



DOG Update

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FUNGAL INFECTIONS

Disease Awareness Can Help Keep Dogs Safe

FUNGAL DISEASES IN DOGS

CAN BE CHALLENGING TO DIAGNOSE & TREAT

The 2017 National Amateur Retriever Champion, the 2016 Westminster Kennel Club Best in Show winner and a Finalist at the 2019 National Derby Retriever Championship have something in common. All suffered from fungal diseases.

Respectively, “Mully” contracted blastomycosis, “CJ” had cryptococcosis, and “Lucy” developed pythiosis, an infectious water mold disease likened to a fungal infection. Being at the wrong place at the wrong time put them at risk.

Fungal diseases occur in dogs when they inhale spores found naturally in the environment. These spores help to decompose organic waste and are

essential for the recycling of carbon and minerals in the ecosystem. Similar to fungal diseases, pythiosis occurs when dogs ingest spores from a type of oomycete, or water mold, or when these spores enter scratches or cuts on their bodies.

According to the Centers for Disease Control and Prevention, [more than two-thirds of 3,624 adults who completed an online survey in 2019 had never heard of six invasive fungal diseases.](#) Disease awareness was studied for aspergillosis, candidiasis, coccidioidomycosis, cryptococcosis, blastomycosis, and histoplasmosis. These diseases

account for [an estimated \\$7.2 billion spent annually in health care costs to treat fungal diseases in humans.](#)

Likewise, “dogs are especially at risk for fungal diseases given their inquisitive nature and close proximity to the outdoors,” says Jane Sykes, BVSc, PhD, MBA, DACVIM, professor of small animal medicine at the University of California-Davis. “Dogs dig vigorously and bury their noses in the soil and in decomposing wood and leaves. They swim, wade and drink from lakes and ponds. They eat grass and chew on sticks. As dogs hunt, explore and roam about, they can inhale or ingest invasive spores that have the potential to cause fungal disease.”

Here is a review of five fungal diseases that occur in dogs and the infectious disease pythiosis. All are endemic in certain areas (See map on page 3) except for aspergillosis that can be found virtually anywhere. Sometimes difficult to diagnose and challenging to treat, these diseases are worthy of being knowledgeable about to keep your dog safe and healthy.

BLASTOMYCOSIS: FOUND IN SOIL, DECAYING WOOD & LEAVES

An animated Labrador Retriever who always delivered a solid performance on his water marks, Mully (NAFC-FC-AFC Mulligan Off The Rainy “T”) returned an uncharacteristic, lackluster performance in the fall of 2019. Owner Randy Spangler of Mondovi, Wisconsin, assumed his 9-year-old, the 2017 National Amateur Retriever Champion, was beginning to show signs of age.

“When Mully became lethargic and lost weight, I grew concerned,” Spangler says. “I took him to his veterinarian, who noticed his prostate was swollen. Suspecting cancer, he took a biopsy of Mully’s prostate.”

Three days later, the test results came back. Rather than having cancer, Mully had blastomycosis. “Mully began



Owner-handler Randy Spangler, left, is shown with “Mully” after winning the 2017 National Amateur Retriever Championship. At right is trainer Wayne Curtis of Fox Hollow Retrievers.

declining rapidly,” says Spangler. “He could not drink or urinate. I rushed him to the University of Minnesota, where he stayed for 10 days.”

Blastomycosis occurs when dogs inhale the spores of *Blastomyces dermatitidis*, a pathogen found in soil, decaying wood and leaves, and animal waste often located near ponds, lakes and rivers. The organism transforms to a yeast that [can invade the lungs and then spreads throughout the body](#).

