

THE PERCEPTION AND KNOWLEDGE OF *GIARDIA* AMONG PEOPLE WORKING IN DOG SHELTERS



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Abstract

In this study the perception and knowledge about *Giardia* among people who work in shelters is examined. This is done on the basis of a questionnaire, consisting of 17 multiple choice questions. The questionnaire focusses on several topics, such as: Do people see *Giardia* as a problem? Which measures are taken to prevent an infection and which measures will be taken if there is an infection? Is *Giardia* seen as a zoonotic disease? Which therapy is applied? Veterinarians have been asked additional questions about treatment, business counseling, advice and guidance.

The results of this study indicate that the majority (up to 84%) of the participants who filled in the questionnaire do not see *Giardia* as a problem at their shelter. Moreover, they seem to have insufficient knowledge about *Giardia*. It can be concluded that the veterinarians seem to use an appropriate therapy for individual cases. However, there seems to be a lack of a protocol focusing on the shelter as a whole. A search in the available literature did not produce a satisfying protocol. Therefore, future research should focus on developing such a protocol, usable for both veterinarians and shelter personnel.

This research is part of a large-scale study, "the *Giardia* Project". In this project, different dog populations in the Netherlands are examined: house dogs, clinical dogs (dogs with gastrointestinal symptoms) and kennel/shelter dogs. Current research in these populations investigates the prevalence of *Giardia* within these three groups, the different diagnostic methods (CSF, IFA and the SNAP® *Giardia* Test by IDEXX) and if there is a connection between *Giardia* and the consistency of faeces. In addition, the prevalence of the humane assemblages of *Giardia* (assemblage's A and B) in the three dog populations is also examined to make a statement about the potential zoonotic risk of *Giardia*. In order to do this, a PCR method will be developed. The research goals of this project are to get a better understanding of the prevalence of *Giardia*, detected with different tests, in combination with the consistency of faeces, and to get a better understanding of the prevalence of assemblage's A and B in dogs and the potential zoonotic risk.

Eventually, when the knowledge and perception of *Giardia* among people who work in shelters have been studied, their knowledge can be expanded. For this, the results of "the *Giardia* Project" are of interest, in order to further educate people.

Chapter 1 Introduction

1.1 *Giardia*

Giardia is a flagellate which can be found in many animals and also in humans. There are different species of *Giardia*: *G.agilis*, *G.ardeae*, *G.psitacci*, *G.microti*, *G.muris*, *G.duodenalis*. Of these different species only *Giardia duodenalis* can infect dogs. *G.duodenalis* consists of different assemblages, namely A, B, C, D, E, F, and G. Some of them are host-specific. Assemblages C and D are dog-specific. Assemblages A and B are found in humans but also in dogs, cats, rodents and herbivores. Therefore, these assemblages are not highly host-specific. Assemblages A and B are potentially zoonotic, but the transmission can also take place from humans to dogs (animals).^{1,2}

Transmission of *Giardia* can occur directly or indirectly. The faeces of dogs infected with *Giardia* contains *Giardia* cysts. Dogs can be infected by eating faeces of infected animals. This is the direct pathway. Water, food and other material can get contaminated with faeces of infected animals, and by ingesting this, others can be infected with *Giardia*. This is the indirect pathway. Only a small number of cysts (10-100) is needed to initiate infection.²

1.2 Life cycle of *Giardia*

The life cycle is composed of two stages, the trophozoite stage and the cyst stage. The cycle begins after ingestion of a *Giardia* cyst. Under the influence of an acidic environment (e.g. in the stomach) and pancreatic enzymes from the duodenum excystation occurs.³ A cyst produces two trophozoites, which multiply by dividing themselves, resulting in a total of four trophozoites. The trophozoite has a ventral disc which can attach to the intestinal epithelium. Under influence of bile acids, the trophozoites undergo encystation. These cysts are excreted with the faeces and are infectious immediately.⁴ Cysts can be found in the faeces of dogs 5-16 days after they have been infected. The (intermittent) secretion of *Giardia* cysts will generally last 4 to 5 weeks, although there are cases where the secretion can last up to 7 months and even longer.¹ Trophozoites can also be excreted with the faeces before encystation has occurred, especially if the intestinal peristalsis is increased and there is too little time for encystation. It is thought that trophozoites are incapable of surviving in the environment, though.⁴ *Giardia* cysts, on the other hand, are highly resistant to environmental influences. Especially in cool and damp areas cysts can survive for a long time.^{3,4} In water that is colder than 10 °C, *Giardia* can survive for three months. In a dry environment with direct sunlight cysts remain infectious for only a couple of days.⁵

1.3 Symptoms of *Giardia* in humans and dogs

Giardia infections can cause chronic diarrhea, but can also be subclinical. If symptoms of malabsorption or maldigestion occur in a dog, *Giardia* should be noted on the differential diagnosis list. The malabsorption and maldigestion which is seen in *Giardia* infections is caused by the trophozoites. The trophozoites cause inhibition of the lipase and disaccharidase enzymes and therefore this leads to maldigestion. The malabsorption is caused by atrophy of the villi and microvilli.¹

The main symptoms of *Giardia* in dogs are a result of the malabsorption: chronic diarrhea (often with mucus), steatorrhea, vomiting and losing weight despite a normal diet. The symptoms are often seen intermittently.^{1,6} Chronic diarrhea is mainly seen in dogs where treatment fails or in immunocompromised dogs.⁷

The symptoms and pathogenesis in humans are comparable with the symptoms that can be seen in dogs. In humans, an infection can be subclinical as well. When there is a clinical infection, diarrhea can also be seen through malabsorption which is caused by the parasite. In symptomatic patients,

diarrhea symptoms are in the foreground. Symptoms that last long (more than seven days) are often accompanied by much flatulence, nausea, abdominal cramps and greasy, smelly stools. Without medication an infection is self-limiting in a couple of weeks. A chronic form could develop. ⁶

1.4 Diagnostics

Giardia can be detected in faeces by a number of methods ⁸, including Centrifuge Sedimentation Flotation (CSF), direct immunofluorescence assay (IFA), rapid diagnostic test (such as the SNAP[®] *Giardia* Test by IDEXX), ELISA and PCR. With these different methods, different aspects are used to detect *Giardia*. With the CSF method, the *Giardia* cysts are diagnosed in a microscopic slide. With the direct IFA method, fluorescent antibodies attach to the cell wall of the *Giardia* cysts and color the cell-wall of *Giardia* apple green. This can be seen under an immunofluorescence light microscope. Both these methods, CSF and IFA, use the detection of the *Giardia* cysts. The trophozoite stage of *Giardia* can only be seen with direct microscopy, and only in samples of fresh faeces, which cannot be older than 4 hours. Detecting trophozoites is only possible under certain circumstances, such as increased peristalsis of the intestines, in which case encystment has not occurred. ^{4,9}

The rapid diagnostic test, such as the SNAP[®] *Giardia* Test by IDEXX, that uses the detection of *Giardia* antigens in the species. It is a rapid in-house enzyme immunoassay that can be conducted on fresh faeces, previously frozen faeces, or faeces stored at 2°C to 7°C for up to 7 days. ¹⁰

The CSF method is in general the most traditional method for the detection of *Giardia* cysts by faecal flotation with zinc sulfate (ZnSO₄). Sucrose has also been described as an effective flotation medium. ¹¹ However, for this method experience is required. *Giardia* can easily be missed and can also be transformed by the flotation medium. The advantage of researching faeces this way is that other eggs, oocytes and cysts also can be seen in the slide. ⁹

Although the CSF method is generally used for the detection of *Giardia* cysts, studies have shown that direct immunofluorescence microscopy (IFA) provides a greater sensitivity and specification for the detection of *Giardia* than the flotation method. Therefore, direct immunofluorescence microscopy is often considered to be the golden standard for the detection of *Giardia* cysts. However, none of the mentioned methods is absolutely perfect. ¹²

Studies have shown that the rapid diagnostic methods are a suitable alternative when there is no specialized laboratory available. ² However, these rapid tests are specific for *Giardia* species, but can provide false positive results with persistent antigen excretion for several weeks or even months after successful elimination of the parasite. An explanation for this phenomenon could be a prolonged persistent antigen secretion or failure of the treatment. ¹³ The rapid diagnostic method by IDEXX is the only diagnostic method which is less influenced by the intermittent excretion of the parasite. ¹³ It is generally recommended that three consecutive samples are examined to exclude *Giardia* in the clinical setting because cysts are excreted intermittently. ¹

None of the methods mentioned above (IFA, CSF, IDEXX SNAP test) are able to distinguish the different subtypes of *Giardia*. Only a *Giardia* infection can be diagnosed with this methods, but not the assemblage type of this *Giardia* infection. With the IFA and CSF methods, *Giardia* can be found, but there is no possibility of making a morphological distinction between the different types of *Giardia*. ¹⁴ The IDEXX SNAP test is not explicit about whether the test detects all different types of *Giardia*, or only specific assemblages. It is assumed that there are different test for different animals, because of the different assemblages. For example, there is a test kit for dogs and cats. One expects that these tests for dogs and cats detect in any case the host-specific assemblages, assemblages C, D, and F. It is not known if the potentially zoonotic assemblages A and B are detected with the test. The *Giardia* snap test only gives a color change if it is positive for *Giardia*, so it is not possible to make a

distinction between the assemblages of *Giardia*. Molecular techniques, such as PCR, are indispensable and are of great value in the study of the different types of assemblages and the potential zoonotic risks of *Giardia*. PCR-based tests are progressively used in the diagnosis and estimation of the prevalence of *Giardia* infections in humans and animals with improved sensitivity over microscopic and immunodiagnostic methods.^{12,15}

1.5 Prevalence of *Giardia* in dogs

In the existing literature, the prevalence that is mentioned varies. Reasons for this variation could be different diagnostic methods, the geographic area of the population that has been investigated and the population that has been investigated. These reasons make it also more complicated to compare the different studies with each other.¹⁶ Moreover, many studies are cross-sectional. This means that from each dog, only one faecal sample has been taken at a certain time. However, *Giardia* is an intermittent excretion and could be missed in cross-sectional studies. Therefore, in some of the literature it is mentioned that *Giardia* is underestimated because of the intermittent excretion, but also because of the low sensitivity of conventional diagnostic methods for *Giardia*.^{15,17,18}

In the article by Ballweber et al.² an overview table can be found of the worldwide frequency or prevalence of *Giardia* in dogs. Differences in prevalence are described in this chart. Within this survey, data can be found for household dogs and shelter dogs.

