PARASITE CONTROL IN THE DOG, NORTH AMERICA

Author: Fred Lanting
updated November 2011

WORMS

Most worms (nematodes) settle and grow in the small intestine, though some species are found in the cecum, heart, lung, and other tissues in various stages of development. The intestinal nematodes produce eggs, which are carried with the digestive products to exit in the feces. But since the egg-laying does not always coincide with the dog's bowel movements, stool samples may not show the presence of worms. A 5 day sampling will probably reveal some eggs if hookworms or roundworms are present, but tapeworms or whipworms may still escape detection. For this reason, many breeders rely instead on outward signs of poor coat, flatu- lence and/or diarrhea, loss of weight, and an abnormal look or smell to the stool.

In many breeds, the topcoat should lie flat, straight, and smooth, giving a water resistant thatch over the softer undercoat and skin. If these coarse, straight guard hairs stand up and out, or if the ends curl out away from the body, it may be a temporarily "open" condition due to worms. Lustre and texture also is gone, and the feel is rough and dry, the natural lubrications being lost when worms take their tariff from the intestinal lining's rich supply of blood vessels, or otherwise interfere with normal absorption of nutrients. In this article you will see the word anthelmintics, which is the more accurate word for "wormer," "worm medicine," etc.

Roundworm — This is the most widespread of parasitic worms in dogs, cats, and many other animals. They are present in almost all newborn pups, having passed in larval stage through the placenta into the fetus's liver. After birth, these larvae are carried by the blood to the heart, then to the lungs. Irritation of the bronchial passages causes the dog to gag and cough the larvae up, then swallow them. This enables the larvae to reach the intestines where they latch onto the walls with lamprey-like tenacity, and in as few as ten days can be found to have matured into identifiable round¬worms of egg laying capacity.

Older pups that get worms a second time usually do so by ingesting worm eggs from stool or stool-contaminated surfaces. Pups (and adults) may also pick up roundworms from cat stools, which present a tremendous attraction. Larvae have also been detected in bitch's milk. Swallowed roundworm eggs hatch in the intestine where the liberated larvae penetrate the wall and are carried in the lymph system to the veins. They, too, take the liver heart-lungs route, molt, and start laying eggs of their own four weeks after being ingested. So, it's a good idea to repeat initial worming a couple weeks later, whether it's a new litter or a dog you have just obtained but aren't sure of its worming history (such as may be the case with some imports).

Adults and half grown dogs tend to trap some roundworm larvae in body tissues in an encapsulated or encysted condition, where they do no further harm. Pregnant bitches, however, undergo a hormone change about three weeks before whelping that releases the encysted larvae, freeing them to migrate to the placenta and affect the fetuses as the bitch herself was affected when she was a growing embryo. This dormant stage of roundworm larvae can also exist in transient or intermediate hosts such as rodents, and if mice are eaten, the process of digestion will release the larvae in the dog's intestine, where they will not migrate (because they are in a different form), but develop into roundworms. Dogs that catch and eat beetles, cockroaches, mice, even earthworms, all of which may be hosts for roundworms, should periodically be given anthelmintics (wormers) as a routine control measure. Pyrantel pamoate (Strongid™, Nemex™) is an excellent anthelmintic for the youngest puppies because it is considered non-toxic and very safe even if rather overdosed accidentally; it is highly effective against round and

hookworms. A good routine is to administer 2 weeks after birth, and then again 10 days after that. The next worming can be with ivermectin, but if you have a very small breed, you might want to dilute that. More on this anthelmintic drug later.

Hookworm — Hookworms are much smaller than roundworms and cannot be seen outside the dog, but as in the case of roundworms, eggs can be detected in fecal matter under the microscope. “Hook,” as dog fanciers often call it, is a debilitating disease in adults and a frequent killer of pups. It is possibly the leading cause of death in puppies over two or three weeks of age. In chewing their way to blood vessels serving the intestinal walls, hookworms inflame the lining and make the organ less efficient. As a result, the dog becomes malnourished as well
as anemic. Bloody stool, diarrhea, anemia, weakness, and dehydration are symptom of hookworm infestation, in addition to the sign of poor coat condition. There are a number of good anthelmintics, but the one I find most convenient, safe, and effective is ivermectin, good not only for heartworm prevention, but also for preventing and treating for round, hook, whip, and even ticks. Interceptor™ (milbemycin) is another heartworm “medicine” that gets many of these parasites. Since all wormers are potentially dangerous especially to debilitated pups, follow your veterinarian’s orders when worming sick or very weak pups. Hookworm can commonly be picked up at dog shows, veterinarians’ lawns and lobbies, city sidewalks, and parks where dogs defecate. The eggs can live a long time in the soil, but sunlight helps to kill them, and full strength chlorine bleach can destroy or force them to hatch and thus be susceptible to attack by products available from your veterinarian.

