cats weigh 2.5 kg on average, so that's a total daily dose (TDD) of 75 mg. Meanwhile, horses average about 680 kg, with an oral dose of 15-25 mg/kg administered every six hours, bringing TDD to roughly 54,000 mg.¹⁴ Horsing around aside, that's more than 700 times more metronidazole than a cat would consume!

The Veterinary Drug Approval Process

Veterinary drug approval follows a process mirroring that of human drug approval. A sponsor, or pharmaceutical company, first develops the drug and then launches a pilot study in a specific species of interest for a given indication. Once the sponsor completes the pilot study and determines that the drug has potential for use in that small subset of animals, the sponsor contacts the Center for Veterinary Medicine (CVM) to begin an INAD (Investigational New Animal Drug) file. This allows the sponsor to distribute the investigational drug for further testing before final FDA approval.

Next, the sponsor uses three common applications similar to the human drug approval process:

- (1) *New animal drug application* (NADA) – for approval of new animal drugs
- (2) *Abbreviated NADA* (ANADA) – for approval of generic versions of new animal drugs
- (3) *Conditional approval drug application* (CNADA) – for approval in drugs that *only* demonstrate a “reasonable expectation of effectiveness.” This application is incomplete and allows drug marketing for only five years; the sponsor must provide further supporting information about effectiveness to extend marketing approval.^{7,8}

Sponsors perform tests only on the specified species for which they seek drug approval. This approach shortens the process for individual animal drug approval by eliminating pre-clinical studies, but means that the drug must be tested in each species individually.⁸

The CVM approves and regulates new animal drugs under the Federal Food, Drug, and Cosmetic Act (FFDCA). The FDA's Approved Animal Drug Products (the Green Book) lists approved veterinary medications.⁸ The 1994 Animal Medicinal Drug Use Clarification Act (AMDUCA) allows veterinarians to prescribe

Emerging Issues

Pet opioid use has increased, and pharmacy teams need to be aware of this trend.¹⁵ The FDA has not approved oral opioids for pain relief in cats or dogs. Opioids have low oral bioavailability and are eliminated rapidly in companion animals. Veterinarians often prescribe opioids to cats and dogs for their antitussive (cough prevention) benefits.⁵ However, numerous veterinarians still prescribe opioids for pain relief, most commonly tramadol (due to its low cost) and carfentanil.^{5,15} In cats, tramadol's long half-life and metabolism lead to large amounts of active opioid metabolite, making it useful in analgesia. Most cats require doses smaller than those currently available in marketed oral formulations, and its bitter taste after breaking tablets makes it difficult to administer.⁵ Opioid analgesic prescribing and dispensing in veterinary practice isn't monitored and no quantity restrictions are in place.¹⁵ Tramadol can be easily purchased through veterinary websites by mailing in a prescription. This increases risk of drug diversion and provides access to those seeking opioids for nonmedical purposes. As prescription drug gatekeepers, pharmacy teams play a key role in preventing diversion and must stay vigilant.

Pharmacists are the medication experts, and pharmacist-led pet owner counseling is a requirement in certain states. Informed pharmacy staff can help pet owners determine which formulations are best for their companions and teach them how to administer medications properly. Pets vary greatly in size, from Singapuras to Siberian cats and Chihuahuas to Great Danes, so pet owners require education about administration techniques and tips. Smaller pets usually need smaller doses and more precise measuring cups and syringes.¹

Safety First: Drugs and Chemicals to Avoid

If a pet ingests a toxic substance, immediate veterinarian care is critical. Often, the veterinarian will induce emesis (vomiting) with apomorphine and α_2 adrenergic receptor agonists (e.g., xylazine) for dogs and cats, respectively. The only household item that may induce emesis is 3% hydrogen peroxide (dogs only, and never after a caustic/alkaline substance like dishwasher detergent), but owners should use it only when advised by a veterinarian. Ipecac syrup (which is no longer commercially available, but is probably still in many homes' medication cabinets) should not be used in pets, as it provides no benefit and may potentiate the substance's toxicity.⁵ Pharmacy teams should refer pet owners to the American Society for Prevention of Cruelty to Animals' Animal Poison Control Center (APCC) for any animal poison-related emergency, 24 hours a day, 365 days a year; the phone number is (888) 426-4435. Unlike human poison control centers, this line is not government-funded and pet owners must pay for the service before they speak to a professional. **Table 1** lists substances that are toxic to companion animals.



ASPCA's Animal Poison Control Center receives more than 167,000 calls a year related to pet exposure to toxic substances. From one recent year, 45,816 calls involved prescription and OTC drugs such as dietary supplements, painkillers, cold medications, and antidepressants.¹⁹ Appropriate treatment in the case of an emergency situation can become costly; the typical poisoning costs \$475 to \$935 for various types of care and intervention. The most expensive treatment can reach \$2,500, especially if the poison is a human antidepressant medication.¹⁹

The Pet Poison Helpline, a 24/7 Animal Poison Control Center at (855) 764-7661, is another resource for pets exposed to a poisonous substance; its experts evaluate the incident. At least half the calls received concern pets ingesting high amounts of human medications. If an owner believes that his/her pet consumed a toxic substance, he or she should monitor for vomiting, lethargy, abdominal pain, loss of appetite, excessive salivation, lack of coordination, and bloody urine. If a dog has consumed prescription medications, the owner can give hydrogen peroxide to induce vomiting. This method is only used if the drug has been consumed in the past hour, and again, owners should check with their veterinarians or a pet poison control center before doing so.¹⁹

Now that we've covered the basics, let's move on to some specifics about cats and dogs.

