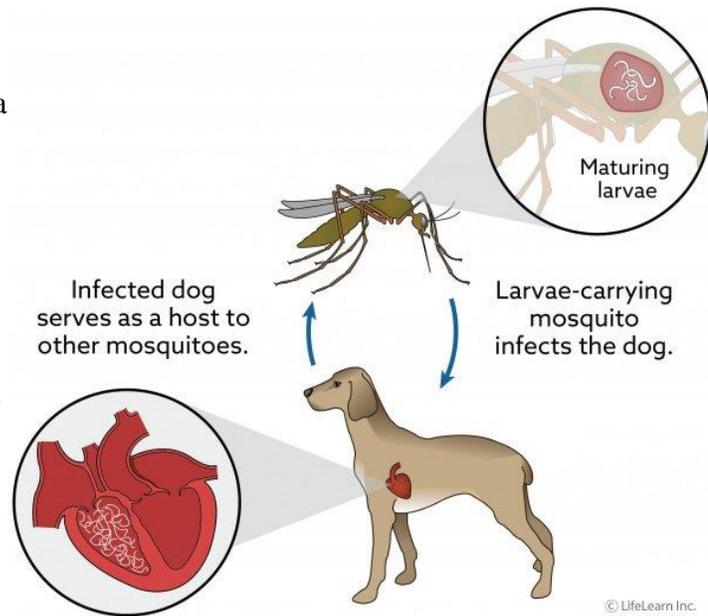


## What causes heartworm disease?

**Heartworm disease**, or dirofilariasis, is a serious and potentially fatal disease. It is caused by a blood-borne parasite known as *Dirofilaria immitis*.

Adult heartworms are found in the heart, pulmonary artery, and adjacent large blood vessels of infected dogs. Rarely, worms may be found in other parts of the circulatory system. Female adult heartworms are 6 - 14" long (15 - 36 cm) and 1/8" wide (3 mm). Males are about half the size of females. One dog may have as many as 300 worms present when diagnosed.



Adult heartworms may live up to five years. During this time, females produce millions of offspring called **microfilaria**. These microfilariae live mainly in the small vessels of the bloodstream.

## What is the life cycle of the heartworm?

The life cycle of the heartworm is complicated; the parasite requires the mosquito as an intermediate host before it can complete its life cycle in the dog. The mosquito is integral in the life cycle of heartworm. As many as 30 species of mosquitoes can transmit heartworms.

The life cycle begins when a female mosquito bites an infected dog and ingests the microfilariae during a blood meal. The microfilariae develop further for 10 to 30 days in the mosquito's gut and then enter its mouthparts. At this stage, they are infective larvae and can complete their maturation when they enter a dog. The infective larvae enter the dog's body when the mosquito bites the dog.

These infective larvae migrate into the bloodstream and move to the heart and adjacent blood vessels, maturing to adults, mating, and reproducing microfilariae within 6 to 7 months.

## Where is heartworm disease found?

Canine heartworm disease occurs all over the world. In the United States, it was once limited to the south and southeast regions. The highest numbers of reported cases are still within 150 miles of the Gulf of Mexico and the Atlantic Ocean coastlines and along the Mississippi River and its tributaries. However, the disease is spreading and is now found in most regions of the United States, including California, Oregon, and Washington.

In Canada, the disease is problematic in areas where mosquitoes are prevalent, such as along waterways and coastlines in many provinces. The greatest number of Canadian cases occurs around the southern Great Lakes.

Factors that affect the prevalence of heartworm infection include the species of mosquitoes, the climate, and the presence of reservoir animals.

The risk of infection is greatest when mosquitoes are actively feeding. This typically requires temperatures over 50°F (10°C).