In this overview table data can be found for household dogs and shelter dogs, asymptomatic and symptomatic, in Europe, Asia and America. The prevalence ranges from 4,1%-12,3% in house dogs. Within breeding kennels and shelters, varying percentages are mentioned from 16,8% to 49%.^{1,2,13,19}

1.5.1 The *Giardia* assemblages

Giardia has different assemblages, but morphologically no distinction could be made.¹⁴

When looking at the genetic level, there are 8 different assemblages (A-H) that can be distinguished. Some of them are host-specific. Assemblages C and D are dog-specific. Assemblages A and B can be found in humans but also in dogs, cats, rodents and herbivores, so these assemblages are not highly host-specific.^{1,2} Therefore it is thought that these assemblages could potentially be zoonotic.¹³

For the host-specific assemblages, the zoonotic potential is negligible, because they are host specific.²⁰ Different studies show that assemblages A and B are found in dogs. These studies have led to growing concerns and questions about the zoonotic potential of *Giardia*. The close contact between humans and dogs has also caused a raised awareness.¹⁶

The review of Feng et al.²¹ shows an overview of the infection rate and assemblages of *Giardia* in studies performed in recent years. This review demonstrates the varying presence of the assemblages in different dog populations. Feng et al.²¹ showed that the dog specific assemblages (assemblage C and D) are well represented. Low numbers of the collected samples are infected with genotype B. However, their review shows that assemblage A is well represented (31,7% of all European samples). Thus, a relatively large percentage of the dogs carries a zoonotic assemblage with them. It also demonstrates that the zoonotic assemblages were found more frequently in Europe than in other continents. It should be noted that in different studies, different diagnostic methods (and in the case of the PCR-method several primers and markers) are used.^{22, 23}

1.6 Treatment and measures against the spreading of *Giardia*

1.6.1 Elimination of *Giardia* out of the environment

The following measures are mentioned as advice to reduce the infection pressure: remove the faeces daily, disinfect the environment and keep the environment as dry as possible. The environment should be disinfected with quaternary ammonium compounds. Products with chlorine and phenol are suggested as well, but should be handled with care because of their harmful effects on humans and the environment. ^{1, 24, 25}

When there is a *Giardia* outbreak in a shelter, treatments such as isolation of the dogs (quarantine), washing the dogs and systemic treatment of the dogs are mentioned. ²⁶

1.6.2 Therapy

In the Netherlands, there are few medications that are commonly used to control a *Giardia* infection in dogs. In the Netherlands, registered veterinary products are Metrazol[®], Metrobactin[®] and Panacur[®]. The active substances are metronidazole and fenbendazole. ^{27,28}

Active substance	Trademarks registered in the Netherlands	Doses
Metronidazole	Metrazol [®]	50 mg/kg a day for 5 to 7 days
	Metrobactin [®]	50 mg/kg metronidazole a day for 5 to 7 days
Fenbendazole	Panacur [®]	50 mg/kg once a day for a maximum of 3 days

Table 1 (based on ^{27, 28})

For a long time, metronidazole was the number one treatment for giardiasis, especially in the United States.²⁶ Metronidazole is an effective product, but it is known to have many side effects, such as acute anorexia, vomiting, and signs of central nervous injury. ²⁹ In the Netherlands, fenbendazole (Panacur[®]) is the product of choice to control a *Giardia* infection. Fenbendazole belongs to the benzimidazoles. It is a safer product than metronidazole with fewer side effects. ^{30, 31, 32} Moreover, metronidazole is an antibiotic and therefore should be used with care.

A combination of pyrantel, praziquantel and febantel for the treatment of giardiasis has been investigated. Products like Drontal[®] Flavour Plus seem to be effective against giardiasis. ^{33,34} Most likely, febantel is responsible for this effect, as it is a prodrug that is metabolized to fenbendazole and oxfendazole. However, there are not enough studies to prove this. ^{35,36} No products containing a combination of the aforementioned substances are registered for the treatment of giardiasis in the Netherlands. ²⁸

Washing of the patient at the end of a medicinal treatment (washing the perineum and if possible the hindquarters) with a regular dog shampoo is recommended for patients with clinical infections. ³⁴ When there is a reinfection, the therapy may be repeated or one can choose to switch to metronidazole (25mg/kg twice a day, for five days). ³⁷

When animals are kept group-wise, keeping *Giardia* under control is a challenge. Payne describes the control of a *Giardia* infection in experimental dogs that were housed in groups. Dogs were treated individually for three days with oral medication. The lofts of the dogs were disinfected daily with quaternary ammonium compounds. After 17 to 24 days dogs developed clinical symptoms such as

diarrhea, again. Some of them tested positive for *Giardia*, too. When dogs were washed at the last day of the treatment (with a regular dog shampoo) and moved to a clean environment, they did manage to get the *Giardia* infection under control.

Therefore, it is advisable to split groups in smaller numbers and quarantine the positive animals. When there is a persistent infection, it is advisable to treat animals with a subclinical infection, too. One should reduce the environmental contamination as much as possible, wash animals at the end of the treatment, and move them to a clean environment. ²⁶

1.7 'The *Giardia* project'

At the moment there is a research project called "the *Giardia* project". In this research, different dog populations in the Netherlands will be examined: house dogs, clinical dogs (dogs with gastrointestinal symptoms) and kennel/shelter dogs. In these various populations, the prevalence of each population will be examined in relation to the consistency of the faeces. The following diagnostic tests will be used: CSF, IFA, SNAP test by IDEXX and PCR. From each population, 400 faecal samples will be collected. In addition to the prevalence of *Giardia* in general, the genotypes in the three different dog populations will be researched to make an assessment of the zoonotic risk of *Giardia*. For this investigation PCR must be developed for detection of the different types of assemblages, sub-assemblages and genotypes.

The research goals of this project are to get a better understanding of the prevalence of *Giardia*, detected with different tests, in combination with the consistency of faeces, and to get a better understanding of the prevalence of assemblages A and B in dogs and the potential zoonotic risk.

In this study 117 faecal samples were collected from shelter dogs and tested for *Giardia* for "the *Giardia* project". Literature and the studies from other students (Iris Roza and Mitchell Huijnen), who have already investigated 200 faecal samples from shelter dogs, have shown that *Giardia* is seen in many shelters ¹⁹, so presumably the prevalence of *Giardia* in shelters is high. Besides this, *Giardia* (assemblage A and B) is a potential zoonotic disease. In this case, it is necessary to find out the knowledge of *Giardia* amongst people that work in animal shelters.

In this overarching project, the scope of this research contains the investigation about the perception and knowledge amongst people who work in animal shelters. Do they see *Giardia* as a problem in their shelter/kennel and are they aware that *Giardia* is a zoonotic disease? In order to answer these questions, a questionnaire was taken among the staff of different shelters (vets, volunteers, employees etc.). To obtain enough data for this particular research, questionnaires have been sent to shelters that already participated in the overarching *Giardia* project as well.

Chapter 2 Research

2.1 Research questions

Research question 1: What is the perception of *Giardia* among people who work in animal shelters?

H₀: People experience *Giardia* as a problem among their shelter

H₁: People do not experience *Giardia* as a problem among their shelter

Research question 2: Do people who work in animal shelters have sufficient knowledge about *Giardia*?

H₀: The knowledge of people who work at shelters about *Giardia* is insufficient

H₁: The knowledge of people who work at shelters about *Giardia* is sufficient

To answer this research-question the following topics are used in the questionnaire:

- Education level
- Prevalence
- Zoonotic disease
- Clinical signs
- Prevention/hygiene
- Therapy
- Transmission pathway

2.2 Research goal

To achieve more knowledge about the perception and knowledge about *Giardia* among people who work in shelters and the measures taken by these people.

Chapter 3 Material and methods

3.1 Collection of faecal samples/shelter visit

Faeces have been used to detect *Giardia* amongst dogs. The aim of this study was to collect and investigate faecal samples from several dog kennels and shelters in the Netherlands of dogs that live in group establishments. A senior group of dogs and a group of hunting dogs were included additionally to this study.

Animal shelters and other establishments where dogs are kept in kennels were asked to collect faecal samples and put them in a refrigerator until they would be retrieved. These samples were collected from the kennel floor and were not older than 48 hours (max) and were kept in plastic bags. These bags were transported in plastic cups. These cups were labeled with the name of the dog and the date posted. The plastic bags and cups had been sent previously, together with an instruction form. Of each dog, the age, gender, breed, origin, clinical symptoms, treatments, date of entrance in the shelter and the section in which the dog was housed within the shelter were collected (appendix I). The data mentioned before were not recorded of the hunting dogs, because these dogs lived in one wide kennel, so it was impossible to collect information about one specific dog, because it was not possible to know which sample belonged to the right dog. These dogs were not taken out individual and therefore their faeces were collected from the wide kennel floor. In the shelters the dogs were kept separately, and therefore it was possible to collect data from these dogs.

In summary, a questionnaire was taken (Appendix I) amongst the people who worked in the visited kennels to collect general information about these kennels. At each kennel there was a guided tour through the kennel.

3.2 Faecal examination

The following diagnostic methods are used to detect *Giardia* in the dog faeces:

- CSF
A sugar solution with a density of 1,28-2,30 will be used as flotation medium, because a zinc solution would be too harmful for the environment. A cover slip is placed on an object glass and is viewed under the microscope.

For this method experience is required. *Giardia* can be missed easily and can also be transformed by means of flotation. The advantage of researching faeces in this way is that other eggs, oocytes and cysts can be pictured too.

- IFA
In this method the *Giardia* cyst will be bound to a specific antibody. These specific antibodies can be seen through a fluorescent microscope because the antibodies light up under the microscope. In this case a DFA (direct fluorescent-antibody test) will be used. DFA is the most widely used antigen detection for *Giardia* in laboratories. DFA tests utilize fluoresce in-labeled antibodies directly against cell wall antigens of *Giardia* cysts. Direct immune-fluorescent microscopy has been adopted as the golden standard for identifying faecal *Giardia* cysts for research purposes.¹³
- SNAP® *Giardia* Test by IDEXX
The SNAP® *Giardia* Test by IDEXX (rapid diagnostic test based on immune-chromatographic assay) is a rapid in-house enzyme immunoassay that can be conducted on fresh faeces, previously frozen faeces, or faeces stored at 2°C to 7°C for up to 7 days. Soluble *Giardia*

Antigen is detected.¹⁰ In this research, this test is carried out on frozen faecal samples, because the SNAP® *Giardia* Test was not directly available. To create the same conditions, all faecal samples will be frozen before they are examined.

See appendix II, III, IV for the protocols (CSF, IFA, SNAP® *Giardia* Test by IDEXX) that have been used.

3.3 Questionnaire

The topics which have been used in the questionnaire are:

- Education level/function in the shelter
- Prevalence
- Zoonotic disease
- Clinical signs
- Prevention/hygiene
- Therapy
- Transmission pathway

The questionnaire is distributed amongst people who work in kennels (vets, employees, volunteers). Their function, education and certificates are filled in on the questionnaire. The goal of the questionnaire was to get information about the perception amongst people who work in kennels about the prevalence in these kennels, whether *Giardia* is seen as a problem in shelters, to get information about what people know about the transmission pathway and clinical signs of *Giardia*, if it is known that *Giardia* is a zoonotic disease and to get more insight in treatment schedules.