Table 1. Dogs and Cats: Toxic Drugs and Products^{5,16,17,18}

	Dogs	Cats	Both
Over-the-Counter (OTC) Medications	☐ Dextromethorphan ☐ Iron supplements ☐ Zinc-containing products (topical zinc products [i.e. for diaper rash or sunscreen], pennies) ☐ Methionine	☐ Permethrin (Nix®)	☐ <i>Groffonia</i> seed extract (5-hydroxytryptophan) ☐ Acetaminophen ☐ Alpha lipoic acid ☐ Aspirin (at high doses) ☐ Caffeine ☐ NSAIDs ☐ Imidazolines (e.g., Afrin®, Visine®) ☐ Phenazopyridine ☐ Phenylephrine ☐ Pseudoephedrine ☐ Vitamin D (esp. in rodenticides) ☐ Benzocaine, benzoic acid derivatives
Prescription Medications	Note: many human medications can be used to treat pets; be aware of overdose potential ☐ ACE inhibitors ☐ Calcium channel blockers ☐ Thyroid medications ☐ Antidepressants		☐ Attention deficit and hyperactivity medications ☐ Benzodiazepines ☐ Z-drugs ☐ Birth control (<i>esp. female pets</i>) ☐ Beta blockers ☐ Statins ☐ Baclofen ☐ Asthma inhalers ☐ Heartworm medications (genetic variants) ☐ Isoniazid
Medicinal oils, solvents or excipients	☐ Xylitol (natural sweetener and humectant)* ☐ Modified castor oil ☐ Polysorbate 80 (surfactant)	☐ Benzyl alcohol ☐ Peppermint oil ☐ Pennyroyal oil ☐ Azo dyes	☐ Propylene glycol ☐ Tea Tree oil
Foods	☐ Grapes/raisins/ Zante currants ☐ Macadamia nuts ☐ High-fat foods (↑ risk of pancreatitis) ☐ Yeast, raw yeast dough		☐ <i>Allium</i> -containing foods (e.g., garlic, onion, leek, chives) ☐ Chocolate ☐ Alcohols ☐ Avocado ☐ Apricot

**In dogs, ingesting xylitol causes a rapid and massive insulin release. Symptoms develop quickly and include weakness, staggering, and vomiting. Coma can develop in as little as 15 minutes, and liver failure is possible. Xylitol is found in hundreds of household items, but most often in sugar-free gum, mouthwash, toothpaste, deodorant, sugar-free baked goods and medication (most often the melt-away type). If an owner so much as suspects the dog consumed xylitol, he or she should take the dog to an emergency vet immediately.*



Part 2: Cats

Cats have been around for thousands of years. The domestication process started some 12,000 years ago, long after domestication of dogs.^{20,21} The first signs of domestication occurred in the Near East region of western Russia, Egypt and Turkey, where the closest ancestor of the domestic cat is *Felis silvestris*, or the "cat of the woods."²⁰ *Felis silvestris*, commonly known as wildcats, and domestic cats share a common ancestor that roamed the Earth more than 100,000 years ago. This ancestor lived in Mesopotamia, where slow, steady evolution began and the two species diverged.²² Today, we recognize all domestic cats, large or small, furry or hairless, under one scientific name: *Felis catus*.²³ Historians believe that the cat domesticated itself by simply adapting to a continuously changing environment. Dozens of cultures worshipped cats for their ability to eliminate pests that interfered with grain and food storage, something numerous pet owners appreciate to this day. Residents of Egypt, where mummified owners have been found buried beside their beloved pets, are especially known as cat worshippers.²³ In ancient Egypt, cat exportation was illegal, and killing a cat was penalized by death.

Egyptians valued a cat's life as worth more than a human life and created a governmental branch solely for the purpose of prosecuting cat-related lawbreakers.²² However, people have not always appreciated cats. Europe and during the Middle Ages considered cats evil, and it wasn't until about 400 years ago that the western world finally accepted them.²⁰

Despite thousands of years of evolution, domestic cats have changed little physically and behaviorally. Even when tame, they remain territorial and mark trees and furniture with claw marks or excrement. They have retained short, simple guts best suited for digestion of raw meat, and rough tongues to help them eat every food scrap and clean themselves.²³ As different breeds evolved, the range in cat sizes has, too. Of the 71 official breeds recognized by the International Cat Association, Siberian and Maine Coon cats are the largest domestic breeds, weighing up to 24 pounds.²⁴ Meanwhile, Singapura cats are the smallest breed, weighing between five and eight pounds.²⁵

Cat Ownership

According to the 2017-2018 National Pet Owners Survey, 68% of households had pets, and 47.1% of surveyed households had a cat, with 31% coming from animal shelters or the Humane Society.²⁶ Following closely, adopting from friends or relatives accounts for 28%.²⁶ Statistically, more households have dogs (60.2%), but don't let that one fact fool you! The survey revealed that a whopping 94.2 million pet cats lived in the U.S. at this time compared to 89.7 million dogs.²⁷ With the U.S. population at 327.2 million people in 2018, that means for every seven Americans, there are two cats. Talk about a crazy cat country! Overall, cat owners make 2.4 veterinary visits yearly and spend considerably less money than dog owners.^{3,27} **Table 2** outlines the American Pet Products Association's (APPA) general breakdown of yearly cat and dog expenditures. The U.S. spent an estimated

Table 2. Estimated Annual Expenses for Dogs and Cats²⁷

Expense	Cat	Dog
Surgical vet	\$245	\$474
Routine visits	\$182	\$257
Food	\$235	\$235
Treats	\$56	\$72
Kennel boarding	\$164	\$322
Vitamins	\$46	\$58
Grooming	\$30	\$84
Toys	\$30	\$47
Total	\$988	\$1549

PAUSE AND PONDER: Do you think that most people estimate the cost of owning a pet realistically? Are they aware of the cost of keeping pets healthy or treating illness?

\$70 billion on all pets, companion and exotics, in 2017. Expenditures were expected to rise another \$5 billion by 2019.²⁸ These costs include food and supplies, over-the-counter (OTC) medicine, veterinary visits, grooming and boarding, and purchasing pets.²⁷ However, these expenditures do not include veterinary drug sales. In 2010 alone, veterinary drug sales reached upwards of \$76 billion.⁵

Diet, Metabolism, and Health Repercussions

Cats are obligate carnivores. Simply put, cats need meat to survive.²⁹ Cats have extremely short digestive tracts that evolved to digest raw meat, unlike those of herbivores (animals that eat plants only) or omnivores (animals that eat a variety of foods).^{23,30} Cats produce glucose as an energy source through gluconeogenesis, using protein from meat they consume.³⁰ If a cat cannot obtain its required protein from a meaty diet, its body will start to consume itself to survive.

Cats lack the ability to metabolize carbohydrates the way humans do.³⁰ Fiber is the only type of carbohydrate helpful to cats; it helps food move along the digestive tract.³¹ Pet owners should observe their cats' bowel movement to determine if dietary fiber intake is optimal. Pencil-thin stools indicate a lack of fiber, whereas soft, watery, or very large stools may indicate too much fiber. Certain commercial cat foods are overloaded with fiber, especially those advertised for weight loss, and most raw, canned food lacks adequate fiber.³¹ It's important to find a balance combining different foods to maintain a cat's health. Manufacturers also focus on other components/additives in their cat food products: taurine, methionine, cystine, vitamins A, B₁, B₃, B₆, B₁₂, and D. Without these, cats are vulnerable to multiple ailments, such as central retinal degeneration, dermatitis, and bone/muscle tissue development issues.³⁰

To top it off, cats can be very particular about what they ingest, making it difficult to provide them with the nutrients (and medications) they need. They prefer foods known to them that have a familiar texture and near body temperature, especially during times of illness. They also adjust water intake to match the dry matter content of their diet.³⁰

Medication Use in Cats

All species develop a pattern of common illness. Cats tend to be remarkably healthy. Especially if they receive routine veterinary care and the associated vaccinations, they are low maintenance pets. Regardless, they are prone to certain conditions that require veterinary care, with the most common listed in **Table 3**.