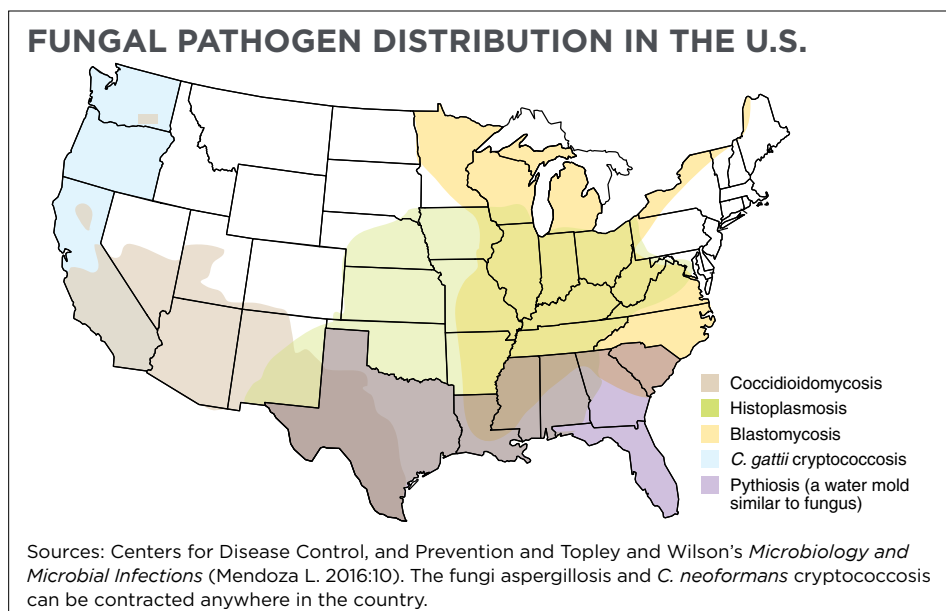
“I believe Mully picked up blastomycosis when traveling to field trials in late summer in northern Minnesota and Wisconsin,” says Spangler. “The pathogen is endemic in these regions, especially in areas near water or disturbed soil.”

[Clinical signs of an infection](#) in dogs include: coughing, exercise intolerance and respiratory distress due to lung involvement in 65 to 85 percent; enlargement of one or more lymph nodes in 30 to 50 percent; ocular lesions in 20 to 50 percent; skin lesions of the nose, face and nail beds in 30 to 50 percent; and bone infections causing lameness in up to 30 percent. Infections of the prostate, kidneys, testes, joints, nasal passages, and brain are less common.

Diagnosis is based on a culture grown from affected tissues or from a *Blastomyces* antigen concentration in urine (BACU) test. Along with lung radiographs, the antigen test helps to determine a dog’s prognosis. A study at the University of Minnesota published in the March-April 2021 issue of the *Journal of Veterinary Internal Medicine* [reports that dogs having higher *Blastomyces* antigen concentrations in urine and more severe radiographic pulmonary disease have shorter survival](#).

As with Mully, most cases of canine blastomycosis are diagnosed in late summer or early fall. The disease may incubate for weeks or months before suddenly progressing. Historically, [53 to 75 percent of dogs survive blastomycosis with treatment](#). The [most common cause of death from blastomycosis is respiratory failure](#), with 75 percent of deaths occurring within the first week of treatment.

Veterinarians treat blastomycosis with an antifungal medication, typically



itraconazole or fluconazole, alone or combined with an injectable medication known as amphotericin B. Treatment is generally required for several months. [Twenty to 25 percent of dogs relapse](#) usually within six months of therapy related to the severity of lung disease. [Retreatment with an additional 60- to 90-day course of medication](#) has an 80 percent chance of producing a cure.

Six months after Mully was treated with the antifungal medication fluconazole, which was chosen for its ability to penetrate the prostate, his BACU test came back negative. “Now, he’s 100 percent,” Spangler says with a sigh of relief. “I tell everyone I talk to who has a dog that seems off with no known cause to test for fungus. If you wait, it may be too late.”

CRYPTOCOCCOSIS: AIRBORNE FUNGUS FROM BIRD DROPPINGS

It was a short ride to the top for CJ, the German Shorthaired Pointer who won Best in Show at Westminster in 2016 at 3 years of age. MBIS/MBISS GCHP VJK-MYST Garbonita’s California Journey CD RN CGCA CGCU TKA settled into semiretirement as the cherished companion of breeder-owner-handler Valerie Nunes-Atkinson, of Temecula, California, and her family.

