**Probiotics: Not Just for People Anymore**

Interest in medicinal nutrition continues to grow. At the 2017 Western Veterinary Conference in Las Vegas, Stanley Marks, BVSc, PhD, DACVIM (Small Animal Medicine and Oncology), DACVN, discussed what we know—and more of what we’ve yet to discover—about microbial gastrointestinal (GI) health.

The term “microbiota” refers to the population of microbes that inhabit body ecosystems. The average human digestive tract contains an estimated 100 trillion bacteria—10 times the number of cells found in the body. This intestinal microbiota influences the health of its host by providing (continued on page 20)

**Rabies Awareness Challenge 2017**

Rich Ford, DVM, MS, DACVIM, DACVP (Hon), conducted an educational audience participation session about rabies at the 2017 Western Veterinary Conference in Las Vegas. His goal was to educate veterinarians about rabies both in the United States and worldwide, including its prevalence, applicable laws, and vaccine exemptions.

Of all the vaccinations veterinarians give to cats and dogs, Dr. Ford reminded the audience that only rabies is regulated by law. (continued on page 19)

**End-of-Life Care at Its Best: Part 2**

In the April issue of American Veterinary Medicine, we introduced Dani McVety, DVM, and Mary Gardner, DVM, founders of Lap of Love Veterinary Hospice. We spoke with these trailblazers at the 2017 Western Veterinary Conference in Las Vegas about hospice care and the human-animal bond, convenience euthanasia, and the veterinarians who are part of their organization.

We conclude our conversation in this issue with a discussion of compassion in euthanasia, including ways to (continued on page 14)

**Pets and Prosthetics: Growing Interest, Advancing Technology**

Teddy was just 10 weeks old when he was surrendered to Boston Terrier Rescue of North Carolina, an organization that fosters Boston terriers in need of a forever home. The playful puppy was a unique case because he was missing his front paws and back toes, which made mobility difficult, says foster caretaker Barbara Bradley of Wake Forest, who adopted Teddy to ensure he received the special care he needed. (continued on page 22)

**Heartworm Incidence on the Rise: What Can Veterinarians Do?**

Although the hotbeds of heartworm disease haven’t changed dramatically in the past 3 years, new data from the American Heartworm Society (AHS) show that the average number of positive cases per veterinary practice has been inching upward. What’s more, the Companion Animal Parasite Council (CAPC) predicts that the incidence of heartworm infection will be above average nationwide this year. American Veterinarian spoke with AHS President Chris Rehm, Sr, DVM, and CAPC President Craig Prior, BVSc, CVI, to learn more about this news and how veterinarians can help keep their patients protected against the potentially deadly disease.

“It’s timely that both organizations are coming out with information at the same time,” says Dr. Rehm, “because it (continued on page 28)
Reliable heartworm treatment. Now with reliable availability.

NEW from Zoetis—DIROBAN™ (melarsomine dihydrochloride)

A heartworm positive diagnosis is serious business. Treatment can be scary for the client, traumatic for the pet and stressful for you and your staff. Having dependable access to an FDA-approved adulticide now means one less thing for you to worry about.

Speak with your Zoetis representative to learn more and visit treatwithDiroban.com for pet owner tools.

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IMPORTANT SAFETY INFORMATION: DIROBAN is for use in dogs only. Do not use in dogs with very severe (Class 4) heartworm disease. Avoid human exposure. Consult a physician in cases of accidental human exposure by any route. DIROBAN should be administered by deep intramuscular injection in the lumbar (epaxial) muscles (L₃ – L₅) ONLY. DO NOT USE IN ANY OTHER MUSCLE GROUP. DO NOT USE INTRAVENOUSLY. Care should be taken to avoid superficial injection or leakage. Safety for use in breeding, pregnant or lactating animals has not been determined. Common side effects include injection site irritation (accompanied by pain, swelling, tenderness and reluctance to move), coughing/gagging, depression/lethargy, anorexia/inappetence, fever, lung congestion and vomiting. All patients should be monitored during treatment and for up to 24 hours after the last injection. See Brief Summary of Prescribing Information for additional safety information and precautions on the following page.
Clinical observations/adverse reactions occurring in less than 1.5% of the dogs treated with melarsomine dihydrochloride include: abdominal hemorrhage, abdominal pain, bloody stool/diarrhea, colitis, gingivitis, pancreatitis, anemia, DIC, hemoglobinemia, icterus (mucous membranes), discoloration urine, hematoma, inappropriate urination, low specific gravity, pyaemia, pyuria, bronchitis, miscellaneous respiratory problems, pancytopenia, tachypnea, tachybradichronis, wheezing, alopecia, hair color and coat character change, miscellaneous skin problem, ataxia, disorientation, fatigue/tires easily, miscellaneous eye problem, weight loss, corneal leucos, leukocytosis, polydipsia, and restlessness.

Onset and Duration of Clinical Observations/Adverse Reactions: The following table is provided to show the average onset time per treatment for the most common reactions and the duration of each event, as calculated from the 311 dogs treated with melarsomine dihydrochloride in the clinical field trials. Averages

<table>
<thead>
<tr>
<th>Clinical Observation/Adverse Reaction</th>
<th>CLASS 1 % OF DOGS</th>
<th>CLASS 2 % OF DOGS</th>
<th>CLASS 3 % OF DOGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection Site Reactions</td>
<td>12.8</td>
<td>3.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Coughing/Gagging</td>
<td>22.3</td>
<td>14.3</td>
<td>4.8</td>
</tr>
<tr>
<td>Depression/Lethargy</td>
<td>15.4</td>
<td>4.8</td>
<td>2.3</td>
</tr>
<tr>
<td>Anorexia/Inappetence</td>
<td>13.2</td>
<td>3.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Pyrexia</td>
<td>7.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Lung Congestion/Sounds</td>
<td>5.5</td>
<td>1.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Eosins</td>
<td>5.1</td>
<td>1.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>2.6</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Dyspepsia</td>
<td>2.6</td>
<td>1.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Hypersalivation</td>
<td>19.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Paining</td>
<td>16.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>16.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

* A zero indicates that the reaction first occurred on the day of treatment.

**Mortality:** Death is a possible sequelae of heartworm disease in dogs with or without treatment, especially in the Class 3 dogs. The following table shows the percentage of dogs that died in clinical trials with melarsomine dihydrochloride and the causes of death, if known.

| Mortality in Dogs with Class 1, 2, and 3 Heartworm Disease Treated with melarsomine dihydrochloride in Clinical Field Trials |
|---------------------------------------------------------------|-----------------|-----------------|-----------------|
|                                                                | CLASS 1 % OF DOGS | CLASS 2 % OF DOGS | CLASS 3 % OF DOGS |
|                                                                | n=26             | n=26             | n=44            |
| Total Deaths                                                   | 5.2              | 18.2             | 2.3             |
| Cause                                                         | Trauma           | 2.3             | 2.3             |
|                                                               | Thromboembolism   | 0.0             | 4.6             |
|                                                               | Euthanasia (unrelated to treatment or underlying disease)    | 1.1             | 0.0             |
|                                                               | Euthanasia (related to treatment or underlying disease)     | 0.0             | 2.3             |
|                                                               | Underlying Disease | 0.8             | 2.3             |
|                                                               | Undetermined      | 1.1             | 6.8             |

In one small (n=51), uncontrolled field study in severely ill (Class 3) dogs, 5 dogs died following treatment. 3 dogs died due to thrombembolism as the cause of one death. The remaining dogs were not necropsied. All 5 dogs were in right heart failure at the time of treatment. Clinical signs seen in this study which were not seen in the larger studies include atrial fibrillation, collapse, hypothenemia, and weakness.

**Post-Approval Experience:** In addition to the aforementioned adverse reactions reported in pre-approval clinical studies, there have also been rare reports of paresis and paralysis in dogs following administration of melarsomine dihydrochloride. To report a suspected adverse reaction, contact Zoetis Inc. at 1-888-963-8471.

**Overdosage:** Three dogs were inadvertently overdosed with melarsomine dihydrochloride in the clinical field trials when the dose was calculated on a mg/kg basis rather than a mg/g basis (2X overdosage). Within 30 minutes of injection, one dog showed excessive salivation, panting, restlessness and fever with all signs resolving within 4 hours. Vomiting and diarrhea were seen in the second dog within 24 hours of injection. The dog vomited once and the diarrhea resolved within 24 hours. The third dog showed no systemic reaction to the overdosage. Clinical observations in healthy beagle dogs after receiving up to 3X the recommended dose included tremors, lethargy, unsteadiness/ataxia, restlessness, panting, shallow and rapid respiration, and rise in temperature. The vomiting progressed to respiratory distress, collapse, cyanosis, stupor, and death (see SAFETY).

**BAL in Oil Ampules (Dimercaprol Injection, USP) (Asom, San Clemente, California, at 1-800-223-8763)** is recommended. The literature is to be an antidote for arsenic toxicity and was shown in this study to reduce the signs of toxicity associated with overdosage of melarsomine dihydrochloride. The efficacy of melarsomine dihydrochloride may be reduced with co-administration of BAL.

**STORAGE CONDITIONS:** Store unopened at controlled room temperature (20°-25°C). After reconstitution, solutions should be stored in the refrigerator for up to 30 days. This solution should not be frozen.

**Warning:** This product is for parenteral use only. No additional ingredient or other substances has been added to the sterile water diluent.
SPECIAL FEATURE

22 Pets and Prosthetics: Growing Interest, Advancing Technology
By Don Vaughan

The use of prosthetics in humans dates to ancient times. Significant advancements have been made over the millennia, and pets are now beginning to reap the benefits.
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CHAIRMAN'S LETTER

A VOTE OF CONFIDENCE

The concept of One Health goes beyond the individual needs of people and animals and extends to food safety, antibiotic resistance, the spread of mosquito and tick-borne diseases, and more. In order for One Health to be all it can be, veterinarians need to be involved and visible at all levels. That's why we were happy to see former Georgia governor, Sonny Perdue, DVM, sworn in as the secretary of agriculture in April, the first veterinarian to hold the position.

Agricultural communities and veterinary associations alike are hailing Dr. Perdue’s appointment as a positive move. Veterinary leadership at all levels of the US Department of Agriculture (USDA) is “crucial to creating and executing effective policies, and Secretary Perdue’s appointment is an encouraging sign that veterinarians will continue to be valued at the agency,” the American Veterinary Medical Association said in a press release.

“The only legacy that I seek is the one that any grandparent or parent seeks: to be good stewards and to hand off our nation, our home, our fields, our forests, and our farms to the next generation in better shape than we found it,” Dr. Perdue said. Outlining the principles that will guide him, he stressed his allegiance to (1) seeing that the American government removes every obstacle preventing farmers, ranchers, and producers from prospering; (2) making the USDA answerable to American taxpayers and consumers by focusing on integrity, efficiency, effectiveness, and excellent customer service; (3) acknowledging that food security is a key component of national security because hunger and peace do not long coexist; and (4) continually remembering that America’s bounty comes directly from the land.

An unapologetic advocate for American agriculture, Dr. Perdue grew up on a dairy and crop farm in Georgia. He knows the success of a great crop and the devastation caused by drought or flooding. A graduate of the University of Georgia School of Veterinary Medicine, he spent a few years in practice and had a career in the military before launching agriculture businesses. His knowledge of farming, global commodities markets, and rural challenges led him to public service, first as a state senator and later as a 2-term governor of the Peach State.

A quick look at his Twitter handle @SecretarySonny reveals the work ethic we’re used to seeing from farmers and veterinarians. He’s already visited rural Midwestern communities from the Dakotas to Arkansas. He posts about meetings with farmers and ranchers, Native American tribal leaders, and Animal and Plant Health Inspection Service veterinarian Beverly Schmitt, DVM, MS, whose research focuses on protecting animal health. The numerous photos with aspiring young farmers reveal his passion about ensuring that agriculture is a viable career path. He’s also brokered deals to sell more American beef to Asia and promoted the organization supporting war veterans in farming. If America grows it or produces it, Dr. Perdue is committed to selling it, citing the statistic that for every $1 billion in agriculture exports, America creates 8000 jobs.

Dr. Perdue is circumspect about future budget cuts and believes that, although painful, cuts can and do lead to greater innovation. He promises he will give the best service he can with what he has. That’s what veterinarians, farmers, and ranchers do every day. So, we salute Secretary Perdue and we congratulate the veterinary community on the prestigious appointment of an esteemed colleague.

Thank you for reading.

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A1c Test Now Available for Cats and Dogs

By Maureen McKinney

Diabetes is a common disease in both animals and humans that requires consistent ongoing monitoring and management. Measurement of glycated hemoglobin (HbA1c) levels has long been the primary tool for diagnosing, monitoring, and managing diabetes in people. Until now, the measurement had not been available in pets due to its cost and the amount of time needed to get a result.

Baycom Diagnostics has developed A1Care, the first cost-effective hemoglobin A1c blood glucose diagnostic test kit for feline and canine diabetes. The test is easy to use and requires only a few drops of dried blood. Here’s how it works: A practice fills out a test request form and then fills in 2 circles on the form with whole blood from the patient. After the blood has dried, the form is mailed to Baycom (typically being received in 3 to 5 business days). Samples are tested the day they arrive, and results are mailed, emailed, and available online. The tests are run in the Florida State University Department of Biology Hybridoma Core Facility.

The benefit of using A1c levels over the traditional tests that employ fructosamine to manage diabetes is that A1c gives 6 times more data by providing an average blood glucose level for the previous 70 days in cats and 110 days in dogs. “Testing for A1c in people with diabetes has been the gold standard for over a decade,” says Gustav Ray, president and CEO of Baycom Diagnostics. “It is the one test that gives doctors a 120-day report card on how the body has been managing its sugar levels. For the first time, we are offering this same test for dogs and cats in a simple, cost-effective, mail-in test.”

Glucose binds to hemoglobin in red blood cells at a steady rate over the lifespan of the cells, giving an accurate average level of the amount of glucose present over time. Higher glucose concentrations indicate higher A1c levels. These levels are not affected by daily fluctuations in blood glucose concentrations caused by medications, exercise, diet, or the amount of insulin present in the blood. Because it measures the average concentration of blood glucose over an extended period, it is not affected by stress hyperglycemia.