Specific Medication Concerns in Cats

Due to differences in diet, drug metabolism varies between species. Cats are obligate carnivores, and consequently, their drug metabolism differs from dogs'. They are considerably more sensitive to certain drugs that humans or dogs process easily.⁵ In short, cats lack typical glucuronidation pathways that metabolize some medications. Felines lack the enzyme UDP-glucuronosyltransferase (UGT)—an enzyme that humans use to inactivate drugs in the liver—and some drugs that require this enzyme are highly toxic to cats. High levels of drugs that undergo glucuronidation to become inactivated into non-toxic metabolites remain in their bodies longer, elevating toxicity risk.⁵ Without this metabolic pathway, the liver will metabolize the drugs using other pathways such as oxidation. In cats, acetaminophen—a drug that requires UGT to undergo metabolism—will be oxidated, producing rapidly toxic metabolites.⁵ Cats cannot and must not have acetaminophen.

In addition to the lack of glucuronidation pathways in felines, cats lack glycation pathways. This pathway is important for aspirin conjugation and elimination. The half-life of aspirin is five times longer in cats than dogs and 10 times longer than in humans. Even though acetaminophen is not safe to use in cats, aspirin is safe at very low doses with long dosing intervals.⁵

Behavior

Behavior is also very important when considering how or what to compound for cats. Sweet flavors are unappetizing to obligate carnivores. Cats prefer meat-based flavors such as salmon, chicken, tuna, or liver. Flavor preferences are important when making a product that cats find appetizing.⁵

Since cats groom themselves constantly, applying creams or ointments in locations that are easily accessible is a safety concern. If cats need creams or ointments in locations they can reach, placing a physical barrier (usually an Elizabethan collar or pet cone) in the way is necessary to protect the cat from licking the wound.⁵



Zoonotic Diseases

Zoonotic diseases are infections that spread between animals and people.³⁵ Cats can transmit diseases to humans, including *Toxoplasma gondii*, *Giardia* (which cause diarrhea), *Bartonella henselae* (the cause of cat-scratch disease that targets red blood cells), *Toxoplasma gondii* (which causes toxoplasmosis in a range of severities), and rabies.⁵ Pregnant women should not handle cat litter/feces. Birth defects or miscarriage are possible if the fetus contracts toxoplasmosis from mom. Several practices reduce transmission of zoonotic disease. First, cleaning the cat's litter box often and properly is important; this means locating the litter box away from food preparation areas, using disposable gloves, and employing disposable litter box liners. Vaccination is as important in cats as it is in humans, and the American Association of Feline Practitioners' Feline Vaccination Advisory Panel makes recommendations about necessary vaccines. These are usually administered at the veterinary practice.³⁶

Cat owners also need to monitor for signs of infection and seek treatment early. If a cat has diarrhea or loose stools, a veterinarian should test the feces for possible infection.

Cats and Medication in the Pharmacy

OTC medication options are very limited for animals; not every animal can take the same OTC medication for the same condition. It's important for pet owners to bring pets to the veterinarian for many—if not most—conditions.³⁷ Some common prescription medications used in cats include antibiotics, specific NSAIDs, opioid analgesics, steroids, antiparasitics, behavior-modifying drugs, sedatives, hormones, and chemotherapy.³⁸

Antibiotics must be tailored to the cat and the infection-causing microbe. Veterinarians often prescribe amoxicillin, cephalexin, clindamycin, and enrofloxacin (Baytril).³⁹ The first three of these antibiotics are also used in humans. Enrofloxacin is currently FDA-approved for treatment of individual pets and domestic animals, but is not for human use.

Table 3. Most Common Conditions Among Cats^{5,32-34}

Condition	Signs/Symptoms	Treatment
Lower urinary tract disease An infection of the bladder and/or the urethra	☐ Urinating outside of the litter box ☐ Straining ☐ Bloody urine ☐ Yowling while attempting to urinate and while moving ☐ Inability to urinate ☐ Excessive licking of genitals ☐ Not eating/drinking ☐ Lethargy	☐ Catheterizing to drain the bladder ☐ Medication to dissolve stones or blockages ☐ Surgery
Stomach upset + Colitis/constipation + Intestinal inflammation/diarrhea Inflammation of the stomach lining that can be mild to severe	☐ Vomiting ☐ Belching ☐ Lack of appetite ☐ Blood stained stools ☐ Straining to defecate (constipation) / loose stools (diarrhea) ☐ Dehydration	☐ Depending on problem's underlying cause: ☐ Medication (e.g., antibiotics, laxatives, anti-diarrheal meds) ☐ Fluid therapy ☐ Deworming ☐ Introducing a fiber-rich diet (constipation) ☐ Bland diet and dietary changes (diarrhea)
Renal failure Common in older cats Symptoms do not usually appear until 75% of kidney damage has already occurred	☐ Excessive thirst and urination ☐ Drooling ☐ Jaw-clicking ☐ Ammonia-scented breath	☐ Diet change ☐ Drugs ☐ Hydration therapy ☐ Kidney transplant/dialysis
Feline Immunodeficiency Virus (FIV) A viral infection that destroys the immune system Symptoms develop slowly Usually acquired early in life through cat to cat transmission contact only	☐ Diarrhea ☐ Lack of appetite ☐ Fever ☐ Anemia ☐ Inflammation of oral/ocular areas ☐ Hair loss ☐ Behavior changes	☐ Antivirals (none approved) ☐ Healthy diet ☐ Immune-enhancing medications ☐ Anti-inflammatory drugs ☐ Hydration therapy
Skin allergies + Ringworm Ringworm is a fungal infection that can affect hair, skin, and nails Ringworm is highly contagious leading to circular hair loss, central red rings, and patchy skin; can spread to other animals in the house and to humans	☐ Scratching/chewing of skin ☐ Rash ☐ Alopecia (patches of hairless skin)	☐ Allergy shots ☐ Diet changes ☐ Antihistamines, corticosteroids (allergies) ☐ Topical/oral antifungal (ringworm)
Diabetes May develop from a lack of insulin production or failure to respond to insulin If uncontrolled, cats may have hyper- or hypoglycemia, leading to further health complications	☐ Increased drinking/urination ☐ Urination outside the litter box ☐ Lethargy and depression ☐ Sweet-smelling breath ☐ Unkempt hair/fur	☐ Daily health monitoring ☐ Diet changes ☐ Exercise ☐ Daily oral medications or injections to control blood sugar
Worms (roundworms, hookworms, tapeworms, lungworms) May not show outward signs of infection, leading to undetected infections and possible serious health problems Keeping cats indoors decreases exposure	☐ Diarrhea/constipation ☐ Worms in stool/bloody stool ☐ Weight loss ☐ Bloating ☐ Coughing/difficulty breathing ☐ Anemia	☐ Deworming
Ear infection Various different causes (e.g., bacteria, fungi)	☐ Ear discharge ☐ Head shaking ☐ Swollen ear flaps ☐ Malodorous ears that are sensitive to touch	Treatment depends on the cause of the infection (e.g., mites, bacteria, fungi, diabetes, allergies)
Upper respiratory virus Bacterial or viral infection in the nose, throat, and sinus area Transmission occurs from cat to cat Minimizing stress and keeping cats indoors helps reduce risk	☐ Sneezing ☐ Sniffling ☐ Coughing ☐ Runny eyes/nose ☐ Congestion ☐ Oral/nasal ulcers ☐ Open-mouth breathing	☐ Nasal drops ☐ Eye ointments ☐ Antibacterials ☐ Rest ☐ Fluid and nutritional support
Hyperthyroidism Commonly caused by a benign tumors on the thyroid gland	☐ Increased drinking/urination ☐ Jittery/hyperactive behavior ☐ Weight loss while eating more than usual	☐ Medication ☐ Radioactive therapy ☐ Surgical removal of the thyroid gland