“A whip so small you could not see it, I’ve known to lash the mighty creature
till it fell.” …Emily Dickinson, 1874

Whipworm — Whipworm infestation is usually less of a problem since it is not so widespread, but it’s harder to detect and eradicate. Eggs are extremely resistant to the environment, and larvae can exist for several years in the soil or cracks in basement floors. Whipworms don’t lay as many eggs, or as often, as other worms, so they are more difficult to detect. Take several days’ stool samples (in one mixture) to the vet. Symptoms are similar to those of hook, and repeated doses with specific whipcides are quite effective when strict sanitation is an adjunct. Generally, anything that will kill hookworms or whipworms will also kill roundworms but it might be a longer battle before you are feeling safe. Febantel™ has generally replaced the old dichlorvos (Task™, Atgard™) as the wormer of choice. Dichlorvos once was widely used for whip, hook, and roundworms as well as an ingredient in impregnated-plastic strips for fly control, but was a bit risky for the youngest pups or dogs with liver or kidney insufficiency or heartworm, or if absorbed along with other cholinesterase inhibitors.

So the lone Taenia, as he grows, prolongs his flatten’d form with young adherent
throngs. …Erasmus Darwin, in The Temple of Nature, before 1800

Tapeworm — A variety of tapeworms (cestodes) infest dogs and all of these flatworm parasites rely on an intermediate host in order to be transmitted from one direct host to another. Depending on the genus and species, some require an insect, others a crustacean, still others a different mammal in which they exist in a non-worm stage such as a larva, usually encysted. Eggs are seldom detected in flotation slides, but the owner may see little white crawling things on the surface of some stools. These are called proglottids, segments of the tapeworm that contain the eggs and are shed by the worm in order to propagate itself while the head and younger segments remain attached to the inside of the dog. The shed segments have been likened to rice grains, cucumber seeds, and tiny blunt arrowheads and can vary in size from those of cucumber seed dimensions down to nearly microscopic particles that can be mistaken for frost if seen on a cold morning. The stool is not necessarily soft, unless the infestation is so bad that diarrhea is around the corner. However, tapeworms should be suspected when the dog has been wormed for hook yet still has flatulence and poor coat. He must then have the specific tapeworm anthelmintic.

Dipylidium caninum, a member of one of the most common flatworm parasite groups in dogs, is transmitted by the dog flea and the cat flea. When the dog bites and eats the flea, the tapeworm larva is given access to the canine intestine where the cycle starts again. The flea's family members, meanwhile, are waiting in the grass (or even your carpets!) to feed on the eggs in the proglottids shed by earlier tapeworms. The genus Taenia includes several species of tapeworm, the most common of which is T. pisiformis. Most cases of infestation come about when the dog eats a rabbit or mouse in whose intestines can be found encysted Taenia larvae. Prevention of infection with Taenia includes not allowing your dog to eat raw wildlife, particularly the internal organs, and especially rodents. The best preventive measure against Dipylidium is to keep your dog from socializing with cats or visiting places where cats hang out, for our feline friends are typical intermediate hosts even though they are seldom bothered by the fleabites. A much-used wormer called praziquantel (trade name Droncit™), is nearly 100 percent effective against both of the above types of tapeworm. It causes the tapeworm to lose resistance to digestion by the host, so you will rarely see pieces of the worm in the stool after the wormer has done its job. Other anthelmintics for hookworms, roundworms, and whipworms don't affect either of these tapeworms. A few minor flatworms are transmitted by the eating of raw fish. Another species, Echinococcus granulosus, is a danger to man, its intermediate host. It is found mostly in Alaska and parts of Canada. There is a tablet anthelmintic sold under the trade name "Drontal™ Plus" which combines Droncit with pyrantel pamoate (the latter paralyzes hook and round worms). There is also febantel, which interferes with the metabolic process of whipworms; a combination with praziquantel is useful in the control of several types of intestinal worms with one dose. Some of these can be also be administered by injection.