The questionnaire consists of seventeen multiple choice questions. In certain cases, more than one answer can be given. In some cases, an option 'otherwise' was added giving the possibility to an alternative answer. For vets who filled in the questionnaire, there were six extra questions about therapy, business counseling, advice and guidance. The six added questions for vets were all open questions.

Questions one to seventeen contain questions such as: is *Giardia* seen as a problem; what is the prevalence of *Giardia* in shelters in the Netherlands; what is the prevalence in an infected shelter; who can be infected by a dog infected with *Giardia*; what are the symptoms of a dog with a *Giardia* infection? (For the exact questions see appendix V)

In order to structure the results from the questionnaire, questions have been categorized as follows:

1. *Giardia*, a problem? (Chapter 4.1)
2. Symptoms (Chapter 4.2)
3. Transmission (Chapter 4.3)
4. Need for information (Chapter 4.4)
5. Vets about therapy, business counseling, advice and guidance (Chapter 4.5)
6. Prevalence at the shelters where the questionnaire was taken (Chapter 4.6)

The topic 'Transmission' from above is divided in the following sub-categories:

- 3.1 Transmission pathway (Chapter 4.3.1)
- 3.2 Measures (Chapter 4.3.2)
- 3.3 Infectious for... (Chapter 4.3.3)
- 3.4 Communication to the owner (Chapter 4.3.4)
- 3.5 Zoonotic (Chapter 4.3.5)

The questionnaire was taken by twenty-five people who work at shelters as seen in Table 2.

Shelter	Number of questionnaires	Function in the shelter
Shelter 1	3	Employee (2x) Vet
Shelter 2	1	Shelter manager
Shelter 3	4	Employee (3X) Vet
Shelter 4	7	Shelter manager Employee (4x) Veterinary assistant Vet
Shelter 5	1	Employee
Shelter 6	4	Shelter manager Volunteer (2x) Volunteer/intern
Shelter 7	1	Employee
Shelter 8	1	Manager
Shelter 9	1	Vet
Shelter 10	2	Employee Vet

Table 2 Overview of questionnaire participants at the shelters.

Chapter 4 Results

4.1 *Giardia*, a problem?

The results of the questionnaire show there are eleven persons who see *Giardia* as a problem at their shelter. Twelve persons who filled in the questionnaire think *Giardia* is not a problem in their shelter. Two people chose both answers, a problem and not a problem. According to the reasons that are given in the questionnaire, it turns out that five persons who see *Giardia* as a problem at their shelter, see *Giardia* particularly as a problem among cats. In this case it can be said that six persons see *Giardia* as a problem among dogs at their shelter and eighteen persons see *Giardia* not as a problem among dogs at their shelter. There is one person who sees *Giardia* as a problem because of the zoonotic risk. This person maintained that there are dogs with diarrhea and some of these dogs are tested positive for *Giardia* regularly. On the other hand, this person also said that “although dogs are sometimes tested positive, this only happens with a few dogs (not many) and therefore it is not seen as a problem”. Therefore, this person is categorized into the group of people who do not see *Giardia* as a problem among dogs at their shelter. The other person, who also answered both options, can also be categorized in “no problem”. Therefore, there is a distribution of six persons who see *Giardia* as a problem and nineteen people who do not see *Giardia* as a problem among dogs at their shelter. 76% of the shelter staff who filled in the questionnaire do not see *Giardia* as a problem at their shelter.

In addition to this question, it is also asked why they see or do not see *Giardia* as a problem. Multiple answers could be given to this question. The results (as seen in Figure 1 and 2) were:

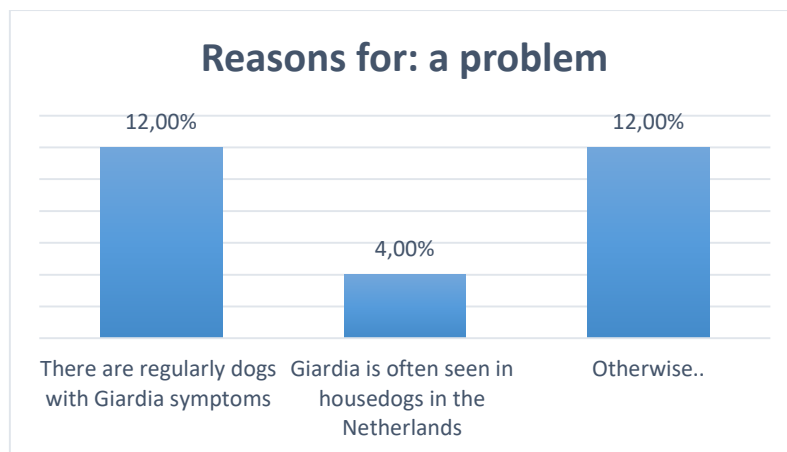


Figure 1 Reasons for: a problem.

The option ‘otherwise’ at Figure 1 is filled-in by people three times as follows:

1. There are occasionally positive tests for *Giardia*
2. It could cause a problem at the senior club
3. It is contagious

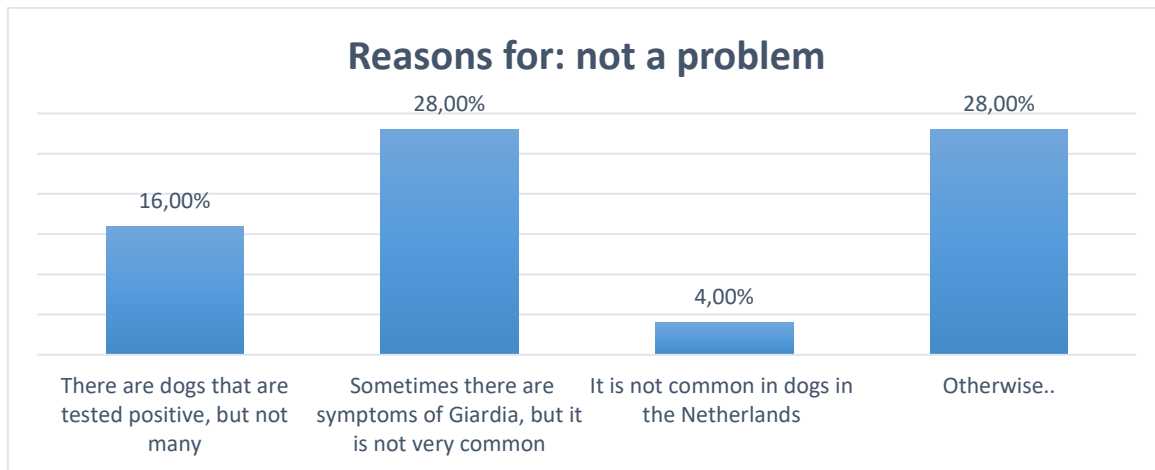


Figure 2 Reasons for: not a problem.

Under the option 'otherwise' as seen in Figure 2, it is mentioned five times that *Giardia* is more a cat problem than a dog problem. These persons only see this as a problem amongst cats, for which reason they are classified in the category that does not see *Giardia* as a problem amongst dogs in a shelter. Some people do not see *Giardia* as a problem and others will only test when they are suspicious that *Giardia* is present. The owner of the hunting dogs does not see *Giardia* as a problem because he believes that hunting dogs are less likely to be infected with *Giardia*. One person who filled in the questionnaire did not mention a reason, but does see *Giardia* as a problem.

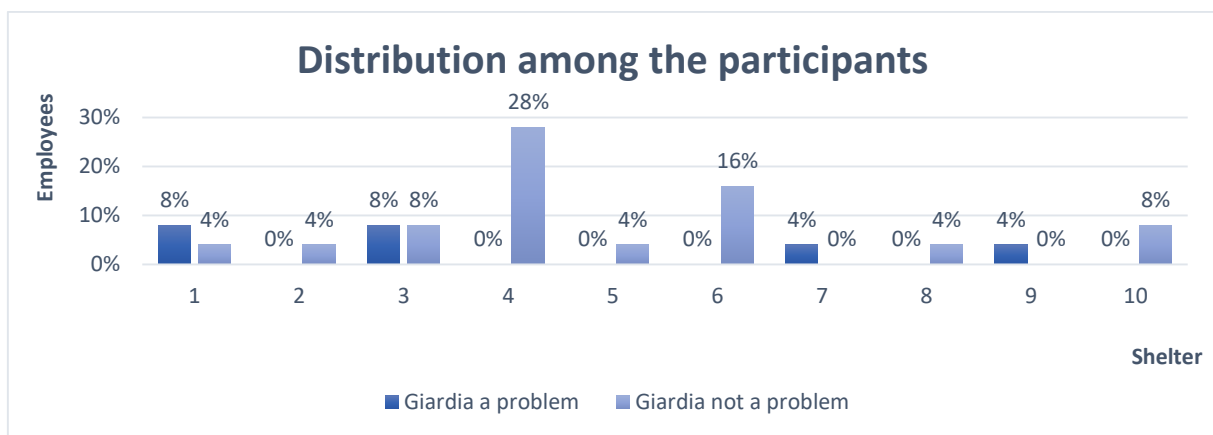


Figure 3 Distribution within a shelter.

Within the shelters, employees have divided opinions about the threat of *Giardia*. Two of the five veterinarians who filled in the questionnaire say that *Giardia* is a problem at the shelter.

4.1.1 Prevalence

Participants were asked to estimate the prevalence of *Giardia* among Dutch shelters. The shelter staff could choose one of the following options, as seen in Figure 4:

- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%

Twenty-two people answered this question. 50% think that *Giardia* is found in 20-40% of the shelters in the Netherlands. One in five people thinks *Giardia* is found in 80-100% of the shelters in the Netherlands. People were asked to estimate the prevalence at a *Giardia* infected shelter, too. These

results are shown in figure 5. One can see that almost 60% of the participants think that 0-20% of the dogs are infected with *Giardia* at a *Giardia* infected shelter.