As with A1c testing in humans, the creation of a verified veterinary test that yields more complete blood glucose information practically, conveniently, and economically may pave the way for better diabetes detection and monitoring for the steadily increasing number of dogs and cats affected by this disease. “In veterinary medicine, testing A1c levels allows for prediabetic testing in overweight pets, which are at high risk for diabetes development,” says Ray. “It’s also good for senior screening since diabetes is a disease of older pets.”

Glucose testing will still be required for day-to-day insulin management (a pet-specific glucose meter is recommended for better accuracy), but the A1c test allows the veterinarian to review home management of the disease and provide education and advice to pet owners about any required changes. “When veterinarians have a better clinical picture of glucose levels over a 90-day period, they can better help their clients manage their pets’ disease, whether that’s by adjusting the amount of insulin given, exercising the pet more, or increasing dietary efforts,” says Ray.

All human A1c tests comply with the National Glycohemoglobin Standardization Program, which assures quality control. Baycom Diagnostics follows those same guidelines with A1Care. No national standards exist for glucose or fructosamine testing.

The manufacturer’s suggested retail price for the test is $99, which is on par with the cost of fructosamine testing—the only current standard in veterinary medicine. The A1Care test is available nationally through all the major distributors. For more information, visit baycomdiagnostics.com.

Stress and Learning in Horses

By JoAnna Pendergrass, DVM

A study recently published in *PLoS One* reported on stress, personality, and learning performance in horses. In the study, 60 female horses first underwent behavioral assessments for 5 personality traits, including fearfulness and locomotor activity, and then were placed into 1 of 4 test groups: positive reinforcement (PR), PR + extrinsic stressor (ES), negative reinforcement (NR), and NR + ES.

For the learning procedure, an individual horse stood in a start box and learned to enter 1 of 2 compartments by following visual cues, which became increasingly difficult through the study’s 4 stages. Horses in the PR groups received a food reward immediately after entering the correct compartment; those in the NR groups received aversive tactile stimulation until they entered the correct compartment. Audience horses stood near the testing area to avoid stress from social isolation. Learning performance was determined by the number of trials needed to reach stage 1 and the highest stage achieved.

To assess stress, each horse was led into a “stress” box before performing the learning procedure. Those in the ES groups could not see the audience horses and received 3 stressors (eg, loud noise) in 10-second intervals. Horses were then led back to the start box and their behavior was observed. Researchers also measured cortisol in salivary samples obtained before and after the procedure. Without ESs, reinforcement type did not significantly influence learning performance, observed behaviors, or salivary cortisol concentration. With ESs, researchers noted these observations:

- Learning performance decreased and salivary cortisol concentration increased for both PR and NR, but more so with PR.
- Several behaviors, including alert postures and startle reactions, occurred more frequently regardless of reinforcement type.

Learning performance likely decreased less with NR because this reinforcement type redirected attention toward the task, the researchers noted. Cortisol levels may have been higher in the PR + ES group than in the NR + ES group because of a lack of stress-reducing coping mechanisms.

Fear played a major role in learning performance. When ESs were absent, the most fearful horses performed best with NR and worst with PR, NR may have increased focus on the task, while horses receiving PR may have become more distracted.

With ESs present, the most fearful horses demonstrated the worst learning performance, regardless of reinforcement type. These horses likely reacted most strongly to these stressors, causing a marked disruption in cognition and attention.

Overall, the researchers believed their study’s findings “provide important clues to more personalized training according to each animal’s needs.”
Baycom Diagnostics announces an easy, accurate, and cost-effective veterinary mail-in A1c (glycated hemoglobin) test for diagnosing and monitoring canine and feline diabetes. With a few drops of dried whole blood, A1Care® determines the average blood glucose levels for the previous 70 days in felines and 110 days in canines.
Exposure to Pets During Infancy Alters Gut Microbiota

By JoAnna Pendergrass, DVM

According to researchers from the University of Alberta, prenatal and postnatal exposure to furry pets alters gut microbiota composition in 3-month-old infants. These findings, published in *Microbiome*, indicate an association between gut microbiota and pet ownership.

Gut microbiota development greatly influences future health and is affected by several factors, including birth mode (vaginal vs cesarean) and infant diet (breast milk vs formula). Given the rise in pet ownership, there has been growing interest in its impact on gut microbiota development.

Previous studies have reported an association between gut microbiota dysbiosis in infants and allergic disease, supporting the “microbiota hypothesis.” This hypothesis explains how environmental factors, such as antibiotic usage, have altered gut microbiota composition and increased allergic disease risk. Importantly, prenatal and early childhood pet exposure can lower this risk, according to the results of studies evaluating pet ownership and allergic disease.

For this study, researchers selected a subsample of 746 infants from the Canadian Healthy Infant Longitudinal Development cohort. Fecal samples collected from the infants when they were 3 to 4 months old underwent 16S rRNA sequencing and taxonomic classification. The infants’ mothers, who were enrolled in the cohort during their pregnancy, completed a pet ownership questionnaire. Using this information, researchers created 3 pet exposure categories for further analysis: prenatal exposure only, prenatal and postnatal, and no prenatal or postnatal exposure.

Researchers also collected information on birth mode and use of intrapartum antibiotic prophylaxis (IAP). Birth modes used for analysis were vaginal birth with and without IAP and scheduled and emergency C-section.

About 45% of households had no pets. For households with at least 1 furry pet (primarily dogs and cats), 8% owned pets only during pregnancy and 47% owned pets during and after pregnancy. In general, gut microbiota diversity and richness increased with pet exposure. Increased richness from prenatal pet exposure could lower this risk with vaginal births.

Across all birth modes, the abundance of 2 genera—Ruminococcus and Oscillospira—significantly increased with prenatal pet exposure. Researchers mentioned that IAP typically is given to prevent group B Streptococcus (GBS) infection in infants. A previous study reported an association between maternal GBS infection and increased cardiovascular disease risk in infants born vaginally; interestingly, prenatal pet exposure decreased this risk with vaginal births.

Both genera are present in dogs and cats. Ruminococci regulate maintenance of the microbiota-mucin layer and predominate in formula-fed infants, but their role regarding infant health is poorly understood. Oscillospira’s role in infant health is also not well known but has demonstrated a positive association with leanness in infants and adults and a negative association with pediatric inflammatory bowel disease.

Monitoring the Asian Influenza A Virus Outbreak in China

By Maureen McKinney

In April, the National Health and Family Planning Commission of China notified the World Health Organization (WHO) about 14 laboratory-confirmed cases of human infection with an Asian lineage avian influenza A (Asian H7N9) virus in mainland China. Cases reported since October 2016 are considered part of the fifth epidemic wave of Asian H7N9, the largest annual epidemic to date.

Onset dates in the most recent outbreak ranged from March 14 to April 4, 2017, with cases reported in 10 provinces throughout China (including a cluster of 3 cases in Beijing). Patient age ranged from 38 to 70 years, with 4 cases in women.

At the time of notification, 1 death had occurred and 13 patients had received a diagnosis of either pneumonia (5 cases) or severe pneumonia (8 cases). Thirteen of the 14 patients reportedly had exposure to live poultry or a live poultry market prior to infection; 1 did not.

Since early 2013, a total of 1378 laboratory-confirmed human infections with Asian H7N9 virus have been reported through International Health Regulations notification. Considering the increase in the number of human cases since December 2016, the Chinese government is taking preventive action at national and local levels by:

- Continuing to strengthen control measures, particularly regarding hygienic management of live poultry markets and cross-regional transportation
- Requesting that all provinces remain vigilant and offer and implement full prevention and control measures
- Offering guidance to epidemic areas on strengthening control and prevention, and providing the public with guidance on self-protection
- Strengthening trace-back investigations and etiology surveillance to define the scope of virus contamination and mutations

In most cases of Asian H7N9, the patient was exposed to the virus through contact with infected poultry or contaminated environments, including live poultry markets. The virus continues to be detected in animals and environments, and live poultry vending continues, so more reports of human cases can be expected. Despite reports of small clusters of human cases of Asian H7N9 infection, current evidence suggests that this virus has not acquired the ability of sustained transmission among humans. Therefore, the likelihood of further community level spread is considered low.

WHO is not recommending any travel or trade restrictions. As always, a diagnosis of infection with an avian influenza virus should be considered in individuals who develop severe acute respiratory symptoms while traveling in or soon after returning from an area where avian influenza is a concern.
Antimicrobial Resistance in Australian Companion Animals

By JoAnna Pendergrass, DVM

In the first study of its kind in Australia, researchers measured the antimicrobial susceptibility of coagulase-positive staphylococci (CoPS) isolated from infections in companion animals and identified risk factors for methicillin resistance. Study results, published in PLoS ONE, indicate the need for effective biosecurity and infection control measures in veterinary practices, the authors wrote.

The emergence of methicillin-resistant strains of CoPS, particularly methicillin-resistant *Staphylococcus aureus* (MRSA) and *Staphylococcus pseudintermedius* (MRSP), has compounded the difficulty of treating infections in humans and animals; resistance to methicillin and all other beta-lactams is conferred through acquisition of the *mecA* or *mecC* gene. MRSA is recognized as a public health issue, while both MRSA and MRSP are major veterinary health issues. Although increasing incidences of MRSA and MRSP infections in Australia have been reported, the frequency of methicillin resistance in the clinical infections of Australian companion animals remained unknown prior to the current study.

Researchers collected 888 CoPS isolates from infection sites or specimens from dogs, cats, and horses. Each isolate underwent susceptibility testing to 16 antimicrobials from 12 antimicrobial classes. Methicillin resistance for presumed MRSA and MRSP strains was phenotypically confirmed by colony appearance and resistance to cefoxitin, oxacillin, or both. Using demographic factors and clinical history data accompanying the isolates, researchers performed logistic regression analysis to identify potential risk factors for methicillin resistance. *S. pseudintermedius* and *S. aureus* were the most commonly identified CoPS, with *S. pseudintermedius* comprising 71% of the isolates. Methicillin resistance was observed in 12% of *S. aureus* isolates and 13% of *S. pseudintermedius* isolates; researchers considered this a moderate level of resistance.

*S. pseudintermedius* was identified in dog and cat isolates. For isolates from both species, resistance to amoxicillin–clavulanate was most common, followed by trimethoprim-sulfamethoxazole. Resistance to amikacin and rifampicin was low to undetectable. Approximately half of *S. pseudintermedius* isolates demonstrated full susceptibility to 8 antimicrobial classes, and 13% demonstrated multidrug resistance (MDR); the majority of MDR isolates were MRSP.

*S. aureus* was identified in dog, cat, and horse isolates. Resistance to amoxicillin–clavulanate was most common in isolates from all 3 species, while frequency of resistance to other antimicrobials varied among the species. Nearly 70% of *S. aureus* isolates demonstrated full susceptibility to 8 antimicrobial classes, and 13% demonstrated MDR; all MDR isolates were MRSA. Fluoroquinolone resistance was more likely in dogs and cats than in horses, while amikacin resistance was most likely in horses. Interestingly, fluoroquinolone resistance in dogs and cats was always associated with methicillin resistance.

Logistic regression analysis was performed only for *S. pseudintermedius* isolates from dogs. This analysis indicated that the infection site and prior antimicrobial treatment strongly correlated with MRSP infection. Specifically, *S. pseudintermedius* in surgical site and skin and soft tissue infections was significantly more likely to be methicillin-resistant in dogs receiving prior antimicrobial treatment than in untreated dogs. This finding, the researchers wrote, “[reinforces] the need for veterinarians to place a high priority on implementing infection control procedures, biosecurity and antimicrobial stewardship.”

Social Behavior Differences in Neutered Versus Intact Dogs

By Laurie Anne Walden, DVM, ELS

Social behaviors of neutered male dogs differ in some ways from those of intact male dogs, according to a study published in *Veterinary Medicine Open Journal*. The authors recommend that dog owners and veterinarians be aware of the potential effects of neutering on dog-to-dog interaction. They also note that castration may not change undesired behavior in a male dog.

The German and Swiss researchers suggest that veterinarians discuss alternatives to neutering with owners. In the United States, many organizations (including the American Veterinary Medical Association, American Society for the Prevention of Cruelty to Animals, Society for Theriogenology, and American College of Theriogenologists) support voluntary neutering to reduce the number of unwanted dogs in shelters.

The investigators conducted the study in 3 parts: (1) video analysis of 17 neutered and 16 intact male dogs interacting with each other in groups, (2) questionnaires completed by owners of 133 male dogs, and (3) information collected from the records of 54 male dogs in a behavior consultancy program. For the video analyses, the researchers observed male dogs placed into 6 groups of 4 to 10 dogs each. Groups consisted of neutered and intact dogs of various breeds, with ages ranging from 8 months to 10 years. Some dogs were already familiar with each other from previous interactions at a dog school. According to the authors, differences in the frequency of behaviors such as sniffing another dog’s perianal region and resting the chin on another dog signified that neutered dogs were less confident and more anxious than intact dogs.

For the second part of the study, the authors analyzed surveys based on a 2011 Hungarian study of trainability and boldness in various dog breeds. Of the 133 surveys available, 29 were from owners of dogs included in the video analyses. Owner scores for “boldness” and “sociability to dogs” were higher for intact dogs than for neutered dogs. Owners scored neutered dogs as being more trainable than intact dogs.

The information gathered for the third part of the study included owners’ reasons for seeking behavior advice and descriptions of their dogs’ behavior. More owners of neutered dogs than intact dogs sought behavioral consultation. And, according to owners’ assessments, neutered dogs were more likely than intact dogs to exhibit fearful behavior and aggression toward other dogs.

The authors acknowledge limitations of the study: dogs grouped together for video analysis were of widely differing ages, and female dogs were not included. They caution dog owners against neutering male dogs with the intent to change unwanted behavior because the procedure may not produce the desired effect; they also suggest further studies of social behavior in intact and neutered dogs.