Heartworm — Once a southern problem, heartworm has spread rapidly since the 1960s, due to increased travel around the United States. Only mosquitoes apparently can incubate the heartworm nematode, and only certain species of mosquito seem willing to do the job; unfortunately, they seem to be everywhere. Apparently, foxes as well as coyotes can keep the problem alive in any given area, but there are enough dogs around that are not on a preventative, that they don't need any help from wild animals to spread this disorder. Prevention used to be obtained through daily administration of diethylcarbamazine citrate, sold under various tradenames, the best known of which were Caracide™ and Styrid-Caracide. A good blood test can uncover microfilariae. Another previously-used control measure in some parts of the South was the twice yearly treatment with "arsenic" (thiacetarsamide), which is used to kill adult heartworm. A newer, far less harsh, and far superior preventative is the once-a-month dosage with either ivermectin (most common trademark as sold by vets is Heartgard™) or milbemycin (sold as Interceptor™). Ivermectin was long used by farmers as a cattle wormer; they found it got rid of all worms (except tapeworms) in their dogs, too. Ivermectin has been used in Australia as a public health measure because it kills ticks which infest the crossbred dingoes and their Aborigine owners. There it has been found that dosing every six weeks was adequate in controlling the tick problem.

The lifecycle of the heartworm begins with the mosquito feeding on an infested dog. It picks up, with the blood, some tiny heartworm embryos called microfilariae. Within minutes, the microfilariae begin to migrate from the gut to another part of the mosquito, changing into an infective form called larvae. In a couple of weeks these larvae move to the mosquito's mouth and when the insect bites the dog they escape into the blood, fat, and mucous tissues of that victim. There they continue to develop in the fatty tissue under the dog's skin and undergo more molts. In a few weeks they enter the veins as immature worms and reach the heart three months after entering the dog. Growing to a length of some seven inches for males and almost twice that for females, they lodge in the heart, copulate, and produce eggs that then hatch into microfilariae, and the cycle is complete.

The danger to the dog is in the worms' interference with flow of blood, proper opening and closing of the heart valves, effective oxygenation of cells, and proper blood flow to the lungs, especially when the worms die and clog up the pulmonary arteries. The principal danger to the dog with an adult heartworm

population being treated with arsenic is when the dead worms let go and obstruct the pulmonary arterial flow; pneumonia is then the most likely cause of death,
so the dog must be kept from exercise or exertion during this treatment period.

Other worms — I have limited these suggestions to worm problems that are most common in North America. There is insufficient room or reason to describe the other, much more minor, worms that can bother dogs in this region, but if your dog exhibits typical "wormy" symptoms and a couple of routine wormings a few weeks apart don't improve his condition, take a 5 day stool sample into the veterinarian for a complete study.

The changing scene — Wormers, like flea and tick killers, are constantly in a state of flux, so make sure your vet and you keep up to date on the latest studies. But don't automatically assume that if something new is highly effective, that it is the best. Many old and relatively safe approaches can still be used. Telmin™ (mebendazole), Scoloban™ (bunamidine), DNP, Vermiplex™, and Styquin are effectively off the market in the USA now. Wormers similar to Vermiplex may kill a fairly high percentage of hookworms, roundworms, and considerable numbers of tapeworms, but not enough to completely eradicate an infestation; many of these are principally toluene or similarly offensive solvents. They usually require fasting before effective administration.

