

THE WHOLE STORY ABOUT HEARTWORM

(much of which you may not be told otherwise)

Notes by Lee Cullens, March 2008
(updated 05/07/08)

*In memory of Daisy 1997-2007
a beloved companion that suffered because of my ignorance,
and blind acceptance of advice from those regarded as knowledgeable.
The crucial quality of life decisions are yours alone,
and should be based on as much balanced information as can be acquired.
Your companion animal can't speak for itself,
it relies on your sense of responsibility for protection.*

This paper was compiled, in part, because of commercial interest fear tactics, misinformation, and the susceptibility of many to not see beyond such. I suspected there was more to the issue, and believed a more balanced understanding might help other companion animals.

This paper is not intended as medical advice, and should not be taken as such. It is simply a compilation of notes from my research to better maintain the health of my own dogs, and is shared for informational purposes only. The idea is to be much better prepared when one does consult with a veterinarian :-)

I am not asking that you “believe” everything I put forth, but I do hope, for the sake of your companion animal, that you read and understand the contents of this paper. You should not believe anything unless you have satisfied yourself with further thorough research.

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What is Heartworm

First, let's make sure we all understand that heartworm infestation can be extremely serious, and that infected dogs and cats that go untreated may die. Even treatment of infestation can be very uncomfortable (sometimes requiring surgery in advanced cases) and can be very detrimental to a pet's health otherwise – pets may die from “complications” during treatment. On the other hand, prevention measures may be just as detrimental to an animal's health in the short term and/or the long term, so it's important that one knows enough to make the best choices in their own circumstances.

Heartworm infection is caused by a filarial organism, *Dirofilaria immitis*. At least 70 species of mosquitoes can serve as intermediate hosts, of which the most common vectors are *Aedes*, *Anopheles*, and *Culex*. Heartworm infections are possible in dogs, cats, wolves, coyotes, foxes, and some other animals, such as ferrets, raccoons, sea lions, and even humans. It is called a "heartworm" because the parasite, in the final reproductive stage of its life cycle, resides most often in the heart of its host where it can live for many years, potentially eventually killing its host. Heartworm disease in cats is thought to be less frequent than in dogs, however due to restricted pulmonary vascular capacity and subsequent pathology, cats are more likely to die as a result of heartworm infection.

Adding to the problem is a parasite called *Wolbachia* that lives symbiotically inside heartworms. *Wolbachia* is a rickettsial organism, similar to those that cause tick disease. Studies indicate that though *Wolbachia* are not known to cause mammalian disease, this parasite may contribute to the adverse effects of both heartworm infection and heartworm treatment, including inflammation, embolism and allergic reaction.

Though infected mosquitos are capable of transmitting heartworm infections to humans, there are no reports of such infections becoming patent. Maturation of the infective larvae may progress to the point where they reach the lungs, become encapsulated, and die. The dead larvae precipitate granulomatous reactions called “coin lesions,” which are medically significant because radiographically they appear similar to metastatic lung cancer and may initiate exploratory surgery.

Please understand herein that, while I'm not exactly enamored with the status quo practice of veterinary medicine, I believe that only a small number think primarily in terms of profits. We are all human, each with our own share of faults, trying to pursue a career as best we know how.

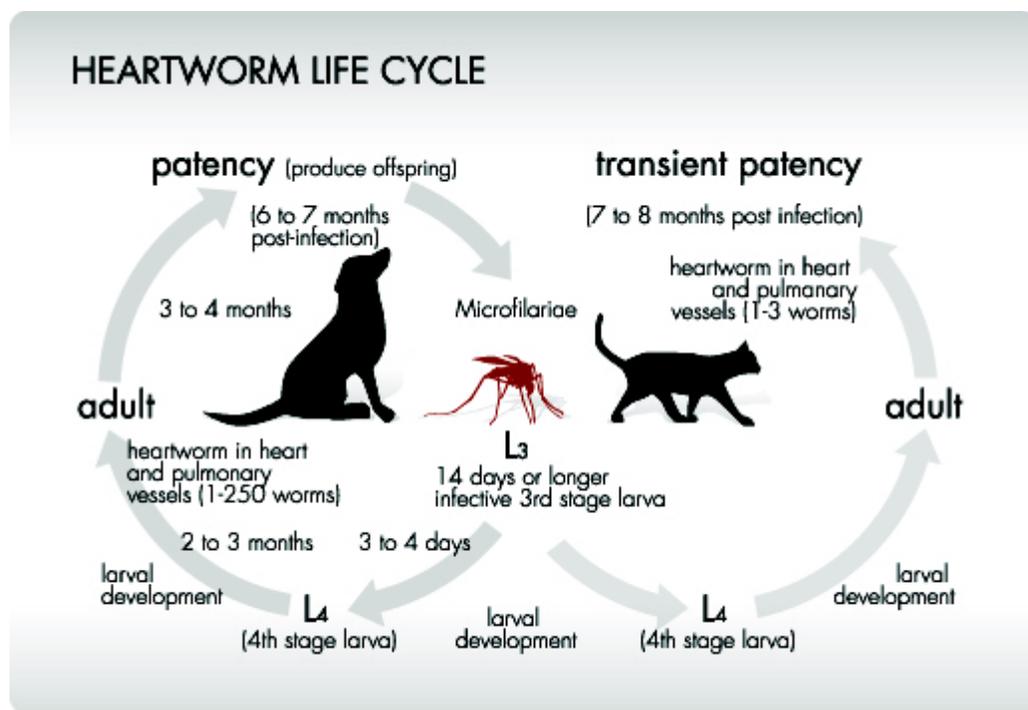
A veterinary practice is a business which faces increasing pressures today. Basic bricks and mortar costs are increasing, the increase in the number of affluent pet owners is slowing, and the number of veterinarians in private practice is steadily increasing, especially in urban areas, and at the same time shifting away from large animal practice.

I also believe that most veterinarians are not intentionally ignoring the growing evidence of long term drug issues. For the last four or five decades their education has been increasingly controlled by the pharmaceutical industry. The drug companies, using their exorbitantly bloated profits, have been pursuing an aggressive campaign of rewriting vet school curricula, influencing veterinarians, and convincing many pet owners that, like ourselves, our dogs, cats and horses need drugs in order to be healthy. They have also established a disproportionate influence in our government with their excessive lobbying expenditures, and have through their markups and incentives made drug sales a significant profit center of a private practice. Even the basic veterinary manual is written and published by Merck and Merial, and has been a leading veterinary reference for 50 years.

Veterinarians that might suspect a drug related cause and effect relationship are caught between the rock and hard plate of the status quo, not to mention the perception of their clients who have been brainwashed by the pharmaceutical industry's misinformation blitz. The pharmaceutical industry is a BIG business (in 2006 \$643 billion worldwide, 45% in USA) with a bean counter mentality, in the same way the insurance industry is. They are no more an altruistic business than the pet food industry is, or used car salesmen are.

Heartworm Life Cycle

You have probably all seen the heartworm life cycle charts (one of the better examples below) in a vet's office, along with the heart statuette crawling with worms. Such are not what one could call inaccurate, but they aren't the whole picture either. I guess they don't want to confuse us with too many details :-). This heartworm display material is provided to vets by organizations like the American Heartworm Society, which in turn receive the bulk of their funding from the pharmaceutical industry.



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So what is the whole picture? Heartworms must go through several life stages before they become adults infesting the heart of the host animal. Initially there must be an infected host animal wherein the adult heartworms bear live young, known as microfilariae. The microfilariae then circulate in the bloodstream of the host for as long as two years, waiting for the next stage in their life cycle in a bloodsucking mosquito.

When ingested by a mosquito, the microfilariae undergo a series of molts to the infective, or third, larval stage and then migrate to the mouth parts of the mosquito, where they wait to infect another host by being deposited on the skin of such. These changes inside a mosquito can occur in as little as two weeks and as long as four weeks, depending on the warmth of the climate, and generally cease entirely at ambient temperatures below 57° F. This time frame involves a simple formula of counting the degrees above 57° F reached each day. Each degree is called a heartworm development unit and when 234 heartworm development units have accumulated within a 30-day period, conditions have been reached that will allow the transmission of L3 life stage heartworm to new hosts. If 30 days pass and 234 heartworm development units have not accumulated, mosquitoes will be dying from the cold before any microfilariae they carry can develop to the infective stage. If a mosquito bites a dog before the larvae reaches stage 3, infection will not occur. Nor will a dog catch heartworm from microfilariae in a blood transfusion or from nursing an infected mother as the infective stage can only be achieved inside a mosquito.

There are laboratory studies that indicate that development to the L3 stage requires the equivalent of a steady 24-hour daily temperature in excess of 64°F for approximately one month. Intermittent daily declines in temperature below the developmental threshold of 57°F for short periods (<2hrs) retard maturation, even when the average daily temperature supports continued development. At a minimum daily temperature of 80° F, 10 to 14 days are required for development of microfilariae to the infective stage.

After the third stage larvae are deposited on the skin of a dog, they stay close to the mosquito bite entry site and grow very little during the next several days. The molt from third to fourth-stage larvae occurs 6-10 days after infection. Fourth-stage larvae migrate through subcutaneous tissue and muscle toward the upper abdomen and thoracic cavity. Fourth-stage larvae grow to about 1/10" in length during the next 40-60 days and then molt to the fifth and final larval stage, or young adults. The young adults penetrate veins to get into the blood stream and eventually, after 70-90 days in the dog, reach the heart.

Upon reaching the heart, the young adults continue to grow. Up to now there has been no evidence of disease in the dog. It is only after adult worms mate and start to discharge tiny motile microfilariae that circulate in the blood that disease becomes apparent. Microfilariae usually appear in the blood about 200 days after infection.

Visible signs of heartworm disease may not appear until a full year after being bitten by infected mosquitoes. In fact, the disease may be well advanced before the dog shows any symptoms. Dogs with typical heartworm disease fatigue easily, cough, and appear rough and not thriving. Blood and worms from ruptured vessels may be coughed up. Blockage of major blood vessels can cause the animal to collapse suddenly and die within a few days.

Dogs with 50-100 mature worms exhibit moderate to severe heartworm disease. Dogs with 10-25 worms that receive little exercise may never show signs of heartworm disease, and one may not be able to find microfilariae in the blood. Heartworm infection without detectable microfilaremia is called occult dirofilariasis.

Although any dog, indoor or outdoor, is capable of being infected, most infections are diagnosed in medium to large-sized, 3 to 8 year old dogs. However, in all dogs generally, the healthier a dog's immune system is, the lower the number of larvae that reach maturity. In a 1991-1996 disease testing study of live-captured wolves in Wisconsin, heartworm infection was found to be very rare (rarer by far than Canine Parvovirus, Infectious Canine Hepatitis, Canine Distemper Virus, Lyme Disease, and Blastomycosis which were also tested for). Though there is no scientific study of domestic dog infections relative to immune system health, I believe the same rarity would be found in dogs that were not immunocompromised – that is, dogs fed a species appropriate diet and not vaccinated, medicated, subjected to environmental hazards, or otherwise diseased. A risk that is very difficult to overcome, however, is immune system problems introduced inadvertently by the hand-of-man – that is through our selective breeding of dogs.

Mosquito Life Cycle

Also important herein is that the probability of any one mosquito bite transferring infectious heartworm can be quite small.

First, as noted above, a mosquito must pick up heartworm microfilariae from a host animal. Then the microfilariae must undergo a series of molts within the mosquito to the infective, or third, larval stage, which takes around two to four weeks. Finally, a mosquito must deposit the infective stage larvae on the skin of another animal where they must survive another three to ten days and molt from third to fourth-stage larvae to migrate through subcutaneous tissue and muscle toward the upper abdomen and thoracic cavity. An animal with a healthy immune system makes this migration very hazardous for the larvae.