NSAIDs are important in pain management, but not all NSAIDs can be used in all species. Especially in cats, NSAIDs warrant caution due to increased sensitivity to renal adverse effects.⁵ The NSAIDs with approval from the FDA for cats are COX-2 selective. Examples of COX-2 selective NSAIDs are meloxicam (Mobic) and robenacoxib (Onsior).⁵

Opioid pain relievers are effective analgesics in both humans and cats. With cats, oral bioavailability is low and cats must receive opioids parenterally (via injection) to have sufficient pain control.⁵ Currently, the FDA has not approved any oral opioid formulations for pain in cats.⁵

Steroids have various approved indications. For feline asthma, inhaled corticosteroids are helpful and usually administered using feline-specific spacers.⁵ Oral prednisolone or methylprednisolone should be used instead of prednisone in cats, due to its low bioavailability.⁵

Antiparasitics vary in ability to kill parasites and not all of them are approved for every animal. Dosing is specific based on species, minimum age, and body weight.⁵ One product (Activyl® Tickplus for Dogs and Puppies) is unsafe in cats.⁵ This product's active ingredients are indoxacarb and permethrin.⁵ Permethrin is toxic to cats.

Behavior-modifying drugs and sedatives are important for separation anxiety, profound fear, and aggression. Benzodiazepines are best for treating behaviors prompted by short term triggers such as storms or fireworks. Tricyclic antidepressants require glucuronidation so are rarely used in cats; cats would tend to experience more side effects because they lack these enzymes. Veterinarians often use fluoxetine, a selective serotonin reuptake inhibitor (SSRI), to treat conditions such as separation anxiety. Paroxetine, another SSRI, is more effective for social anxiety and depression.⁵

Hormonal therapy in cats is usually for diabetes or thyroid functions.³⁸ Vets prescribe methimazole for hyperthyroidism for cats often and prescribe levothyroxine for hypothyroidism.

When cats develop cancer, veterinarians plan chemotherapy using medications developed for humans, as the FDA has not approved many antineoplastics for specific animals. Not all chemotherapeutic agents have acceptable side effect profiles for every animal. Cisplatin, a platinum compound, is contraindicated in cats because it frequently leads to acute fulminant pulmonary edema in this species.⁵

Cats are Finicky: Dosage Form and Schedule

Customer convenience, in this case for the pet owner, is very important when medicating animals. If the owner finds the process easy, it's more likely that he or she will continue medicating the cat, adherence will increase, and the medication will have a better pharmacokinetic profile.



Rigi and Lady, Australian labradoodles

Medicating cats orally is challenging. Usually, cats will not swallow pills and won't eat foods that have flavors that they dislike. Using compounded chewable treats is more successful because the flavor options and consistency available are more palatable to cats. Some companies make treats that are suitable for pharmacy compounding, facilitating the process. Alternatively, veterinarians can order compounded transdermal gels. Usually the pharmacy compounds gels with penetration-enhancing vehicles, such as pluronic-lecithin-organogel (PLO) or Lipoderm.⁵ Drugs that have lower molecular weights (i.e., less than 300 kDa) are most suitable for this formulation.⁵ Subcutaneous formulations are also an option; these medications usually tend to be insulin or newer injectables to treat diabetes mellitus.^{40,41}

Because cats can't metabolize certain compounds, compounding for them requires the pharmacist to examine all components carefully. Certain additives are toxic. Alcohols, azo dyes, and benzoic acid derivatives can be deadly at low doses because cats cannot metabolize and excrete them safely.⁵ The compounding process must exclude all of these.

Part 3: Dogs

The domestic dog, or *Canis lupus familiaris*, has accompanied humans for more than 20,000 years.^{42,43} All dogs have a common ancestor, the grey wolf (*Canis lupus*); modern dogs share 99% of their DNA with wolves. National Geographic states that the transformation from wolf to dog occurred around 20,000 to 40,000 years ago when humans and wolves lived in close proximity. Aggressive wolves socialized poorly with humans, but mellower wolves thrived around humans and scavenged carcasses left behind by hunters. Wolves became tamer and lost some predatory qualities such as large, sharp teeth. Their genes began to change, as did their hearing and sense of smell. Over time, wolves were less fearful of humans. This notion suggests that humans did not domesticate dogs; dogs domesticated themselves.^{42,43}

Thousands of years later, humans began to breed dogs actively. The ancient Egyptians used dogs for hunting, guarding, and war. Selective breeding gave rise to many different-looking dogs, also known as pure breeds. The Alaskan Malamute from Northern Alaska’s Norton Sound Region, the Chow Chow from China, and the Saluki from Egypt are among the oldest breeds. In the 18th century, only the wealthy owned pure breeds, but by the 19th century, cross-breeding grew not only for utility, but also to create dogs with unique looks and characteristics. Today, the more than 300 breeds make dogs the most diverse species on Earth. Although cross-breeding has advantages, it has disadvantages. Mixing breeds can be unpredictable and may result in genetic disorders. Some genetic disorders can lead to medical problems including difficulty breathing, hip dysplasia, eye disease, and an increased risk of cancer.^{42,43}