RELATIVE EFFICACY OF THE MORE COMMON ANTHELMINTICS (WORMERS)

Product	Hook , Round	Whip	Tape	Heartworm
Ivermectin*	+++	+++	—	+++
Pyrantel pamoate (Nemex, Strongid™)**	+++	—	—	—
Fenbendazole (Panacur™)***	+++	+++	++***	—
Praziquantel (Droncit™)	—	—	+++	—
Prazi + Febantel™ (Paracitide-10™)	+++	+++	+++	—
Drontal-Plus™ (prazi, Febantel™, pyr. pam.**)	+++	+++	+++	—
Milbemycin (Interceptor™)	++	++	—	—

* Commonly bought from a feed store or on-line, same ingredient as, but cheaper

than Heartgard; When packaged for cattle and swine and sold in feed stores without prescription. Ivermectin comes in multiple strengths; I use the 1% solution. Ivermectin had long been sold "off-label" for dogs; it has been considered dangerous in Collies, Shelties, and crosses of these, if given in doses large enough for treating intestinal worms. In these breeds, you may wish to consider fenbendazole instead, which is also moderately successful against Giardia.

**Pyrantel pamoate is also sold as a paste for horses, but dividing doses of that form is difficult; the pleasant-tasting liquid sold for dogs is easiest to administer, though tablets are also available. For hookworm, which can be hard to rid from the premises, every other week for 6 weeks may be required. Better to switch to ivermectin after the first dose.

***Panacur is effective against only one type of tapeworm (Taenia, not Dipylidium); it is administered for 5 days for the tapeworm and 3 days for other worms.

In all cases, it is wise to treat the dam 2-3 weeks after whelping, or after her pups start eating "solid" food in the last stage of the weaning process. I have found that almost all intestinal worm problems seen in North America can be prevented by initially dosing pups when they are 2 weeks old with Nemex, effective against canine roundworms and hookworms, and then start oral ivermectin another two weeks after that. For both worms and ticks, I use Ivomec™ (a brand name, and labeled "for cattle and swine"), purchased at feed stores in 50-ml bottles of 1% injectable ivermectin (it's the active ingredient in Heartgard™). Sold there for cattle & swine, the same stuff takes care of various worms in the canine. One bottle will possibly last most of a little dog's life, but even with large breeds, you won't be spending the small fortune that others do. I store mine in the refrigerator, even though there doesn't appear to be a shelf-life problem at room temperature. It's up to you (and maybe your vet, if you wish) what you choose, but I have had good results for many years with the protocol I describe in this article.

The Heartgard dosage to prevent heartworm, as I once wrote down from their old literature, is 6 micrograms per kilogram of body weight. But buying the high-priced pills from the vet is too expensive for my tastes, when I get the same results by shopping where the livestock farmers shop. The insert in the package of 1% Ivomec recommends one milliliter (1 ml = approx. 1 cc) per 110 pounds of bovine, and 1 ml per pound of swine. Anatomically and medically speaking, dogs are more similar to pigs than to cows, so I chose the swine dosage as a starting point. Equivalents in medical jargon are 200 and 300 micrograms per kilogram of body weight in cattle and swine, respectively, both much higher than what I use monthly.

The insert explains that ivermectin's "wide margin of safety [in mammals] is attributable to the fact that... [the active ingredients, lactones]... do not readily cross the blood-brain barrier. In other words, the chemical/drug acts so much more on the brainless parasite than on your smart, "brainy" dog. In cattle and swine, the Ivomec insert says, ivermectin is effective against gastro-intestinal worms, lice, and mites.

Some people ask, "Can I figure out the dosage from the label on the bottle?" Yes, but is it necessary? You may have to do a lot of converting of volume measurements, metric system designations, etc. What others use (it already has been done for you) may be close enough, as long as you feel comfortable with its use in your breed. I have had many years of success,

treating my GSDs, Shibas, and Whippets with never a sick dog because of ivermectin. I dose orally, not by injection, even though I buy the "injectable" form from my local farm supply & feed store. You should understand that less of almost any drug gets into the circulatory system if ingested, than if injected. Keeping that in mind, the manufacturers' suggested levels (designed for hypodermic injection) are usually a good bit below what they probably would recommend for oral administration.

Heartworm — Only mosquitoes apparently can incubate the heartworm nematode, and only certain species of mosquito seem willing to do the job; unfortunately, they seem to be everywhere. Reportedly, foxes as well as coyotes can keep the problem alive in any given area, but there are enough dogs around that are not on a preventative, that they don't need any help from wild animals to spread this disorder. A good blood test can uncover microfilariae. An old control measure once used in some parts of the South was the twice yearly treatment with "arsenic" (thiacetarsamide), to kill adult heartworm. A newer, far less harsh, and far superior preventative is the once-a-month dosage with either ivermectin (most common trademark as sold by vets is Heartgard™) or milbemycin (sold as Interceptor™). Ivermectin was long used by farmers as a cattle wormer; they found it got rid of all worms (except tapeworms) in their dogs, too.