Several studies have found that the number of microfilariae ingested by a mosquito is in direct proportion to the mortality of either mosquito or microfilariae within the mosquito. The studies with *Aedes* and *Culex* mosquitoes also found that the number of L3 (infective stage) larvae that reached the mosquito mouth parts was on average 1.5. A conclusion of the studies was that animals with low microfilariae density are implicated as the main source for the transmission of *D. immitis* from dogs to mosquitoes.

Considering that a dog with a healthy immune system further reduces the number of L3 to adult stage heartworms, it would seem that a dog would have to be bitten many times by mosquitoes with infective stage larvae for a serious number of adult stage heartworms to develop. Of course, you must factor in that dogs not fed a species appropriate diet, being over vaccinated, and/or getting suppressive drug treatment for other symptoms, do not have an optimally healthy immune system.

Let's back up a minute and also consider that the female mosquito, when biting the initial infected host, consumes more than its weight and will not feed again for three to four days. Let's also consider that most female mosquitoes can survive up to a month (or longer in captivity) but most probably do not live longer than one to three weeks in nature. Their chances of survival depend on temperature and humidity, not being eaten themselves, and also their ability to successfully obtain a blood meal while avoiding host defenses.

So, from the time the female mosquito bites the initial infected host, around three weeks at a minimum must pass before infectious stage larvae can be deposited on the skin of another animal. Thus most female mosquitoes will have only one opportunity to potentially infect another animal, and then only if they have bitten an infected host early on and survive at least three weeks afterwards in optimal conditions.

If one is in a seasonal mosquito area, it should also be apparent that the threat of an infectious mosquito bite in almost the first month of conducive temperatures is virtually nil (unless an infectious mosquito is shipped to your immediate local from the gulf coast :-).

The idea that mosquitos might linger around inside say your house might be a concern at the end of a mosquito season for a month or two at the most, but after that they will be dead, and if they have managed to propagate, the new mosquitos will not achieve an infectious state unless there is also a host animal present. In seasonal mosquito areas there is no real justification for year around chemoprophylaxis other than profit, or to treat a heartworm positive dog.

Another limiting aspect is that many mosquitos remain within one half to one mile of their breeding site, though some may range five miles. Flying takes a great deal of energy, so with the exception of unintentional assisted distribution like high winds, potential heartworm hosts would usually need to be within their range. Heartworm host findings outside the range of local mosquito populations are not of immediate concern, though several seasons of the spread effect through overlapping mosquito populations could be.

In subtropical and tropical zones there are some longer lived mosquitos, and usually a greater host pool, so augment this information with local conditions. Some adult mosquitos can hibernate over cold months, and though there is evidence that viruses in such may not be killed, I can find no evidence that heartworm microfilariae can survive such.

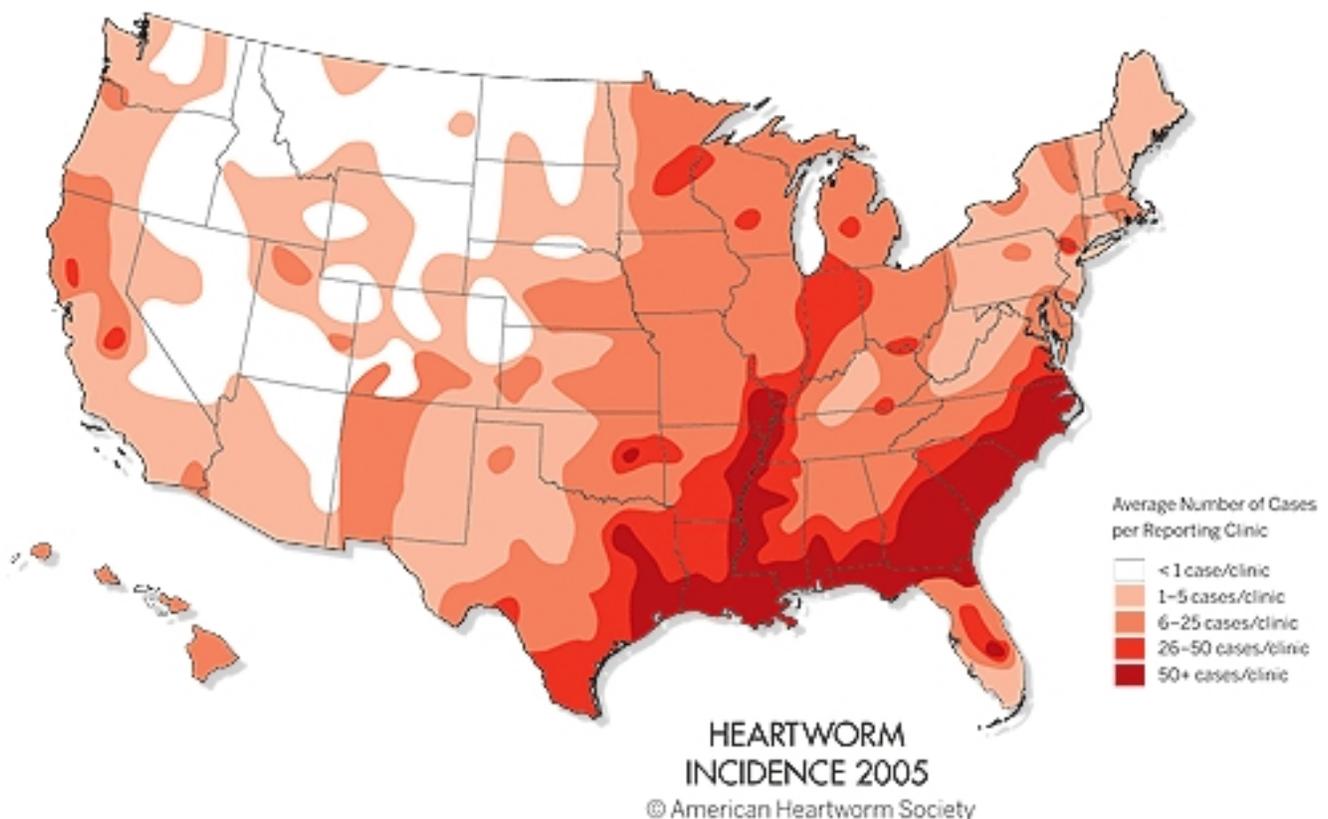
There is a simple home-made mosquito control you can employ in moderate sized areas such as around dog runs. Fill one or more 5 gal. containers about 2/3 full of water and add about an ounce of household dish soap and a few squirts of WD-40. Cover the containers with chicken wire to keep birds and small mammals out, and place them where pets can't get into them or knock them over. If you'd like, decorate the buckets to blend in with your landscape :-)

When a mosquito lands on the water it will get stuck, because the WD-40 in the water acts to break up the surface tension, impeding the mosquito from flying away. If a mosquito lays any eggs the dish soap will kill any larvae that do happen to hatch from the eggs.

Periodically check the buckets and refill them as needed. You'll be surprised how many mosquitoes you'll catch this way.

Heartworm Infection Distribution

Shown below is a 2005 Heartworm incidence map from the American Heartworm Society. It provides a relative indication of incidence, but one must understand that it also lacks perspective. The incidences are voluntarily reported by veterinary clinics, but the total proportion of clinics reporting is not noted, nor is the total number of pets seen within each in which the incidences are observed. Nor does it take into account other important factors such as state of health. Basically all it really indicates is that more cases are generally reported in areas with higher mosquito densities, without relation to pet populations, or any other pertinent factors such as their relative health.



The information provided is ambiguous enough to use for promotional purposes, but not any real scientific analysis. Compounding the issue is that there are no reliable definitive statistics of pet and wild host populations from independent sources, let alone correlation of other health indicators in pets.

In an attempt to gain a partial but rough perspective however, we can consider some commercially funded surveys. A survey of 12,000 veterinary clinics across the country conducted by the American Heartworm Society and Merial [50% owned by Merck and maker of Heartgard® (ivermectin)] found that more than 250,000 cases of heartworm were reported in 2004. Then in 2005/2006 the American Pet Products Manufacturers Association (APPMA) National Pet Owners Survey came up with pet population figures of 73.9 million dogs and 90.5 million cats among the pet categories.

If we round the reported heartworm incidence up to 300,000 [assuming it has increased since 2004], and use only half the cat population over the dog population [cats have a much lower detected incidence] for a total rounded population of around 120 million, we arrive at a very rough overall probability of incidence of 0.25% (1 in 400). This could easily be higher/lower in specific locals. With all the ambiguity and variance in the statistics, one can easily argue that the probability of incidence is higher or lower – be your own judge.

The number of pets on heartworm prevention drugs at any point in time could skew the incidence. Also, the number of strays, waifs, and wild hosts can also add to the probability of infection, but any statistics of such are essentially a guessing game, and would be strongly influenced by the quality of local habitats.

In my research, I've come across many conflicting articles. A few years back in Washington state there were numerous articles about a serious outbreak of heartworm in foxes and coyotes, and a single article interviewing a public health official that said they had found only one case of heartworm in the wild in the last ten years. One might suspect commercial interest hokey-pokey :-)))

There are, of course, more elusive factors that bear on incidence. For example, Louisiana has a high incidence of heartworm and after Katrina many of the dogs there were relocated throughout the country, potentially providing hosts for increased distribution. Then there is global warming and the effect it will have on mosquito populations.

The most elusive factor of all is that all the applicable statistics are strongly influenced by voluntary reports in a commercial environment – that is, not an altogether scientific or altruistic environment :-). While heartworm cases are readily reported, adverse effects to the drugs aren't as often reported and/or maintained by the drug companies, especially if they are not immediate and incontrovertible. In my research I have come across numerous statements by vets that say that probably less than ten percent of drug reactions are reported, and some state a lower number.

Whatever percent of incidence you arrive at should only be viewed as a general potential probability of infection, as a specific pet's circumstances strongly influence the probability of infection, just as they do the probability of adverse effects.

Heartworm Prevention

There are two initial primary actions applicable to heartworm prevention, followed by a choice of steps aimed at prevention.

First, one should clarify in their own mind, and consider the implications of, environmental factors in general and a dog's state of health in particular. As to environmental factors, considering where the dog has spent any time in the last year, what are the chances of heartworm infection? If the dog has spent the last year in the Arctic or Antarctica, and will continue to reside there, there is no chance of infection, but if the dog has been in any relatively warmer local, or will be traveling to such, where there are mosquito populations for a month or more, there certainly is a chance of infection. As to a dog's state of health, just how healthy is it, and are there any potential immunological issues? A dog's true state of health is not necessarily apparent. If a dog “seems” healthy consider whether it has had the benefits of a species appropriate diet (see diet note below) for most of its life, has a history of few or no vaccines and medications, has spent most of its life in a positive emotional environment, has had sufficient exercise and rest, and has had sufficient exposure to build its immune system. Then consider immediate environmental factors such as potential exposure to toxic chemicals, like those used in the house or garden or on the lawn. Detrimental chemicals might also be found in a dog's drinking water, especially if the water is from a treated municipal source.

Also, keep in mind that man's selective breeding has contributed to health problems in domestic dogs. Various breeds are more susceptible to adverse effects issues such as autoimmune problems, hypo-thyroidism, lymphoma sarcoma, seizure disorders, heart problems, and skin allergies.

So, first know your dog! You should realize that you know the most about your dog if you take the time to consider the above points. A veterinarian's opinion of a dog's health provides more insight, but generally (in my experience) will not get into all these considerations, and/or because of their education will see diet and potential drug effects if a different light.