Nunes-Atkinson recalls vividly late June 2020 when CJ gave a tiny yelp when getting up. “The next day he was

slightly lame on his right front leg,” she says. “A couple of days later, he was no better. He was lethargic, had quit eating and had blood in his urine.”

A veterinary examination that included a complete blood count found nothing amiss. However, over the next two months CJ’s signs worsened as Nunes-Atkinson desperately sought answers. “It was a very difficult diagnosis,” she says. “We not only did multiple blood panels, ultrasounds, MRIs (magnetic resonance imaging), a spinal tap, a joint tap, and various specific blood tests, they all came back negative. Even initial cancer lymphoma screening proved negative.”

While reviewing CJ’s extensive veterinary file, a veterinary neurologist saw that an MRI scan showed enlargement of his brachial plexus, the first two thoracic nerves and last three cervical nerves of the spine, which control the front legs. As a precaution, the veterinarian took bloodwork for an antigen test for *Cryptococcus*, which can cause nerve enlargement, inappetence, lethargy, and blood in urine. Three days later, the test results came back showing CJ was positive for the fungal disease.

Cryptococcosis can occur when dogs inhale the spores of *Cryptococcus*. [Cryptococcus neoformans is found worldwide in soil, on decaying wood, in tree hollows, and droppings from birds](#), especially pigeons. Another species, *Cryptococcus gattii*, is endemic in the Pacific Northwest; it is found in soil



“CJ” shown with Valerie Nunes-Atkinson wins Best in Show at Westminster in 2017. Although he was a young dog who had been shown on a limited basis, he had won 17 Bests in Show going into Westminster. Top: CJ is pictured at home in California.

and is associated with eucalyptus and several hardwood tree species. The fungal pathogen [can remain viable in the environment for years](#). The [incubation period between exposure to the fungus and development of disease can be two to 13 months](#).

The *C. neoformans* infection that CJ had is believed to be transmitted via airborne inhalation. Humans who are immunocompromised, especially those

with AIDS, are vulnerable. Dogs with cryptococcosis frequently develop severe disease throughout their bodies.

“This disease affects the central nervous system in nearly two-thirds of dogs after it disseminates from the lungs,” Dr. Sykes says. “Other major organ systems affected are the eyes, urinary system and nasal cavity, but any organ can be involved.

“Weight loss, lethargy and loss of appetite are common. As the disease progresses, clinical signs may include seizures, vomiting, diarrhea, incoordination, blindness, enlarged lymph nodes, and skin lesions.”

“CJ was healthy his entire life,” Nunes-Atkinson says. “The last two weeks of his life, months after the onset of cryptococcosis, he was diagnosed with lymphoma. It was then we knew we were in a no-win situation. To provide care for cryptococcosis you need to booster the immune system and to fight cancer you essentially deactivate the immune system.”

CJ was among the dogs in which *Cryptococcus* involves the central nervous system. “His veterinarian started him immediately on antifungal medications and the steroid prednisone,” says Nunes-Atkinson. “Even without the lymphoma, his recovery was against the odds.”

The medications gave CJ a temporary reprieve, but it was short-lived. On Sept. 21, 2020, the unforgettable Westminster Best in Show winner, was euthanized at home surrounded by his family of humans and dogs.

“In the beginning, I wanted him to run and gallop across the yard as he used to do,” says Nunes-Atkinson. “Once I realized that was never going to happen, I just wanted him to be happy and not in pain. This was such a heartbreak to endure.”

Dr. Sykes and co-investigators recently published [a study evaluating a rapid diagnostic test for the fungal disease](#). “We collected blood samples and analyzed them with the standard *Cryptococcus* test and comparing those results to two new rapid point-of-care fungal tests,” Dr. Sykes says. “Increased availability of rapid, inexpensive diagnostic tests that can be performed in the veterinary clinic will enable earlier diagnosis and the potential for an affected dog to begin treatment sooner.”