The lifecycle of the heartworm begins with the mosquito feeding on an infested dog. It picks up, with the blood, some tiny heartworm embryos called microfilariae. Within minutes, the microfilariae begin to migrate from the gut to another part of the mosquito, changing into an infective form called larvae. In a couple of weeks these larvae move to the mosquito's mouth and when the insect bites the dog they escape into the blood, fat, and mucous tissues of that victim. There they continue to develop in the fatty tissue under the dog's skin and undergo more molts. In a few weeks they enter the veins as immature worms and reach the heart three months after entering the dog. Growing to a length of some seven inches for males and almost twice that for females, they lodge in the heart, copulate, and produce eggs that then hatch into microfilariae, and the cycle is complete.

The danger to the dog is in the worms' interference with flow of blood, proper opening and closing of the heart valves, effective oxygenation of cells, and proper blood flow to the lungs, especially when the worms die and clog up the pulmonary arteries. The principal danger to the dog with an adult heartworm population being treated with arsenic is when the dead worms let go and obstruct the pulmonary arterial flow; pneumonia is then the most likely cause of death, so the dog must be kept from exercise or exertion during this treatment period.

For heartworm prevention, I aim for approximately 0.15 ml for every 50 lbs. of dog body weight, 0.21 ml for 75 lbs., and 0.27 for 100 lbs. Naturally, you can't be accurate to two decimal places, even when you use a 1-ml "TB" syringe, but I don't have to be precise, as it is quite a safe drug for almost all breeds, especially at this low preventive/maintenance level. I dose once a month and I don't worry about giving a little more than the above amounts. I don't even do stool checks anymore; just use that dosage as a prophylactic (preventive) approach. Almost any diabetic can get a hypodermic syringe and needle for you.

For actual round-, hook-, or whipworm presence, or high exposure risk such as weekly exhibition on probably-contaminated dog show grounds, I give my dogs a higher dose: 0.3 to 0.4 ml per 25 lbs., or 1 ml per 75 lbs. every 4 or 6 months instead of their regular low-dose level. I also use the higher dose to combat ticks when they get especially bothersome.

TICKS and Ivermectin

While I still maintain that the best way to control ticks is to go over your dog every day and pluck them off with a tweezers and drown them in soapy water (or other detergent), you can also get an additional measure of control by using ivermectin. Especially if you have an unusually bad tick year. Higher doses than I use against worms are used in Australia as a public health measure in rural Aboriginal communities (where the children and some of the adults sleep and otherwise are in intimate contact with their crossbred dingoes) to kill ticks and sarcoptic mites on family dogs. There it has been found that dosing every six weeks was adequate in controlling the tick problem on both the pets and their owners. In that country, the use of ivermectin as a public health measure has favorably affected mortality rates of both man and dog, and greatly improved the health of both. When the dogs are made tick-free and cleared of Sarcoptes, the children benefit because they no longer contract these diseases from their furry friends. There is much history elsewhere of using it for mites & ticks. In much larger, more frequent long-term doses, it has been used against demodectic mange. My personal experience, verified by anecdotes from others, is that ivermectin has considerable action against ear mites and ticks (which are non-insects) but not against fleas (insects).

The higher de-worming level I mentioned earlier is what I also use (in alternate months or two to four times a year) when ticks get bad (as in 2007 - 2008 when we in northern Alabama saw the third-worst tick problem in 30 years). Or else, I'll give the dogs an extra mid-month (roundworm-control-size) dose, and that helps control the ticks a great deal. The nasty little arthropods still bite, but very few survive long enough to suck much blood. They tend to "die and dry." By the way, this "large dose" (as I call the one I give for other than heartworm preventive), is the same that pigs get by injection. And as I said, not as much gets absorbed through the gut as would if injected subcutaneously.