The researchers observed greater antimicrobial resistance in MRSP isolates than MRSA isolates. Given the isolates’ infrequent resistance to amikacin, researchers recommended continuing to reserve this antimicrobial for MDR infections as a last resort. With the frequency of antimicrobial resistance of CoPS demonstrated in this study, researchers proposed continued surveillance to “[understand] the trends in emergence and dissemination of antimicrobial resistance in companion animals.”

Saputra S, Jordan D, Worthing KA, et al. PLOS One. 12(4)e0176379.
Review of Common Urologic Disorders

By Amanda Landis-Hanna, DVM

(continued from front cover)

CHRONIC KIDNEY DISEASE

CKD is a challenging disease to treat due to its insidious nature and high risk for complications such as vomiting and anorexia. Additionally, clients, general practitioners, and internists may all focus on differing aspects of the disease. For this reason, it is vital that all parties (clients, primary care veterinarians, and referral veterinarians) speak the same language when discussing the severity and prognosis of CKD.

Dr. Fischer reviewed International Renal Interest Society staging, as it may help guide therapeutic options. Nutritional management is key to sustaining patients with CKD, she noted; inappropriate nutrition may hasten progression of the disease.

Options for clients whose pets won’t eat the prescribed diet include force feeding, feeding an inappropriate diet, or placement of a feeding tube. Dr. Fischer was quick to discuss the many benefits of feeding tubes. In her experience, patients can live with a feeding tube for extended periods of time, thereby enhancing their quality of life through improved medication delivery and nutrition. “Food is medicine,” she said, “and feeding the appropriate diet for any disease state may help enhance outcomes.”

Feeding tube selection may be based on a number of factors. The intended duration of tube use is important, as some tubes (eg, nasogastric tubes) are intended for shorter-term use. Esophageal tubes can be in place for a week or more, with minimal expense, anesthesia, and recovery time. Percutaneous endoscopic gastrostomy (PEG) tubes are preferred for long-term (semi-permanent or permanent) use, but they should be used with caution in cases of vomiting. PEG tubes protrude from a gastric perforation and need proper care and covering to prevent infection. Jejunal tubes are less common but are recommended in cases of intractable vomiting.

ACUTE URETERAL OBSTRUCTION

Acute ureteral obstruction may result from inflammation, uroliths, neoplasia, trauma, mucus, or stricture. For ureteral obstruction to cause azotemia, both ureters must be impacted. This may occur in patients with bilateral disease or in those with unilateral disease without contralateral compensation.

The most common cause of ureteral obstruction is calcium oxalate urolithiasis, the incidence of which has increased over the past 20 years. In cases of unilateral obstruction, it may be possible to identify asymmetric kidneys on palpation or radiography. In acute obstruction, the patient may show signs of pain or behavior changes. In chronic obstruction, the affected kidney will be small, firm, and nonpainful while the functional kidney may be enlarged, turgid, and painful.

Acute ureteral obstruction increases ureteral pressure, resulting in an increase in proximal tubular pressure, which leads to an increase in renal blood flow and additional increases in ureteral pressure. Simultaneously, an increase in glomerular capillary pressure occurs, but the net hydrostatic pressure gradient across the glomerular capillaries decreases (due to the much higher ureteral pressure), resulting in a decreased glomerular filtration rate (GFR). Several hours later, intratubular pressures decrease, but glomerular capillary pressures decrease faster, so GFR remains significantly diminished. After 24 hours of obstruction, the contralateral kidney begins to compensate, and prostaglandins temporarily increase renal blood flow to the cortex, but GFR continues to diminish (~50% at 24 hours, ~30% at 6 days, ~20% at 2 weeks, ~12% at 8 weeks).

Interstitial fibrosis begins to develop following obstruction. Interstitial collagen increases are detectable by 7 days post obstruction. Fibrosis and tubular basement membrane thickening are detectable by 16 days post obstruction. The severity of the renal damage largely depends on the duration and severity of the obstruction. The longer the obstruction is present, the more severe the fibrosis and the less likely a kidney will be to recover. If treated promptly, urine concentrating ability can recover fully.

Clinically, these patients may present with a variety of signs. Many are painful, but some animals may be moribund while others are bright and alert. Careful assessment of hydration is vital, as many patients may be oligoanuric and overhydrate as a result. Dr. Fischer recommends assessing skin turgor because uremic toxins may create dry mucous membranes. Retroperitoneal hemorrhaging may also be present and cerebral damage may occur due to hypertension, resulting in “sudden blindness,” a decreased menace response, and/or decreased pupillary light reflex.

Imaging is important to assess the severity and stage of kidney disease. Radiography can be highly sensitive for the diagnosis of ureteroliths. Survey radiographs can also help identify kidney size and shape. Ultrasound, however, is good for evaluating renal pelvic dilation. If surgery is planned, computed tomography or contrast radiography is needed to assess the location of the obstruction.
Medical management of acute ureteral obstruction focuses on appropriate diuresis while managing signs of uremia. Selective α₁ agonists, such as prazosin, can be used to ureteral relaxation; up to 20% of patients will have spontaneous clearance of the obstruction when treated with judicious fluids and ureteral relaxants. Amitriptyline relaxes urinary smooth muscle and may be considered as an adjunct therapy. Extracorporeal shock wave lithotripsy is often used in humans and may be considered if geographically and financially feasible.

In many acute cases, surgery is required to resolve the obstruction. These surgeries are technically difficult and may be expensive, and the patient is at high risk (~30%) for post-operative complications, such as urine leakage. Subcutaneous ureteral bypass ports and stenting are other options, as is surgical removal of the blockage via ureterotomy.

**INCONTINENCE**

Incontinence is a common complaint in practice. Incontinence is usually due to failure of urine storage during filling, although in some patients (particularly animals with congenital disorders) multiple mechanisms may be at play. Causes of incontinence are traditionally described as neurogenic or non-neurogenic in nature. For a pet to be continent, it must have ureters that open solely into the bladder, bladder capacity and sphincter tone, and nervous system communication to maintain the system. Urinary incontinence is defined as involuntary leakage of urine through the urethra. Incontinence is most common in female dogs but is also seen in male dogs and in cats. In neurogenic incontinence, nervous system communication fails but the urinary organs function normally. These cases often involve the sacral spinal cord and/or the pudendal nerve, resulting in a loss of normal detrusor contractile abilities. For this reason, the animal’s urination occurs as a result of increased abdominal pressure, not voluntarily.

Non-neurogenic incontinence is due to a decreased ability to sense and/or respond to signals from the nervous system. Anatomic or functional disorders may play a role. Urethral sphincter mechanism incontinence is the most common type and is seen most often in medium- to large-breed spayed or neutered dogs. Therapeutic options include sympathomimetic agents (eg, phenylpropanolamine) and estrogens (eg, estriol, diethylstilbestrol). Gonadotropin-releasing hormone agonist therapy (eg, deslorelin, leuprolide) has been used in dogs successfully and may be a possible treatment for cats in the future (additional testing is being conducted). Combination therapy, including sympathomimetics with estrogens, can also be considered.

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End-of-Life Care at Its Best: Part 2

(continued from front cover)
help clients through the decision-making process and how to be truly present with them during the procedure itself.

**HOW DO YOU HELP CLIENTS WHOSE PET IS VERY ILL AND THE END IS NEAR?**

Dani McVety, DVM: Going through the decision-making process with families is probably one of the more important things we do. One of the best things we can do for people to set them up for success through the end-of-life process is really to make them understand that there's no one perfect moment in time when it's the right decision to make.

The way that we explain it is to tell the client that there's a subjective time period when euthanasia is a good decision. It may not be your only decision, but it's a good decision. Before that time, we're going to refuse to euthanize as veterinarians because we have to be okay with the decision as well. After that period, we're going to insist on euthanizing because there's sustained suffering going on. As a former emergency clinician, this is where so many euthanasias occur, in the emergency room during sustained suffering. But the subjective period of time is when people need to know that they have the right to come to us with that decision and we get to help them through that decision-making process. I never say, “You are making the right decision.” Instead, it’s, “We are making the best decision together.” It’s not on them, I can separate the grief and the guilt and help them through the guilt part, and the grief is going to be there no matter what. But we can take the guilt away as much as possible at the beginning so that through the decision-making process they don’t feel that it’s 100% on their back and their choice to make.

Mary Gardner, DVM: There are a few other short and sweet things I like to say because the family just wants to be reassured that they’re making the right decision. I always like to say, “It’s better a week too soon than a day too late.” Or if it’s a dog that’s still eating and happy and wagging its tail but mobility issues are so bad, I tell them that’s how I want to go. I want to go on a good day when I’m still looking good and eating and happy and understanding that everybody there loves me so much.

DM: People always say, “You know, I want them to die naturally.” We respond with, “Gosh, our 18-year-old dogs aren’t natural anymore” or “Our 20-year-old cats aren’t natural.” Nature didn’t necessarily mean for them to get this old, and that’s okay, there’s nothing wrong with wanting that by any means. The other thing they say is, “I just want them to go to sleep and not wake back up,” and I say, “That’s what euthanasia is. They go to sleep and don’t wake back up.”

**MANY PEOPLE ARE UNCOMFORTABLE WITH OTHER PEOPLE’S GRIEF. HOW WOULD YOU ADVISE VETERINARIANS WHO WANT TO PUSH THROUGH THE DISCOMFORT AND BE “PRESENT” FOR THEIR CLIENTS DURING THE EUTHANASIA PROCEDURE?**

DM: Being present with someone’s grief is really such an art form. When I first started doing in-home end-of-life care, I felt a bit uncomfortable until I realized how to really be present with somebody. I had a family tell me once when I came back for a second pet, “You know, your presence with us last time was so important. You just being here with us made everything better.”

I remember thinking back to that earlier appointment and remembering that I didn’t say anything; I was just there. But I was present, I was with them. I wasn’t trying to tell them that everything is okay, that their pet was no longer in pain. There’s nothing you can say at that moment that will take their grief away—their grief is their own journey. I think that was one of the cases where I learned how to be present and be silent and what that means.

MG: Honoring silence is huge, although it’s kind of a problem sometimes with me being a chatty Cathy. I think we’re able to help clients with their guilt, but they do have to go through their grief. I think a lot of veterinarians have trouble breaking from the nice puppy/kitten appointment to maybe diagnosing a disease and then going to a euthanasia, or maybe a couple in a row. But I think you have to be present during every single appointment, particularly the euthanasias. We may perform 4 or 5 euthanasias a day, but that appointment, for that person or that family, is the only important thing about their day, so you have to be present.

DM: If there’s anything that we can probably share with other veterinarians, it’s that one statement: “Honor the silence.”

**SO, IT’S ABOUT FOCUSING ALL YOUR ATTENTION ON THAT ONE CLIENT OR FAMILY?**

DM: Definitely. When clients ask, “How many have you seen today?” we say, “One, just this one.” Then we go to another one and when the client asks, “How many have you seen today?” I say, “I’m right here. This is the only one I’m seeing today.” It literally is just about that 1 pet, that 1 moment, that 1 time. We don’t even bring a cellphone into the home. It is one of the more peaceful times for me, even in my daily life.

MG: We like to go alone, too. I don’t bring a technician because I don’t want somebody else interfering with that moment.

**WHAT ABOUT HUMOR? DOES HUMOR HAVE ANY PLACE IN END-OF-LIFE CARE SETTINGS?**

MG: A lot of people ask if our appointments are full of dread and grief. The answer is no. There is definitely a place for humor in end-of-life care, but it has to be done with the right tone and with the right family—it won’t work with every client. Most of my appointments end or have a portion where we’re laughing about the situation or laughing about what the pet brought to that home or just the snot dripping out of the pet’s nose, and that’s okay! I think humor alleviates some of the pressure, the guilt, the grief, and the awkwardness of the appointment because clients don’t know what to expect. They’re saying goodbye to the most important furry thing in their world. So, I think if you’re able to bring humor, it’s absolutely appropriate.

DM: We all have our little things that we say. For me, some-
times it’s walking into a stranger’s home for the first time and saying, “Hi, how are you?” And of course, they say, “Oh, aw-
ful!” and I respond, “I know, stupid question, isn’t it?” And they’ll smile a little bit. Or if I’m helping a pet that belonged to
the wife before she met the husband, I’ll look at the husband and say, “You’re going to move up in the world now.”

These are little things that will make people kind of just
smile. It’s not about laughing; it’s really about bringing to life
what’s actually happening because we’re there to help people
through the process. They don’t have the words sometimes or
the experience to see the big picture because they’re so in that
time and in their grief. So, we can add little tips like that. Even when we give the first injection we might say something
like, “He might tell me his opinion on this.”

**MG:** I like it when the pet is giving me kisses. I’m like, “That is
the best hot garbage breath I’ve smelled,” and the client is always
like, “Oh yes, it’s the worst!” It’s just to lighten the mood a little bit.

**DM:** If a pet gets a little bit riled up, I love saying, “This must
be how he lived, isn’t it? This must be very much in line with
how Max is,” and they’re always like, “Yes, this is exactly how
he is always.” Any type of humor can help make the situation
easier, but make sure it’s delivered in a very compassionate
tone. It elevates the feeling of the whole appointment.

**YOU’VE TALKED ABOUT SOME OF THE THINGS YOU SAY TO
CLIENTS IN EUTHANASIA SITUATIONS. WHAT SHOULD VETER-
INARIANS NOT SAY TO A CLIENT WHO IS CONSIDERING
EUTHANASIA FOR HIS OR HER PET?**

**DM:** Probably one of the worst things you can say to a cli-
ent who is going through the decision-making process, and
even after we’ve made the decision, is anything that puts that
decision and/or the guilt on
them. For example, “Call me when
you’re ready,” or “Call me when you are ready to make the de-
cision,” or “You are making the right decision.” Anything like
that, or especially the one that, “You’ll know when it’s time.”

**Those types of statements can cause added guilt.**

**MG:** Or, “He’ll give you a look.” If you’re waiting for a look,
sometimes you’re going to wait for a very long time.

**DM:** Sometimes people will say, “I’m waiting and I don’t know
what I’m waiting for,” and I’ll say, “I know. I think you’re
waiting for that handwritten note from your pet that says I’m
ready, Mom.” One client said to me, “I’ve been looking for that
note everywhere. I can’t find it!”