## How is heartworm disease spread?

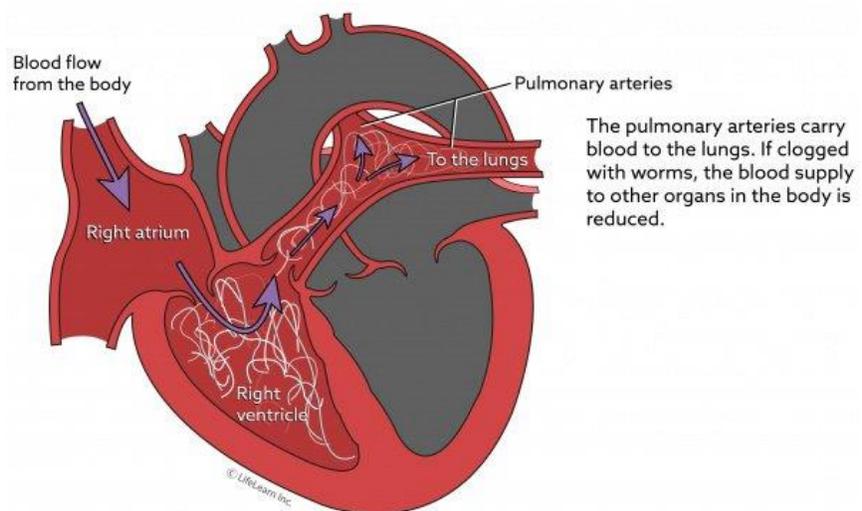
Since transmission requires the mosquito as an intermediate host, the disease is not spread directly from dog to dog. Spread of the disease therefore coincides with mosquito season, which can last year-round in many parts of the United States. The number of dogs infected and the length of the mosquito season are directly correlated with the incidence of heartworm disease in any given area.

## What do heartworms do to the dog?

It usually takes several years before dogs show clinical signs of infection.

Consequently, the disease is diagnosed mainly in two- to eight-year-old dogs. The disease is rare in dogs less than one year of age, because the microfilariae take 5 to 7 months to mature into adult heartworms after infection.

Unfortunately, by the time clinical signs are seen, the disease is usually well advanced.



**Adult heartworms.** Adult heartworms cause disease by clogging the heart and major blood vessels leading from the heart, including the pulmonary artery. They also interfere with the function of valves within the heart. By clogging the main blood vessels, the blood supply to other organs of the body is reduced, particularly blood flow to the lungs, liver, and kidneys. Decreased blood flow and decreased oxygen delivery can cause these organs to malfunction.

The signs of heartworm disease depend on the number of adult worms present, the location of the worms, the length of time the worms have been in the dog, and the degree of damage that has been sustained by the heart, lungs, liver, and kidneys.

"The most obvious clinical signs of heartworm disease are a soft, dry cough, shortness of breath, weakness, listlessness, and loss of stamina."

The most obvious clinical signs of heartworm disease are a soft, dry cough, shortness of breath, weakness, listlessness, and loss of stamina. All of these signs are most noticeable following exercise, when some dogs may even faint or become disoriented. Your veterinarian may notice abnormal lung and heart sounds when listening to the chest with a stethoscope.

In advanced cases, congestive heart failure may cause the abdomen and legs to swell from fluid accumulation. There may also be evidence of weight loss, poor condition, and anemia. Severely infected dogs may die suddenly during exercise or excitement.

**Microfilariae (immature heartworms).** Microfilariae circulate throughout the body but remain primarily in the small blood vessels. Because microfilariae are about as wide as the small vessels, they may block blood flow in these vessels. The cells being supplied by these vessels are then deprived of the nutrients and oxygen normally supplied by the blood. Microfilariae primarily injure the lungs and liver. Destruction of lung tissue leads to coughing. Liver injury leads to cirrhosis of the liver, causing jaundice, anemia, and generalized weakness. The kidneys may also be affected and allow toxins to accumulate in the body.

### **How is heartworm disease diagnosed?**

In most cases, one or more simple blood tests will diagnose heartworm disease. Further diagnostic tests are often required in heartworm-positive dogs to determine if the dog can safely undergo heartworm disease treatment. Some or all of the following diagnostic procedures are recommended before treatment is started:

**Serological test for antigens to adult heartworms (antigen test, ELISA).** This test is performed on a blood sample. See the handout "Testing for Heartworm Disease in Dogs" for further details.

**Chest radiographs (X-rays).** Radiographs are often recommended in dogs with heartworm disease, to assess the extent of heart and lung damage present prior to beginning treatment.

**Bloodwork (complete blood cell count, serum biochemistry).** Blood tests may also be recommended prior to the treatment of heartworm disease, in order to assess for the presence of heartworm-associated organ damage.