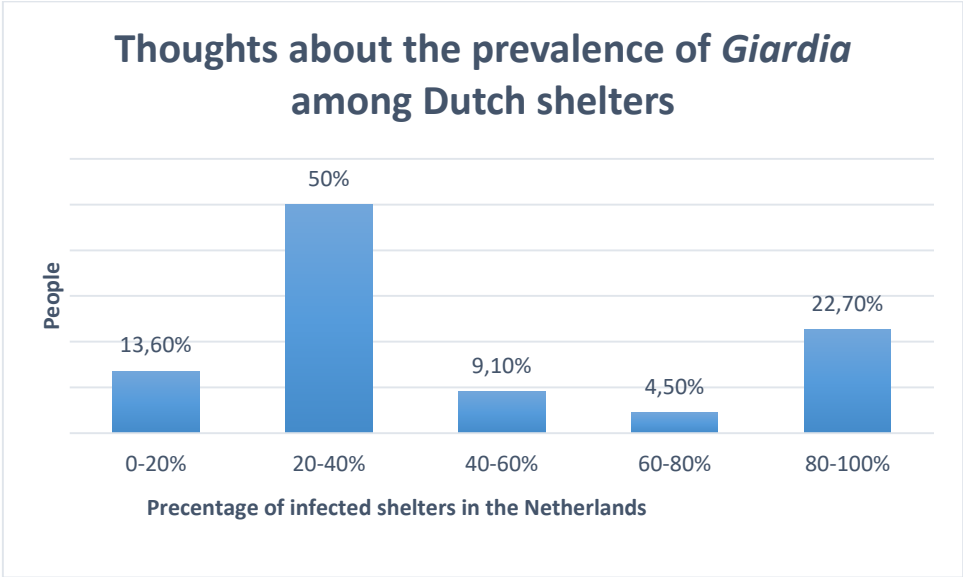


Figure 4 Thoughts about prevalence of *Giardia* among Dutch shelters.

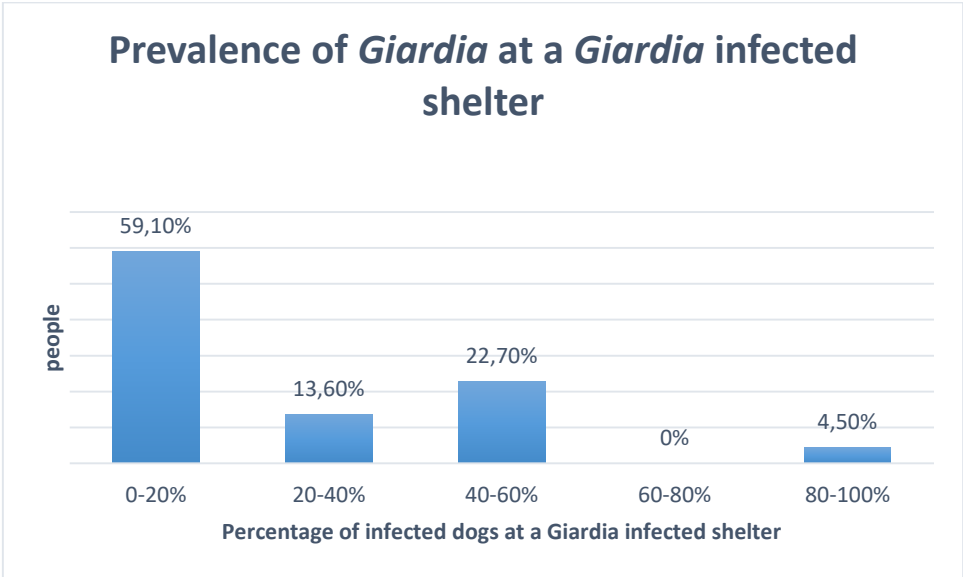


Figure 5 Prevalence of *Giardia* at a *Giardia* infected shelter.

The answers at the questions about the *Giardia* prevalence among shelters in the Netherlands is compared to whether or not participants experience *Giardia* as a problem. These results are seen in figure 6.

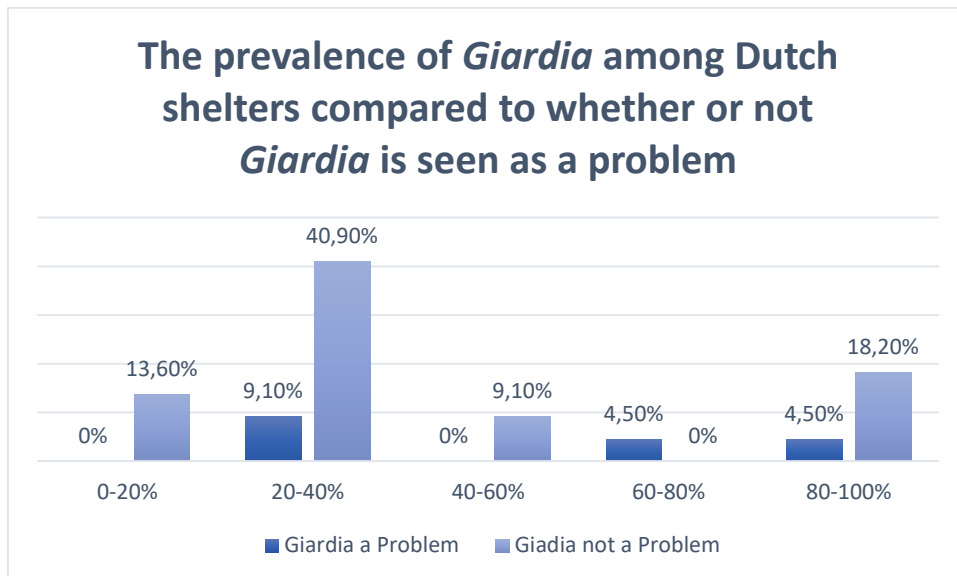


Figure 6 The prevalence of *Giardia* among Dutch shelters compared to whether or not *Giardia* is seen as a problem.

When the prevalence is compared with the question if *Giardia* is seen as a problem (figure 6), one can see that 50% of the people who filled in the questionnaire think that 20-40% from the shelters in the Netherlands are infected. This 50% can be split in a part of 40,9% who do not see *Giardia* as a problem and a part of 9,10% who do think *Giardia* is a problem in shelters in the Netherlands. Most of the people who do not see *Giardia* as a problem filled in lower percentages (0-20% by 13% of the participants and 20-40% by 40,9% of the participants). However, there are also high percentages, such as 60-80% (4,5% of the participants) and 80-100% (18,2% of the participants) among the participants who do not see *Giardia* as a problem.

The same is done with the prevalence of *Giardia* in a *Giardia* infected shelter.

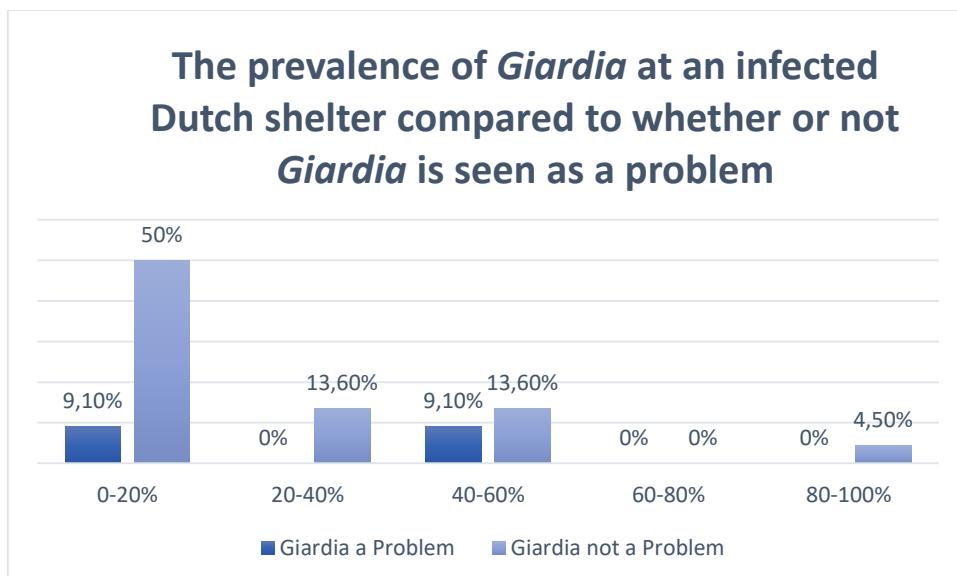


Figure 7 The prevalence of *Giardia* at an infected Dutch shelter compared to whether or not *Giardia* is seen as a problem.

Of the 59,1% who think that 0-20% of the animals in a shelter are infected (Figure 7), 50% do not see it as a problem. Notable is that of the people who do not see *Giardia* as a problem, 50% give a very low percentage (0-20%) as their answer. However, other percentages are also given (see figure 7). Also, the people who do see *Giardia* as a problem give relatively low percentages of 0—20% (9,1%),

but the percentages of 40-60% are also given as answer by 9,10% of the people who filled in the questionnaire.

4.1.2 Standard testing

Testing/screening for *Giardia* is not a standard procedure when a dog enters the shelter for the first time at any of the shelters where this questionnaire was taken. Two people who filled in the questionnaire say that they would test for *Giardia* when dogs enter a shelter for the first time. However, other people who work at the same shelter say they do not test for *Giardia*, including the manager. Therefore, it is assumed that testing for *Giardia* is no standard procedure at these shelters.

Reasons that are given why testing is no standard procedure are that it is too expensive (21,7%) or that it is not necessary (56,5%). People who answered 'Otherwise' (17,4%), mentioned the following reasons:

- One person remarked: "Never thought about it that this could be a good idea" and "it isn't seen very often with old dogs"
- Two people answered: "I don't know why dogs with clinical symptoms are not tested"
- The people who filled in that they test for *Giardia* do this because of the measures that can be taken consequently

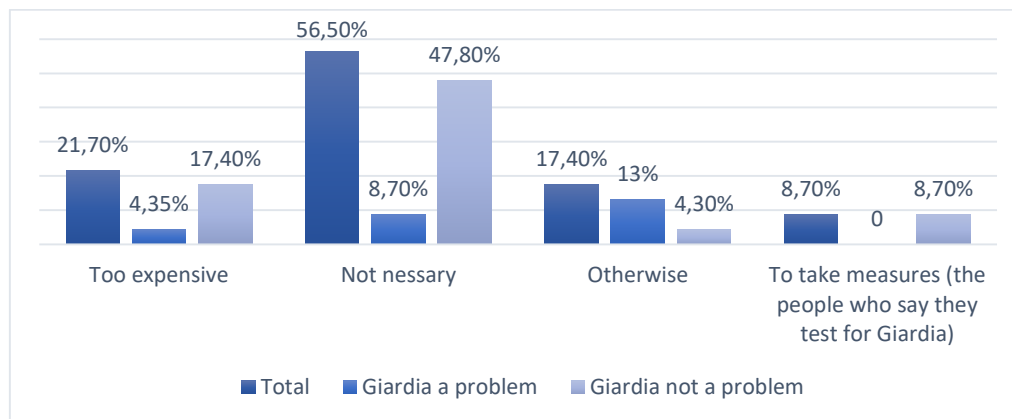


Figure 8 Comparison between this question 1 and question 4.

When one compares question 1 (if *Giardia* is seen as a problem) with question 4 (if testing is a standard procedure and why it is a standard procedure or not), one sees that of the 24% who filled in that they see *Giardia* as a problem, 33,33% (two of the six people) filled in that standard testing is not a standard procedure because *Giardia* is not really a problem, so standard testing is not necessary. When looking at the answers that these people filled in for question 1, one person reasons that *Giardia* is a problem because there are regularly dogs with symptoms. The other person filled in the option "otherwise" and indicates that they see it as a problem when a *Giardia* infected dog enters the senior club. Therefore, it can be said that four persons see *Giardia* as a problem. Consequently, this means that 84% of the persons who filled in the questionnaire see *Giardia* not as a problem and 16% sees *Giardia* as a problem.