But anything that puts that decision solely on the client can
be detrimental. Even when we walk into a home and that pet
is lateral recumbent, not responsive, and absolutely ready in
medical terms, the client still needs
that reassurance from us.

At Lap of Love, there are 3 things we
want every veterinarian to do in a eu-
thanasia appointment:

1. **Acknowledge the decision.** Even
   if that pet is already in the dying
   process, we can still say this is the
   best decision we can make at this
time.

2. **Love on that pet.** Make sure you compliment the pet be-
   cause you know no one else has complimented that pet in a
   very long time. He’s old, he’s crusty, and when you walk in
   and say, “Oh my gosh. Hi, angel! How are you?” you just see
   the relief on that owner’s face.

3. **Physically touch the client some way.** It can be on the
   hand, on the shoulder, on the elbow. It doesn’t matter where
   because there’s nothing that you can say at that moment of
   grief that is more powerful and more compassionate than
   just a gentle touch.

**MG:** And I can guarantee that it goes well.

**DM:** It’s going to be as peaceful as it can possibly be.

There is definitely a place for humor in end-of-life care, but it has to be done with
the right tone and with the right family.
Preparing Your Team for Trauma Triage

By Maureen McKinney

(continued from front cover)

TRIAGE: THE DANGER OF NOT KNOWING

“In human medicine,” Dr. Palmer noted, “prehospital emergency medical services may limit or even halt the cascade of events that would otherwise lead to death or permanent disability. In animals, the cascade of systemic events goes unchecked until the animal arrives at the veterinary hospital.” It is for this reason, he said, that all veterinary team members must understand and be trained on how to deal initially with trauma cases.

“If anyone on the hospital team—from front desk staff to technicians to veterinarians—is not trained or does not understand how to triage a patient, then many serious conditions may be missed that could further jeopardize the patient’s condition and chance of survival,” said Dr. Palmer, who is chair of the K9 Tactical Emergency Casualty Care Working Group; assistant professor of emergency and critical care medicine at Wilford and Kate Bailey Small Animal Teaching Hospital in Auburn University, Alabama; and an adjunct instructor in the Emergency Medical Services Program at Southern Union State Community College in Opelika, Alabama.

VITAL TRAIGE QUESTIONS AND ANSWERS

Questions to ask a client who is calling with a potential pet emergency:

• What are the nature and mechanism of the injury (eg, blunt or penetrating trauma)?
• What areas or parts of the body is/are affected?
• How is the animal breathing?
• What color are the animal’s gums?
• Are there any obvious wounds, fractures, or bleeding?
• What is the animal’s level of consciousness?
• Is the animal ambulatory?

Key responses that should raise a red flag during phone triage for a trauma patient:

• The animal is unconscious or has a decreased level of consciousness.
• There is spurring, bright red blood or obvious and significant external bleeding.
• The animal is not breathing normally, is having trouble breathing, or does not seem to be breathing at all.
• There are open wounds in the chest or abdomen and/or protruding organs.
• The animal has injuries to the head or neck or injuries that have caused it to be nonambulatory.
• The animal has protruding bones.

As a receptionist who can prioritize patients and reduce waiting times, can help close the time gap between the onset of injury or another life-threatening medical condition and the reception of medical care, ultimately providing the patient with a greater chance of survival.

RECEPTION TRIAGE

Reception triage is a vital component of hospital-based triage because receptionists serve as the hospital’s “first responders” when trauma patients are presented. Because nonmedical staff are not trained to perform a hands-on physical exam or assess a patient’s vital parameters, it is easy to miss conditions that are not obvious from the patient’s outward appearance (eg, internal bleeding such as hematoabdomen, non-opened fractured bones, pneumothorax).

TRIAGE TRAINING

Developing a list of common injuries or conditions classified by triage categories (eg, red, yellow, green) as well as checklists and standard operating procedures for triaging patients can all enhance the reception staff’s ability to triage quickly and effectively. “Implementing organ- and condition-specific questions, flow charts, or algorithms for the reception staff to refer to when talking on the phone with clients may further facilitate their success with providing appropriate phone triage,” said Dr. Palmer. “The key is to develop protocols that your staff must follow in relation to telephone triage and face-to-face contact with patients, similar to the triage guide cards developed for human 911 emergency medical dispatchers.” Consider training front desk staff to listen for common key words or phrases that would indicate a potentially severe condition, suggested Dr. Palmer. Examples may include “nonproductive” retching in a German shepherd or “straining to urinate” with no urine production in male cat. “For gross observation,” he said, “the team should understand the dire urgency of more serious conditions, such as spurring red blood from a traumatic wound, unconsciousness in a patient that was hit by a car, and extreme difficulty breathing in a Labrador retriever that presents with blue mucous membranes and high-pitched breathing sounds.”

One of the best ways to foster a positive training environment is through teamwork and a positive work environment, said Dr. Palmer. “Promote training as a team to develop cohesion and to allow everyone the ability to understand the triage process and flow fully,” he said, “thereby allowing the triage process and patient admission to flow smoothly and seamlessly.” Training should not be a chore, he noted. Rather, it should be fun and relevant. Promote buy-in from the staff by letting them know the vital role they play in helping the patients they admit and how important they are to the team. Dr. Palmer suggested showing the reception staff examples of how the training they receive will increase their ability to help patients and the team overall.

To assess what your staff has learned and, better yet, how effectively they can apply their training to real-life scenarios, Dr. Palmer recommended conducting mock practice scenarios with both phone triage and walk-in emergencies. “Consider implementing a quality assurance program that includes an anonymous 360° constructive review from all members of the hospital team. A quality assurance program may help identify gaps in care as well as be able to provide constructive feedback to team members on how they can improve their performance,” he said.

(continued on page 18)
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Training refreshers and performance evaluations given periodically through the year are helpful as well,” said Palmor, “let people know how they are doing, highlighting both the good points as well as areas that need improvement,” he suggested. “Incorporate all hospital staff into the development process.”

**CONCLUSION**

A primary tenet of trauma triage is to identify and treat any grave conditions as soon as possible. Without training and guidelines, front desk staff may easily miss a grave situation that could ultimately lead to a patient’s death. Each case is different and unique, however, and it is difficult to cover all possible situations that front desk staff may encounter. “Any trauma case may have a myriad of hidden injuries,” said Dr. Palmer, “and there is only so much that can be determined through a phone conversation—even for the most experienced emergency veterinarian.”

<table>
<thead>
<tr>
<th>TABLE. COMMON LIFE-THREATENING EMERGENCIES</th>
<th>WHAT THE CLIENT TELLS YOU</th>
<th>WHAT THIS COULD MEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>My pet was just attacked by another dog, and there is some blood spurting from her groin region.</td>
<td>This sounds like an arterial bleed, which involves severe and rapid blood loss.</td>
<td></td>
</tr>
<tr>
<td>My cat has been straining to urinate and has appeared constipated for the past day or so.</td>
<td>If this is a male cat, then these signs are highly indicative of a urethral obstruction, which is a true emergency.</td>
<td></td>
</tr>
<tr>
<td>My Labrador retriever has been retching for the past 12 hours but hasn’t thrown up.</td>
<td>This could indicate a potential gastric dilatation-volvulus.</td>
<td></td>
</tr>
<tr>
<td>My asthmatic cat ate a Tylenol tablet a few hours ago, and now he isn’t breathing right and his face seems swollen.</td>
<td>This cat is experiencing potentially deadly respiratory distress and signs of acetaminophen toxicity.</td>
<td></td>
</tr>
<tr>
<td>My dog was hit by a car this afternoon. I think he hit his head. He vomited once and initially appeared drunk, but he has been resting quietly and now is sleeping.</td>
<td>Mental status may be altered subsequent to the Cushings reflex due to cerebral edema, cerebral hemorrhage, or elevated intracranial pressure. Likewise, hypotensive hemorrhagic shock may result from unrecognized internal hemorrhage into a body cavity.</td>
<td></td>
</tr>
<tr>
<td>My dog was hit by a car just now, but he appears to be fine.</td>
<td>Clinical manifestations following severe trauma may take hours to days to fully manifest.</td>
<td></td>
</tr>
<tr>
<td>My cat received her annual vaccines today, and now she doesn’t seem to be breathing right.</td>
<td>Animals may experience anaphylaxis after a vaccine or insect sting/bite.</td>
<td></td>
</tr>
</tbody>
</table>

During investigational studies for the chewable tablet formulation, gastrointestinal signs were observed in some dogs. These signs included vomiting, diarrhea, inappetence, melena, and transient vomiting and soft stools.

The product vehicle served as control.

<table>
<thead>
<tr>
<th>Percentage of Dogs with Abnormal Health Observations Reported in Surgical Pain Field Studies with Capsules (2 mg/kg once daily)</th>
<th>Carprofen (n=148)</th>
<th>Placebo (n=149)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation*</td>
<td>Vomiting</td>
<td>10.1 9.0</td>
</tr>
<tr>
<td></td>
<td>Diarrhea/Soft stool</td>
<td>6.1 8.0</td>
</tr>
<tr>
<td></td>
<td>Urinary tract disease</td>
<td>1.4 1.3</td>
</tr>
<tr>
<td></td>
<td>Wound drainage</td>
<td>1.4 1.0</td>
</tr>
</tbody>
</table>

* A single dog may have experienced more than one occurrence of an event.
Rabies Awareness Challenge 2017

By Beth Thompson, VMD

(continued from front cover)

It is essential that veterinarians know their responsibilities as they pertain to the law and public health in their state. At this national meeting, he discussed legal trends that apply to most states.

For the past year, Merial, in conjunction with the National Association of State Public Health Veterinarians (NASPHV; nasphv.org), has sponsored a state-by-state rabies education awareness campaign. At the time of publication, information about laws and regulations in more than 30 states could be found at rabiesaware.org.

Rabies vaccination requirements are dictated by each state’s department of health. The Compendium of Animal Rabies Prevention and Control is a periodically updated publication of guidelines devised by the NASPHV. State public health veterinarians work for state health departments and deal with zoonotic disease control—focusing on protecting health—whereas state veterinarians work for state agriculture departments and primarily target livestock diseases (some of which can be zoonotic).

RABIES PREVALENCE AND INCIDENCE

Even though rabies is uncommon in the United States, the World Health Organization estimates that worldwide it kills between 50,000 and 60,000 people per year. Forty percent of those affected are under 15 years of age, and 99% of victims have contracted the virus from a dog.

The incidence of canine rabies has plummeted in the United States over the past 30 years. Since 1986, there have been more reported cases of feline rabies than canine rabies. In 2014, about 500 cases of rabies were reported in domestic animals; 272 of those cases were in cats and 59 in dogs. In comparison, there were about 5000 cases of rabies in wild animals.

VARIATIONS IN THE LAW

According to Dr. Ford, rabies laws vary widely among states. Take, for example, eastern Pennsylvania, which has the highest concentration of feline rabies in America. Pennsylvania law requires rabies vaccination for pet cats. Contrast that with neighboring New Jersey, where the prevalence of feline rabies is lower, even though there is no law requiring cats to be vaccinated. Another example is Ohio, which is the only state east of the Mississippi River not to have a requirement for canine or feline rabies vaccination. Further, within each state, some cities and counties have laws that take precedence over state mandates, leading to confusion about the interpretation, application, and necessary actions required to manage vaccinations, bites, and cases of exposure.

Most states stipulate that only a licensed veterinarian can administer a rabies vaccination, but some allow a veterinary technician to give the vaccine provided that the technician is under the “direct supervision” of a licensed veterinarian. By contrast, in a handful of states, a veterinarian must be accredited and licensed to give a rabies vaccine, and in some jurisdictions, an owner can legally administer a rabies vaccine.

The minimum age an animal can receive a rabies vaccine is 12 weeks. Most states consider an animal to be “currently” vaccinated against rabies 28 days after the initial vaccination. In contrast, most states have a zero-tolerance policy for overdue rabies vaccination and consider an animal unprotected if its vaccine is given a day late. However, once that animal receives a vaccine, it is immediately considered “currently vaccinated.”

When revaccinating a dog that is overdue, most states allow the veterinarian discretion to choose either a 1-year or 3-year vaccine. Usually, pet owners do not have to start the series again. If it’s been 5 years since the last vaccine, a 3-year vaccine can be given that is valid for 3 years.

EXPOSURE DEFINED

What about rabies “exposure”? Some states define exposure carefully, and others do not. Usually, the final determination of exposure is made by an animal control officer and not a public health veterinarian or the state health department.

In general, if a currently vaccinated pet is exposed to rabies, most states require a 4-month quarantine. For unvaccinated pets, a 6-month strict quarantine is often required—at the owner’s expense. The only other option is to euthanize and test. Several states are currently reviewing quarantine regulations for rabies-exposed dogs and cats that are overdue for vaccination. With valid documentation of prior vaccination, a 45-day home observation period is becoming more common. Some states also allow prospective serologic monitoring because in the United States, a rabies titer is not recognized as an index of immunity in lieu of revaccination.

VACCINE EXEMPTIONS

About 15 states recognize a veterinarian’s authority to exempt a pet from rabies vaccination; the rest do not. In those states, even a dying or ill pet is legally required to be current on rabies vaccination.

Because the law, and not common sense, dictates rabies regulations, Dr. Ford reminded the group to avail themselves of the rabiesaware.org resource to ensure that they all know their obligations in their practice state.
(continued from front cover) nutritional substrates, modulating the immune system, and supporting the body’s defense against intestinal pathogens. By contrast, the term “microbiome” refers to the total number of microorganisms and their genetic material. Disruptions of the intestinal microbiota can result in GI distress. According to Dr. Marks, who is a professor of medicine at the University of California, Davis, Veterinary Medical School, antibiotics are a significant destroyer of normal GI flora and function. Antibiotic use is linked to increased risk for *Clostridium difficile* infection, type 1 diabetes in children from repeated dosing between 1 and 2 years of age, and obesity, infections, asthma, and allergies in humans.