Dogs range from six to 33 inches tall and three to 175 pounds. Although dogs are heavily domesticated, they exhibit some behaviors that are similar to wolves, foxes, and jackals. Many dogs defend their territories, such as their homes and their owners. They also mark their own territories by urinating on trees and other objects. Many dogs bury bones and toys, similar to the way their wild relatives buried food. Dogs are not only companions but

hard workers. Working dogs herd livestock, aid the blind, and can even perform rescue work.^{42,43}

A dog’s origins can have lifelong consequences, and dogs generally come from one of three places: a responsible breeder, a backyard breeder, or a puppy mill (See [Table 4](#)).⁴⁴ Around 30% of pets in homes come from shelters and rescues. Responsible breeders do not associate with pet stores because they want to meet prospective pet owners in person and ensure their dogs go to good homes. Backyard breeders may have the pet’s best interest at heart; sometimes, a family pet becomes pregnant and the owner is simply trying to find the best homes for the puppies. Many backyard breeders purposefully breed dogs with the intention of making profit and should be avoided.



Leo, Alaskan Malamute

Table 4. Common Origins of Dogs ^{5,26,44-46}		
Responsible Breeders	Backyard Breeders	Puppy Mills
☐ Are educated about the science of dog breeding ☐ Care about the future of the puppies and the well-being of the parent dog ☐ Allow potential buyers to visit and see all areas where dogs are kept ☐ Provide records of veterinary care ☐ Offer guidance for training and caring for the puppy ☐ Require proof of the puppy going to a good home ☐ Accept any dog from their kennel back into their care	☐ Usually don’t provide comprehensive background information on dogs and puppies ☐ Usually advertise through social media ☐ Often sell mixed-breed dogs (often pit bull mixes) ☐ No history of specializing in a certain breed or breeds	☐ Usually sell dogs in pet stores, classified ads, flea markets, breeder directories or on the Internet, ☐ Disregard the animals’ well-being in the interest of turning a profit ☐ Breed dogs in sub-par living conditions, with little quality of life or vet care ☐ Do not provide records of veterinary care ☐ Often sell puppies that suffer from serious health/psychological problems

Table 5. Common Illnesses/Defects Among Puppy Mill Dogs⁴²

Most Common Illnesses	Most Common Congenital Defects	Most Common Temperament Problems
□ Intestinal parasites (worms, giardia, coccidia) □ Respiratory issues □ Infectious diseases □ Ear issues □ Skin disorders □ Urinary infections/Bladder issues □ Hypoglycemia	□ Deafness □ Eye issues □ Heart disease/Heart murmur □ Hernias □ Liver Disease □ Seizures/Neurological issues □ Skeletal disorders (hip/elbow/knee) □ Spinal Disorders	□ Abnormal behavior (walking in circles, eating feces) □ Aggressive tendencies (biting, growling) □ Fearful behavior (hiding, shaking)

A puppy mill is “an establishment that breeds puppies for sale, typically on an intensive basis and in conditions regarded as inhumane.”⁴⁵ Puppy mills focus on quantity rather than quality by producing and selling as many puppies as possible for their own profit. Owners start breeding females at an early age, and do not screen for heritable disorders, increasing the chance of congenital defects, especially in cross-breeds.⁴⁶

Severe overcrowding and horrible living conditions increase the chance of disease. Most dogs have little to no exercise due to constant confinement in cages. Because of this, many dogs suffer from social isolation and anxiety. Poor sanitation, lack of food and water, and contact with their own feces and urine are common problems.⁴⁶ Some other health concerns are damaged paws, and lack of grooming and oral hygiene.

The Humane Society of the United States (HSUS) received 2,479 puppy buyer complaints between 2007 and 2011. Typical complaints about puppy mill dogs included illness (40%), congenital defects (34%), death (15%), and temperament issues (3%).⁴⁷ **Table 5** lists conditions often identified in dogs from puppy mills.

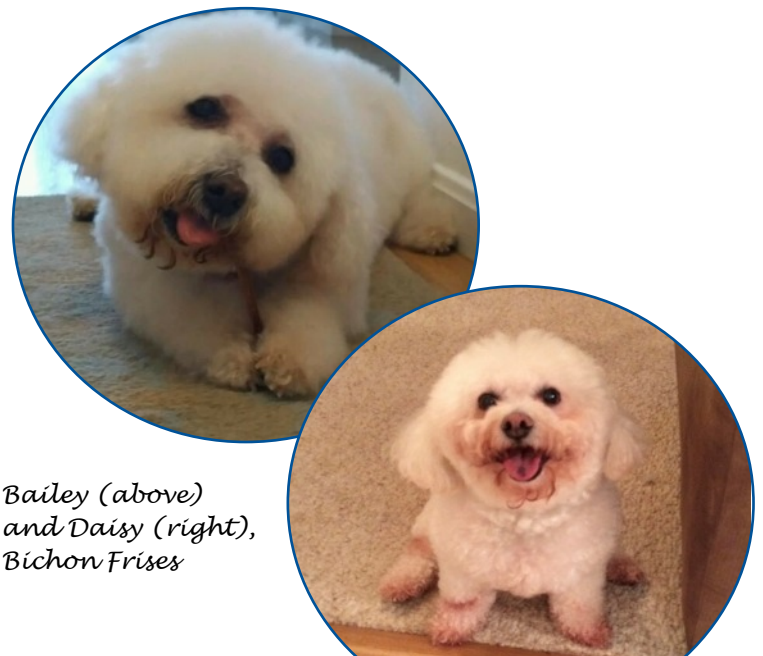
Although many pet owners believe they are saving puppies from pet stores conditions, they are actually helping puppy mills to continue. These puppies come from all over the country, usually from breeders that have more than one Animal Welfare Act violation. Because most pet stores do not disclose puppies’ origins, they use deceptive sales pitches such as “professional breeders” or “USDA licensed.” However, not all pet stores work with puppy mills. Individuals interested in pet store puppies should ask if the store works with animal shelters and rescue agencies.⁴²

Medication Use in Dogs

Dogs also need routine veterinary care and the associated vaccinations to thrive. Regardless, they also have a tendency to develop certain conditions that require veterinary care (see **Table 6**).