Procedure: I stick a 1-ml "hypo" (the size used by diabetics, and what used to be called a "TB syringe") into the rubber-stoppered 50-ml bottle. The first of the month, I pull the desired amount into the barrel, disconnect it so that the needle stays in the bottle (stuck in the rubber seal), and squirt the selected volume into the mouth of the dog. The website http://www.vin.com/proceedings/Proceedings.plx?CID=WALTHAMOSU2002&PID=2984 has more on efficacy of medications like this. This information is not a medical recommendation; by law in most states, you need to confer with your veterinarian for that.

BREED CAUTIONS

Owners of certain at-risk Collies, Shelties, Sheltie mixes such as Silken Windhounds, perhaps Australian Shepherds, Kelpies, etc. might want to check current knowledge on vet websites for information on "the mdr1 mutation." As the moderator of a veterinary medicine Internet chat list says, "Mixes of unknown pedigree should be treated with caution at the higher ivermectin

doses." Which higher doses, you may ask? Well, that's a reference to using the drug for killing intestinal worms, not the level for heartworm control.

Well-versed and careful researcher John Cargill says, "Moxidectin (in Proheart™ tablets) is given once a month to prevent heartworm disease. [Several] products contain macrocyclic lactones which kill the tissue stages of heartworm larvae and are given once a month. They are generally very safe, but should not be used in young pups as they can enter the brain and cause nervous system symptoms such as depression and signs of stupor. Collie-type dogs are more sensitive to nervous-system effects than other dogs, but even in these breeds, the products are safe at recommended doses."

See: http://www.petshed.com/articles/preventative-dog-heartworm-meds.html

Bonnie Dalzell, Borzoi breeder and another respected data researcher, says: The dose I got from a vet working for Merck, using the 1% liquid "horse Ivomec": for dogs who do not have the MDR1 gene, 1 cc orally for 135 lbs of dog; the heartworm prevention dose, safe for MDR1 dogs: 0.1 cc orally per 135 lbs of weight. I do not try to get an accurate low heartworm dose for a 10-lb. dog—I would use the Heartgard or Interceptor instead. Breeds that have been shown to have around 30% individuals with the MDR1 gene include Silken Windhounds (Whippet cross, probably with Sheltie), Shetland Sheepdogs, Rough Collies, and Australian Shepherds. If you are in doubt, there is now a PCR test for this gene. Since you can test to find carriers, you could even eliminate it from a lineage of dogs. Here are two abstracts:

http://www.blackwell-synergy.com/doi/abs/10.1111/j.1365-2885.2005.00692.x

http://www.blackwell-synergy.com/doi/abs/10.1111/j.1476-4431.2006.00196.x

In case you have not heard of that gene Bonnie talked about, here is a news item from late 2007:

A MYSTERY OF DRUG SENSITIVITY IN DOGS CAN BE PUT TO REST!

"When given a high dosage of ivermectin heartworm medication, many Collies developed severe neurological signs that often resulted in death due to respiratory arrest. Statistical data on drug sensitivity included Collies, Australian Shepherds, Bearded Collies, Border Collies, Shetland Sheepdogs, etc. and drugs ranging from an over-the-counter anti-diarrhea medication (Loperamide) and pain controller Butorphanol to some chemotherapy drugs. The mystery has finally been solved. A recent study by Dr. Katrina Mealey has identified that the problem of drug sensitivity relates to a genetic mutation in the multidrug-resistance gene (MDR1). One of the responsibilities of the gene MDR1 is the production of a protein called P-glycoprotein (P-gp). This protein allows many toxins and drugs to be removed from the brain. An affected dog lacks functional P-glycoprotein that leads to toxins not being pumped out of the brain and, as a consequence, to an abnormal neurological reaction. The mutation has an autosomal recessive way of inheritance which means that, in order to be affected (super sensitive to drugs), a dog has to have both genes mutated. However, even the presence of a single mutation increases drug

sensitivity in a dog. A new DNA test for the presence of the mutation MDR1 gene allows for the detection of affected dogs as well as dogs carrying a single mutation. Knowing the dog's status will help veterinarians to properly administer treatment and will help breeders to eliminate this disease in their bloodlines. To learn more about ordering the test, see

http://www.healthgene.com/canine/C142.asp "

Ivermectin vs. other drugs:
Here, as additional information, is a collection of some of the statistics on adverse effects of the various heartworm preventatives currently on the market. The data in the following list was compiled from the Food and Drug Administration listing of Adverse Drug Experience Reports, <http://www.fda.gov/cvm/ade_cum.htm> The number of deaths per year is significant, although comparative percentages are not given. Selected other adverse events are also reported.