**MANIPULATION OF THE INTESTINAL MICROBIOME** Therapeutic manipulation of the intestinal microbiome is a newer area of research. Efforts to maintain healthy flora or to re-balance gut microbes focus on antibiotic use, dietary manipulation, helminth therapy, fecal microbiota transplantation (FMT), and prebiotic, probiotic, or symbiotic use.

**Probiotics** All three “biotics” are oral products. The traditional definition of a probiotic is accepted by the World Health Organization (WHO) but not the Food and Drug Administration (FDA) (see “BIOTICS” DEFINED). The FDA’s position is that the commercial development of probiotics has outpaced scientific data proving their benefit. Therefore, no approved substantiated health claims exist for probiotics in the United States.

Although the popularity of probiotics has surged in recent years, the idea that living organisms in food can be salutary is not a new concept. During the Roman Empire, Plinius, a naturalist, advocated for fermented milk products for the treatment of gastroenteritis. And, more than 100 years ago, Russian zoologist Élie Metchnikoff theorized that manipulation of the intestinal microbiome with host-friendly bacteria found in yogurt could enhance health and delay senility. He also predicted the existence of bacterial translocation and anticipated theories linking chronic inflammation with the pathogenesis of atherosclerosis and other disorders of the elderly.

Over the past 2 decades, there has been growing interest in both basic and clinical science in probiotics. This interest has

**“BIOTICS” DEFINED**
- A **prebiotic** is a nondigestible food item that promotes the growth of beneficial gut bacteria.
- A **probiotic** consists of live microorganisms that, when administered in adequate amounts, confer a health benefit by maintaining or restoring beneficial bacteria to the digestive tract.
- A **symbiotic** is a combination of prebiotics and probiotics.
led to more than 6000 publications in the biomedical literature, more than 60% of which have been published in the past 5 years, some in the top-ranking scientific journals. Health benefits can be gained from probiotic strains of the following genera: *Lactobacillus*, *Bifidobacterium*, *Saccharomyces*, *Enterococcus*, *Streptococcus*, *Pediococcus*, *Leuconostoc*, *Bacillus*, and *Escherichia coli*.

Some human probiotics such as VSL#3 and Visbiome contain 8 bacterial strains. Visbiome is intended for the dietary management of human dysbiosis associated with irritable bowel syndrome, ulcerative colitis, pouchitis, and hepatic encephalopathy. VSL#3 is designated for the dietary management of ulcerative colitis, irritable bowel syndrome, and ileal pouch.

Probiotics are purported to work via 4 methods:
- Production of various antimicrobial metabolites (e.g., bacteriocins)
- Competitive exclusion of enteric pathogens
- Enhancement of epithelial barrier functionality
- Modulation of mucosal immune response

There is compelling evidence for the effectiveness of probiotic use in people to treat malabsorption, lactase intolerance, acute diarrhea in children, antibiotic-induced diarrhea, and ulcerative colitis, to name a few. Less compelling but intriguing results indicate that they may help in cases of traveler’s diarrhea, limit sepsis associated with acute pancreatitis, and aid in the prevention of postoperative infections.

Fewer studies have been conducted in dogs, most of which have involved healthy specimens. Two studies involving the use of probiotics for diet sensitivity and food-responsive diarrhea have yielded positive results, while others have shown promising, if limited, results. We know less about cats. One study with *Enterococcus faecium* ST68 in shelter cats showed a significant decrease in diarrhea among treated cats versus placebo subjects. A deeper understanding of the intestinal microbiome of healthy dogs and cats versus animals suffering from GI disease is necessary before we can make specific recommendations for treatment and product use.

Veterinary professionals should remember that probiotics are not regulated by the FDA. Dr. Marks told the audience about results of a review in the *Canadian Journal of Veterinary Medicine* that examined 23 veterinary probiotic products. He discovered that only 17 of the 23 products listed numbers of organisms. Plus, only 5 of the 23 products listed numbers of organisms. While inadequate labeling does not necessarily mean poor quality, the lack of consistency is confusing at best. The study authors suggest that when selecting a probiotic, veterinary practitioners should be sure the label lists the organisms included, at least to the species level; states the number of viable organisms; and guarantees a certain number of live organisms at the time of expiration. Dr. Marks advised the audience to rely on products that report research. The most extensively researched probiotic product is Fortiflora, by Purina.

**FUTURE DIRECTIONS**

With more studies, we hope to discover the best ways to manipulate the intestinal microbiome for optimal dog and cat health. Many questions remain: Are single-strain probiotics as active as multistrain probiotics? Is there an ideal number of organisms in preparation? What is the optimum dose of bacteria for dogs and cats? Do we treat a Yorkie with the same dose as a husky? Are probiotics most helpful as a preventive measure or as treatment? Does FMT therapy offer hope for chronic diarrhea cases?

References available at AmericanVeterinarian.com.
Pets and Prosthetics: Growing Interest, Advancing Technology

The use of prosthetics in humans dates to ancient times. Significant advancements have been made over the millennia, and pets are now beginning to reap the benefits.

By Don Vaughan
(continued from front cover)

After consulting with her veterinarian about having Teddy fitted for prosthetics on his front limbs, Bradley was referred to the North Carolina State University College of Veterinary Medicine in Raleigh, where doctors and rehabilitation specialists have been advancing the field of prosthetics for years. Teddy was a good candidate, she was told, but he would have to reach maturity before the work could be done.

“It was always my intention to get Teddy prosthetics,” Bradley says. “He was basically walking around on his wrists and I knew that wasn’t comfortable for him. I wanted him to have the best quality of life he could have.”

When Teddy reached his first birthday, he was fitted with silicone sleeves that attach to lightweight carbon-laminated “feet.” “The first time we put them on, he acted really funny, like, what’s on my feet?” Bradley recalls. “But very quickly he got the hang of them.”

Teddy is one of a growing number of pets to receive prosthetics to correct a disability, most commonly the partial loss of a limb. “I would definitely say there is an upsweep in both interest as well as providing that clinical service,” observes Jamie Peyton, DVM, DACVECC, CCRT, CVA, CVT, chief of the Small Animal Integrative Medicine Service at the University of California, Davis Veterinary Medical Teaching Hospital. “Owners want their pets to have a good quality of life, and mobility is certainly an important part of that for animals.”

YESTERDAY AND TOMORROW

The use of prosthetics to correct disabilities in humans dates back to antiquity, reports the nonprofit Amputee Coalition. In 1858, an artificial limb dating to about 300 BC was found in Capua, Italy. Made of bronze and iron with a wooden core, the prosthesis apparently was made for a below-the-knee amputation. The Roman historian Pliny the Elder wrote about a Roman general in the Second Punic War who had an iron fist made after he lost his right arm so he could hold his shield and return to battle.

The evolution of human prosthetics has seen steady technological innovation in both the materials from which prosthetics are made and their design, resulting in greater comfort and functionality. Dramatic refinements occurred following the Civil War, World War I, and World War II, all of which witnessed a dramatic increase in the number of veterans returning home with missing limbs. Today, many prosthetic devices are controlled via advanced microprocessors.

As with other aspects of medicine, many advances in human prosthetics have trickled down to the veterinary side. “On the material side and on the design and fabrication side, we often use materials adopted by prosthetists for people,” notes Denis J. Marcellin-Little, DEDV, DACVS, professor of orthopedic surgery at North Carolina State University College of Veterinary Medicine. “We might incorporate a hinge for a pediatric knee into a dog device, or the tamarack hinges used in a human ankle might be incorporated into a dog ankle or elbow.”

Transdermal osseointegration is one area in which veterinary medicine has taken the lead, reports Dr. Marcellin-Little, who consults on approximately 200 prosthetic cases around the country each year. The procedure involves implanting a titanium rod directly into the bone at the end of the impacted limb and attaching a prosthetic foot to the protruding post. Only a handful of animals have undergone the procedure to date, but it shows great promise, he says.

Another area for growth is the use of 3D scanning, which can create a more detailed image of the residual leg, making for a better prosthetic fit. “In addition, the use of 3D printers will allow us to make a more precise model of what we’re trying to create,” Dr. Peyton notes. “It may also make prosthetics less expensive in the future.”

WHY PROSTHETICS?

Animals require prosthetics for a variety of reasons, one of the most common being neonatal injuries resulting in amputation. “It’s sometimes unclear why very young puppies lose portions of their limbs,” Dr. Marcellin-Little says. “It could be an overactive mother who cleans the umbilical cord and mistakenly chews the end of a newborn’s foot.”

Trauma is another common reason for amputation, as are tumors of the extremities, especially the toes. “Tumors of the nail bed must be excised, along with a portion of the foot,” Dr. Marcellin-Little explains. “Roughly an inch of tissue must be removed around the edge of the tumor to prevent regrowth.”

But just because an animal might benefit from a prosthetic device doesn’t always mean it will receive one. A tremendous number of factors come into play in determining whether an animal is a good candidate, including the age and size of the animal (very small and very large dogs pose greater challenges), the amount and health of the residual limb, soft tissue coverage, and skin mobility relative to underlying tissue. Other issues include possible orthopedic problems in the limb, how the limb is innervated, whether the partial limb is affecting the range of motion in adjacent joints, and gait issues.

A TOUGH BUT SUCCESSFUL CASE

Teddy is a good example of a challenging case because he’s small, his limbs are bony, his skin is fragile, and he likes to chew on things. “I decided the best approach would be to apply a suspension concept used in human prosthetics, but we wondered if we could achieve this on such a small scale,” says Heather M. Davidson, CO, BSc, O&F, a pediatric orthotist with Bio-Tech Prosthetics and Orthotics, the Durham, North Carolina–based company that manufactured Teddy’s devices.

Custom silicone liners were made to protect Teddy’s residual limbs, and tiny components were incorporated into the distal ends for suspension, Davidson explains. Dacron and Velcro straps attach to the ends of the silicone liners and pass through slots in the sockets, which provide stability for Teddy at his wrists and cover the liners so he can’t chew on them. In addition, soling material was added to the sockets to provide traction and shock absorption and to stop Teddy from wearing out the laminated sockets.

“Teddy’s mom approached the finicky challenge of donning and doffing very optimistically and Teddy took to his new feet like a champ,” Davidson says.

The patient’s personality also plays a role. Is the pet friendly and easy to work with? How has it adapted to the loss of a limb? How active is the pet? “The patient profile will influence whether a device would be effective,” notes Dr. Marcellin-

(continued on page 24)
Little. Even the client affects the decision. Does the client own other animals? Does the owner have the time and is he or she committed to helping the pet learn how to use the prosthetic device? Most importantly, does the client have the patience to follow through, because optimizing fit and retraining can be very time-consuming.

THE CHALLENGES OF REHAB

Indeed, it can be a challenge getting a patient used to moving about on its new mechanical limb(s). “The initial training is getting the patient comfortable wearing it and putting weight on it, then helping build muscle strength to be able to use it properly,” Dr. Peyton says. “People always assume that once you put a device on an animal, it will automatically start running. But if you compare it with a person who receives a prosthetic leg, you know the pet will have to go through rehabilitation as well. It’s a requirement at our facility that a prosthetic patient be in therapy for at least 10 weeks.”

According to Barbara Bradley, Teddy is still learning how to get around on his artificial feet. “He tires out when using them. It’s a bit of exertion as he gets used to them,” she says. “He gets halfway around the pond we walk around and, when he tires, I put him in my dog stroller for the rest of our walk. I’m letting him set the schedule. When we get back from our walks, I’ll leave the prostheses on him for a little while; he’ll go to bed and take a nap with them on. He just treats them like they are normal feet.”

THE POWER OF COLLABORATION

Veterinary prosthetics is, by necessity, a collaborative endeavor. “I think it’s important to work as a team because as veterinarians we don’t always have specialized training in prosthetics, so we must collaborate with human prosthetists,” Dr. Peyton explains. “Veterinarians understand the biomechanics of animals better, as well as how we want something to work for them. But human prosthetists bring all their knowledge. They go to school to learn how to build devices and make them fit well.” Other members of the team may include orthopedic surgeons, oncologists, rehabilitation specialists, and the family veterinarian, who will observe and care for the patient for the rest of its life.

Once a patient receives a prosthetic device, the results can be life-changing. In addition to enabling improved, more comfortable mobility, prosthetics can help prevent a variety of health problems later on. Dr. Peyton believes the value of prosthetics is 2-fold. “One, it helps prevent more chronic changes that could cause pain for the patient long term as it compensates for the missing limb, such as the development of arthritis and spinal issues. And two, it allows the animal to be more functional. Dogs and other animals want to have independent movement. Providing that support allows them to resume activities they may not have been able to do as much, such as running and playing.”

LOOKING TO THE FUTURE

As the science of prosthetics continues to advance, its future looks bright. “Our first goal should be greater knowledge and education about veterinary prosthetics,” states Dr. Peyton. “My hope is that this becomes a standard option for owners, meaning [that] if their pet has to have an amputation that all veterinarians will know the value of prosthetics and give them that choice. The next step would be further development of the devices, whether it be continual advancement of the socket to make them fit better or the potential of osseointegration. I think that will be another big advancement as well.”

As veterinarians we don’t always have specialized training in prosthetics, so we must collaborate with human prosthetists.
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Perception Versus Reality: Insecticide Resistance in Fleas

Are modern flea control products ineffective? A review of recent research answers this important question.

By Karen Todd-Jenkins, VMD

Research shows that the common cat flea (Ctenocephalides felis felis) has developed resistance to some flea control products that have been used on pets and in the environment for many decades, such as organophosphates, pyrethroids, and carbamates. Now, however, concern has grown that because of the development and widespread use of newer products, including convenient oral and topical agents, fleas could be showing evidence of resistance to these chemicals. According to Michael K. Rust, PhD, professor of entomology at the University of California, Riverside, research does not support the suggestion that they are. Dr. Rust discussed his recent work in a review article published in Insects.