Although there is some debate as to whether the dog is a carnivore or an omnivore, most experts consider dogs omnivores.⁵ Regardless of where you stand in the debate, certain facts dictate how dogs respond to medication. Plants contain ample amounts of cellulose and starches requiring the digestive enzymes amylase and cellulase to break these materials down. Cats and dogs don’t produce salivary amylase. As noted, cats have the shortest GI tracts of all species, measuring 12 to 15 inches. This is because carnivores typically eat easily digestible food such as meats. The canine GI tract is also quite short, and this is especially important to note because dogs cannot take extended-release medications, and they pass oral dosage forms quickly.³⁴

A common concern in pharmacies is the use of levothyroxine in dogs. Accustomed to doses prescribed in ranges of 0.1 to 0.25 mg in humans, a prescription for a dog starts at 0.1 mg/10 pounds of body weight twice daily. Seeing that a 10 pound dog receives the same dose as its 150 pound owner can be startling. A prescription for 0.5 mg twice daily certainly can create alarm, but that is the correct dose for a 50 pound dog. Pharmacy staff members should use resources described at the end of this article to check doses when they have questions.⁵⁵



*Bailey (above)
and Daisy (right),
Bichon Frises*

Table 6. Most Common Conditions Among Dogs ⁴⁸⁻⁵⁴

Condition	Signs/Symptoms	Treatment
Cancer	Lumps Swelling Rapid, unexplained weight loss Decreased or loss of appetite Abnormal discharge from any part of the body Lethargy	Surgery Chemotherapy Radiation Immunotherapy Combination therapy
Diabetes	Change in appetite Weight loss Excessive thirst Increased urination Urinary tract infection	Oral medication or high-fiber diets to normalize glucose levels Insulin injections Spaying/neutering
Heartworm	Labored breathing Coughing Vomiting Weight loss	Prevention using chewable or topical medication Treatment using injections of adulticides
Kennel cough	Persistent dry cough Gagging White foamy phlegm Fever Nasal discharge	Isolation Cough suppressant or antimicrobial Avoidance of respiratory irritants
Ringworm	Skin lesions on head, ears, paws and forelimbs Patchy, crusted, circular bald spots	Medicated shampoo or ointment Oral medications
Ear infection	Ear scratching Head shaking Ear discharge	Thorough ear cleaning Topical medication or systemic antibiotics Tramadol for pain Steroids for inflammation
Osteoarthritis Degenerative joint disease	Exercise avoidance or lethargy Problems jumping Difficulty moving Irritated when touched	Pain medications Cortisone or steroids Exercise and weight management
Urinary tract infection	Excessive urination Inappropriate urination Fever Licking around the urinary opening	Antibiotics
Dental disease	Bad breath Broken or loose teeth Bleeding from the mouth Excess tartar Extraction Discolored teeth	Depending on the severity: Thorough dental cleaning X-rays Pain management
Skin allergies + external parasites (fleas and ticks)	Red, inflamed, flaky, or scaly skin Constant scratching or chewing	Prevention with topical or oral medications (fleas and ticks) Antihistamines, cyclosporine, prednisone (allergies) Allergy injections



Although oral drug formulations are the most convenient way for most humans to receive their medications, that isn't the case for animals. Veterinary patients use quick defense mechanisms when they feel uncomfortable or scared.⁵ This can make it difficult for owners, as dogs can growl, show teeth, bite, run, or even hide to avoid medication. And, not all medications can be given with or in food. Most veterinarians explain how the medications should be administered, but pharmacy staff should be prepared to reiterate the information. Veterinarians and pet owners tend to employ five approaches to administer oral medications to dogs⁵⁶:

- Physically give the dog the tablet/capsule as it is; this works best with tablets that are flavored to disguise the medicine
- Mix the tablet/capsule in dog food, or wrap food around the medication; cheese and peanut butter are good choices
- Insert the tablet/capsule in a treat or a "Pill Pocket"
- Crush the medication and sprinkle into dog food
- Have the medication compounded to a flavored liquid, chewable, or topical form

Here are the hands-on steps when giving oral medications to a dog⁵⁷:

- Hold the dog's head with one hand on top around its snout
- Tilt the head back
- Gently fold the upper lip over the teeth as you open the mouth
 - This will prevent the dog from biting the human's hand; it will bite its own lip instead
- With the hand on the snout, place the thumb on the roof of the dog's mouth
- Hold the tablet/capsule with the other hand between the thumb and index finger
- Use the middle finger and press down on the small incisor teeth to pull the dog's lower jaw open (do NOT place the middle finger over the sharp canine teeth)
- Drop the tablet/capsule as far back over the tongue as possible
- Immediately close the dog's mouth and gently blow on the dog's nose
 - Blowing on the nose encourages the dog to swallow

Dogs may bite when people attempt to medicate them. A dog's mouth contains many bacteria, so it is important to clean the wound thoroughly and seek medical advice if the bite is severe. Because it can be very difficult for owners to medicate their pets, pharmaceutical companies have created easier ways for pet owners to administer medications. One pharmaceutical company focuses on different dosage forms for a variety of animals: dogs, pigs, chickens, and humans.⁵⁸ It is currently developing a tasty, meat-free chewable tablet.

Unique Goals for Veterinary Medication

United States Pharmacopeia (USP) sets purity and quality standards for compounding. USP is a non-government agency that goes through periods of revision and updating to ensure its standards are up-to-date. After the revision process, the standards become adopted and therefore enforceable by the Joint Commission and other government agencies.⁵ Pharmacies—retail, hospital, and compounding—must follow the standards developed by USP if the state in which they practice adopts them. If compounders follow the standards set forth by USP, their products should be safe for use, but compounders must know which ingredients are harmful for specific species.

Zoonotic Diseases Associated with Dogs

Like cats, dogs sometimes become infected with diseases that they can share with humans (zoonotic disease). Several parasitic diseases—giardiasis, cryptosporidiosis (a gastrointestinal infection), toxocariasis (roundworm, which causes diarrhea)—can infect humans. Like cats, dogs can also transmit rabies if they bite a human. Two other conditions are particularly important: tick-borne disease and methicillin-resistant staphylococcus aureus (MRSA). Ticks can be a problem for dogs, and certain varieties cause Lyme disease. Pet owners need to be aware of Lyme disease's hallmark symptoms (a "bull's-eye" rash with fever, headache, and muscle or joint pain), especially if dogs live in high-risk areas. Dogs can also contract and share MRSA. This drug-resistant infection usually affects the skin, soft-tissue, and surgical infections. Usually, pets acquire MRSA-associated infections from their owners, and then re-infect their owners in a vicious cycle. Infected pets need to be treated with effective antibiotics as in certain cases, MRSA can be severe and life-threatening.⁵⁹