As to diet, I've said it before but it bears repeating, understand that despite outward appearances the dog [Canis lupus familiaris] is a domesticated wolf, differing from gray wolves [Canis lupus] by at most 0.2% of mtDNA sequence, and there is almost no correlation between a dog's breed and the mitochondrial DNA sequences it carries. In comparison, the gray wolf and domestic dogs differ from their closest wild relative, the coyote, by about 4% of mitochondrial DNA sequence. Even analysis of the highly variable markers in the regular (nuclear) DNA of dogs and wolves shows a considerable overlap there as well. Jackals and coyotes, though they can interbreed with dogs and produce fertile offspring, possess quite distinct groups of mitochondrial DNA sequences which are not found in domestic dogs. The evidence comes from a 1997 study by Robert Wayne, an evolutionary biologist at the University of California at Los Angeles, who has applied the modern tools of genetic fingerprinting to dogs, coyotes, wolves, and jackals. This study has been scientifically validated numerous times (e.g. Feldhamer, G.A. 1999. Mammology: Adaptation, Diversity, and Ecology. McGraw-Hill. pg 472.) since, and its conclusions accepted (even by the Smithsonian Institute in reclassifying the genus of domestic dogs), despite what commercial interests and others that anthropomorphize would have you believe otherwise. Yes, the little toy poodle is a domesticated wolf, and it has all the same optimal dietary needs as a gray wolf. As determined by scientific observation and biologists studying gray wolf scats, in nature gray wolves thrive when they consume diets high in the best quality animal protein and fat, rich in vitamins and minerals, low in carbohydrates and fibrous materials, and devoid of plant based protein (e.g. see the Smithsonian National Zoological Park Gray Wolf Facts, and the Wisconsin Dept. of Natural Resources Gray Wolf Facts). What has not been observed is wolves sitting around a campfire preparing their dinner :-))) The only difference in dietary needs one might note, is that for domestic dogs less quality fat is needed unless they are serious working dogs.

Commercial pet foods are composed mostly of low quality plant processing by-products, rendered meat by-products, and a wide variety of chemical additives, many of which are questionably safe (e.g. cancer-causing agents such as BHA, BHT, and ethoxyquin). Nutritionally these pet foods are a disaster, with associated health problems of oral disease and the toxins such cause to be distributed through a dog's body, kidney and urinary tract diseases, digestive system problems, hyperthyroidism, and heart disease, to name only the more common problems.

Secondly, a heartworm infection test should be done semi-annually or annually (depending on the temperate region) if there is a chance a dog might be infected. Available antigen detection tests are very sensitive and specific. To determine when testing might become useful, it is advisable to add a pre-detection period to the approximate date on which infection may have been possible. A reasonable interval is 7 months. The level of antigenemia is directly related to the number of mature female worms present. At least 90% of dogs harboring at least 3 adult females will test positive. In general, strong-quick positive reactions correlate with relatively high worm burdens. For low-burden suspects, commercial laboratory-based microwell titer tests are the most sensitive. If a dog has been on some chemical preventative, then simply looking for microfilariae in a blood smear may be ineffective.

Even if you have been administering one of the macrocyclic lactones (conventional chemoprophylactics), a lack of effectiveness has been reported for all of them, and there is growing concern of resistance* to macrocyclic lactones, so it is important that you follow through with the periodic testing. [I know, it's not the reason given me either by most of the veterinarians I have seen, but their explanation that in a heartworm positive dog microfilariae may be killed off too fast, causing anaphylactic shock, is also true for many of the macrocyclic lactones.]

**The intensive use of the macrocyclic lactones for the treatment of a variety of parasitic diseases has hastened the development of resistance to this family of parasiticides among sheep, goats and cattle. Resistance to ivermectin, moxidectin and doramectin by Haemonchus contortus has been documented throughout the world. The concern is that intensive use with our companion animals will result in similar resistance.*

This periodic testing has no harmful effect, and is one of the most important steps you can do in monitoring the health of your companion animal. Catching heartworm infection early on limits the risks you might impose on your companion animal.

Now, **if** you have given due consideration to these two primary actions, then you are ready to consider what preventative measures are appropriate in your circumstances. Herein, preventative measures fall into three general categories that will be outlined in turn – conventional, alternative medicine, and a natural approach. There are, of course, overlaps, but the idea is simply to present all possible approaches that might be considered, and categorization helps in assimilating the information.

Conventional (Chemoprophylaxis) approach to heartworm prevention

There are a seemingly confusing number of chemoprophylactic heartworm products on the market, but the most commonly used active ingredients in them are the macrocyclic lactones (ivermectin, milbemycin oxime, moxidectin and selamectin), together in some cases, to extend their applicability, with anthelmintic and benzoylurea pesticide agents. These drugs have high therapeutic/toxicity ratios [*drug industry's words*], and possess anthelmintic activity against microfilariae, 3rd and 4th stage larvae, and in some instances young adult heartworms, and the combined drugs extend applicability to intestinal worms and fleas. What the drug companies and many vets don't mention is that the long-term effects of constant use are unknown (i.e. not scientifically proven), and they have made no genuine effort to study such.

According to the American Veterinary Medical Association (AVMA) a minority of animals experience adverse drug reactions, but those that occur are seen in most breeds. The AVMA went on to say they have found that 65% of all drug reactions reported, and 48% of all reported deaths caused by drug reactions were from heartworm preventive medicine. [*quoted on many Holistic Veterinary sites, but I was unable to gain access to the source AVMA report*]

The following FDA “official” data below may provide some perspective. Bear in mind that these were obvious immediate incidents voluntarily submitted, and that there are no studies for, or reporting of, long term effects.

**Reported Canine Heartworm Medication Adverse Reaction Comparisons
(Source, FDA, As of 5/03/2004)**

Drug	Total Adverse Reactions	Total Deaths	Year Approved	Avg. Reactions	Avg. Deaths	Form
ProHeart 6* (Moxidectin):	4499	415	2001	1500	138	Injection
Revolution (Selamectin):	8695	181	1999	1737	36	Topical
Interceptor (Milbemycine oxime):	1922	84	1995	214	9	Oral
Heartguard (Ivermectin/Pyrantel):	2840	51	1996	355	6	Oral
Sentinel (Milbemycine oxide/luferon):	892	25	1999	233	6	Oral

*In 2004 the manufacturer reluctantly withdrew this product from the U.S. market, while denying any problem with its product and smearing the FDA vet that brought the issue to light. The same manufacturer is currently involved in another flap over a new flea & tick preventative.

*In my research I've previously found published data on government sites that I can no longer find. One example is that in 2000 the above data included the ingredient "Ivermectin" alone with 681 dogs under **Total Adverse Reactions** and 134 dogs under **Total Deaths** from 1987 to 2000. You should also keep in mind that with highly probable underreporting by those with a commercial interest, such might represent 10% or less of actual cases.*

Keep in mind, as we discuss chemoprophylaxis, that the word preventative is a misnomer. These drugs do not prevent infection, but rather are parasiticides – that is, their use is to kill heartworm microfilariae that gain a foothold.

It is important to understand that all these chemical products are made up of “active” and “inert” ingredients, and the actual definitions of those phrases are very different from what they seem to connote. The word “inert” suggests benign activity and even connotes safety in the minds of many consumers, but legally it simply means added substances that are not registered “active” ingredients. The Environmental Protection Agency requires a higher (if not high enough) standard of scrutiny for ingredients they have denoted as “active” ingredients - these must undergo short term tests to determine their toxicological profiles, and be listed on product inserts and packaging. In contrast, “inert” ingredients need not be listed on product inserts and packaging and are subject to much less testing than the “active” ingredients - “inerts” are generally tested, if at all, for immediate acute toxicity only.

For example, naphthalene, one of the “inerts” in an imidacloprid product (see active ingredients below), showed clear evidence of cancer activity through inhalation (nasal cancers), as well as anemia, liver damage, cataracts, and skin allergies. Also, an unidentified “inert” ingredient in the flea product Advantage was implicated in the death of kittens who received doses within laboratory tolerances.

Our government at work: In 1949, the U.S. Congress passed the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), allowing manufacturers confidentiality on issues they claimed would otherwise make them vulnerable to market competition. “Inert” ingredients, in other words, became protected by industry as “trade secrets.” Add to this the strong influence big industry has in our government, and “Inert” becomes a very misleading word. Also the word “active” conveys a more ominous note.

So, without full disclosure, I am unable to determine all the ingredients in these products, and together we are unable to make more educated decisions as to which chemicals we want to avoid.

We'll go through the most commonly used active ingredients, then through many of the chemoprophylactic heartworm products on the market today that use the active ingredients.

Common chemoprophylactic active ingredients

Note: The so-called “ivermectin sensitivity” of some dog breeds (Collie, Sheltie, Border Collie, Australian Shepherd, English Shepherd, Bearded Collie, Silken Windhound, and others) is a central nervous system (CNS) toxicity issue that has been traced to a mutation in a gene responsible for the MDR1 pump protein resulting in a defect in the blood-brain barrier that allows the drug to pass through. It is not just ivermectin that can pass through the blood-brain barrier, but all of these parasiticides and insecticides.

Also keep in mind that most of this data originated from, or studies were funded by, drug companies, and that they tend to play down short term side effects and suppress any long term health effects studies :-) This information is mostly in their words.

Ivermectin: is a broad-spectrum parasiticide, derived from the bacterium *Streptomyces avermitilis*, traditionally used against worms (except tapeworms), but more recently found to be effective against most mites and some lice too. It binds and activates glutamate-gated chloride channels (GluCl_s) present in neurons and myocytes, resulting in neuro-muscular paralysis and death. Although similar in structure to vertebrate ionotropic glycine receptors, glutamate-gated chloride channels are specific to invertebrates. Ivermectin can be given either by mouth or parenterally. It does not readily cross the blood-brain barrier of mammals, although crossing may still become significant if ivermectin is given at high doses. [*Reread this last sentence in the light of how carefully it is worded.*]

Unlike other heartworm preventatives, ivermectin is better tolerated by heartworm positive dogs because it kills off the microfilariae slowly, avoiding the shock-like reaction which may occur when too many of the first stage larvae die at once. In addition to killing microfilariae, ivermectin will also suppress reproduction in the adult female worms and shorten the overall life span of adult worms.

Commonly prescribed veterinary formulations of ivermectin used for heartworm prophylaxis with dosages in the range of 6 to 12 µg/kg are generally considered safe, but no reliable scientific studies of long term (life-cycle) effects have been published to my knowledge.

Excessive dosage may cause depression/lethargy, vomiting, anorexia, diarrhea, mydriasis, ataxia, staggering, convulsions and hypersalivation.

Milbemycin oxime: is a broad-spectrum parasiticide isolated from the fermentation of *Streptomyces hygroscopicus* var. *aureolacrimosus*. It is effective against heartworm larval stages (L3, L4, and the microfilariae), and destroys dog roundworms, dog whipworms, and hookworms. The activity of milbemycin is correlated with its action on invertebrate neurotransmission in that it potentiates GABA (gamma-amino-butyric acid), an inhibitor of neuromuscular transmission, leading to paralysis.

Milbemycin should not be given to a dog with an active heartworm infection, as the microfilariae are killed much faster than with the ivermectin products, which could cause a shock-like reaction when all the first stage larvae die at once.

The following adverse reactions have been reported in dogs after giving milbemycin oxime or lufenuron: vomiting, depression/lethargy, pruritus, urticaria, diarrhea, anorexia, skin congestion, ataxia, convulsions, hypersalivation and weakness.

Moxidectin: is another parasiticide in the milbemycin (see above) chemical class. It also acts by interfering with chloride channel-mediated neurotransmission in the parasite, resulting in paralysis and elimination of the parasite. In dogs and cats it is more commonly used for the treatment of heartworm disease, roundworms, hookworms, whipworms and mites.

One injectable heartworm disease preventative product for six month efficacy that contained moxidectin was removed from the U.S. market because of too many adverse effects including death. It was purportedly a slow release formulation, but proved to be overly toxic none-the-less. This might give one cause to reconsider any such longer term (higher dosage) heartworm preventatives.

Selamectin: is a closely related cousin of the parasiticide ivermectin (it's a modified version of doramectin which in turn is a derivative of ivermectin), designed for broad coverage of small animal parasites such as heartworms, ear mites, sarcoptic mange mites, ticks, and fleas. It is not effective against flukes or tapeworms. It achieves efficacy by replacing glutamate which normally interacts with receptors that open chloride channels at muscle synapses found in parasites. Unlike glutamate, selamectin activates the chloride current without desensitization, thereby producing prolonged hyperpolarization and impaired muscle contraction.