In his review, Dr. Rust defined and challenged the concept of resistance by examining research published throughout the world on hundreds of flea strains known to parasitize cats and dogs. Laboratory simulations and on-animal studies were included in his analysis, which used laboratory animals, pets, and dogs and cats representing stray populations. Chemical susceptibility studies involving multiple stages of C. felis (larvae, eggs, and adults) were reviewed, and laboratory data detailing genetic mutations known to be responsible for the development of resistance among fleas were incorporated into the analysis.

WHAT DOES RESISTANCE REALLY MEAN?

Dr. Rust defined resistance as “a heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species.” Although resistance has been documented for some traditional flea control products used in the environment and on pets, he notes that significant decreases in susceptibility have not been demonstrated for the neonicotinoids (eg, imidacloprid, dinotefuran) or phenylpyrazoles (eg, fipronil).

Researchers investigating insecticide resistance typically consider a list of variables that may contribute to the required genetic mutations in fleas. These can include the number of offspring a flea strain typically produces for each generation, how quickly new generations are born and reproduce, and the number of generations produced per year. Other factors affecting the likelihood of insecticide resistance include the chemical behavior of the insecticide itself, how long residues persist in the environment and on pets, and how many treatments are required to achieve the desired effect.

Conversely, certain factors tend to help reduce the chances of resistance developing for a specific insecticide. These factors include using a chemical that is effective against more than 1 flea life stage (eg, a product that is adulticidal, larvicidal, and/or ovicidal). Products that kill adult fleas quickly enough to prevent feeding and egg deposition may have an advantage, Dr. Rust notes, as they help disrupt the life cycle (by preventing egg production) and prevent access to adult flea feces that larvae need for their development.

Similarly, products that interrupt flea development in the environment are less likely to be associated with resistance. Agents such as fluralaner, lufenuron, methoprene, pyriproxyfen, selamectin, fipronil, and imidacloprid have this advantage. Further, products that demonstrate multiple modes of action or synergism between their chemical components may have an advantage that limits the likelihood of fleas developing resistance. Dr. Rust points out study results that suggest possible synergism between methoprene and fipronil and between pyriproxyfen and methoprene.

RESEARCH DOES NOT PROVE RESISTANCE

Dr. Rust writes: “Since the introduction of the [insect growth regulators] lufenuron, fipronil, and imidacloprid in the mid-1990s, there has been little direct evidence of resistance developing to them.” Although variability in responses by some flea strains to fipronil and imidacloprid has been noted, he comments that there has been no significant reduction in the susceptibility of fleas to these agents. His findings make a compelling case for the assertion that resistance to newer products such as fipronil and imidacloprid has not been proven based on available data.

He does caution, however, that “product failures” have been reported for some currently used flea control products, but these failures can generally be attributed to improper use of the product and not to fleas’ resistance to the active ingredients. According to Dr. Rust, inappropriate application or administration of the product, failure to treat all pets in the household, frequent bathing (which can reduce the effectiveness of some topical products), and discontinuing treatment during the winter months can contribute to treatment failure. Additionally, pets that have been treated successfully with a product can become reinfested with fleas, which could be misinterpreted by some pet owners as a treatment failure. Urban and suburban wildlife, such as raccoons and opossums, can contribute to reinfestation of household pets that venture outdoors.

Fleas are a significant parasite affecting the overall health and well-being of cats, dogs, and the humans who share their lives. Veterinarians and researchers should understand how chemical resistance develops, become familiar with factors that help reduce the likelihood of chemical resistance, and work to help determine the best ways to prolong the longevity of the safe and highly effective parasiticides currently on the market.
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Heartworm Incidence on the Rise: What Can Veterinarians Do?

Expert insight on the number of cases and trends of heartworm disease throughout the United States, plus tips for improving client compliance with preventive medicines.

By Maureen McKinney

(continued from front cover)

provides ammunition to help veterinary practitioners step up their educational efforts with pet owners.” While the AHS incidence study is based on a retrospective look at heartworm incidence in 2016 and the CAPC information is predictive for 2017, both sets of information are based on diagnostic data that identify trends in heartworm incidence.

“Unfortunately,” says Dr. Rehm, “both models raise cause for concern, as these data indicate that heartworm incidence is on the rise and may continue to rise. It’s more important than ever that veterinarians recommend year-round heartworm prevention and stress on-time preventive administration with their clients.”

CURRENT INCIDENCE NUMBERS

The AHS 2016 Incidence Survey revealed that the average number of dogs diagnosed with heartworm disease in 2016 rose by 21.7% compared with 2013 (the AHS conducts its survey every 3 years). Of practices responding to the question, 23.3% reported seeing more heartworm cases in 2016 than in 2013 while 19.8% reported a decline in their practice areas.

No US state is heartworm-free. The survey showed that the top 5 states in heartworm incidence in 2016 were Mississippi, Louisiana, Arkansas, Texas, and Tennessee—all states that have been in the top tier since the AHS began tracking incidence data in 2001. Rounding out the top 10 states with the highest incidence were South Carolina, Georgia, North Carolina, Alabama, and Florida. Among the top 10, only Alabama, Louisiana, and Texas saw decreases in the per-practice averages of dogs diagnosed, while increases were noted in the other 7 states.

Among veterinarians who reported a decrease in heartworm incidence since the 2013 survey, 64% attributed the change to owner behavior, including increased use of heartworm preventives and improved owner compliance. Veterinarians who reported incidence increases agreed; almost half (47.8%) cited failure to give preventives, skipped doses, or failure to give preventives year-round as contributing factors.

Dr. Prior concurs. “A huge part of the problem,” he says, “is that owners are not giving the preventives as prescribed—every 30 days, year round.”

Heartworm disease is complex and involves many factors, from weather patterns conducive to transmission to the presence of vectors to the movement of infected animals from

Shifting weather patterns have created ideal breeding conditions for mosquitoes across the country.
endemic to nonendemic areas to pet owner behavior and the on-time administration (or lack thereof) of heartworm preventives. According to CAPC, the emergence of resistance to macrocyclic lactones may also be also a contributing factor. A simple fact remains, however: Heartworm disease is present in every state in the country, and where there are infected dogs or other canids, such as coyotes, native pets are at risk.

LOOKING TO THE FUTURE
According to CAPC's 2017 parasite forecast, the only area of the country expected to see below-normal heartworm activity this year is western Texas. The forecast also predicts that the hyper-endemic prevalence seen in the lower Mississippi River region will be even higher than normal. Veterinarians in the Rockies and westward, where heartworm is traditionally not seen, may see a problematic rise in infections among their patients.

CAPC and the AHS agree that shifting weather patterns, including milder temperatures and increased precipitation, have created ideal breeding conditions for mosquitoes across the country. Warm and wet weather is often associated with increases in mosquito populations and longer periods of mosquito exposure and heartworm transmission.

“Looking at areas such as the western United States,” says Dr. Rehm, “it’s very possible that an uptick in heartworm incidence can be expected.” The heartworm incidence rate in states such as California was down in 2016, which is not surprising given the extended drought conditions in much of the west. “Now that those same areas have experienced a dramatic reversal in weather conditions and above-average precipitation, it’s highly possible that growth in mosquito populations will lead to increases in heartworm transmission in the future,” notes Dr. Rehm. “Higher incidence rates could very well be expected in 2017—and perhaps even more so in 2018.”

REDUCING HEARTWORM INCIDENCE
To prevent further cases of heartworm infection, veterinarians must convince more pet owners to use preventives and to use them throughout the year—no lapses. How can veterinarians convince pet owners to get on board?

“The message to pet owners,” says Dr. Rehm, “is this: Not only is treatment of heartworm infection expensive, while treatable in dogs, infection can be fatal or have a life-long impact on the dog’s health (it can also be fatal in cats and ferrets—and there’s no approved treatment for these species).”

What’s more, Dr. Prior notes, many of the preventives available today not only prevent heartworm disease, “but they also treat and/or prevent intestinal parasites (some of which are zoonotic) and other parasites.” He recommends that veterinarians discuss heartworm disease with every client, during every visit. “Open up conversations regarding the risk of heartworm for their pets—dogs and cats,” he suggests. “Use Facebook, Instagram, and Twitter to engage your clients, then use the CAPC maps to educate them.” Practices can also sign up with CAPC to receive automatic monthly parasite updates for Facebook. Likewise, the AHS shares a continuous stream of infographics, facts sheets, videos, and other engaging client education resources—as well as resources for veterinary and staff education—through its Facebook and Twitter pages.

In addition to statewide data, CAPC offers prevalence data that localizes reported parasitic disease activity at the county level for veterinarians to use in their discussions about annual testing and year-round protection. This information is available for free at the CAPC website (capcvet.org). The annual CAPC parasite forecasts provide important information to help veterinarians and pet owners understand that parasites are a true risk to both pets and people. With significant shifts in prevalence, the CAPC maps can serve as a critical educational tool for veterinary practices.

HEARTWORM INCIDENCE 2016
© American Heartworm Society

The severity of heartworm incidence as shown in this map is based on the average number of cases per reporting clinic. Some remote regions of the United States lack veterinary clinics, therefore, we have no reported cases from these areas.

COMBATTING HEARTWORM: WHAT’S ON THE HORIZON?
Different classes of compounds are being explored, along with various prevention and treatment options, says Dr. Rehm. “Some are in very early development at this time, but any alternatives are a long way off.” For now, he says, we have only drugs currently available in the macrolide class. “These are good products that work very, very well,” he notes. “What’s important is for clients to use them!”

An integrated pest management strategy employs the use of Environmental Protection Agency–registered repellents/insecticides on pets and people, minimizing exposure, and altering the environment to discourage mosquito growth development. “So, while no new heartworm preventives are on the horizon,” says Dr. Prior, “there is good evidence that if clients engage in vector control—killing the mosquito—and diligent use of heartworm preventives, the risk for their pets is even lower.”

AmericanVeterinarian.com 29
Leptospirosis is a complicated disease for a variety of reasons. Clinical presentations can vary, disease-causing serovars can be difficult to pin down, and the zoonotic potential can threaten both veterinary caregivers and pet owners.

Diagnosis is another aspect of this disease that continues to challenge veterinary professionals. The microscopic agglutination test (MAT) has long been considered the preferred diagnostic method, but it has many shortcomings. Fortunately, recent developments in serologic testing may help to improve our diagnostic capabilities, which can translate into earlier intervention and improved patient outcomes.

OVERVIEW OF DIAGNOSTIC OPTIONS
Once exposure and infection occur in a dog, leptospires multiply in the bloodstream for about 4 to 10 days before spreading into body tissues such as the kidneys, liver, eyes, and central nervous system. At this point, they replicate in the renal tubules, facilitating urine shedding within 10 to 14 days. This timeline is important for understanding what serologic tests and other diagnostic modalities actually detect.

Some serologic tests rely on identifying immunoglobulin (Ig)M and IgG antibodies produced in response to the infection. IgM antibodies are generated relatively early—within 3 to 10 days of infection—but they don’t persist for very long, tending to decline by approximately 14 days. IgG antibodies rise more slowly, appearing 2 to 3 weeks post infection, but IgG levels remain elevated for a longer time.

Specific diagnostic tests for leptospirosis generally can be divided into 2 types:
- Tests that identify the organism itself (eg, culture testing, polymerase chain reaction [PCR] testing)
- Tests that detect the body’s immunologic response to the organism, such as the MAT or enzyme-linked immunosorbent assay (ELISA)

Test results must be interpreted in context. For example, titers take time to rise, so certain types may be low or negative during the very early stages of disease. Similarly, dogs that are vaccinated against leptospirosis are expected to have detectable antibodies, so a titer should be evaluated in light of the pet’s vaccination history.

Point-of-care tests that facilitate rapid and accurate diagnosis of leptospirosis are also available (eg, from IDEXX Laboratories and Zoetis). These tests have several advantages, including high sensitivity, small blood sample size, and quick results that permit early intervention for the patient and implementation of safety precautions for the owner to help reduce the likelihood of zoonotic transmission.

Because administration of antibiotics can affect many diagnostic tests for leptospirosis (including PCR and MAT), some diagnostic algorithms recommend first obtaining blood and urine samples. In many cases, veterinarians make a tentative diagnosis of leptospirosis based on clinical signs, suspicious chemistry panel/complete blood count (CBC) results, a medical history that supports the possibility of exposure, and supportive results from MAT testing. These results can all be inconclusive, however, making more sensitive testing modalities critically important.

The TABLE summarizes the available tests for leptospirosis. As described here, all the tests have advantages and disadvantages, and many diagnostic algorithms recommend combining tests to improve diagnostic accuracy.

MICROSCOPIC AGGLUTINATION TEST
The MAT is likely the most widely used test for the diagnosis of leptospirosis. Relatively inexpensive and performed on serum at a diagnostic laboratory, the test involves creating serial dilutions of the patient’s serum and exposing each dilution to live leptospires grown at the laboratory. Agglutination is determined via dark-field microscopy such that the highest serum
dilution that causes at least 50% of the leptospires in the sample to agglutinate is considered the patient’s titer.

Most diagnostic laboratories that conduct MAT titers maintain quantities of leptospirosis serovars based on the serovars that occur locally or in the patient’s species, but cross-reactivity can occur. Therefore, the serovar that has the highest titer does not necessarily represent the serovar causing infection in a specific patient.

False-negative results or very low titers are possible during the early stages of illness (e.g., during the initial 7–10 days) if antibiotics have been initiated prior to testing or if the serovar causing the infection is not included among the serovars used to conduct the test. False-positive results can occur in recently vaccinated patients.

In an unvaccinated patient with suspicious clinical signs and chemistry/CBC findings, a single high MAT titer is consistent with leptospirosis infection. However, titers in vaccinated dogs can be quite high, and a high titer in a vaccinated dog displaying clinical signs is not necessarily due to infection with leptospirosis. If the initial titer is inconclusive, however, a convalescent titer is recommended 2 to 4 weeks later. Ideally, a 4-fold or greater change (normally an increase) in titer strongly supports a diagnosis of leptospirosis. However, antibiotics can blunt the convalescent titer.