4.1.3 Do people want to test?

This question was answered by twenty-four out of twenty-five people. Thirteen of them (54,2%) would like to test every dog that is introduced to the shelter. Of these 54,2%, 25% wants this in order to take suitable measures, 4,2% wants to test because it is a zoonotic disease. 25% filled in the option 'otherwise' and gave answers like "age increased the risk", "shelter dogs live in the same environment as the pension dogs", and "it is more common than we think". Of the participants who do not want to test (45,8%), 12% gives as reason that testing is too expensive, 20,8% says it is too labor-intensive/logistically not viable and 4,2% says that *Giardia* is rarely seen. 12% filled in the

option 'otherwise' and gave reasons like "would be interesting but has no added value", "a dog without symptoms would not be tested" and, "hunting dogs have never had any trouble".

In summary, the most common reason to test is because measures can be taken to prevent spreading of *Giardia*. The most common reason why people do not want to test is because they find it only necessary when there are symptoms of *Giardia* and they do not want to test preventively.

4.2 Symptoms

To check if the symptoms are well-known, a question about the symptoms of a *Giardia* infection was asked. The results of this multiple choice question are shown in figure 9. Participants were allowed to check more than one option.

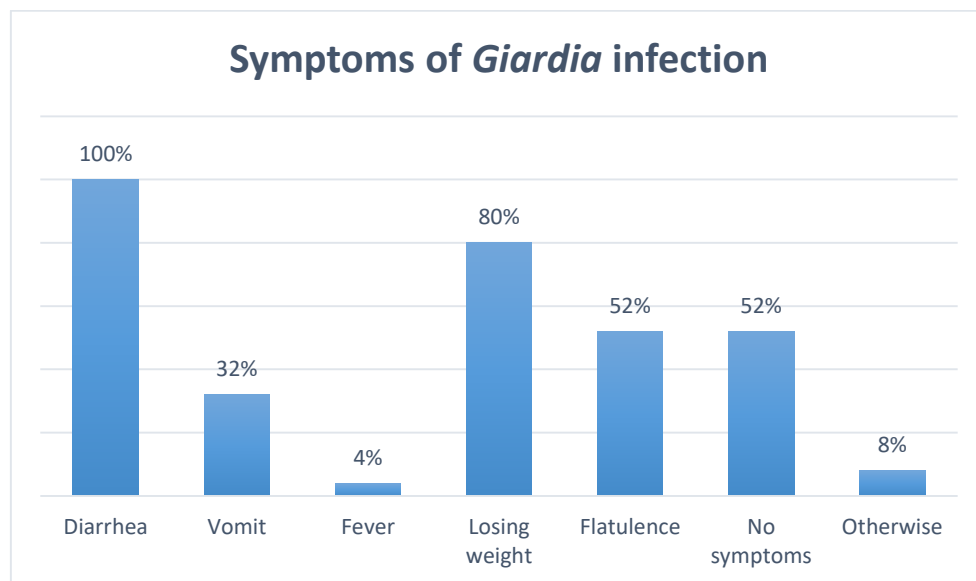


Figure 9 The results of the question regarding symptoms seen in a *Giardia* infected dog.

When one takes a look to the given answers, it can be concluded that everybody who filled in the questionnaire knows that diarrhea could be a symptom. Other symptoms are not known by everybody. 52% of the people who filled in the questionnaire know that there could be no symptoms, so it is assumed that these people are aware that a *Giardia* infection could be subclinical.

A distinction can be made between the total number of participants and the surveyed veterinarians. The number of veterinarians who know that an infection can proceed subclinical is 80%. The number of participants who know this is 45%.

4.3 Transmission

Two questions were asked to check if people who work at shelters know how *Giardia* enters a shelter and if they know how spreading of *Giardia* occurs. The results are shown in figure 10 and 11. When asked how *Giardia* can enter a shelter, 20% answered the option 'otherwise'. With this option, the following answers were given:

- via cats
- defecation
- through infected soil and dog walking fields

When asked about the spreading of *Giardia*, two participants answered 'otherwise'. One veterinarian filled in "no idea". Another person wrote: "Through contact between employees and dogs and between dogs-dogs".

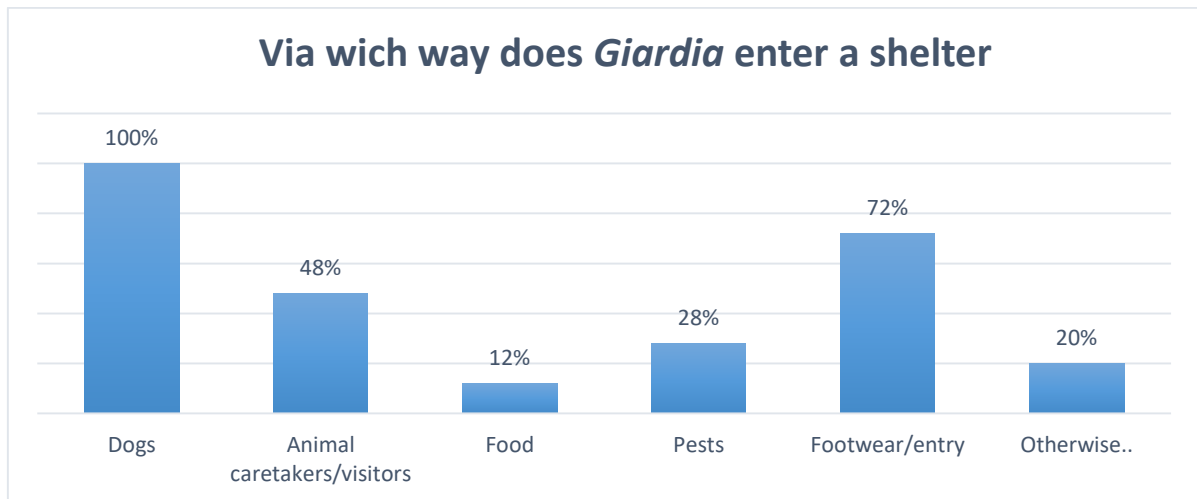


Figure 10 Results on the different ways *Giardia* can enter a shelter.

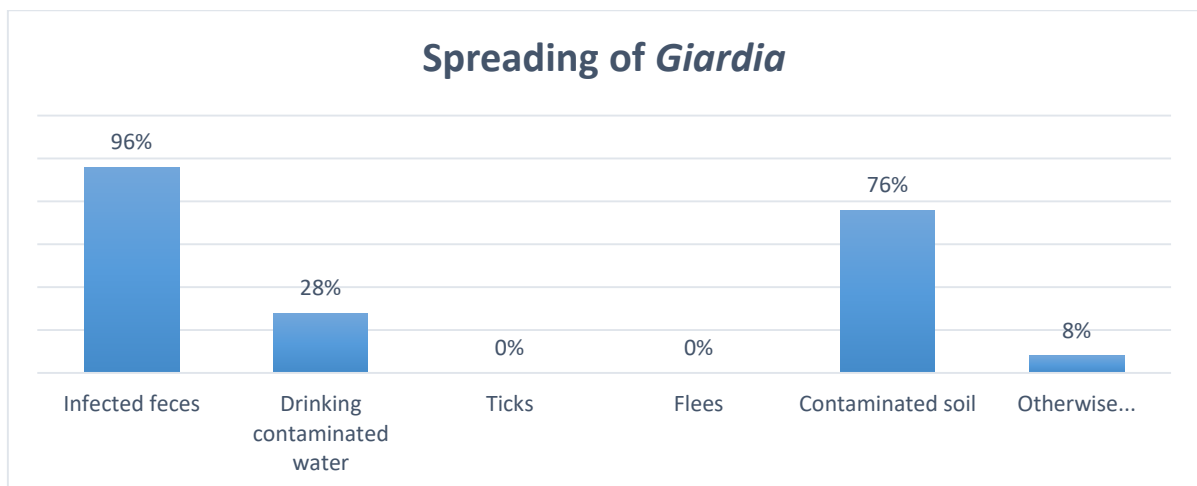


Figure 11 Results on the spreading of *Giardia*.

4.3.2 Measures

In question 8 there was asked what to do when there is a *Giardia* infected dog (clinical).

In this question there was asked if measures should be taken for only the infected dog, all dogs of the department, all dogs in the shelter or no measures at all. For each group the participants could choose between isolating, testing, treating with medication or washing the dog. Multiple answers could be given. The results for this question can be seen in figure 12.

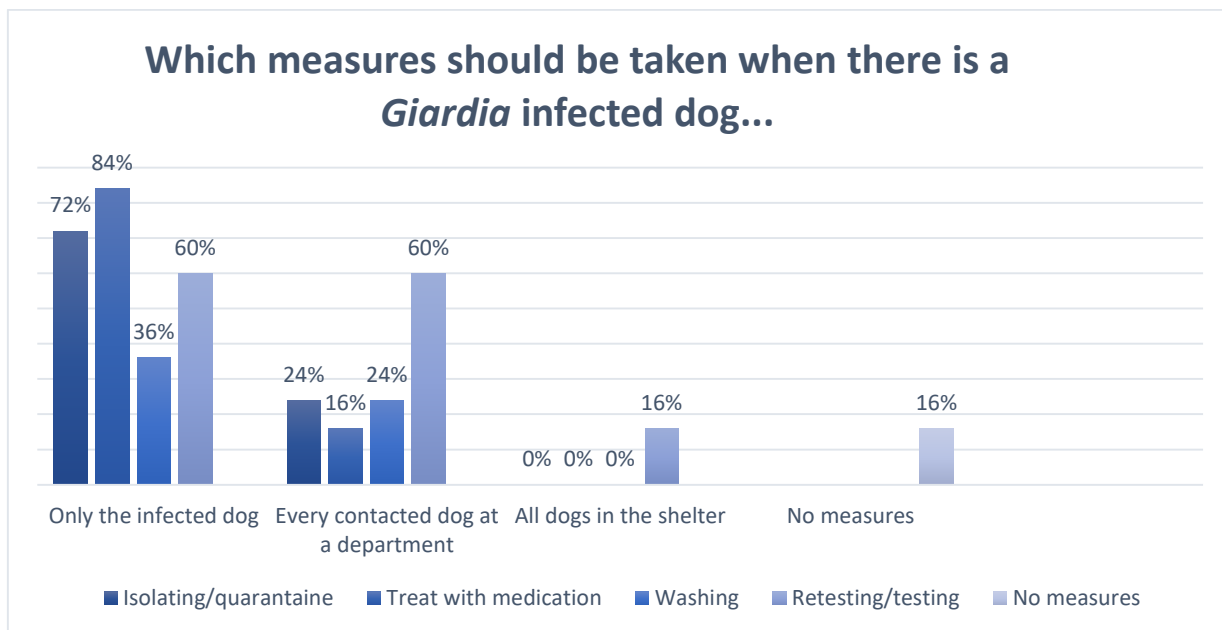


Figure 12 Results of the measures that should be taken when there is an *Giardia* infected dog.