Selamectin is normally used topically where it is absorbed into the body and circulates through the blood stream. It is not recommended for use in debilitated or underweight animals. Potential side effects include temporary irritation and hair loss at the site of application, and through ingestion, loss of appetite, drooling, vomiting, diarrhea, anorexia, rapid breathing, increased heart rate, lethargy, and/or muscle tremors.

Diethylcarbamazine Citrate (DEC): is an anthelmintic drug that does not resemble other antiparasitic compounds. It is a synthetic organic compound which is highly specific for several parasites and does not contain any toxic metallic elements. It is an inhibitor of arachidonic acid metabolism making filarial more susceptible to immune attack. DEC is the mainstay for treatment of human patients with lymphatic filariasis (Elephantiasis) and loiasis (parasitic disease of eyes and skin). It is also used in the prevention of dog heartworm.

In cases of onchocerciasis (difficult to distinguish from loiasis), another common filarial parasite, the drug is not used because the itching associated with the dead subcutaneous parasites is intense and unbearable.

When used in the prevention of dog heartworm, the efficacy of DEC is critically dependent upon uninterrupted daily administration during the prescribed period of use (from one month before a potential infestation period through two months after). Discontinuation for only two to three days will necessitate retesting. In the event a microfilaremia should occur, dogs are at serious risk of developing potentially fatal reactions following resumption of DEC chemoprophylaxis. Non dose-dependent gastrointestinal distress frequently develops shortly after administering DEC to previously untreated microfilaremic dogs. These reactions recur with each dose, and although usually self-limiting, may progress to hypovolemic shock and death.

Pyrantel Pamoate: is a broad spectrum anthelmintic agent belonging to a family classified chemically as tetrahydropyrimidines. It works by paralyzing the nervous system of intestinal parasites, which are then passed in the stool. Worms are frequently passed with some diarrhea, straining, and sometimes vomiting. Spastic (tetanic) paralyzing agents, in particular pyrantel pamoate, may induce complete intestinal obstruction in a heavy worm load. It should not be used with other dewormer drugs or organophosphate insecticides.

Praziquantel: is an anthelmintic effective against flatworms and tapeworms. The mode of action is not known exactly, but there is experimental evidence that Praziquantel increases the permeability of the membranes of parasite cells (certain schistosomes) for calcium ions. The drug thereby induces contraction of the parasites resulting in paralysis in the contracted state. The dying parasites are dislodged from their site of action in the host organism and may enter systemic circulation or may be destroyed by host immune reaction (phagocytosis).

An extremely heavily parasitized small animal may suffer a worm impaction when a large number of worms die and try to pass at the same time. Side effects may include vomiting, loss of appetite, drowsiness or diarrhea in dogs and increased salivation and diarrhea in cats. Praziquantel passes into breast milk and it may affect a nursing baby.

There are reports of infected patients not cured by multiple doses of praziquantel (PZQ), suggesting that resistance to the drug may be possible.

Lufenuron: is a benzoylurea pesticide, that inhibits the production of chitin in larval fleas. Without chitin, a larval flea never develops an exoskeleton. At therapeutic levels, lufenuron has no effect upon adult fleas, but adults absorb lufenuron via their bloodmeal and pass it transovarially to act upon certain stages of the development of the insect (egg and larva), thus interrupting the insect life cycle.

It has no known toxic effects at any dosage on humans or other animals in the environment that do not depend on chitin, though the orally-administered pills can sometimes cause an upset stomach with acid reflux. Potential side effects include lack of appetite, vomiting, diarrhea, lethargy, itching, difficulty breathing, or reddened skin. There are no known drug interactions. It must be given with a meal to have adequate absorption.

Lufenuron is also sold as a crop protection product (pesticide) by Syngenta for use against lepidoptera, eriophid mites, and Western flower thrips.

Imidacloprid: is a chlorinated analog of nicotine, and thus the compound belongs to the class of chloronicotinyl insecticides. The chlorination inhibits degradation by acetylcholine-esterase as it acts on the nicotinic acetylcholine receptor. Its relatively low toxicity in most animals other than insects is due to its specificity for this type of receptor, which is found more often in insect nervous systems and zooplankton than that of many animals. Administered topically it collects in the oils of the skin and in hair follicles, and is not absorbed into the body or circulated through the blood stream.

This product is not recommended for use in pregnant, nursing, debilitated, or geriatric animals, and may interact with other medications. No short term side effects, other than profuse drooling if ingested, are noted, but long term side effects (as with any of these spot-on insecticide products) suspected by some independent parties include thyroid lesions, organ damage, incoordination, labored breathing, and muscle weakness.

Advisory: Imidacloprid is receiving increased attention as a possible factor in Colony Collapse Disorder, a mysterious condition that causes sudden death of honey bee populations. Mass die-offs of bees threaten pollination of food crops in the USA and Europe.

Oxibendazole: is a benzimidazole (a fusion of benzene and imidazole produced commercially as a parasiticide) derivative for intestinal worm control. Oxibendazole acts by disrupting the generation of ATP (adenosine triphosphate production) and irreversibly inhibiting glucose uptake in the gastro-intestinal worms resulting in a depletion of the worm's energy sources and their slow death.

Resistance or tolerance by worms may develop either when a product is used continuously over many years, when less than the recommended dose rate is given or if the parasite gets exposed to chemicals which "hang around" in the body for too long. It is recommended that products containing this active ingredient be employed as part of an annual rotation program with pyrantel based wormers.

Oxibendazole in combination with diethylcarbazine has been implicated in causing periportal hepatitis in dogs.

Chemoprophylactic heartworm products

Dosage of these heartworm preventatives is dependent upon an animal's weight, so read the product label and package insert, and know your animal's normal weight range.

Specific product adverse effects are not noted herein unless such have been reported in addition to any noted in the common active ingredients above. The drug company's package insert with each product generally only notes drug interactions, sometimes overdose effects, and cautioning against using for an animal with a known hypersensitivity or allergy to the drug. In case of ingestion of an animal heartworm chemoprophylactic by humans, contact a physician immediately (um...but it's ok for my dog?).

Many holistic veterinarians that recommend heartworm chemoprophylactics, recommend the monthly PLAIN heartworm medicine given every 45 days, to reduce potential adverse drug effects.

Heartgard: which contains *ivermectin* as its active ingredient, is a monthly **oral** medication for the prevention of heartworm disease by eliminating heartworm larvae. It can be used in an extra-label manner to kill microfilaria (microscopic offspring), suppress reproduction in the adult female worms and shorten the overall life span of adult worms in heartworm infected dogs.

Heartgard Plus: which contains *ivermectin* and *pyrantel pamoate* as its active ingredients, is a monthly **oral** combination heartworm preventive and wormer. The added deworming agent is for the treatment and control of hookworms and some roundworms.

In a small percentage of ivermectin/pyrantel treated dogs, digestive and neurological side effects may occur.

Iverhart Plus: which contains *ivermectin* and *pyrantel pamoate* as its active ingredients, is essentially the same as Heartgard Plus.

Iverhart Max: which contains *ivermectin*, *pyrantel pamoate* and *praziquantel* as its active ingredients, is a monthly **oral** combination heartworm preventive and wormer. The added deworming agents are for the treatment and control of hookworms, roundworms, and tapeworms.

Tri-Heart Plus: which contains *ivermectin* and *pyrantel pamoate* as its active ingredients, is essentially the same as Heartgard Plus.

Sentinel: which contains *milbemycin oxime* and *lufenuron* as its active ingredients, is a monthly **oral** combination heartworm preventive, wormer, and flea control. The milbemycin oxime is intended to prevent heartworms and help control roundworm, whipworm and many hookworm infections. The lufenuron is intended to help control flea infestation.

Interceptor: which contains *milbemycin oxime* as its active ingredient, is a monthly **oral** heartworm preventive, and intestinal wormer. In addition to heartworm prevention, it is intended to control roundworm, whipworm and many hookworm infections.

Advantage Multi: which contains *moxidectin and imidacloprid* as its active ingredients, is a monthly **topical** combination heartworm preventive, wormer, and flea control. In addition to heartworm prevention, it is intended to control roundworm, whipworm, hookworm, and fleas.

If the dog or cat ingests the product or licks the application site, serious adverse effects may occur including depression, salivation, incoordination, panting and tremors. Hair may appear stiff, matted oily, or damp after application. Can cause eye and skin irritation. Can be Poisonous when swallowed. Warnings for use on sick, pregnant or nursing animals.

Revolution: which contains *selamectin* as its active ingredient, is a monthly **topical** heartworm preventive, which is also effective against fleas, flea eggs, ear mites, sarcoptes mange, and American Dog Ticks (*Dermacentor variabilis*) which transmits Rocky Mountain spotted fever, but is not effective against the Deer Tick (*Ixodes scapularis*), aka Blacklegged Tick, which is the one that transmits Lyme Disease.

Filaribits, Nemacide, Dimmitrol (outside USA): which contains *Diethylcarbamazine Citrate (DEC)* as its active ingredient, is a daily **oral** tablet that is often used for dogs that are sensitive to some of the monthly heartworm preventatives. Filaribits has been discontinued, but you can still find generic versions.

Filaribits Plus: which contains *Diethylcarbamazine Citrate (DEC)* and *oxibendazole* as its active ingredients, is a combination daily **oral** tablet that is often used for dogs that are sensitive to some of the monthly heartworm preventatives. It is also effective for hookworm (*A. caninum*), whipworm (*Trichuris vulpis*), and ascarid (*Toxocara canis*).

Filaribits Plus chewable tablets have been occasionally associated with hepatic toxicity including several fatalities. Close monitoring of animals receiving this drug may identify early hepatic injury. The hepatic injury has usually been reversible upon discontinuation of Filaribits Plus administration; thus dogs exhibiting signs of hepatic dysfunction should be removed from treatment immediately. Dogs with a history of liver disease or dogs receiving Filaribits Plus concurrently with other potentially hepatotoxic drugs should be carefully monitored for clinical or biochemical evidence of hepatic disease.

JUST SO YOU KNOW

There are many case accounts of heartworm infected dogs that are circulated by those with a financial interest in heartworm preventatives, and as intended play on the phobias of others that just don't know better. Even though I resent their tactics, make no mistake, heartworm infections do happen and they can be serious, but that is not the whole story.

There is another equally tragic side of the coin, that you likely hear very little of even though the number of accounts is significant. I could relate a story of my own, or any of many others I'm aware of, but instead I'm including an account (on the next page) from a nationally recognized source. Keep in mind that it is just one such account of a large number that can be found, and I'm sure there are many that are never made public.

Hearts United for Animals is a national no-kill animal shelter, sanctuary and animal welfare organization dedicated to the relief of suffering. HUA rescues animals from all over the country and specializes in long distance adoptions. Their Jet Set Dogs program was honored by the Smithsonian Institution in Washington, DC for its innovative use of technology in using the internet to find appropriate homes for dogs. On their web site is a story entitled "The Hobbesian Choice" which is related in part herein.

The HUA site is <http://www.hua.org/Welcome.html>

Four years ago HUA alumni, Zeke, was diagnosed with diabetes. We had a terrible time with the disease. He went completely blind and had to have cataract surgery to restore his sight. He developed a neurological disease that caused his eye to sag. Then he developed a different neurological disease that caused him to waste in his back legs. He, of course, met every challenge with the grace of a dog - always an inspiration.

We've done a lot of research on diabetes since that time and learned that Zeke is not the typical type of dog who gets this disease. He's a mixed breed dog, and it typically strikes certain breeds of purebred dogs. He has not been vaccinated annually, and it typically strikes dogs whose immune systems are stressed by annual vaccinations. He eats top quality foods and drinks filtered water, and it typically strikes dogs who have poor diets. And he's not treated with flea and tick chemicals which can also stress the immune system. So we asked his vet how it could be possible that this dog, who has never been sick in his life, got this disease. Although the vet can't prove it, the probable cause of Zeke's diabetes was the heartworm pill that he got two weeks before the onset of the diabetes. Heartworm chemicals alter the normal cells so that the body considers them foreign and attacks them. This can lead to a variety of immune problems from allergies to liver failure or as in Zeke's case, diabetes.