POINT-OF-CARE ASSAYS AND ELISA TESTS

Because of some of the shortcomings of the MAT, ELISA tests and other point-of-care tests have been developed. ELISA tests generally detect IgG and/or IgM antibodies to leptospires. Because IgM antibody levels increase relatively quickly before waning, ELISA tests that detect IgM can be helpful during the early course of illness, when MAT is more likely to be negative.

A recently released immunomigration test (WITNESS Lepto, Zoetis) detects IgM antibodies as early as 4 days post infection but is somewhat different from an ELISA test (although the functionality is arguably similar). Serum IgG levels tend to increase 14 to 21 days after infection and peak within 30 days. Some ELISA tests detect both IgG and IgM, which increases the likelihood of disease detection.

*Leptospira* possess outer surface proteins that can induce an immune response in infected dogs. Some ELISA tests can detect antibodies to these proteins. For example, IDEXX Laboratories’ SNAP Lepto Test (an ELISA test) detects antibodies to lipoprotein LipL32, which occurs abundantly on the outer membrane of *Leptospira* bacteria.

Both of these tests provide rapid results, and the ability to conduct the tests relatively early during the course of disease offers additional clinical advantages. However, both tests may yield positive results in dogs recently vaccinated against leptospirosis, so results should be interpreted in light of vaccine history.

POLYMERASE CHAIN REACTION

PCR detects the DNA of leptospires in a specimen. The test can be conducted on blood samples, ideally within the first 10 days after infection. After approximately 14 days, the organism is more likely to have invaded the renal tubules, so urine should be submitted. Submitting blood and urine samples together can improve diagnostic reliability, especially when the time of exposure is undetermined. Some test protocol algorithms recommend performing PCR testing and serology (e.g., ELISA) together to improve diagnostic reliability. Other body fluids, such as aqueous humor and cerebrospinal fluid, may also be acceptable for PCR testing. Subclinical leptospirosis carriers may test positive using PCR testing.

Potential advantages of PCR testing include the ability to conduct the test fairly early during the course of disease and the fact that recent vaccination does not influence results. Recent administration of antibiotics or a low quantity of leptospires in the sample may, however, produce false-negative results. And, although a positive PCR result confirms the diagnosis, a negative result does not rule it out. Recent administration of antibiotics or a low quantity of leptospires in the sample may result in false-negative results.

BACTERIAL CULTURE

Culture testing can be performed on urine, tissue samples, or blood, which ideally should be obtained before antibiotics are administered. Because leptospires remain in the blood for only a short time, blood cultures are recommended during the first 10 days of infection and urine samples later in the course of disease.

Outside a research setting, cultures are not widely used because the leptospirosis organisms do not survive transportation well and a special culture medium is required to maintain them. Also, the organisms grow very slowly, so results take several weeks, which would delay treatment and protective measures in a clinic setting. Further, leptospires can be cultured from blood or urine samples in clinically healthy animals, so culture results can be difficult to interpret in a practice setting.

For recommended reading, visit AmericanVeterinarian.com.

**TABLE. AVAILABLE TESTS FOR CANINE LEPTOSPIROSIS**

<table>
<thead>
<tr>
<th>TEST</th>
<th>CAN RECENT VACCINATION AFFECT RESULTS?</th>
<th>RECOMMENDED SAMPLE(S) FOR TESTING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microscopic agglutination test</td>
<td>Yes (result is also affected by prior vaccination)</td>
<td>Serum</td>
<td>• Titer may be low or inconclusive during the very early stages of disease (&lt;7-10 days).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Interpretation of results is subjective.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Paired titers are generally recommended to confirm diagnosis.</td>
</tr>
<tr>
<td>ELISA and immunomigration</td>
<td>Yes (extent may vary based on the test)</td>
<td>Whole blood, serum, plasma</td>
<td>Rapid results, the ability to test relatively early during the course of disease, and the convenience of performing some of these tests in house facilitate earlier diagnosis and treatment.</td>
</tr>
<tr>
<td>Polymerase chain reaction</td>
<td>No</td>
<td>Blood, urine, body fluids</td>
<td>• Test can be used early during the course of infection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• If the duration of the infection is unknown, submitting blood and urine samples together can improve diagnostic reliability.</td>
</tr>
<tr>
<td>Bacterial culture</td>
<td>No</td>
<td>Urine, blood, tissue samples</td>
<td>Rarely performed in a clinic setting.</td>
</tr>
</tbody>
</table>

For recommended reading, visit AmericanVeterinarian.com.

**MAT is likely the most widely used diagnostic test for leptospirosis.**

ELISA, enzyme-linked immunosorbent assay.
**Health Benefits of Functional Foods**

A literature review reveals the effects of enriched foods on a number of health conditions affecting dogs and cats.

*By JoAnna Pendergrass, DVM*

Dogs and cats are often seen as family members in pet-owning households. So, it's no surprise that dog and cat owners have become increasingly interested in purchasing wholesome pet foods that provide more than just basic nutrition.

Functional foods go beyond meeting minimal nutritional needs. The American Dietetic Association describes functional foods as "whole, fortified, enriched or enhanced foods which have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis at effective levels." Examples of functional foods studied in human nutrition include fruits, vegetables, whole grains, prebiotics, and probiotics. The results of these studies have highlighted numerous benefits of functional foods, including better digestive function, improved satiety, and enhanced antioxidant activity.

Commercial dog and cat foods contain ingredients like dietary fiber and cereal grain that have nutritional benefits. However, according to the authors of a review recently published in *Research in Veterinary Science*, little research has been conducted to evaluate functional food activity in dogs and cats. Additional research is needed to better understand how diet can affect disease prevention and treatment in pets, the authors wrote. For their review, the authors performed an extensive literature search on the use of functional foods in dog and cat nutrition.

**FUNCTIONAL FOODS IN DOGS**
The authors identified several studies that evaluated functional foods in dogs. One study reported that a diet enriched with oligofructose reduced fecal ammonia and *Clostridium perfringens* concentrations. Other studies investigated functional foods' effects on specific health issues.

**Reproductive Performance**
Antioxidant-enriched diets have been shown to improve reproductive performance. One study of 14 fertile male dogs reported increased semen motility and vitality with a diet supplemented with antioxidants.

**Cognitive Function**
Several studies have investigated the effect of functional diets on canine cognitive health. Diets enriched with antioxidants and botanicals increased levels of brain-derived neurotrophic factor, which regulates neurogenesis and supports cognitive function. These diets also improved serotonin and dopamine levels and decreased the incidence of behavioral problems associated with cognitive dysfunction.

**Halitosis**
Canine halitosis can have a negative effect on the relationship between a dog and its owner. A functional diet fed to 16 dogs with chronic halitosis was evaluated for its effect on the concentrations of oral volatile sulfur compounds. The diet significantly reduced halitosis within 30 days and continued to have a noticeable effect several weeks after the diet was discontinued.

**Chronic Otitis Externa**
Chronic otitis externa treatment for dogs often involves topical combination therapy with an antimicrobial. Given the grow-
ing problem of antimicrobial resistance, functional diets have been evaluated as an alternative treatment option for dogs with chronic otitis externa.

In a study of 15 dogs with chronic otitis externa, a functional diet was fed in conjunction with medical therapy for 8 days, then alone for 82 days. Dogs experienced marked reductions in otitis externa signs, representing “a starting point for developing functional foods endowed with antibacterial activity,” the authors wrote.

**Leishmaniasis**

Functional diets with immunomodulatory activity have been evaluated in the treatment of leishmaniasis, a parasitic infection spread by sand flies. A study compared the effects of an immune-modulating diet versus a standard diet in 20 dogs receiving medical therapy for leishmaniasis. Compared with the standard diet, the immune-modulating diet restored regulatory T-cell levels and decreased T-helper cell levels. Signs of leishmaniasis, including conjunctivitis and corneal keratinization, also improved with the immune-modulating diet.

**Palatability**

Although not a specific health issue, palatability can affect a dog’s food intake. One study determined that stabilized rice bran, a functional food with demonstrated health benefits in humans, can increase palatability of dog foods without compromising their nutrient digestibility or triggering an immune response.

**FUNCTIONAL FOODS IN CATS**

Functional foods have also been evaluated in the treatment of feline health issues.

**Chronic Diarrhea**

In a study of 55 cats with chronic diarrhea, high- and low-fat diets improved fecal scores within the first week of dietary treatment. However, no significant differences in clinical responses were observed between the 2 diets, suggesting that fat content does not play a major role in feline chronic diarrhea management.

**Obesity**

Feline obesity treatment involves reducing caloric content, which can be done by decreasing a diet’s energy density. In 1 study of 9 obese cats, researchers observed that increasing a diet’s quantity of apple pomace, a dietary fiber source, proportionally decreased the diet’s energy density. However, food intake decreased at the highest apple pomace percentage, indicating an upper limit to how much palatable fiber can be added to a cat’s diet.

**CONCERNS WITHIN THE PET FOOD MARKET**

Despite these demonstrated benefits, pet owners are skeptical of certain functional foods. For example, they tend to view corn and wheat negatively (low quality, poor nutritional value) even though these foods have antioxidant and anticancer activities. In contrast, perceptions are better for ingredients like oats and barley, which are seen as more wholesome.

Food safety is also a concern for the pet food market, given that contamination can cause nutritional deficiencies, even when a particular diet is properly formulated. Unfortunately, studying the effects of food contamination has been challenging because of the sheer number of potential contamination sources.

The authors mentioned consumer education as an additional concern, given that food labels can be difficult for pet owners to understand. More accurate food labels could help pet owners feel more informed when purchasing food for their pets.

**CONCLUSION**

A fuller understanding of functional pet foods will require more basic and applied nutritional research, the authors noted. Importantly, they believe that “the ultimate success of functional pet foods will depend on delivering bioactive components in a predictable, safe, and functional manner to effectively reduce the risk of disease and support the domestic animal’s body.”

References available at AmericanVeterinarian.com.

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**Right from the Experts’ Mouths**

*American Veterinarian* brings you video insights from experts in all areas of clinical medicine. Check out the video section of AmericanVeterinarian.com for your daily dose of knowledge.

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References available at AmericanVeterinarian.com.
The word “colic” can inspire fear and dread among horse owners. Although colic occurs in many horses at some point during their lifetime, it is often a brief episode that resolves uneventfully. Some horses may develop acute colic, however, which requires surgery and, ultimately, euthanization due to the severity of the lesion or complications after surgery. Yet, there is hope for horses after colic surgery (ventral midline celiotomy). In a recent study of horses that underwent colic surgery, the majority of animals survived to discharge, recovered fully, and returned to their prior level of activity.

In this retrospective study, recently published in *Acta Veterinaria Scandinavica*, researchers evaluated 236 horses that underwent colic surgery at the Helsinki University Equine Teaching Hospital in Finland between 2006 and 2012. The objective of the study was to evaluate the short- and long-term effects of celiotomy on a heterogeneous population of horses, including survival more than 8 years after surgery, postoperative complications, return to athletic function, and owner satisfaction. The equine patients were followed either until they died or until the end of the study on November 30, 2014, with a total time of following these patients at 8 years 10 months. Of the study horses, 17.4% were euthanized during surgery and 20.8% were euthanized during hospitalization after surgery; 82.6% recovered from anesthesia.

Of the 195 horses that survived surgery, 146 (74.9%) survived to discharge. The authors reported that the most common diagnoses at surgery were nonstrangulating displacement of the large intestine (37.3%), strangulation of the small intestine (22%), and strangulating displacement of the large intestine (20%). Enterotomy was performed in 50.4% of cases during surgery. Complications included postsurgical reflux in 27.2% of horses, and a second laparotomy was performed in 7.2% (14/195) of the operated patients (11 during the immediate postoperative period and 3 after discharge). Of the 135 horses for which full follow-up data were obtained, surgical site infection (ie, incisional drainage) occurred in 28.9% and 11% developed an incisional hernia.

If the horse survived to discharge, the prognosis for long-term survival and return to previous level of activity was good. Median survival time was 79.2 months; 83.7% of horses were able to return to their previous or intended activity after surgery, and 78.5% performed at or above their previous level of performance. While colic recurred in 20% of cases within the first year after surgery, horses with large intestinal lesions were 3.3 times more likely to have another episode of colic than were horses with small intestinal lesions.

The mean age of the horses at the time of surgery was 8.9 years, with a range of 4 days to 22.2 years. Interestingly, the age of the horse did not affect overall survival in this study. Older horses (≥15 years) had no significant difference in survival rates compared with younger horses (0–14 years); however, the number of older horses in this study was small (16%). Various breeds were represented, including Warmblood, Standardbred, Finnhorse, and other horse breeds; however, Warmblood horses were the most prominent breed (38.6%) in the study. Mares, stallions, geldings, and ponies were included.

The majority of owners (96.3%) were satisfied with the veterinary care that their horses received, and 98.5% stated that their horse’s recovery was satisfactory to good. Of the 146 horses that were discharged, survival information (the date and reason of death) was obtained for 143 (97.9%). A total of 135 owners were interviewed either by phone or email questionnaire.

The study authors stated that after colic surgery, the “majority of discharged horses had a good prognosis for long-term survival, [and] were able to return to their intended use, compete postoperatively on a satisfactory level, and also perform for several years after the operation.”
New Advice on Sterilizing Kittens: Earlier Is Better

New recommendations support kitten spay/neuter by 5 months of age. Here’s why.

By Kim Campbell Thornton

Conventional wisdom states that kittens should be spayed or neutered no earlier than 6 months of age, but feline medicine specialists now say that an earlier age for the surgery benefits cats, owners, and veterinarians alike.

The Veterinary Task Force on Feline Sterilization, which comprises 11 experts representing the breeding, shelter, and behavior communities, reviewed and discussed a year’s worth of literature to reach the recommendation—released at the 2017 North American Veterinary Community Conference—to sterilize kittens by 5 months of age.

The American Association of Feline Practitioners (AAFP) has endorsed the recommendation, stating that it parallels its own position statement on early spay and castration.

“At the moment, most of the data indicate that we have effective anesthetic protocols for younger patients,” says AAFP President Lauren Demos, BVMS, HonsBSc, resident ABVP (Feline). “As we start to piece [together] what we do have, there’s a huge suggestion that we can move this time for spays and neuters forward and do better for the cat population and cat owners.”