Prescriptions for Pups in the Pharmacy

As noted throughout this continuing education activity, one of the most interesting aspects of veterinary pharmacy is that many drugs used in veterinary medicine are also used in people; this is called extralabel drug use, and the [sidebar](#) describes this process. [Table 7](#) list frequently used medications for dogs.⁶⁰



Table 7. Frequently Used Medications for Dogs^{5,63}

Antibiotics ☐ Cephalexin ☐ Enrofloxacin* ☐ Penicillin ☐ Trimethoprim-sulfamethoxazole	NSAIDs ☐ Carprofen* ☐ Deracoxib* ☐ Firocoxib* ☐ Meloxicam	Opioid Analgesics ☐ Butorphanol ☐ Fentanyl ☐ Hydrocodone/homatropine ☐ Hydromorphone ☐ Meperidine ☐ Oxycodone ☐ Tramadol
Steroids ☐ Dexamethasone ☐ Prednisolone ☐ Prednisone	Antiparasitics ☐ Metronidazole ☐ Tinidazole	Anti-epileptic, behavior-modifying and sedative drugs ☐ Acepromazine* ☐ Diazepam ☐ Fluoxetine ☐ Phenobarbitol ☐ Trazadone ☐ Xylazine*
Hormones ☐ Insulin ☐ Levothyroxine ☐ Methimazole	Cardiac Medications ☐ Atenolol ☐ Digoxin ☐ Pimobendan*	Chemotherapeutic Agents ☐ Cisplatin ☐ Cyclophosphamide ☐ Doxorubicin ☐ Vincristine

SIDEBAR. Extra-label Veterinary Drug Use

Extra-label veterinary drug use (ELDU) has grown since 1994 and led to the expansion of pharmaceutical care for animals. ELDU is classified as the use of a medication that strays from the FDA-approved label in any of the following ways:

- In a species not included on the label
- At a dose or frequency not included on the label
- At a concentration not included on the label
- For an indication not included on the label
- Using a route of administration not included on the label

The Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA) made ELDU possible. AMDUCA greatly expanded the range of prescribing for veterinarians due to the relatively low number of drugs labeled for animal use. This act's main provision is that a valid veterinarian-client-patient relationship must exist. This relationship assumes that the veterinarian has assumed responsibility for the patient's health, has ample knowledge, and is available to follow-up with the patient if needed.

ELDU differs depending on whether the patient is a food-producing animal or a non-food-producing animal (i.e., a household pet). When prescribing extra-label medications for food-producing animals, the FDA's rules are more stringent in order to protect public health. This is the main difference: Veterinarians cannot use a human drug in food-producing animals if an animal drug approved for that population can be used in an extra-label way. This does not apply for non-food-producing animals; human drugs can be used even if the FDA has approved an animal drug.

Source: References 61 and 62

Table 8. Select OTC Medications Used in Dogs^{5,63}

Famotidine: Upset stomach • Human: 10-20 mg PO q 12-24 hours • Dog: 0.5-1 mg/kg q 12-24 hours	Hydrogen Peroxide 3%: Emergency emetic • Not recommended • Dog: 2 mL/kg PO q10 minutes for 3 doses*
Diphenhydramine: Acute allergy symptoms • Human: 25-50 mg PO q 6-8 hours • Dog: 2-4 mg/kg PO q 8-12 hours	Sucralfate: GI distress & ulcers • Human: 1 g PO q 6 hours • Dog: 0.5-1 mg/kg PO q8 hours

*Only as directed by a veterinarian



Heidi, a German Shepherd

Counseling

Pharmacy staff members must take a few minutes to think about the specific medication prescribed, and ask the owner about the pet. Not only will asking about the companion animal's age and breed engage the customer—everyone likes to talk about their pets—it can help in other ways. For example, if the patient is a Chihuahua or a toy breed, and the veterinarian has prescribed a tablet, make sure that the medication is scored if the dose is a partial tablet. And note that by law, most states require the owner's name and the patient's name and species or breed on the prescription. Owners also appreciate medications that can be given once or twice daily, as it increases adherence. Also be familiar with topical preparations and how to apply them. Less experienced pet owners may need more coaching and administration advice.⁵⁵

Pet owners will have the most difficulty with diseases that require major lifestyle changes for their pets. Diabetes and pancreatic insufficiency—diseases that occur often in pets—require dietary changes. That may mean that dogs won't be able to run loose because the risk of consuming something that's forbidden is too great.⁵⁵

Last, owners will need counseling about adverse event (AE) monitoring. Just like in humans, AEs can be known effects, an expected response, idiosyncratic (unusual), allergic in nature, or associated with the unique patient's constitution or disease. Just like in humans, dogs who need prednisone will usually experience excessive thirst (and associated increased urination), increased appetite, and changes in the luster of their coats. Dogs that take prednisone may also develop diabetes. Just like small children, companion animals can't tell their owners what's wrong, so owners need to be observant. Some adverse events can be identified with laboratory monitoring, but since most veterinary care is self-pay, many owners may be reluctant to schedule routine laboratory monitoring. That's where insurance can help.⁵⁵

Insurance for Cats and Dog

Insurance is not just for people anymore. It's now available for animals, specifically cats and dogs. Veterinarians don't require

insurance coverage, but it is an option for pet owners. Pet insurances are generally reimbursement plans. Owners will pay the veterinarian bill up front and then process the claim through their insurance company.⁶⁴

Multiple plans are available, which allows coverage customization. Available plans vary in the coverage they provide⁶⁵:

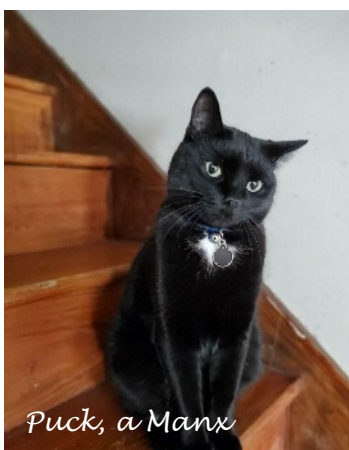
- Accident only
 - Covers: Harm and injury
 - Not covered: Injuries due to pre-existing conditions, illness, routine medical coverage
- Accident and Illness
 - Covers: Accidents and sickness or disease
 - Not covered: Pre-existing conditions, tick and flea bites
- Comprehensive coverage
 - Covers: Accident, illness and routine care
 - Not covered: nothing

Medications are covered based on the indication. For example, if pain medication is given due to an accident, medication is covered under all plans but if it is needed due to a pre-existing condition then it is only covered by comprehensive care.