It can be seen in Figure 12, that most people who filled in the questionnaire only take measures for the infected dog. Also, 60% of the participants who filled in the questionnaire say that they would test the contacted dogs.

Question 14 is about which measures should be taken when a dog without symptoms is tested positive for *Giardia*. This question was asked to see if the participants would take the same or different measures as in question 8 (clinical infection). Figure 13 shows the answers to question 14.

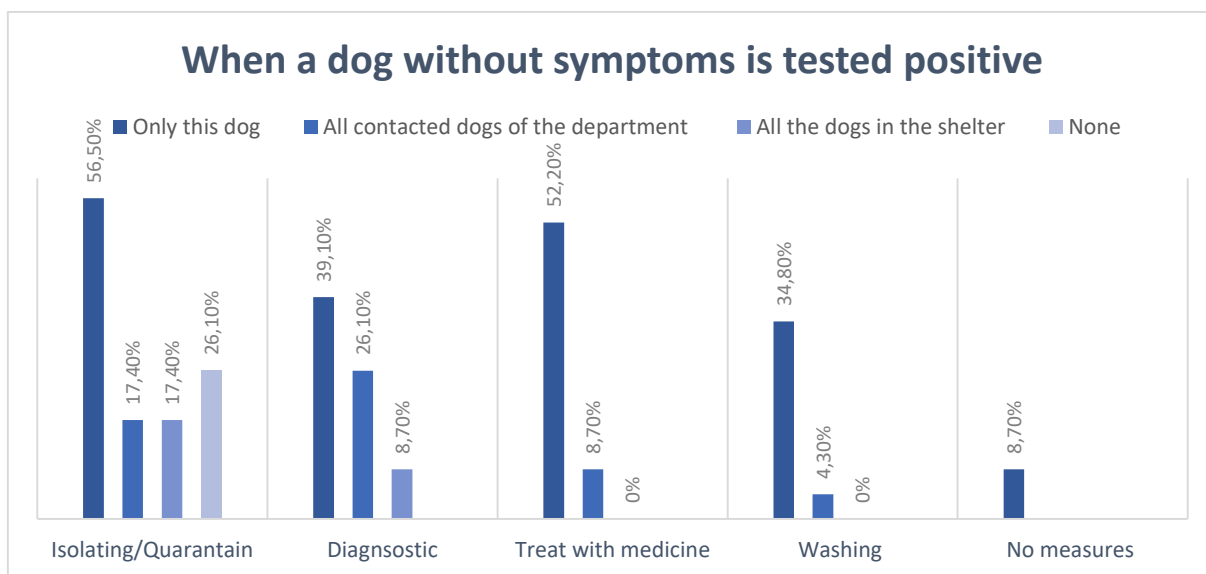


Figure 13 Results on when a dog without symptoms is tested positive.

If the answers to questions 8 and 14 are put together, it can be compared if people make a distinction between clinical and subclinical animals. This data can be seen in figure 14.

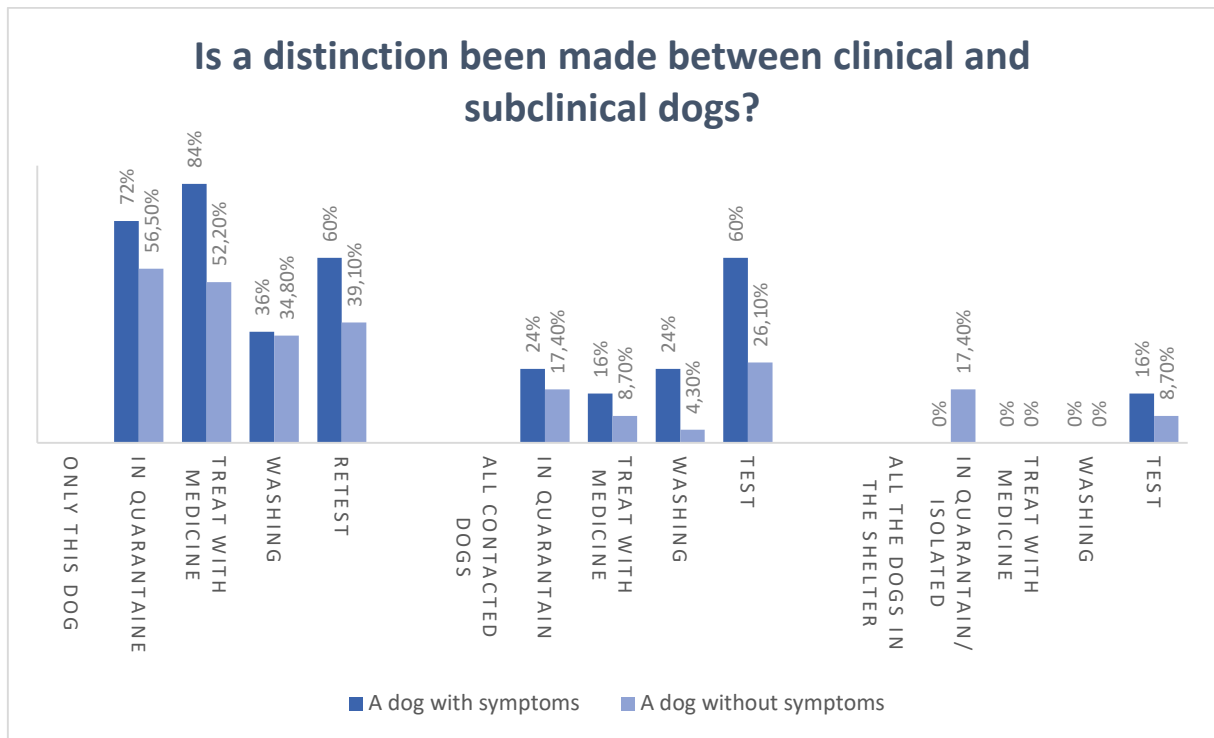


Figure 14 Comparison between question 8 and 14.

If one compares the measures that should be taken when a dog has clinical symptoms with a dog that is tested positive for *Giardia*, one can see that different answers are given. In general, it can be said that the number of participants who take measures in case of subclinical dogs is lower than in case of clinical dogs.

4.3.2.1 Washing of the dogs

Because washing is recommended to reduce the risk of re-infection, participants were asked if they wash the dog and if it is useful. This question was answered by twenty-four people. The majority of the participants (54,2%) filled in that washing the dogs should be done, 8,3% answered it is not possible to wash *Giardia* out of the dogs coat, and 37,5% answered it is not necessary to wash because it is an intestinal parasite. One veterinarian (4,2%) wrote down that washing the dog is not necessary and he remarks that the environment should be taken into account. Presumably the veterinarian meant that washing is not necessary because the dog most likely gets re-infected through the environment. In that case, washing is not useful.

4.3.2.2 The Giardia cysts

To check if it is known that *Giardia* cannot survive in a dry area, participants were asked whether *Giardia* lives longer in a dry or a damp area, or if there is no difference. Figure 16 shows that a small majority knows that it is hard for *Giardia* cysts to survive in dry areas.

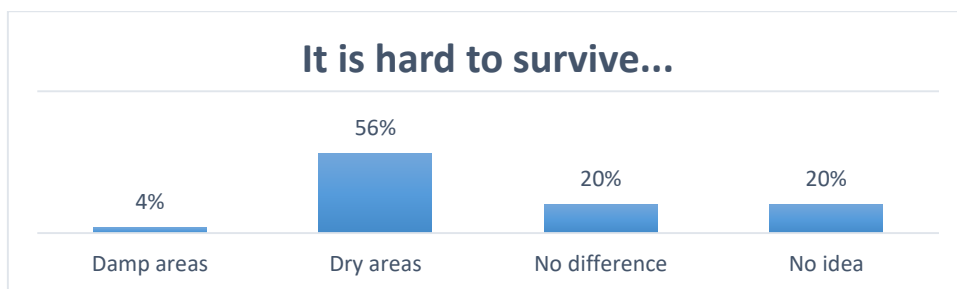


Figure 15 Results on the survival of Giardia cysts.

To check if people know the proper disinfectants, a question was asked about disinfection products. The results are shown in figure 16.

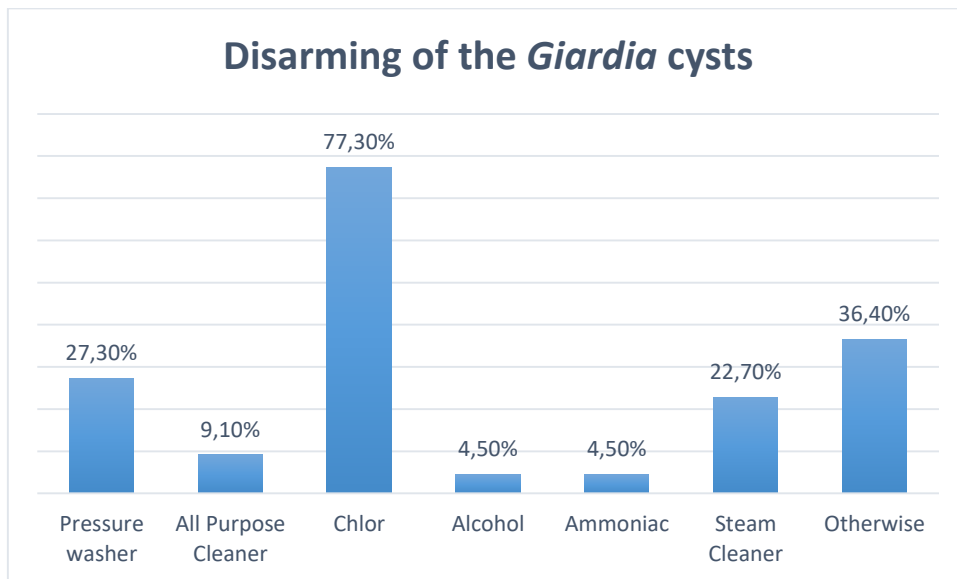


Figure 16 Results on disarming of the *Giardia* cysts.

This question was completed by twenty-two of the twenty-five participants who participated. With the option “otherwise” the participants mentioned: flush with “water”, “Halamid”, “F10” and “quaternary ammonium compounds”.