PYTHIOSIS: A WATER MOLD DISEASE

“Lucy” (Coolwater’s Little Knockout Slugger QAA), a Labrador Retriever owned by Robin and Chuck Cagle of Clanton, Alabama, was only 8 months old when she developed a mass under her neck that did not respond to antibiotics. Her veterinarian discovered the mass while putting stitches in an injured foot. Suspecting the mass was caused by the infectious disease pythiosis, the veterinarian sent tissue and blood samples off for analysis.

Pythiosis is caused by the oomycete, or water mold, *Pythium insidiosum*. Clinical signs of the potentially fatal infectious disease, even its appearance in cultures, resemble the infectious disease lagenidiosis and the rare fungal infection mucormycosis. Thus, a definitive diagnosis is essential via micro-

STEPS TO HELP REDUCE RISK OF FUNGAL DISEASES IN DOGS

Here are preventive practices to help reduce the risk of your dog having contact with invasive fungal spores.

- Be cautious of letting your dog roam and explore soil containing decaying wood and leaves, particularly near lakes and rivers, in areas endemic for **blastomycosis**. Do not let your dog run where there is recently dug up soil or construction sites undergoing excavation.
- Avoid letting your dog dig or run freely in areas endemic for **coccidioidomycosis**. Precautions include avoiding construction areas where dirt excavation is taking place. Also, dogs should not be housed outdoors in desert areas known for having the fungal pathogen.
- Restrict your dog from exploring caves or running in areas where the soil is heavily contaminated with bird or bat droppings to avoid **cryptococcosis** and **histoplasmosis**.
- Do not let your dog swim or drink from lakes, ponds and standing water containing grass or aquatic vegetation especially during the hot months in areas endemic for **pythiosis**.
- Seek prompt veterinary care if your dog develops respiratory or other signs indicative of a possible fungal infection. Ask your veterinarian about the possibility of fungal disease, particularly if you have traveled through an area known for having disease.

biological, molecular and proteomic assay laboratory testing. Clinically distinguishing the type of infection is important because it affects therapy choices as well as a dog's prognosis.

Pythiosis is a potentially fatal disease that dogs contract in tropical and subtropical areas, though cases have been reported as far north as the upper Midwest. [An environmental sampling by researchers at the University of Florida](#) studied the prevalence of *P. insidiosum* spores in Florida.

"We used animal hair as bait and found swimming spores to be common in Florida lakes and ponds during the warmer months," says Erica M. Goss, PhD, associate professor of plant pathology at the Emerging Pathogens Institute of the University of Florida.

"We found that warm standing water in lakes and ponds in north central Florida is a suitable habitat for *P. insidiosum*,"

Dr. Goss says. "This study provided the first evidence that this organism may be more widely distributed in freshwater lakes and ponds in the Southeastern U.S. than previously thought. Dogs that are infected can die from this, so it is critical to prevent infection."

Pythiosis [can be cutaneous affecting the skin or subcutaneous affecting the gastrointestinal system](#). The cutaneous form occurs when *P. insidiosum* spores infect the skin or enter through open scratches or cuts on a dog's body. Ulcerations are found at the base of the tail,



As an 8-month-old puppy, "Lucy" contracted cutaneous pythiosis. Above: The ulceration under her neck likely developed when *P. insidiosum* spores entered her body from an open wound on her elbow, says owner Robin Cagle.



PHOTO: JILLIAN H. GREEN PHOTOGRAPHY

below the anus, on the legs, or under the neck, chest and abdomen. The ulcerations progress quickly, eventually becoming wounds that do not heal. Hence, they are often misdiagnosed as bacterial infections.

The gastrointestinal form of pythiosis causes weight loss, diarrhea and vomiting. Hard tumor-like masses form in the gastrointestinal tract, and the intestinal

walls become thickened and ulcerated. These masses can spread to adjacent tissues, such as the pancreas, uterus and lymph nodes. "Dogs that drink contaminated water or eat contaminated grass are susceptible to intestinal infections," Dr. Goss says.

Veterinarians treat the disease by removing the infected tissues or mass, even limb amputation or intestinal

resection, if necessary. If *P. insidiosum* is not completely removed, the ulceration may return. Antifungal medications have not been shown to be successful in treating pythiosis.