This statement by Zeke's vet sent us off to research heartworm preventatives. The Summary of Adverse Drug Reactions published by the Food and Drug Administration tracks the numbers of dogs who have reacted to heartworm preventative treatment and who have died from them. The numbers are pretty startling. For instance ivermectin which is the ingredient in Heartgard had 681 dogs react and 134 dogs die from 1987 to 2000. These numbers don't even include dogs like Zeke since the links can't be proven. The story of Sage the Aussie who died after being treated with Revolution was reported widely on the Internet. The fact is that the heartworm "preventatives" are all poisons. They are designed to kill the worms. Now of course heartworms are an terrible thing. So the question is whether the treatment is worth the risk.

Your dog can't speak for himself, he relies on you to protect him. His life depends on you.

Alternative medicine approach to heartworm prevention

With the conventional (chemoprophylaxis) approach there are efficacy studies, but played down (and potentially incomplete) immediate adverse effects, and no long term studies of adverse effects. On the other hand, with the alternative approach, although there is long standing empirical evidence of many of the compounds (though not necessarily with dog and cat use) in numerous cultures, there is not full fledged scientific studies with most (and again not necessarily with dog and cat use). There are also studies that question the efficacy of some of the compounds, and there are claims made as to use which are suspect.

In my research I have found many efficacy accounts from alternative practitioners and laypersons, and many accounts from others in and out of the medical profession that question efficacy. I'm not arguing with other's experience that have found alternative compounds effective, but I wonder to what degree the specific effectiveness can be contributed – there are too many unknown factors with relayed experiences.

*Also with the alternative medicine approach, one has to be very careful about offered products because there are many very low quality products on the market, some even fraudulent. So select very carefully, and follow product instructions because products might be **toxic** if used incorrectly. While some nutritional supplements such as glucosamine, which is believed to relieve joint pain, and milk thistle, valuable for liver disease, have been evaluated in animals, most herbs given to pets have not been tested for safety or effectiveness, and you can't assume that because something is safe for humans it's safe for animals.*

And just because it's “natural” doesn't mean it's safe – some of the most virulent poisons known to man are natural. On the other hand, many virulent poisons known to man are found in allopathic prescriptions, so what is one to do? A first step might be learning enough to prepare for the hard decisions :-)

Alternative approach components

There is a homeopathic nosode, made from heartworm larva, that is employed as a heartworm preventive to avoid conventional drug side effects.

There are also a considerable number of herbal and “natural” preventatives. Most of these preventatives have their “roots” in traditional Chinese and Ayurvedic (traditional Hindu) medicine that go back thousands of years. The most common are outlined below, and those that have been the subject of recent scientific interest and study are noted.

Many of the following are not specifically for heartworm, but are said to help improve overall health, or discourage external and intestinal parasites, and thereby help the immune system fight off heartworm.

Allium sativum (Garlic) has been used since ancient times in India and China for a beneficial effect on the heart and circulation. One notable constituent of garlic is allicin, one of the most impressive broad-spectrum antimicrobial substances in nature that has been studied at length. In dogs, garlic has been found to lower blood pressure, have significant antifungal effects, and in diabetic animals lowers hyperglycemia. The juice from the bulb has been used as an insect repellent. Garlic contains a compound named thiosulphate. At higher levels thiosulphate can be a dangerous toxin that may cause heinz body hemolytic anemia in dogs (as can onions and vaccinations).

American Worm seed oil (Chenopodium Oil) has been shown to be of great service against the tapeworm, and is employed in veterinary practice in a worm mixture for dogs, combined with oil of turpentine, oil of aniseed, castor oil and olive oil. It is, however, a dangerous remedy in the hands of the layman on account of its activity - in cases of slight overdoses it has been known to cause symptoms of poisoning.

Artemisia annua (Wormwood) is a herb in both Eastern and Western herbal medicine that is said to be a digestive tonic and to help cleanse the digestive tract. Thousands of years ago, wormwood had already been harvested in China as a cure for malaria thanks to its artemisinin component, which reacts with the high iron levels in the malarial parasite, producing free radicals. These then destroy the cell walls of the parasite, effectively subduing the illness. Today, it is still one of the most effective malarial cures. It has been extensively used to purge intestinal worms (thus its name), particularly roundworms and pinworms, and it has been used as an insecticide. Cautious use is advised.

Artemisia vulgaris (Mugwort) has a long history of use in herbal medicine especially in matters connected to the digestive system, the treatment of worms, and cleansing toxins from the blood, among many other uses. It is slightly toxic, and large, prolonged dosage can damage the nervous system.

Azadirachta indica (Neem) The Ayurvedic medicine from this tree is used as a wormer because the wood from the tree is worm resistant. A tea made of boiled neem leaves, sometimes combined with other herbs such as ginger, can be ingested to fight intestinal worms. According to Ayurvedic medicine the bark of the Neem tree will strengthen an individual's resistance to disease. Modern clinical studies have identified a number of compounds in the Neem tree that effectively regulate immune system functions. The oil is often used in a diluted spray for cats and dogs to control insects. Of its chemical constituents Azadirachtin, the insecticide constituent of the seeds, is biodegradable, non-mutagenic, and is said to be nontoxic to birds, fish, and warm-blooded animals. Cautious use is advised.

Capsicum annuum (Capsicum Fruit, Cayenne Pepper) mainly used in formulas as a "driver" of other herbs, because it enhances circulation. One of its active ingredients, capsaicin, is effective in reducing pain (such as in arthritis) by acting as both an anti-inflammatory and a nerve blocking agent, and has been studied for cancer treatment. It should be used only in very small amounts (remember this is the key ingredient in pepper spray).

Coenzyme Q10 (Ubiquinone) is produced by our bodies and is essential for energy production at the cellular level. Coenzyme Q10 tissue levels decrease with age, especially in the heart, kidneys, and liver. Supplementation is said to increase the energy and exercise tolerance in older animals and may be effective in correcting age-related decline in the immune system. It is used to treat congestive heart failure in humans. According to Nutramax, a company which produces Coenzyme Q10, it is safe to use in dogs, cats, and horses.

Curcuma longa (Turmeric Root) has been used for thousands of years as a safe anti-inflammatory in a variety of ailments as part of Indian traditional medicine. It is also taken in some Asian countries as a dietary supplement, which allegedly helps with stomach problems and other ailments. Currently the U.S. National Institutes of Health has four clinical trials underway to study curcumin (a component of Turmeric) treatment in humans for pancreatic cancer, multiple myeloma, Alzheimer's, and colorectal cancer.

Crataegus oxyacanthoides (Hawthorn Berries) is used to treat atherosclerosis, high blood pressure, congestive heart failure, and cardiac arrhythmias. It is said to improve the blood supply to the heart, improve the strength of heart muscle contraction, lower blood pressure and cholesterol levels, and reduce angina attacks. It is said to be safe for dogs and in recommended doses added to food for long periods.

Cymbopogon citratus (Lemongrass - High Myrcene) is considered an antiseptic and astringent. It is one of the most popular plant medicines in Brazil, where it is used to treat nervous disorders and stomach problems. In the Amazon, lemongrass is highly regarded as a sedative tea. It also has a strong reputation as an insect repellent.

In rare cases, lemongrass essential oil has caused allergic reactions when applied to the skin. The citral in lemongrass is what makes it a skin irritant. The higher Myrcene level in the *Cymbopogon citratus* variety gives it a proportionally lower citral content, and should make it less irritating. In any case it should be highly diluted.

Diatomaceous Earth, Food Grade (DE) helps eliminate intestinal and external parasites, which helps boost your pet's immune system by reducing the problems it has to deal with. It works in a mechanical, not chemical, manner. DE is a mineral substance formed by the fossil remains of prehistoric algae (diatoms). To the naked eye it is a powder that is fine and smooth to the touch. While non-toxic to people and pets, at the microscopic level, it is razor-sharp and is lethal to intestinal parasites and external insect pests like fleas and ticks, whose skin/shells are cut as the powder comes in contact with them. When these parasites, and their eggs and larvae, come in contact with DE they become dehydrated and die within hours.

DE is used extensively to protect and treat livestock, and is commonly used by many pet owners that avoid chemicals. It is also used by humans to clear intestinal worms. It is not absorbed into the blood system so it has no direct effect on heartworms once they enter the body, but by eliminating external and intestinal parasites it reduces the “load” on the immune system to better deal with heartworms. When administered internally, it should be given between meals so as not to absorb nutrients in meals.

As an example, I lightly sprinkle DE on the dogs' coats and in their bedding – don't get carried away. I also lightly sprinkle DE under rugs in the house where fleas may lay eggs. Every four to six months I also give the dogs a maintenance dosage in small meat treats for a week to make sure they are clear of any intestinal worms. I have not found it very effective against ticks nor at all against mosquitos, because they do their dirty work quicker than it has time to affect them. But, my dogs have never had any other external or intestinal parasites.

A side benefit is that there is no chemical residue to linger in the body or pollute the environment. Food grade diatomaceous earth is approved by the EPA, USDA, and FDA for internal and external use.

Be **very careful** to use only ***food grade*** DE as there are other forms of DE on the market (such as for filters) that could be hazardous to you and your pets.

Eucalyptus globulus (Eucalyptus Oil) is sometimes administered in veterinary practices for influenza in horses, for distemper in dogs, septicaemia in all animals, and for parasitic skin affections. It is also sometimes used diluted in a water or vegetable oil based combination with lavender oil and Basil as an insect repellent.

Eucalyptus Oil can increase cardiac activity, and if used internally in large doses, can turn into an irritant to the kidneys and suppress the nervous system by eventually arresting the respiratory system on the medullar center. It contains high levels of phenolics and terpenoids which can be toxic.

Eugenia caryophyllata (Clove Flower Buds) is said to contain strong detoxifying agents. Clove oil is virtually pure eugenol, a powerful, multifaceted phytochemical that numbs pain, and kills bacteria and fungi. It has been studied in dogs, cats, and other farm animals as an anthelmintic.

Inula helenium (Elecampane Root) has antibacterial, antiviral and antifungal effects. It is a digestive tonic, an expectorant, and also reduces coughing by relaxing the bronchial muscles. It is commonly used in combination with other components that kill intestinal parasites to reduce gastrointestinal and respiratory problems. Elecampane Root is best left to short term use combination products, and should not be applied topically.

Juglans nigra (Black Walnut) powder from green hulls is anti-parasitic, the bark is astringent and has been chewed for toothaches. It is sometimes used for intestinal flora imbalances, and as an anti-fungal, it may help in yeast infections. It has been reported to have been successfully used to treat heartworm positive dogs, and is used by some as a natural heartworm prevention.

Use very carefully as it is toxic to horses, and can be at inappropriate dosage in dogs.

Lavendula spp. (Lavender Oil) has antiseptic and anti-inflammatory properties. It is also commonly used as an insect repellent. There is scientific evidence to support the effectiveness of some of these remedies, especially the anti-inflammatory effects, but they should be used with caution since lavender oil can also be a powerful allergen. Lavender Oil is used in aromatherapy to treat anxiety, difficulty sleeping, nervousness, and restlessness. Topically, lavender oil has been found to be cytotoxic as well as photosensitizing in humans. It should be used only in very small amounts, but Lavender plantings around pet areas may repel insects.

Melaleuca alternifolia (Tea Tree Oil) has been recognized as a potent antiseptic in Australia anecdotally for much longer than there has been scientific evidence. However, recent studies support a role for tea tree oil in skin care and treatment of various ailments. It is a known antifungal agent, effective in vitro against multiple dermatophytes found on the skin. In vivo, shampoo with 5% tea tree oil has been shown to be an effective treatment for dandruff due to its ability to treat *Malassezia furfur*, the most common cause of the condition. Effectiveness of topical tea tree oil preparations for Candidiasis is supported by their ability to kill *Candida* in vitro.