In the literature, chlorine, phenol and quaternary ammonium compounds and also steam cleaning are mentioned as ways to disarm *Giardia* cysts. Chlorine is mentioned most often by the participants (77,3%). Quaternary ammonium compounds, which are mentioned in most of the literature, are only filled in by one participant (a veterinarian) as an open answer under the option “otherwise”. Steam cleaning is only mentioned by 22,7% of the participants. Some participants mentioned options that are absolutely not useful, such as high pressure cleaning with water (27,3%), all-purpose cleaner and at the option otherwise a disinfectant (without mentioning a particular one).

Participants had to fill in if there was a *Giardia* protocol at their shelter. 33% says there is a *Giardia* protocol at their shelter and that they are familiar with the contents, 48% says there is no protocol and 19% says they have no idea. The distribution between the shelters is depicted in figure 17. In every visited shelter, at least one of the employees answered that there is no protocol for dealing with *Giardia*, except for one shelter. In three other shelters, this question – is there a *Giardia* protocol at your shelter? – is answered with both yes and no by different employees.

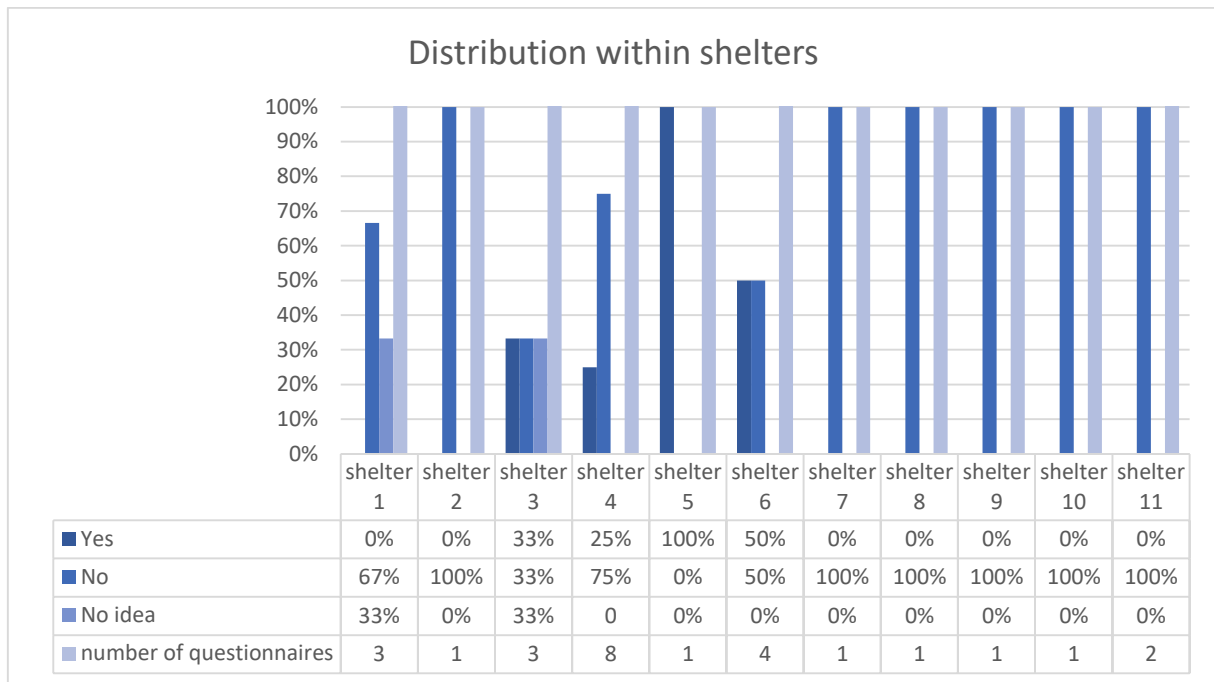


Figure 17 Results on the distribution within shelters.

4.3.3 Infectious for...

People were asked who can get infected by an *Giardia* infected dog. This was done to check if people:

- know that *Giardia* can infect other dogs;
- know that *Giardia* is a potential zoonotic disease;
- know about the different assemblages.

100% of the people who filled in the questionnaire know that dogs can be infected by dogs (figure 18). Humans and cats are also mentioned by the majority of the participants. A small number of people mentioned sheep and rabbits.

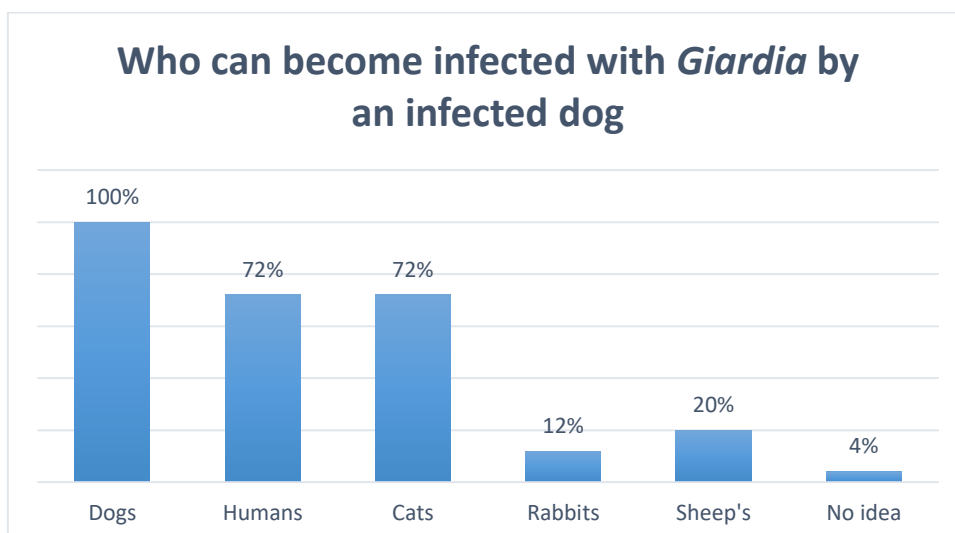


Figure 18 Results on *Giardia* infectious for...

4.3.4 Communication to the owner

People were asked if the shelter personnel mentions a *Giardia* infection to the owner of the dog (both the previous and the new owner) and why they tell an owner about an infection. All

participants answered that they inform at least one of the owners. Nineteen people clarified which owner they tell about a *Giardia* infection. 63,2% inform both the previous and the new owner about the infection (whenever possible, because in the case of stray dogs there is no known previous owner). 36,8% of the participants only inform the new owner.

Additionally, there was an open question where participants could explain why they tell owners about a *Giardia* infection. Reasons that are given are:

- Because of an open communication towards the owner and for informative purposes
- Because the owner knows the dog's history so appropriate measures can be taken
- One of the veterinarians said she would explain it is a zoonotic disease, but that the risks are very small
- A dog with a *Giardia* infection is only relocated when it is free from *Giardia*

Besides the question whether or not the owner is informed when a dog has a *Giardia* infection, the participants were also asked if they would prefer to tell the owner about an infection if the policy of the shelter prescribes that the owner should not be told.

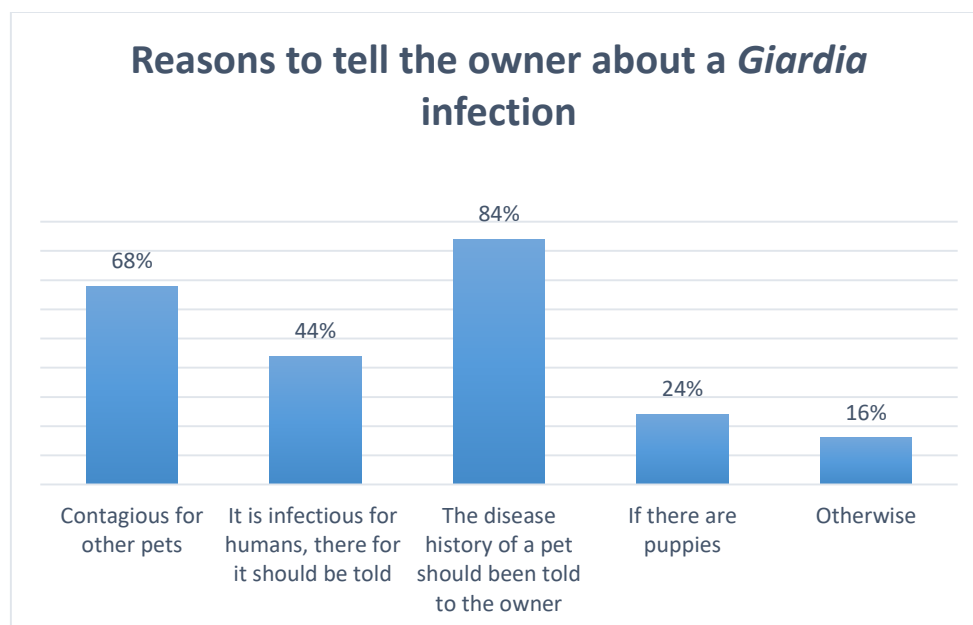


Figure 19 Results on reasons to tell the owner about a *Giardia* infection.

The majority of the participants answered that the disease history of a pet should be told to the owner. 68% also said that it should be told because it is infectious for other pets, and 44% said the owner needs to be informed because it is infectious for humans. Here it is seen that only 44% of the people who filled in the questionnaire see a zoonotic risk as a reason to tell the owner about a *Giardia* infection.

4.3.5 Zoonotic

When asked for who *Giardia* is infectious (question 11, appendix V), 72% answered it is infectious for humans, and therefore it is assumed that these people know that *Giardia* is a potentially zoonotic disease. However, when people were asked for reasons to inform owners about a *Giardia* infection (question 16, appendix V), only 44% mentioned the zoonotic risk. 8% of the people did mention the zoonotic risk on question 16, yet did not fill in that *Giardia* can infect humans on question 11. It is assumed that these people do know about the zoonotic risk, though, even though they did not mention it in question 11. Therefore, it is concluded that 80% of the people who filled in the questionnaire know that *Giardia* is a zoonotic disease.

4.4 Need for information

It was asked if participants wanted more information about *Giardia* and about which area in particular. twenty-three participants answered this question. 73,9% wants more information about transmission, 73,9% wants more information about the prevalence, 60,9% wants more information about therapy/measures and 17,4% has no need for more information at all.

4.5 Vets about therapy, business counseling, advice and guidance

This part of the questionnaire, consisting of open questions, has been filled in by five veterinarians. See appendix V for the questions that were asked.

4.5.1 Diagnostic methods

As diagnostic methods, rapid in-house tests are mentioned. The rapid in-house tests that are mentioned are the SNAP® *Giardia* Test by IDEXX, the FASTest® by MEGACORE and an ELISA rapid test (name not mentioned). Also, these veterinarians say that they perform a general parasite checkup with a test by IDEXX. The other veterinarian also indicates a rapid in-house test is used (name not mentioned). This test is applied to three faecal samples (from three consecutive days).

4.5.2 Therapy

The veterinary medicines that are mentioned are: Panacur®, Metrazol® and Fenbendazol (active substance in Panacur®). Four veterinarians also give washing the dogs as advice.