Lucy was treated for cutaneous pythiosis with the surgical removal of the ulceration under her neck. Six months after her diagnosis, Lucy resumed training with short retrieves.

FUNGAL DISEASES AFFECTING DOGS

Nonspecific clinical signs including lethargy, weakness, inappetence, weight loss, and fever may occur with all fungal diseases. Fungus-specific signs are listed below.

Disease/Pathogen	Clinical Signs	Treatment
Aspergillosis/ <i>Aspergillus fumigatus</i>	<ul style="list-style-type: none"> Nose bleeds and/or nasal discharge Sneezing Ulcerated or depigmented nostril edges 	<ul style="list-style-type: none"> Infusal of antifungal medication, such as terbinafine combined with posaconazole, voriconazole or itraconazole, directly into the nasal passages under anesthesia
Blastomycosis/ <i>Blastomyces dermatitidis</i>	<ul style="list-style-type: none"> Coughing, exercise intolerance and respiratory distress Enlargement of lymph nodes Ocular lesions Lameness Skin lesions of the nose, face and nail beds Infections of the prostate, kidneys, testes, joints, nasal passages and brain are possible though less common 	<ul style="list-style-type: none"> Antifungal medication such as itraconazole or fluconazole alone or combined with an injectable medication known as amphotericin B Corticosteroid such as prednisone
Coccidiomycosis/ <i>Coccidioides</i> spp.	<ul style="list-style-type: none"> Seizures, blindness, behavioral changes, and cranial nerve defects due to central nervous system and neurological involvement Infection throughout the body Lower respiratory signs 	<ul style="list-style-type: none"> Long-term antifungal medication such as fluconazole or itraconazole Supportive care
Cryptococcus/ <i>Cryptococcus</i> spp.	<ul style="list-style-type: none"> Severe disease throughout the body Central nervous system Respiratory lesions Eyes, urinary system and nasal cavity involvement 	<ul style="list-style-type: none"> Antifungal medication such as fluconazole or itraconazole Short-term treatment with corticosteroid such as prednisone if central nervous system or severe pulmonary disease is present
Histoplasmosis/ <i>Histoplasma capsulatum</i>	<ul style="list-style-type: none"> Cutaneous form includes ulcerations on the tail, legs and under the neck, chest and abdomen Gastrointestinal form involves weight loss, diarrhea and vomiting plus tumor masses may form in the GI tract and spread to other tissues 	<ul style="list-style-type: none"> Antifungal medication such as itraconazole or fluconazole
Pythiosis*/ <i>Pythium insidiosum</i>	<ul style="list-style-type: none"> Cutaneous form includes ulcerations on the tail, legs and under the neck, chest and abdomen Gastrointestinal form involves weight loss, diarrhea and vomiting plus tumor masses may form in the GI tract and spread to other tissues 	<ul style="list-style-type: none"> Surgical removal of infected tissues or mass Immunotherapy injections Gastrointestinal pythiosis involves giving antifungal medications, itraconazole and terbinafine, combined with a corticosteroid such as prednisone

*A water mold infection that is similar to fungal infections

Fourteen months after the diagnosis, she made it through 10 rigorous land and water series to be a Finalist at the 2019 National Retriever Derby Championship.

“It was a miracle that Lucy’s ulceration was found in time,” Robin Cagle says. “Today, I check her often for any unusual sores, and I don’t let her in ponds or lakes until cuts or abrasions are completely healed. If there is algae or plant growth, I refrain from allowing her to retrieve in water.”

ASPERGILLOSIS: FOUND IN COMPOST & LEAVES

Sinonasal aspergillosis is a fungal infection that affects dogs when they inhale *Aspergillus fumigatus* spores. Most often living in compost and leaves, *A. fumigatus* can be found almost anywhere in the country.