External application of undiluted tea tree oil and/or at inappropriate high doses has been associated with toxicity, including death, in cats and other animals. Do not use even a diluted mixture in the ears or around the nose.

Mentha spicata (Spearmint Herb) medicinal herb tea made from the leaves is used in humans in the treatment of fevers, bronchitis, chills, cramps, chronic gastritis, common cold, headaches, indigestion, morning sickness, motion sickness, nasal congestion, nausea, halitosis, painful menstruation, and various minor ailments. It is sometimes found as an ingredient in some herbal medicine pet products, probably to sooth the stomach, and it is found in pet treats to reduce bad breath. There are no reported adverse effects in dogs.

Nepeta cataria (Catnip) has a long history of use in alternative medicine, being employed especially in treating disorders of the digestive system and, as it stimulates sweating, it is useful in reducing fevers. An extract from the leaves (called nepetalactone) has herbicidal and insect repellent properties, that has recently been found in a University study to be 10 times as effective as Deet at repelling mosquitoes. No health hazards or side effects have been associated with proper administration of catnip in designated dosages, and no drug interactions have been documented, but your dog may not like cats following it around :-)

Olea europa (Olive Leaf/Oil) is sometimes used as a base in herbal medicine pet products. Other uses are claimed, especially in horses, but there are no supportive studies. No adverse effects are noted from olive oil in dogs when administered in moderation.

Ruta graveolens (Herb of Grace) has been used for centuries to promote digestive and systemic cleansing, and it has been studied in dogs, cats, and other farm animals as an anthelmintic. Caution, ingesting large amounts of rue can cause stomach pain, vomiting, and convulsions.

Silybum marianum (Milk thistle) has long been used to promote liver health (among other uses) and reduce inflammation, both of which are very important to overall health. There are no safety studies of its use in pregnant dogs, and for any dog large doses have increased bile flow with a potential side effect of diarrhea.

Ulmus fulva or rubra (Slippery Elm) inner bark is a mucilage which acts as a lubricant and protectant making it an excellent choice for any inflammation or ulceration of the gastrointestinal tract. It is useful for digestive upsets of all varieties from diarrhea to constipation, and is often used to treat dogs and cats with inflammatory bowel disease, and to relieve the discomforts of kennel cough & other types of bronchitis.. It has been traditionally used as a balm to heal external cuts and bruises.

Slippery elm is considered a safe herb, and there are no known side effects or interactions with any other medicines.

Zingiber officinale (Ginger Root) quickly improves circulation and digestion so it is a catalyst or stimulant in many herbal medicines. Two uses are to help pets that suffer from motion sickness, and to reduce flatulence. It is claimed to be safe and well-tolerated by humans and pets of all ages.

Alternative approach compounds

This is a sampling of what I could find. Some are also used in alternative heartworm treatment, though the dosage may vary.

Artemisia Combo [producer's description]

This product combines elecampane root with two species of Artemisia, mugwort and wormwood, to provide a powerful herbal formula. Artemisia has a long history of use in China, Europe, and the U.S. for its anti-parasitic qualities and is believed to create an unfavorable environment for parasites.

Ingredients are stated as:

- Elecampane Root (*Inula helenium*)
- Mugwort Herb (*Artemisia vulgaris*)
- Clove Flower Buds (*Eugenia caryophyllata*)
- Garlic Bulb (*Allium sativum*)
- Ginger Root (*Zingiber officinale*)
- Spearmint Herb (*Mentha spicata*)
- Turmeric Root (*Curcuma longa*)
- Olive Leaf (*Olea europa*)
- Wormwood Herb (*Artemisia annua*)
- Other Ingredients: Cellulose (plant fiber), magnesium stearate (vegetable), silicon dioxide (powdered silica), gelatin, and water.

HS II [producer's description]

This product is a combination designed for support to the circulatory system, containing: hawthorn berries, capsicum and garlic. Hawthorn berries is used to strengthen and tone the heart, feed the adrenals, cleanse arteries, and has been known to balance blood pressure. Capsicum has long been used as a way to boost circulation and cleanse the body. Recent studies have shown garlic to be of benefit to the digestive, circulatory and immune systems.

Ingredients are stated as:

- Hawthorn Berries (*Crataegus oxyacanthoides*)
- Capsicum Fruit (*Capsicum annuum*)
- Garlic Bulb (*Allium sativum*)
- Other Ingredients: Gelatin and water.

Transfer Factor Plus Tri-Factor Formula[producer's description]

This proprietary Cordyvant blend features known immune-supporting ingredients. It includes:

- ✓ Maitake and Shiitake Mushrooms—long known to promote T-Cell (immune system) function and other healing properties.
- ✓ Cordyceps—rich in polysaccharides, which help activate immune system response.
- ✓ Inositol Hexaphosphate—gaining attention for its preventative immune power.
- ✓ Beta Glucans—an important immune cell stimulator. They are the “wake-up” call to white blood cells.
- ✓ Beta Sitosterol—a phytosterol that has been shown to help activate immune system response.
- ✓ Olive Leaf Extract—may be instrumental in slowing the duplication of infectious cells.

The producer says there is research showing it substantially increases immune system effectiveness, and is noted in the 2003 Physicians Desk Reference. I have not read the book and have found no scientific studies.

Bandit's Mom homemade mosquito repellent.

Combine 1 cup of spring water with 4 drops of Tea Tree Oil and 4 drops of Lavender Oil. Shake before each spraying.

Jeannie's homemade mosquito repellent.

Combine 1 cup of spring water with 4 drops each of lemongrass oil, grapefruit and peppermint oil (not recommended for cats). Shake before spraying.

Anonymous homemade mosquito repellent.

Combine 1 cup of spring water with 6 drops each of catnip oil, and lemongrass oil (*Cymbopogon citratus* - high myrcene). Shake before spraying.

All these mosquito repellents have a short term (2-7 hours) effectiveness, should be used sparingly, and should not be sprayed on the face or in ears.

A Natural approach to heartworm prevention

The basic idea of this approach is to do nothing medicinally to specifically prevent heartworm, but rather to minimize the chances of infestation by helping your pet to be healthier, and thereby less susceptible. This means avoiding those things that are detrimental to health, feeding a species appropriate diet, regular exercise, a healthy emotional environment, and, most of all, avoiding vaccinations and medications that stress and weaken the immune system. Those that take this approach usually go a bit further in trying to control mosquitos and other parasites.

The mindset here comes from considering a pet's wild brethren in an optimal environment. The heartworm has been out there forever as far as we know, but we don't read reports of wild canines being wiped out by heartworm, and yet domestic dogs are increasingly victim to it. Nature didn't intend for parasites to kill off their hosts, otherwise the parasites would not survive either.

Consider that wolves, not subjected to man's tinkering, go unvaccinated and unmedicated, eat only raw meat, bones, organs, and only a very few herbs and/or berries when there is no meat available. These wild canines are never exposed to the dozens of toxic chemicals we use to kill fleas, ticks and even heartworm on our dogs and in our homes. Interestingly, research has found evidence of wild canines seeming able to "fight off" heartworm infestations, while some others become host to the parasite, however, in small enough numbers that the heartworms don't threaten their hosts' lives.

Now all of that is well and good in the survival of a species, but what if your one beloved companion is that one in whatever number that might become infected by heartworms, and further might have to suffer the extremely toxic conventional treatment?

One of the most important issues is an animal's healthy, balanced immune system. If an animal's immune system is not up to par, then it will be more susceptible to serious heartworm infection. However, it will also be more susceptible to adverse drug effects and/or long term damage by such, since chemoprophylaxis is strongly suspected of debilitating the healthiest of animals over time.

As an example of a healthy, balanced immune system, consider the lowly flea. Some holistic veterinarians view fleas as an indicator of an animal's general health, in the absence of some other specific supportive environment for fleas. Some dogs and cats have severe flea problems, while others are hardly bothered by them. Parasites in general, and fleas in particular, are most attracted to the very young, weak, or unhealthy animal whose immune system is not functioning well. These veterinarians advocate that the long-term solution to a flea problem is to reduce a pet's susceptibility to fleas by improving its health.

You won't hear it from the pharmaceutical industry, or their lackeys in government, or many veterinarians, but there is considerable empirical evidence that a dog's liver and kidneys are adversely affected to varying degrees by the use of commercial flea and tick products such as Frontline, Advantage, and ProMeris, chemical de-wormers, and even heartworm drugs. The drug company line is “high therapeutic/toxicity ratios,” but many believe that if there were ever an unbiased full accounting these ratios would be considerably lower. When I think about the odds of heartworm infection, I also think about the potential odds of adverse drug effects.

There are many pet owners, and so far a small minority of vets that have said so publicly, that highly suspect that the toxic chemicals in these chemoprophylactic products will eventually result in renal failure (kidney failure), liver damage to the point of the liver becoming unable to filter the blood, and complete liver failure. The contaminated blood circulating throughout the body for months and years from using these products is very likely to contribute to other more complicated health issues, such as diabetes, arthritis, epileptic seizures, and brain damage, to name only the most common suspected long term side effects.

Did you know that the pharmaceutical industry, in their never ending quest for new proprietary products, commonly focuses their search on natural sources, such as herbals, with empirical evidence of applicability to their interests. Then they isolate and synthesize components for testing, and add toxic adjuvants. One might say they take something natural and turn it into something unnatural, which might, in part, suggest why these drugs have so many adverse side effects. Even natural compounds that we and our pets did not evolve to handle in a positive manner, or excesses otherwise, have adverse effects. Our metabolic physiology, and that of our pets, is much more complicated and finely tuned than we seem to understand in looking for a “quick-fix” or a new profit stream.

The pharmaceutical industry's avoidance of long term studies of adverse drug effects in humans and especially animals over the years, in stark contrast to the 25 to 30% of every sales dollar spent on product promotion, is very unsettling to me. I believe one aspect is that there is so much money involved that too many turn a blind eye on the issue – 30% of worldwide sales is almost \$200 billion with about half disseminated in the U.S.

Even so, one should not allow their disillusionment with one industry to blind them to the shortcomings of another. The so-called “natural” alternatives is a rapidly growing industry with their eye on greater profits, which entices many of the same types of business people.

*“Success, like war and like charity in religion, covers a multitude of sins.”
-- Sir Charles Napier*

Anyway, you get the idea behind avoiding vaccinations and medications that stress and weaken the immune system. I'm sure you also understand the ideas of regular exercise, and a healthy emotional environment relative to a pet's health. The species appropriate diet aspect, however, is another area where big industry has brainwashed a majority of pet owners. I won't get into the inappropriateness of commercial pet foods herein because I have another lengthy paper entitled “The Facts About Pet Diets,” but I think a few points applicable to a species appropriate diet are necessary herein.

The first point is really understanding what a species appropriate diet is. Basically, for dogs and cats, it is raw meat, bones, and organs in approximately a 80% meat, 10% bone, and 10% organ (half of which should be liver) ratio, fed over time (such as a week). It must be raw because cooking meat and organs destroys many of the nutrients, and cooked/smoked bones are dangerous because they are brittle and splinter. Fortifying/supplementing cooked foods is not nearly as bioavailable as the natural nutrients, and is a slippery slope. As to plant matter, how many reports have you heard of wolves attacking a grain field or vegetable garden, and yet they thrive (except for the predation of, and competition for food from, mankind). Maybe they just sneak into the garden when we're not looking :-)))

It is also important that this diet be fed whole (as whole as possible relative to the size of the recipient) and not pre-ground. This promotes oral health and prevents periodontal disease which otherwise looses toxins in the blood stream for yet another burden on the immune system.

Aside from a human squeamishness aspect :-), unless one has access to complete wild game prey, or can afford such from a reputable source, there are a few considerations in trying to mimic such. The meat one can normally purchase originates from industrial agriculture, and it is not the meat that wild game is, or even the next best choice of organic grass-fed/free-ranging livestock.