While only 1% to 2% percent of cats and dogs are currently insured, it's a growing industry and some employers are even adding it as an employee benefit.⁶⁶ Monthly policy premiums vary widely based on the coverage and the type of animal or breed. Accident/illness coverage and comprehensive coverage both pay for some or all medications whether a prescription is filled at the veterinarian or a retail pharmacy.⁶⁷ If a retail pharmacy receives a medication for an animal, they fill the prescription the same way they fill human prescriptions. For the owner to process a claim with an insurer, most only require a copy of the prescription (given at the veterinarian) and the pharmacy receipt.⁶⁷ The pharmacy needn't worry about special paperwork or processes.

Conclusion

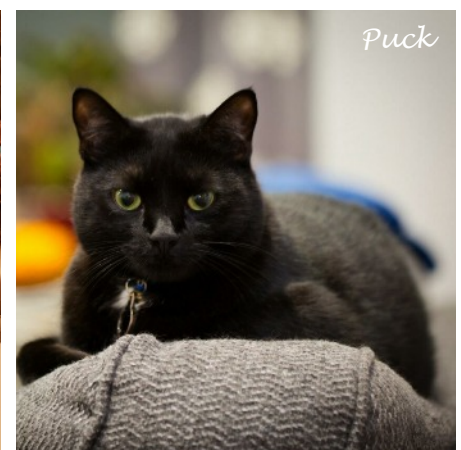
Pharmacy staff members are barking up the wrong tree if they think they can fill veterinary prescriptions without learning some new information. And, having access to an appropriate set of reference materials is the cat's meow! **Figure 2** helps you maximize your role in pet care in the pharmacy.



Puck, a Manx



Silvester



Puck

Additional Resources for Pharmacy Teams

U.S. Food and Drug Administration

**FDA - Animal & Veterinary: <https://www.fda.gov/animal-veterinary>

Online Green Book: <https://animaldrugsatfda.fda.gov/adafda/views/#/search>

Reference Books or Websites

*Plumb's Veterinary Pharmacy (online access): <https://www.plumbsveterinarydrugs.com/#!/pharmacy>

Plumb's Veterinary Drug Handbook (ISBN-13: 978-0470959640; hard copy)

The Merck Veterinary Manual: <https://www.merckvetmanual.com>

Veterinary Clinical Drug Information Monographs: <https://www.aavpt.org/page/43>

Pharmacotherapeutics for Veterinary Dispensing (ISBN-13: 978-1119404545)

Professional Organizations

American Veterinary Medical Association (AVMA) website: <https://www.avma.org/Pages/home.aspx>

Society of Veterinary Hospital Pharmacists (SVHP): <https://svhp.org/resources/>

Handy Websites

**ASPCA Animal Poison Control Center, (888) 426-4435, <https://www.asPCA.org/pet-care/animal-poison-control>

Pet Poison Helpline, (855) 764-7661, <https://www.petpoisonhelpline.com/>

* Requires a subscription

** Pet-owner friendly

Figure 2. Maximizing the Pharmacy's Role in Medication Dispensing for Animals

Best

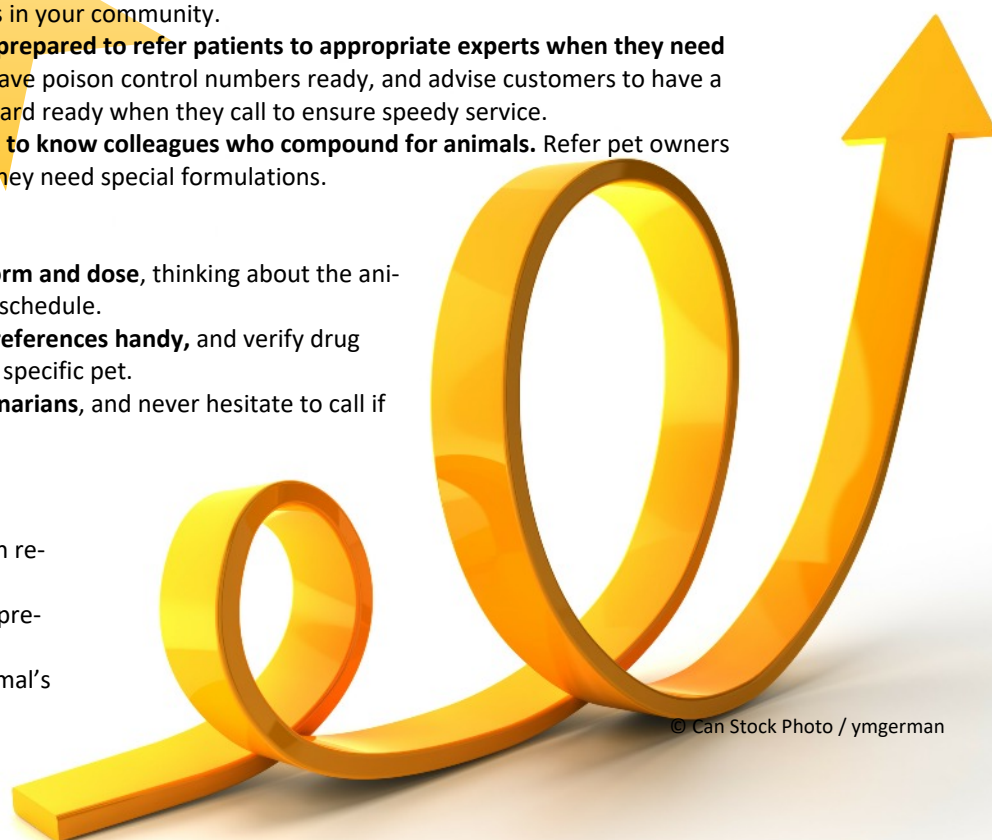
- ① **Be COMMUNITY CHAMPIONS.** Know organizations that serve needy animals in your community.
- ② **Be prepared to refer patients to appropriate experts when they need help.** Have poison control numbers ready, and advise customers to have a credit card ready when they call to ensure speedy service.
- ③ **Get to know colleagues who compound for animals.** Refer pet owners when they need special formulations.

Better

- ① **Consider the dosage form and dose,** thinking about the animal's size and the owner's schedule.
- ② **Keep a few veterinary references handy,** and verify drug and dose suitability for the specific pet.
- ③ **Know your local veterinarians,** and never hesitate to call if you have a concern.

Good

- ① **Know your state and local law** with respect to filling pet prescriptions.
- ② **Confirm with pet owners** that the prescription is for a companion animal.
- ③ **Ask a few questions** about the animal's species, breed, weight, and diagnosis.



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