When dogs inhale *A. fumigatus* spores, the pathogen destroys the delicate bony scrolls of their nasal sinuses. Not all dogs are affected; those that develop the illness may produce **too much of specific cytokine chemicals** preventing the immune system from fighting the fungus. Nose bleeds, nasal discharge, sneezing, and ulcerated or depigmented nostril edges are **signs of aspergillosis**. Less commonly, other species of *Aspergillus*, such as *Aspergillus terreus* and *Aspergillus deflexus*, cause disease involving other parts of the body, known as disseminated aspergillosis. This type could affect the bones, especially the intervertebral discs, causing lameness and incoordination. Fever, reduced appetite, weight loss, and depression may occur as well.

Diagnosis of sinonasal aspergillus involves radiographs, computed tomography or magnetic resonance imaging combined with a rhinoscopy to check for fungal plaques in the nose, cultures of nasal discharge, and a urine antibody test. **Veterinarians treat aspergillosis** by infusing an antifungal medication directly into the nasal passages while a dog is anesthetized. The procedure is effective in about 86 percent of dogs, though some dogs may need more than one infusion to resolve the illness.

COCCIDIOIDOMYCOSIS: ‘VALLEY FEVER’ OF THE DESERT SOUTHWEST

Coccidioidomycosis, or “Valley Fever,” is a systemic fungal infection caused by *Coccidioides immitis* or *Coccidioides posadasii*, organisms endemic in California, Arizona, New Mexico, Texas, and northern Mexico. When dogs inhale the dustborne spores brought to the surface after heavy rain, they can cause respiratory infection and spread throughout the body. Illness ranges from mild to severe disease.

“Cases of coccidioidomycosis have increased dramatically in the Southwest over the past decade,” says Krystle L. Reagan, DVM, PhD, assistant professor of small animal medicine at the University of California-Davis. “Clinical signs appear one week to three years after infection.”

Seizures are the most frequent **clinical sign of dogs** with central nervous system involvement. Blindness, behavioral changes, and cranial nerve deficits also occur with neurological effects. Pain, fever, inappetence, and coughing are common signs.

Detection of anti-*Coccidioides* antibodies using cytology to study cells, histopathology to look at tissue cells or a culture to identify the fungal organisms helps in **diagnosis of the disease**. A more recent diagnostic tool is an antibody test shown by researchers at the University of California-Davis to effectively screen dogs suspected of having coccidioidomycosis. The lateral flow assay (LFA) point-of-care test provides more rapid test results compared to the traditional a gar gel immunodiffusion (AGID) test.

“The LFA test provides accurate, positive results,” says Dr. Reagan. “A definitive diagnosis can be difficult, invasive, slow and even risky to laboratory personnel, so this helps by making the process faster and easier.”

Veterinarians treat coccidioidomycosis with long-term antifungal medications and supportive care. Fortunately, for most dogs, their prognosis is good when coccidioidomycosis is caught early.

HISTOPLASMOSIS: FOUND IN SOIL WITH BIRD & BAT WASTE

Dogs are at risk for developing histoplasmosis when they **inhale *Histoplasma capsulatum* spores contained in soil**, often with bird and bat excrement. Found in the Midwest, particularly around the Mississippi River Valley, *H. capsulatum* thrives in warm environments. **Dogs with prolonged exposure** to high levels of the organisms are at increased risk of contracting histoplasmosis. After dogs inhale the spores, they are converted to yeast in the lungs where they reproduce and are spread throughout the body via the circulation.

The **disease can affect any organ**, though most often the lungs, gastrointestinal system, lymph nodes, liver and spleen are affected. If the lungs are involved, a dog may have difficulty breathing or chronic coughing. Intestinal involvement may include signs such as diarrhea, bloody stools or difficulty passing a bowel movement. Other affected organs may include lymph nodes, eyes, bone marrow, and the liver.

Veterinarians use radiographs, urinalysis and blood tests to help detect the fungus. Biopsy samples may be needed for histopathology analysis. Not all dogs survive treatment with antifungal medications, and some dogs may need several months of therapy.

Fungal diseases in dogs can be dangerous. Treatment can be expensive and long term, even lifelong. Being aware of these pathogenic fungal organisms can help you keep your dog safe while enjoying the outdoors. ■

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