BENEFITS OF EARY STERILIZATION

As a species, cats tend to be underrepresented in scientific literature, especially in terms of case-controlled studies, and Dr. Demos notes the need for more data. The task force’s review of available study results, however, found that early neutering in cats is not associated with serious health problems and does not appear to adversely affect skeletal, physical, or behavioral development.

Surgery at this earlier age takes less time and permits better visualization of organs because younger kittens have less body fat. Kittens are also typically anesthetized for a shorter time because surgery goes more quickly, so the recovery period is also shorter. Kittens weighing at least 1 kg can be sterilized safely as early as 6 weeks of age.

Julie Levy, DVM, PhD, DACVIM, task force member and professor of shelter medicine at the University of Florida College of Veterinary Medicine, notes that kittens bleed less than older cats, the trauma to their tissue is not as great, and they are highly responsive to pain medication, making it easier to keep them comfortable postoperatively. Surgical techniques such as ovarian pedicle increase surgical efficiency.

The main difference between spaying kittens at 6 months of age versus 4 to 5 months of age is the perioperative environment, Dr. Levy says. Young kittens have a higher risk of becoming chilled or hypoglycemic.

“That means we feed them a few hours before surgery so they don’t become hypoglycemic, and we have a big focus on keeping them warm,” she says. “This involves making sure the air temperature in the rooms is warm, they’re not kenneled in a cold place before they’re anesthetized, all the surfaces they’re on are warm, and the whole procedure is efficient so they wake up quickly.”

Spaying or neutering earlier means that owners also can avoid the potential risk for unwanted litters. Many pet owners are surprised to learn that kittens as young as 4 months of age, and potentially even 3 months, are capable of reproducing.

“Cats, as a species, are the epitome of evolution,” Dr. Demos says. “They are made to reproduce. They’re great at surviving an environment and being prolific reproducers. That works in their favor most of the time, but in modern society, it’s less than ideal.”

Sterilization also eliminates the unpleasant behaviors that accompany feline sexual maturity, such as vocalizing, urine marking, and roaming. Multiple studies have even suggested that neutered animals live longer than intact ones, possibly because these animals are less likely to roam and fight.

A medical benefit for spayed or neutered cats is a reduced risk for mammary tumors later in life.

“There’s also a benefit if you look at it from the approach that we tend to do a kitten vaccine series and generally wrap that up by 16 weeks of age,” Dr. Demos says. “If we can tie an early spay or neuter in with that rather than asking a client to come back 2 months later for spay or neuter surgery, we might get better compliance with cats actually becoming sterilized.”

This could mean better control of the feline population because of fewer unwanted litters or that fewer cats would end up in shelters because of unwanted behavior problems related to a lack of sterilization, such as urine marking and spraying.

LINGERING OPPOSITION

Some veterinarians still worry that sterilization before 6 months of age is too early. According to the AAFP website, concerns include the safety of anesthesia and surgery in young kittens as well as potentially detrimental long-term effects on feline development. Opponents cite obesity, a decreased immune response, delayed closure of the physes of long bones, and predisposition to obstructive lower urinary tract disease as possible harmful effects.

There are certainly always going to be concerns, notes Dr. Demos. “When we discuss making a recommendation that’s broad and sweeping for patients, there will always be people on each side of the fence, and that’s valid,” she says.

“One of the reasons that we picked 5 months as an initiative, rather than potentially 2.5 or 3.5 months, is that we want to take this slowly, but if performing sterilization just 1 month earlier can reduce the risk for breeding and reduce the risk for offspring, then we’ve made some impact.”

Dr. Levy hopes that the American Veterinary Medical Association (AVMA), will also officially support the initiative. “[The] AVMA has several position statements that address the appropriateness of pediatric spay and neuter,” Dr. Levy says. “I think when the science is displayed on this topic for cats, there is no reason not to embrace it.”

References available at AmericanVeterinarian.com.
Teleradiology enables veterinarians to consult radiologists about their patients by digitally sharing images over the Internet. Eli Cohen, DVM, DACVR, a clinical assistant professor of radiology at North Carolina State College of Veterinary Medicine, recently hosted a webinar in which he offered tips for getting the most from teleradiology.

Dr. Cohen stressed the value of communication between practitioners and radiologists. “There’s no replacement for having a direct conversation about a case,” he said. However, high caseloads make it impractical to discuss every patient by telephone. In the webinar, Dr. Cohen focused on 3 areas: clinical history, positioning, and technique.

**CLINICAL HISTORY DO’S AND DON’TS**

Context is essential to making clinical decisions, said Dr. Cohen. He explained that image interpretation depends on 2 functions: the ability to pinpoint lesions, which is developed through training, and cognitive decision making, which relies on clinical context. The case history provides context and often determines which conditions remain on a radiologist’s diagnostic differential list. Without clinical context, Dr. Cohen said, a radiologist is simply an image interpreter, not a clinician consultant.

Radiographic findings are often nonspecific, he remarked, noting that a complete case history increases the sensitivity and specificity of his own reading. A referring veterinarian’s own diagnostic differential list is also useful because it means the case has passed through another person’s cognitive filter. In other words, 2 readers are better than 1.

**What Not to Do**

- **Don’t use vague or colloquial terms.** A good teleradiology relationship depends on clear communication. A consultant should be able to understand your meaning without having to guess. Use standard medical terminology in case descriptions to ensure clarity.
- **Don’t use acronyms.** Acronyms and abbreviations can also obscure your meaning. Dr. Cohen asks radiology residents not to use acronyms in their own reports.

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**As a specific example, Dr. Cohen discussed a consultation about a dog with a caudodorsal alveolar lung pattern. The referring veterinarian reported lip ulcerations and a history of chewing an electrical cord. These details, in addition to the presence of small curvilinear metal opacities in the stomach, confirmed the diagnosis of electrocution.**

**What to Do**

In addition to the images themselves, Dr. Cohen recommended providing the following information when requesting a teleradiology consult:

- **Signalment**
- **Presenting problem**
- **Relevant clinical history**
- **The referring veterinarian’s differential diagnosis**
- **Specific questions from the referring veterinarian**

**POSITIONING**

**Cervical Radiographs**

The dens of the axis should not be visible in a properly positioned lateral cervical radiograph, said Dr. Cohen, because the transverse processes of the atlas should overlie the dens. “If the dens looks great, the rad’s not straight!” For lateral cervical views, Dr. Cohen suggested placing padding under the neck to keep the cervical vertebrae horizontal and to prevent the neck from bowing toward the table. A vertical curve in the neck cre-
brates obliquity, affecting the appearance of the disk spaces and vertebral endplates (FIGURE 1).

**Orthogonal Views (taken at 90° angles)**
For thoracic radiographs, Dr. Cohen said that 3 or 4 views should be standard: at least 1 ventrodorsal (or dorsoventral) view and 2 lateral views. Lung lesions may be visible on only 1 of the lateral views, so it is best to obtain both. When a veterinary patient is in lateral recumbency, the dependent lung (toward the table) undergoes temporary positional atelectasis. The resulting decrease in gas opacity can obscure soft tissue lesions that would be visible on the other lateral view (FIGURE 2). Dr. Cohen also reminded the audience to take thoracic radiographs at maximal inspiration (if possible) and to use dorsoventral, rather than ventrodorsal, projections in unstable patients.

For abdominal radiographs, 3 views should be standard and 2 are necessary, said Dr. Cohen. Dorsoventral views of the abdomen are not usually helpful except for contrast studies and examinations focusing on the stomach, he noted. The first abdominal view taken should be the left lateral. Dr. Cohen cited a 2015 study in which dogs undergoing 3-view abdominal radiography were significantly more likely to have duodenal gas if the first projection was left lateral, followed by ventrodorsal and then right lateral. (Duodenal gas is useful as a negative contrast agent to depict mucosal lesions.)

**TECHNIQUE**
With regard to technique, Dr. Cohen focused on 2 problems: quantum mottle (FIGURE 3) and saturation artifact. “Quantum mottle is the appearance of graininess on the image and is the result of too few photons reaching the image detector,” he said. He later added by email, “The main determinant of photon number is milliampere seconds (mAs), but kilovolt peak (kVp) also impacts photon number. Doubling mAs is one method to reduce quantum mottle artifact, but because some systems do not allow changing mA and s (time) independently, it can result in increased time of exposure as time is also increased. This can lead to in-motion blur artifact, particularly in the thorax. Unlike film-screen systems where kVp has a large impact on image contrast, contrast in digital systems is largely the result of processing algorithms and presets (assuming adequate exposure). Therefore, increasing kVp can also be used to reduce quantum mottle and still achieve diagnostic contrast.”

Saturation artifact is the loss of anatomic information caused by detector overexposure. “This occurs most commonly at thin body parts in an image with variable thickness (often portions of the lung) but can occur in any part of the image,” said Dr. Cohen. “Saturated regions of the image cannot be assessed even if the image is windowed/leveled (adjusting contrast). Depending on the manufacturer of the plate, linear background striations (planking) can also be seen with overexposure. With appropriate technique, digital systems allow diagnostic assessment of the patient even across regions of different thickness.”

**CONCLUSION**
Dr. Cohen concluded the seminar by again pointing out the importance of communication between the referring veterinarian and the radiologist. He suggested making a telephone call if the radiology report does not seem to fit the case. “It really needs to be a relationship,” he said.
Private Practices and Shelters: Two Sides of the Same Coin

If healthy pets are the mutual goal, why all the controversy?

By Meredith Rogers, MS, CMPP

Being on the front lines of care for pets in your community, you are no doubt aware of the many issues that affect animal welfare. In response, you may have wondered how you could help more animals. Perhaps you’ve even thought about the work your local shelter or rescue groups are doing.

The majority of animals that leave shelters for adoptive homes are healthy, but they often do not arrive that way. Of the 6.5 million companion animals that enter shelters each year, almost 650,000 are picked up as strays.1 These animals may be sick or injured, and around 90% are intact.1 Some shelters have veterinarians on staff to treat these animals, but many partner with 1 or more veterinarians in the community who work for the shelter on a part-time or voluntary basis.

In addition to providing standard medical services, shelters often also rely on community veterinarians to help establish their intake protocols, including clinical assessment practices, vaccinations, and isolation procedures, and to assess their ongoing management routines, such as prophylactic parasite control, zoonotic and infectious disease testing, and euthanasia. Unfortunately, shelter budgets are typically less than adequate, and veterinarians who work in or with shelters do not do it to get rich.

The veterinarian–shelter relationship is essential when it comes to addressing the care of shelter animals. Where there is controversy, it is in the services that some shelters provide post adoption and to the community at large. Many shelters provide low-cost spay/neuter surgeries and vaccinations, and some also offer wellness and emergency services. Independent nonprofit groups that do not take in animals but provide low-cost assistance can also be found across the country. No one debates the value of these services, as it has been shown that the most effective way to reduce the number of animals entering shelters is through the voluntary sterilization of owned pets.2,3

However, private practice veterinarians argue that offering these services takes business away from them, and results of the 2011 Bayer Veterinary Care Usage Study—which found that profits at veterinary practices are decreasing4—seem to confirm these fears. Although the Bayer report showed that people were not taking their pets to the veterinarian as often, however, it was not because they were using subsidized services but for a number of other reasons:

• Poor economy
• Increased competition from new practices
• The substitution of Internet research for office visits
• Difficulty in getting cats to the practice

Meredith Rogers has a bachelor of science degree in animal health from the University of Connecticut and a master of science degree in microbiology and molecular genetics from Rutgers University. She has more than 19 years of experience creating content for a variety of health care audiences. She lives in Kingston, New Jersey, and shares her life with a horse, a dog, and a cat.
• The perception that wellness visits are unnecessary
• The high cost of care

The growing tension between private practice veterinarians and shelters has resulted in the filing of several legislative bills across the country. In South Carolina, for example, a bill introduced in 2013 by the South Carolina Association of Veterinarians aims to limit the kinds of services shelters can provide to animals not living in their facility; the bill was revised and reintroduced a number of times but has not yet been adopted as law.

Shelters argue that they provide valuable services to people who otherwise would not seek veterinary care for their pets due to financial constraints. Most private practice veterinary groups, including those behind restrictive legislation, support the use of low- or no-cost services for the estimated 23 million pets that live in poverty, but they feel that because many shelters do not ask for proof of income, pet owners who otherwise can afford these services are taking advantage of the subsidized programs. Shelters feel that the income levels are too limiting. The South Carolina bill would restrict the assistance shelters can provide to only those who met the federal poverty level, which is currently less than $24,600 per year for a family of 4.

Numerous communities are making it work, and these adversarial examples seem to be the exception rather than the norm. A survey of 455 private practitioners and 772 shelter representatives conducted by the CATalyst Council found that only 5% of veterinarians and 1% of shelter respondents felt that their own shelter-veterinarian relationship was antagonistic, and 53% of veterinarians and 71% of shelter representatives perceived their relationship to be one of mutual support and respect.6

Regardless of how you feel about shelters and rescue groups, they are a source of many of your clients. About 30% of pets come from shelters.7 Because most shelters and rescue groups have veterinarians to whom they refer adoptees, it is advantageous to the bottom line of practice owners to get on those lists. This does not mean that practices need to offer low-cost services; rather, they need to be available as a friendly voice. Research and visit your local shelters and rescue groups so you can support them when clients, legislatures, or the media ask. This can mean serving as a resource for health questions the shelter may have, proactively supplying information about disease outbreaks in your patients, or volunteering at an adoption Ask-the-Vet event. A more involved option is to become a member of your local shelter’s board of directors, where you will not only help direct the operations of the shelter or rescue but will be integral to fundraising and serving as a link to the community.

At the end of the day, everyone wants the same thing: healthy pets in loving homes. ■

References available at AmericanVeterinarian.com.
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1. Data on file. Zoetis Market Research: Blood Glucose Monitoring Study, February 2015. Zoetis Inc. All trademarks are the property of Zoetis Services LLC or a related company or a licensor unless otherwise noted. © 2017 Zoetis Services LLC. All rights reserved. ATK-00082