One of the major problems with industrial agriculture meats is, while they have a high omega 6 content, they have a much lower omega 3 fatty acid content. Ideally a dog needs a 4:1 (n-6:n-3) fatty acids ratio in their diet and closer to 2:1 would be better. Supplementing with wild salmon oil [not from a mass rendering facility and not molecular distilled] can offset this problem, but not cod liver oil because then you would be adding too many fat soluble vitamins as well.

Omega-3, being one of the essential fatty acids, is a significant problem in human diets as well, where the actual ratio is typically more like an unhealthy 30:1.

Industrial agriculture livestock are fed out on high gain feeds and don't get a lot of exercise which adds a couple issues. The first is a higher proportion of fat, so you might need to trim away some fat. The second is potentially lower taurine (a sulfur-containing amino acid important in the metabolism of fats and a potent neuroprotectant) in some meats, but including enough heart and/or brains can compensate. Consider heart a meat rather than an organ.

Lastly, the food processing industry is using more and more additives to packaged meats for longer shelf life and better appearance. Avoid all you can, especially nitrates, sweeteners, and hydrogenated fats. Industrial agriculture livestock are also given lots of medications which you can't completely avoid, and even nowadays GMOs (genetically engineered organisms) which should be avoided because we really don't know the long term effects. Avoid farmed fish because they receive more antibiotics per pound than any other livestock, and even many wild caught fish contain high levels of contaminants such as mercury, so select carefully and feed sparingly.

So what else can one do to improve their pet's odds?

- Set out as many of the home-made mosquito traps (described earlier herein) that you can keep up with around areas where your pet is commonly. Plant flowers thought to repel mosquitos every where else on your property you can (I don't think they do much good, but they look nice :-).
- Encourage natural mosquito predators in your yard, such as frogs, lizards, bats, mosquito fish for ponds or koi and other pond fish to take care of mosquito larvae naturally, etc.
- Avoid walks in the early morning and late evening. Mosquitos usually aren't out and about much midday. Use one of the natural mosquito repellants (lightly and only occasionally) when on walks.
- Use DE externally (lightly), and occasionally internally to keep other parasites at bay. Doesn't help much with mosquitos, but it reduces the potential burden on the immune system from other parasites.
- Some people add small amounts of garlic to their pet's food in the belief that it will make them less tasty to mosquitos. If you do, remember that excessive amounts of garlic can cause heinz body hemolytic anemia (as can onions).
- Don't have anything around the property with standing water in it that you don't have there purposely. Those that are there purposely, like bird baths, should be cleaned and refreshed every couple days. Some mosquito species need only a quarter inch of water in a small place for a couple weeks to propagate, and others can propagate in consistent moisture at the base of tall grasses and weeds.
- Brush and inspect your companion animal daily for ticks. Even when I use a natural insect repellant, I've found ticks in the areas one can't use such (around the eyes, nose, mouth, sex organs, and anus). Daily brushings are also great for your companion animal's emotional state – one of the key components of optimal health.

Heartworm Treatment

Here again, after discussing testing, we'll categorize by conventional, alternative, and natural.

Testing

Whether you just suspect your dog has a heartworm infection because of symptoms, or an annual/semiannual heartworm test is positive, you should see your veterinarian for further tests, regardless of whether you might follow the veterinarian's treatment advice. It is important to understand exactly what you need to deal with. Diagnosis and treatment for cats will vary.

False-positive and false-negative antigen tests do occur, the former usually due to technical error, and the latter (if unexpected) occurs most commonly when infections are light, female worms are still immature, only male worms are present and/or the test kit (for test kits requiring refrigeration) or sample has not been warmed to room temperature. If an antigen test contradicts other clinical evidence, a second antigen test format might be employed. Even when a positive test result is not questioned, quantitative analysis of antigen results is highly speculative and requires correlation with other relevant information, such as concentration tests for microfilariae, thoracic radiography to detect signs of heartworm disease or ultrasonographic (echocardiography) visualization of worms. Radiography provides the most objective method of assessing the severity of heartworm cardiopulmonary disease. Echocardiography can provide definitive evidence of adult heartworm infection, but is not an efficient method of assessment of cardiac anatomic and functional consequences, particularly in lightly infected dogs. Obtaining a second independent diagnosis from another veterinarian is not unheard of.

If there has been limited potential for exposure, insist that all positive antigen tests in asymptomatic dogs be rigorously confirmed prior to any adulticide therapy.

If a dog is unquestionably diagnosed as heartworm positive, then other testing and examination is in order to determine a dog's true state of health otherwise, so as to assess treatment options.

When additional health testing and examination has been accomplished, then you and your veterinarian should be able to agree on a categorization of infection relative to treatment risk, even if you don't agree on the actual treatment options. Important factors include: how many worms are thought to be present based upon the tests performed, the size of the dog, the age of the dog, concurrent health factors, severity of heart disease, and the degree to which exercise can be restricted in the recovery period. The usual categories into which patients are grouped are as follows:

- Class I: Lowest Risk. Young healthy dogs with minimal or no disease evident on radiographs, normal blood work, and no symptoms of illness. They may cough only occasionally if ever, and they only fatigue with extended exercise.
- Class II: Moderately Affected. Healthy dogs with minimal signs as above, occasional coughing, and fatigue only with moderate exercise, but their radiographs show definite evidence of heart disease. Lab testing shows mild anemia, urine dipsticks show some protein present but not severe urinary protein loss.
- Class III: Severely Affected. Dog is suffering from weight loss, cough, difficulty breathing, blatant damage to the vasculature is apparent on radiographs, lab work reveals a more severe anemia and marked urinary protein loss.
- Class IV: Caval Syndrome. Dog is collapsing in shock with dark brown urine evident. Heartworms visible by ultrasound in the AV valve of the right side of the heart, very abnormal blood work. These dogs are dying and can only be saved by the physical removal of adult heartworms via an incision through the jugular vein. If such a dog can be saved from this crisis, further heartworm infection treatment cannot be contemplated until the dog is stable enough to fit into one of the other categories above.

After reaching an agreement of potential risk, treatment options can be considered. Treatment may vary relative to the three groups of heartworms present:

- The microfilaria (newborn children of the adult worms) swimming freely in the bloodstream. The microfilaria present make the dog a potential host in spreading (through a mosquito) heartworms to other animals.
- The new arrival heartworm larvae (L3 and L4 larvae). They will continue their maturation and repopulate the heart and pulmonary arteries if not killed.
- The L5 larvae (young adults) and adult worms living inside the heart and pulmonary arteries. For quick destruction this group requires the arsenic compounds, while the other two groups can be killed with less toxic products.

An important consideration in initiating adulticide treatment, whether conventional or alternative, or a natural approach, is the serious threat of embolism. The dead worms migrate to the lungs and form emboli, and it is those emboli that present a serious risk to your dog, especially if the dog is heavily infested, active, older, or a small dog. Acute lung injury is associated with the death of heartworms, regardless of the cause of death. This is a greater risk with a fast kill approach, but on the other hand, with a slow kill approach there is the as yet unanswered question of whether such will have a greater tendency to develop lung injury as a consequence of the prolonged lung insult. The time frame over which adulticide is to be effected is also important relative to keeping a dog inactive, because increased flow through the diseased pulmonary capillary beds can result in fibrosis and extend to hemoptysis, and in the extreme, ARDS (Acute Respiratory Distress Syndrome) and death.

Another important consideration is in effecting microfilaricide. All those little worms dying at once create inflammation, possibly enough to cause anaphylactic shock.

Recent research has shown that it is also important to treat for Wolbachia, a parasite that lives symbiotically with the heartworms and may be responsible for much of the damage that they cause, both from inflammation and from pulmonary emboli, no matter what other form of treatment you decide on.

Exercise restriction should be enforced from the time of diagnosis through the complete treatment.

Conventional Treatment

The first step, nowadays, is usually treatment with doxycycline (an antibiotic) to kill the Wolbachia parasite in heartworms. The purpose is to weaken the heartworms and make them unable to reproduce, lessen their adverse effects on the body and reduce the chance of adverse reaction during heartworm treatment. A current recommendation is to treat with doxycycline for 30 days prior to beginning adulticide and microfilaricide treatment. However, a study done in a UK lab showed that intermittent treatment was more effective in depleting Wolbachia than continuous treatment. Wolbachia will repopulate over time, so the treatment with doxycycline should be repeated intermittently during heartworm treatment, depending on the time span of treatment.

Alternately, for a Class IV diagnosis, surgical extraction of adult heartworms must be pursued first and promptly, if such a dog can potentially be saved. Further heartworm infection treatment can't be contemplated until the dog is stable enough to fit into one of the less severe classes. This may entail enlisting another veterinarian that has special training in the procedure and special surgical equipment. Fluid therapy may also be necessary in critically ill, hypovolemic dogs to restore hemodynamic and renal function.

Though there is some disagreement, the second step for at least Class I and II diagnosed dogs is usually killing the microfilaria and migrating worms. Ivermectin (Heartgard) at prophylactic doses will kill microfilaria, L3, and L4 larvae, and reduce female worm mass by inhibiting their reproductive system. Administration of ivermectin at prophylactic doses for greater than three months should result in reduced antigenic mass, which in turn may reduce the risk of pulmonary thromboembolism during adulticide treatment.

A veterinarian may recommend a higher ivermectin dosage, or shortening the administration interval to two weeks, to shorten the time before adulticide treatment, but such is your call based on how urgently adulticide treatment needs to begin, considering that it is the adult worms that cause heartworm disease, but there is a risk of anaphylactic shock in killing off the microfilaria too fast. Comments by holistic veterinarians I have come across in my research question whether a higher dose protocol is any more effective. Macrocyclic lactones, other than ivermectin, might also be recommend, but others don't have as wide a range of effectiveness, and some substantially increase the risk of anaphylactic shock.

This second step may be combined with the first step (intermittent treatment with doxycycline) and may proceed for a term of three to six months. While most heartworm positive dogs get away with taking ivermectin safely, the dog might be pretreated with anti-inflammatory medication, and ideally observed in the hospital for this first day of treatment. However, the empirical use of aspirin for its antithrombotic effect or to reduce pulmonary arteritis is not recommended for heartworm-infected dogs. Convincing evidence of clinical benefit is lacking, and there is some research suggesting that aspirin may be contraindicated.

The rapid death of large numbers of microfilariae during the early elimination phase, 4-8 hours following the first dose, can cause systemic side effects and potentially acute circulatory collapse. Close observation of higher risk dogs is advised for the first 8-12 hours following administration of microfilaricidal drugs at doses that produce a rapid reduction in circulating microfilariae.

For acute circulatory collapse, prompt treatment with parenteral fluids and one or two shock therapy doses of glucocorticosteroids is usually an effective antidote.

For some with heartworm positive dogs, this second step extended is the treatment regimen. This is termed the “slow kill” approach, and takes from 18 months to sometimes over two years. This “slow kill” approach does work, and is safer than the “fast kill” adulticide treatment from the point of view of drug reactions, but the risk of emboli is the same, or even worse, since you're stretching it out over a much longer time. An Italian study presented at the American Heartworm Society Symposium in 2004 followed actual client owned dogs treated with this approach, and the incidence of pulmonary changes and other problems was very high - higher than with the standard "fast kill" protocol. Though there is still not sufficient scientific evidence to quantitatively assess individual risk, there is the general warning “owners of dogs receiving such therapy should be advised that any respiratory difficulty should be considered an emergency.”

This “slow kill” approach might be practical for a Class I diagnosis of a dog that is not overly active, but beyond that it may be increasingly risky.

Adulticide therapy is the administration of Melarsomine Dihydrochloride (Immiticide made by Merial; an organic arsenical chemotherapeutic agent) which is highly effective against both sexes of L5 larvae and adult heartworms. It is administered via deep intramuscular injection into the epaxial lumbar muscles. This is a painful injection with a painful substance, and it is common for the patient to experience swelling and considerable soreness at the injection site for a few days (pain medication may be needed). The injection site may actually form an abscess that requires warm compresses, and some dogs develop a permanent firm lump at the site of the injection. The potential extent of swelling and soreness may be reduced somewhat by ensuring that the injection is deposited deeply with a needle of appropriate length and gauge for the size of dog and body condition.