### **How is heartworm disease treated?**

There is some risk involved in treating dogs with heartworms, although fatalities are rare.



"A new drug is available that does not have as many side effects, allowing successful treatment of more than 95% of dogs with heartworms."

In the past, the drug used to treat heartworms contained high levels of arsenic and toxic side effects frequently occurred. A new drug is available that does not have as many side effects, allowing successful treatment of more than 95% of dogs with heartworms.

Many dogs have advanced heartworm disease at the time they are diagnosed. This means that the heartworms have been present long enough to cause substantial damage to the heart, lungs, blood vessels, kidneys, and liver. Rarely, cases may be so advanced that it is safer to treat organ damage and keep the dog comfortable than it is to risk negative effects associated with killing the heartworms. Dogs in this condition are not likely to live more than a few weeks or months. Your veterinarian will advise you on the best treatment approach for dogs diagnosed with advanced heartworm disease.

**Treatment to kill adult heartworms.** An injectable drug, melarsomine (brand name Immiticide®), is given to kill adult heartworms. Melarsomine kills the adult heartworms in the heart and adjacent vessels. This drug is administered in a series of injections. Your veterinarian will determine the specific injection schedule according to your dog's condition. Most dogs receive an initial injection, followed by a 30-day period of rest, and then two more injections that are given 24 hours apart.

Many dogs will also be treated with an antibiotic (doxycycline), to combat potential infection with bacteria (*Wolbachia*) that inhabit the heartworm.

"Complete rest is essential after treatment."

**Complete rest is essential after treatment.** The adult worms die in a few days and start to decompose. As they break up, they are carried to the lungs, where they lodge in the small blood vessels and are eventually reabsorbed by the body. This resorption can take several weeks to months, and most post-treatment complications are caused by these fragments of dead heartworms. This can be a dangerous period so it is **absolutely essential** that the dog be kept as quiet as possible and is not allowed to exercise for one month following the final injection of heartworm treatment. The first week after the injections is critical because this is when the worms are dying. A cough is noticeable for seven to eight weeks after treatment in many heavily infected dogs. If the cough is severe, notify your veterinarian for treatment options.

Prompt treatment is essential if the dog has a significant reaction in the weeks following the initial treatment, although such reactions are rare. Notify your veterinarian if your dog shows loss of appetite, shortness of breath, severe coughing, coughing up blood, fever, or depression. Treatment with anti-inflammatories, antibiotics, cage rest, supportive care, and intravenous fluids is usually effective in these cases.

**Treatment to kill microfilaria.** In addition to the drug that is used to kill adult heartworms, your dog will receive a drug to kill microfilariae (heartworm larvae). Your dog may need to stay in the hospital for observation on the day this medication is administered, and this may be performed

either before or after the injections for adult heartworms. Following treatment, your dog will be started on a heartworm preventative.

"Newer heartworm treatment protocols use a variety of drugs to kill the microfilariae."

Newer heartworm treatment protocols use a variety of drugs to kill the microfilariae. Your veterinarian will select the correct drug and administration time based on your dog's condition.

### **Are any other treatments necessary?**

Dogs with severe heartworm disease may require antibiotics, pain relief medications, special diets, diuretics to remove fluid accumulation in the lungs, and/or drugs to improve heart function prior to treatment for the heartworms. Even after the heartworms have been killed, some dogs may require lifetime treatment for heart failure. This includes the use of diuretics, heart medications such as ACE-inhibitors, beta-blockers or cardiac glycosides, and special low-salt diets.

### **What is the response to treatment and the prognosis post-treatment?**

Dog owners are usually surprised at the improvement in their dog following treatment for heartworms, especially if the dog had been demonstrating clinical signs of heartworm disease. **Many dogs display renewed vigor and vitality, improved appetite, and weight gain.**

### **How can I prevent my dog from getting heartworms?**

You can prevent your dog from getting heartworms by using a heartworm preventative. When a dog has been successfully treated for heartworms, it is essential to begin a heartworm prevention program to prevent future recurrence. With the safe and affordable heartworm preventives available today, no pet should ever have to endure this dreaded disease. Consult with your veterinarian to determine which heartworm preventive program is best for your dog.