Ivermectin, Oral, Dogs (Heartgard & other brands) Year approved: 1987
Number of Adverse Drug Experience (ADE) Reports in FDA through 7 June 2007:
1,069 (per year: 53)
Total Deaths: 126 (6 per year since FDA approval); Anemia: 6; Platelets low: 3;
autoimmune hem: 3
Reports of ineffectiveness against heartworm: 10 per year

Ivermectin & Pyrantel combination, Oral, Dogs (Heartgard Plus): Year approved: 1993
Number of Adverse Drug (ADE) Reports in FDA through 7 June 2007: 9,871 (705/yr)
Total Deaths: 97 (7/yr); Selected other adverse events reported: Convulsion(s):
197; Anemia: 25; Autoimmune hemolytic anemia: 20; Platelets low: 9
Reports of ineffectiveness against heartworm: 156/yr

Milbemycin, Oral, Dog (Interceptor™ brand name) Year approved; 1995
ADE Reports in FDA through 7 June 2007: 4,745 (395/yr)
Total Deaths: 159 (13/yr); Convulsions: 268; Anemia: 29; autoimmune hem: 15;
Platelets low: 1
Reports of ineffectiveness against heartworm (total): 2757
Ineffective against heartworm reports per year: 230

Milbemycine oxide with Luferon, Oral, Dogs (Sentinel™): Year approved: 1995
ADE Reports in FDA through 7 June 2007: 1,777 (148/yr)
Total Deaths: 43 (5/yr); Convulsions: 109; Anemia: 10; autoimmune hem.: 8;
others: 4; Platelets low: 12
Total reports of ineffectiveness against heartworm: 775 (65/yr)

Selamectin, Topical, Dogs (Revolution™) Year approved: 1999
ADE Reports through 7 June 2007: 10,917 (1,365/yr)

Total Deaths: 217 (27/yr); Convulsions: 339; Anemia: 60; Autoimmune hem: 16; Other anemia: 37; Platelets low: 59
Total reports of ineffectiveness against heartworm: 3,855 (481/yr)
Selected other ineffectivness reports: fleas: 1,622; ticks: 501; ear mites: 206; mites: 61; sarcoptes mites: 56; other ectoparasites: 11; treating for hookworms: 11; hookworm prevention: 45. Selamectin lufenuron* is a once-monthly topical liquid applied to the skin at the back of the neck and sold as a preventative for heartworm and to control fleas (by preventing flea eggs from hatching, but it does not kill adults) plus sarcoptic and ear-mites in dogs. Revolution has about 4 to 5 times the fatality rate of other wormers.

* Luferon, lufenuron: Lufenuron is also sold under the brand name of "Program." Lufenuron is an insect egg killer; will not work on adult nematodes, it is said. It is sold by dog weight. The active ingredient is Luferon and is promoted as a "flea contraceptive" -- prevents fleas from successfully breeding but does not kill adult fleas. Program (Lufenuron) and Sentinel (Luferon/Mibemycin Oxime) break the reproductive cycle by preventing flea eggs from developing. Sentinel also kills heartworm larvae, adult roundworm, hookworm and whipworm.
In addition, http://www.thedogplace.org/DOGCARE/Ivermectin-Wormer_Lanting-1109 has a good short article on recommended ivermectin use.

I hope this has been helpful to you in the management of your dog's health.

Fred Lanting is an internationally respected show judge, approved by many registries as an all-breed judge, has judged numerous countries' Sieger Shows and Landesgruppen events, and has many years experience as one of only two SV breed judges in the US. He presents seminars and consults worldwide on such topics as Gait-&-Structure, HD and Other Orthopedic Disorders, and The GSD. He conducts annual non-profit sightseeing tours of Europe, centered on the Sieger Show (biggest breed show in the world) and BSP.

All Things Canine consulting division, Willow Wood Services. Tel.: 256-498-3319
Mr.GSD[at]netscape.com
Also use this address for inquiries regarding judging or lecturing schedule and availability.