Adverse reactions may occur after the second/third injection in the series even if no problems were encountered with previous injections. All patients should be closely monitored during treatment and for up to 24 hours after the last injection. Post-treatment mortality due to thromboembolism and/or progression of the underlying disease may occur in 10 to 20% of the Class 3 patients.

Treatment can be done in two doses or three doses depending on the class of heartworm infection. The three-injection staged protocol is the treatment of choice of the American Heartworm Society and several university teaching hospitals, regardless of the stage of disease, due to the increased safety and efficacy benefits with a more gradual kill of the adult worms (which is safer in terms of embolism and shock), and subsequently fewer dogs that require further treatment with melarsomine.

In the two dose protocol, the dog receives a second injection the next day on the opposite side of the lower back. In the three dose protocol, the dog receives a second injection one month after the first, and then a third injection 24 hours after the second. In the three-injection staged protocol the first dose represents an introductory treatment to kill some of the more sensitive worms to avoid too many worms dying at once and creating circulatory shock.

During treatment, and for at least one month following the final injection, the patient must be strictly confined (no exercise) because embolism to some degree is inevitable and it is important to minimize embolism-related problems. If coughing, fever, or nose bleeds occur, consider it an emergency and contact your veterinarian immediately. The most critical time is 7 to 10 days following a melarsomine treatment but they can occur anytime in the following month. If the dog can not be monitored full-time at a veterinary hospital, then you should have some help at home throughout the treatment and one month afterward.

Six months post-adulticide treatment an antigen test is done to determine the treatment efficacy. At this point a microfilaria test could also be performed to insure the dog is no longer a potential host. If any microfilaria are still present ivermectin at prophylactic doses might be given for a period.

Alternative Treatment

See the initial notes under “Alternative medicine approach to heartworm prevention” (page 30).

This is a sampling of what I could find. Some are also used in alternative heartworm prevention, though the dosage may vary.

HeartWorm Free™ (aka HWF) [producer's description]

Studies have shown Amber Tech's natural organic formula can help relieve your dog of heartworms. It can eliminate the heartworms slowly over a period of time allowing the dog's own immune system to help rid the heartworm from his or her body. Because it works slowly your dog does not need to be confined and can continue to play as he or she normally would (not allowing over exertion such as racing or breeding). It can take 14 to 36 weeks to overcome heartworms. The ingredients are:

- ◆ GARLIC - Helps to repel parasites and has antimicrobial properties. Antioxidant, immunostimulant, lowers blood pressure, and overall tonic.
- ◆ BLACK SEED - An overall tonic herb known for its effects on the respiratory system, gastrointestinal tract, kidneys, liver, circulatory, and immune system. Anti-parasitic.
- ◆ LICORICE - An anti-inflammatory and expectorant, controls coughing and has hormonal and laxative effects. It is further used to prevent liver toxicity and treat tuberculosis and adreno-corticoid insufficiency. Blood cleansing, supports lung tissue, and immunostimulant.
- ◆ HAWTHORN - Supports and strengthens heart structure and overall heart functions (tonic). Improves coronary circulation, relaxes and dilates arteries, improves blood circulation, lowers blood pressure, antioxidant, nutritive.
- ◆ HOPS - Used as a diuretic. It is known to be relaxing to the central nervous system, eases tension and anxiety, induces sleep. Tonic for the digestive system, eases irritable bladder syndrome, good for sluggish livers, and cleanses the blood.

- ◆ SORREL - Cleanses the vessels of parasites.
- ◆ APRICOT PITS - Contain small amounts of natural occurring cyanide.
- ◆ GRAPEFRUIT SEED EXTRACT - Anti-microbial activity against viral, bacterial, and fungal infections. Also rids the body of microscopic parasites.
- ◆ FLAVORINGS - To make the product more palatable.
- ◆ ALCOHOL - Intensifies the herbs in the HWF™ tincture while acting as a natural preservative.
- ◆ DISTILLED WATER

During treatment they recommend also putting your dog on another of their products, Kidney Rejuvenator™ to help eliminate some of the stress on the kidneys.

After treatment they recommend keeping the dog on HWF, but at 1/2 the normal dose once/day for 3 to 4 months. They also note that one might give a full body detox to help the body eliminate dead worms using Amber Technology's Internal Gold Detox Kit™.

Their qualification is: Although most dogs recover on the 16 - 24 week course not all dogs will. Severely infested dogs may not recover if the worms have formed a tight ball within the heart. A good diet, moderate exercise, and plenty of fresh water may increase your dog's odds of overcoming heartworm. If your dog is on the HWF™ longer than 36 weeks, take a 3 week break, then continue if needed.

PetAlive Parasite Dr.™ [producer's description]

Parasite Dr. is a 100% natural, safe effective herbal remedy for the healthy and effective expulsion of intestinal parasites such as roundworm, heartworm and tape worm. It helps to rid your pet of unhealthy infestations of internal parasites without the unwanted side effects sometimes associated with synthetic parasite medication. It performs the following:

- ◆ Naturally treats canine and feline parasites, hookworm, heart worm, roundworm
- ◆ Promotes digestive health and balance
- ◆ Calms and soothe the digestive system
- ◆ Cleanses and detox the digestive system and improve digestive functioning
- ◆ Cleanse the blood
- ◆ Supports correct balance of intestinal flora
- ◆ Acts as a tonic for the entire digestive system

Ingredients:

- ◆ *Artemisia absinthium* (Wormwood) is a very well respected herb in both Eastern and Western herbal medicine. It is an excellent digestive tonic and helps to cleanse the digestive tract
- ◆ *Eugenia caryophyllata* (Cloves) contain strong detoxifying agents.
- ◆ *Azadirachta indica* (Neem) This tree is highly prized for making furniture as the wood is worm resistant. For the same reason, it is a highly prized Ayurvedic medicine.
- ◆ *Ruta graveolens* (Herb of Grace) has been used for centuries and is included in our Parasite protector capsules for its ability to promote digestive and systemic cleansing.
- ◆ Rice powder (inactive ingredient)

Capsules may be swallowed whole by larger dogs. However, most owners find that it is easier and more convenient to open the capsule and mix the contents with wet food or a treat. This prevents stress to both pet and owner! Cats, especially, hate to have capsules forced down their throats and will happily eat the dried herb when it is mixed with a treat, a little fish or rolled into a butter ball. A 14 - 21 day treatment will usually suffice.

Follow dosage as specified. Continue for approximately three weeks. Repeat when necessary. Not recommended for kittens and puppies under 6 months or very elderly animals unless under medical supervision. Avoid during pregnancy and nursing.

Bandit's Heartworm Treatment Program [producer's description]

As described by The Herbs Place (Sunshine Life Center, Inc.). This program consists of a number of herbs and nutritional products described below. The amounts to be used for each animal are different based on breed, indoor/outdoor pet, and weight.

Upon waking and nightly before bed, Artemisia Combination is given on an empty stomach.

With AM and PM meals, Coq10 and HSII is given. In the evening Black Walnut was added occasionally.

Yucca is used as needed for coughing, since it is considered an herbal cortisone.

To avoid further mosquito bites, they also recommend using use a spray spritz that contains 4 drops each of Tea Tree Oil and Lavender Oil in 1 cup of water in a spray bottle.

The components (except Yucca) are described under “Alternative medicine approach to heartworm prevention.”

They warn that all components are needed for a successful program, and that the components should be purchased from them to ensure the proper potency and quality.

Natural Treatment

If you understand the section “A Natural approach to heartworm prevention” (page 41) then you should understand (whether you agree or not) the thinking that for a dog with a healthy immune system the best treatment may be no medical treatment.

If a dog has a light infestation and has a very healthy immune system, then it is possible the dog will be able to “fight off” heartworm infestations, or at least tolerate a small number of adult worms. If this approach is taken, then the state of the heartworm infestation should be closely monitored with more frequent testing. If the infestation increases, then it might be time to consider either an alternative or conventional approach.

One should also understand that in not treating a healthy dog that seems to tolerate a small number of worms, one is allowing one more potential host for spreading heartworms.

Closing Comments

Whatever approach one takes to heartworm prevention and treatment, locally appropriate periodic testing and the overall health of your companion animal are the keys to prevention, the extent of possible infestation, and the long term overall success of treatment.

You know (or should) that eating one french fry is as hazardous to our health as smoking one cigarette, and that soda pop is a nutritional disaster, but we can “exist” many years on a diet of mostly french fries and soda pop, although we will be more susceptible to health problems. Commercial pet foods, or any non-species-appropriate diet, have a similar effect on our companion animals.

Similarly, consider all the potential side effects and long term damage of the medications humans take (even OTCs), and you know there is hokey-pokey reporting (at least you have a suspicion if you have followed the news, and know if you have done much research). Then consider that because animals are supposedly “inferior” to humans, oversight of drugs is even more of a sham, and there is considerably more industry chicanery.

I wont even get into all the environmental dangers humans have created, that can affect us and our companion animals.

Whether to take a conventional, alternative, natural, or some combination thereof, approach to the heartworm issue is an individual decision that should be made in the best interests of your companion animal. Here in northern New England, when most veterinarians began advising year around chemoprophylaxis (remember that is a misnomer) some years back, I began to suspect their understanding and/or priorities, and started learning everything I could about mosquitos, heartworms, chemoprophylaxis and chemotherapy, alternative approaches, and natural approaches. Along the way I have become increasingly aware of just how much big business tries to influence our decisions by sophisticated manipulation of our emotions. It doesn't matter whether such is for a new TV, car, influenza vaccinations, or pet food.

A conventional approach might be necessary in some situations (extent of heartworm infection, immunocompromised issues, age, and so on), but should be carefully balanced with immediate and long term adverse drug effects considerations.

An alternative approach might also satisfy in some situations. I would tend to leave myself some wiggle room here, though, as I have yet to find any definitive scientific evidence of the extent of efficacy. I would also choose an alternative veterinarian very carefully as harm can be done here also.

With a natural approach one is relying on the best of nature – that is the ability of our bodies to ward off damage and repair any damage that does occur. The problem here is that mankind has so screwed up nature that even our food sources can be detrimental. Man's attempts to manipulate, isolate, and synthesize nature, with a limited understanding of natural balance, is historically an abysmal failure.

So, hopefully with a more rounded understanding of the risks involved, it all boils down to mosquitos, and the heartworm disease they can initiate, being a serious problem that will increase with mankind's inevitable ignorance and greed (like in global warming). But, what we may now understand, is that there are other equal and more serious problems affecting our companion animals. Ones that we are directly responsible for, and in many cases can't seem to recognize the source of.

In the hope that reiteration will make the point clearer “The heartworm has been out there forever as far as we know, but we don’t read reports of wild canines, distanced from the hand of man, being wiped out by heartworm, and yet domestic dogs are increasingly victim to it. Nature didn't intend for parasites to kill off their hosts, otherwise the parasites would not survive either.” And evidence supporting this line of thinking “In a 1991-1996 disease testing study of live-captured wolves in Wisconsin, heartworm infection was found to be very rare (rarer by far than Canine Parvovirus, Infectious Canine Hepatitis, Canine Distemper Virus, Lyme Disease, and Blastomycosis which were also tested for).” [Check out Wisconsin on the heartworm incidence map – I've been there and it is a mosquito paradise in the summer.]

Why are more domestic dogs increasingly more seriously affected by heartworm?

If you're stumped then you missed some salient points in this paper :-)

Just my personal take, but for what it's worth, my dogs and I take a mostly natural approach, believing that a [metaphorical] meteor strike is less likely to do us in than man's tinkering with nature in general and our physiology in particular. I grew up on a ranch in Wyoming in the 1940s and have come full circle, learning not to play the game of life with those having loaded dice ;-)

I sincerely hope this paper gave you sufficient insight to be more fruitful in your own research.

And I hope this finds you and yours "As fit as a butcher's dog"