The veterinarians indicate that no distinction is made between clinical infections and subclinical infections, because subclinical animals are not tested. Therapy is only applied to animals for which the diagnosis is made and to animals that show symptoms.

Different medicines and therapies are mentioned:

- Veterinarian 1
Gives a combination of Metrazol® and Panacur® for 5 days. Sometimes when a dog/cat keeps having diarrhea, the treatment will be extended. This veterinarian does not retest.
- Veterinarian 2
Indicates making a difference between small and large dogs. Small dogs get Fenbendazol and large dogs get Metrazol® (with regards to the costs and it is easier to administer). The dosage is as follows:
 - Fenbendazol: 50 mg/kg once a day for 3 days
 - Metrazol®: 50 mg/kg once a day for 5 days
- Veterinarian 3
Gives Panacur® for 5 days: 50 mg/kg. Advises to wash the dog at day 1 and day 3. After 3 weeks the procedure should be repeated with all pets.
- Veterinarian 4
Gives Panacur® for 5 days: 50 mg/kg. Their advice is to wash the dog at the last day of the treatment.
- Veterinarian 5
Gives Metronidazole: 25-30 mg/kg twice a day for 5 days, or gives Fenbendazol (Panacur®) 50 mg/kg once a day for 5 days (depending on age and weight).

4.5.3 Business counseling, advice and guidance

It is not mentioned specifically that any of the veterinarians provide business counseling at the shelter. Rather, it is mentioned that they visit the shelter, inspect the animals and give vaccinations. One veterinarian specifically indicates that there is no business counseling. One veterinarian indicates that in the 30 years that he/she has been a veterinarian, he/she has never seen *Giardia* as a problem at a shelter.

The other veterinarians mentioned as advice:

- Isolate, treat, wash (clean) the area, purify and disinfect, inspect and retest
- Wash the dogs, wash and clean out the kennels, isolate the dog and treat all the dogs in the shelter
- Take a look at the cleaning policy (do not use a pressure washer), remove the faeces and retest the dog
- Sharp the hygienic protocol, treat and wash, isolate and give animals with symptoms their own field

The veterinarians supply information when it is necessary. Veterinarian 1 communicates with employees and owners, veterinarian 2 gives information to the manager, veterinarian 3 sends an information letter, veterinarian 4 has not provided any information yet and veterinarian 5 said to give information. Table 4 (next page) shows the results on the veterinarians about therapy, business counseling, advice and guidance.

	Vet 1	Vet 2	Vet 3	Vet 4	Vet 5
Diagnostic method	SNAP® <i>Giardia</i> Test by IDEXX	A rapid ELISA in house test. And a general endoparasitic investigation by IDEXX	FASTest® by MEGACORE	Snap test, (3 days faecal samples)	SNAP® <i>Giardia</i> Test by IDEXX (3 days faecal samples) Also sending to IDEXX for endoparasitic research
Veterinary medicine against <i>Giardia</i>	Fenbendazol (small dogs) Metrazol® (large dogs)	A Combination of Panacur® and Metrazol®	Panacur®	Panacur®	Metronidazole Fenbendazol (depending on age and weight)
Dosage and frequency of the medicine	Fenbendazol 50 mg/kg once a day for 3 days Metrazol® 50 mg/kg once a day for 5 days	Dosage not mentioned For 5 days	50 mg/kg a day for 5 days	50 mg/kg a day for 5 days	Metronidazole 25-30 mg/kg twice a day for 5 days Fenbendazol (Panacur®) 50 mg/kg once a day for 5 days
Washing of the patient	-	Yes	Washing of the dog at day 1 and day 3 of the treatment with water. Repeat after 3 weeks. (treat all animals in house)	Advice to wash at the last day of the treatment	In case of recurrence and persistent complaints
Business counseling	Three times a week, a visiting is made	No	-	Once a week, check and vaccinating of the animals	Yes, 2 times a week, to discuss and treat the dogs
Advice	So far not yet necessary; in the 30 years that this vet has been active he has not seen it as a problem	Isolate, treat, wash the dog, clean/disinfect the environment, retest/control tests	Wash the animals, clean and wash out the kennels, isolate the animal	To cleaning policy, don't use a pressure washer, remove faeces and test the dogs	Treat animals with symptoms, wash, isolate and give their own field, etc. tighten hygienic protocols
Guidance	Yes, every time when there is an infection	Yes, to the manager	An information letter if there is an infection	So far no	Yes

Table 3 Results on the veterinarians about therapy, business counseling, advice and guidance.

4.6 Prevalence at the shelters where the questionnaire was taken

In the different shelters, differences in prevalence were found. Moreover, within one shelter variations in prevalence were found with different test methods. The results can be found in table 4. In shelter 1 to 7, the questionnaire and faeces research were taken in the same time schedule. In shelter 8 to 10, the faecal samples were collected by other students and the questionnaire was taken at a later time, about 4 months after the faecal samples were collected.

Prevalence / Shelters	Number of dogs tested	CSF	IDEXX	IFA
Shelter 1	13	30,76%	30,76%	38,46%
Shelter 2	33 CSF, 34 IDEXX and IFA	36,36%	35,29%	29,41%
Shelter 3	7	0%	42,85%	14,28%
Shelter 4	12	8,33%	8,33%	8,33%
Shelter 5	12	25%	25%	25%
Shelter 6	7	57,14%	57,14%	57,14%
Shelter 7	14	7,14%	7,14%	0%
Shelter 8	9	0%	11,11%	0%
Shelter 9	25	4%	16%	20%
Shelter 10	14	21,43%	42,86%	42,86%

Table 4 Results on the prevalence of *Giardia* at the shelters where the questionnaire is taken.

Notable is that the prevalence of *Giardia* is very low in shelter 4 and 7. Different prevalences are found with the different diagnostic methods.

Chapter 5 Discussion

5.1 Experience of *Giardia*

In general, it can be said that the majority (76% to 84%) of the participants who filled in the questionnaire do not see *Giardia* as a problem at their shelter. 76% of the participants answered no to the question if they see *Giardia* as a problem. Additionally, when looking at the reasons that were given at the question if standard testing is a procedure, two of the participants who had previously indicated that they see *Giardia* as a problem, added the explanation that they “do not test here because *Giardia* is not really a problem”. Therefore, it can also be said that 84% do not see *Giardia* as a problem.

In this research, no firm connection is seen between the perception of the prevalence of *Giardia* at an infected shelter or at shelters in the Netherlands and experience *Giardia* as a problem. This inference can be drawn from the varying answers. Most people who see *Giardia* as a problem estimate the prevalence at an infected shelter 0-20% and 40-60%, and they estimate the prevalence among Dutch shelters to be 20-40% or 80-100%. On the other hand, the majority of the participants who do not see *Giardia* as a problem gave relatively low numbers for prevalence, namely 0-20% at an infected shelter and 20-40% among Dutch shelters. Still, almost one in five people who do not perceive *Giardia* as a problem answered that 80-100% of all Dutch shelters are infected. Perhaps they do not experience *Giardia* as a problem because they have only experienced dogs with mild symptoms.

5.2 Testing

According to the questionnaire, testing is not a standard procedure at any of the shelters. The most common reason is that it is not necessary because *Giardia* is not really a problem (56,5% of the participants). This is another confirmation that *Giardia* is not seen as a problem at a shelter according to most of the participants who filled in the questionnaire.

When one looks at the question if people do want to test, it appears that 54,2% of the participants want to test. The most cited reason (25% of the total number of participants) is that appropriate measures can be taken in advance. Of the people who do not want to test as a standard procedure, the most common answer (20,8%) was that they only want to test if they have suspicions or if there are symptoms. It is debatable if one should test every dog. After all, it is recommended to not treat asymptomatic dogs. On the other hand, by testing every new dog you can diagnose carriers and separate them from susceptible animals.

5.3 Symptoms

If one considers the knowledge of the symptoms of *Giardia* among people who work at shelters, it is seen that 100% of the participants who filled in the questionnaire know that diarrhea is a symptom. Losing weight is mentioned often as well (80%). 52% of the participants checked the option ‘no symptoms’. Therefore, it is concluded that half of the participants know that a *Giardia* infection can be subclinical. In conclusion, the most common symptoms are known among the participants, but symptoms that are seen less frequently appear to be less familiar among the participants.

5.4 Transmission

Most of the participants are aware that the entrance of *Giardia* occurs through infected dogs that enter the shelter. Footwear of visitors and animal keepers are also mentioned. The majority of the participants is aware of the fact that *Giardia* can be spread via contaminated faeces (96%) and contaminated soil (76%). The possibility of contamination via drinking water is only known to 28% of the participants. In short, the knowledge of the spreading of *Giardia* is well known. Since we visited

the shelters to collect faecal samples, one can imagine that the option 'faeces' had been given away a little bit, though.

In general, it can be said that there are a few participants who also take measures in case of subclinical dogs. The majority does not take any measures at all. The results show that 80% of the questioned veterinarians answered that dogs with a subclinical infection do not have to be placed in quarantine, while 61% of the shelter employees (except the veterinarians) think that the individual infected dog has to be placed in quarantine.

Most people who filled in the questionnaire only take measures for infected dogs. Most of them isolate the individual dog and start a treatment. The majority would not wash the dog (question 8 and 14), even though half of the questioned people agrees that dogs with a (sub)clinical *Giardia* infection should be washed (54,2%; question 9). Evaluating the success of the treatment by repeating faecal examination was done more often in clinical dogs (60%) than in subclinical dogs (39.1%). Another interesting fact was that many people were motivated to test contacted dogs in case of a clinical infection (60%), but not in subclinical cases (26.1%).

In the literature it is stated that washing dogs helps to eliminate a *Giardia* infection. According to the answers that were given, only 54,2% of the participants see washing dogs as part of the elimination of *Giardia*. One veterinarian has remarked that it is not necessary to wash a dog, because the environment should be taken into account. This veterinarian probably suspects that washing is not useful because the dog is likely to be re-infected through the environment.

In addition, 37,5% answered that washing is not necessary because it is an intestinal parasite, and 8,3% answered that washing does not remove *Giardia* from the fur. Because only a small majority knows that washing is helpful to eradicate *Giardia*, one can conclude that this is not generally known. Still, four of the five veterinarians advise washing as part of the therapy.

Furthermore, it seems like the majority of the participants know how to eliminate *Giardia* cysts. A small majority of the participants (56%) know that it is harder for the *Giardia* cysts to survive in a dry area. With the question about how to disarm *Giardia* cysts, the option of quaternary ammonium compounds was not given as an option in the multiple choice question, because it would be too suggestive. This could be filled in at the option otherwise, though. There was only one person who came up with this answer. Therefore, it is thought that in general this option is not familiar among people who work in shelters. 70% of the participants answered that chlorine can disarm *Giardia* cysts. Indeed, chlorine is an effective disinfectant, but should be handled with care because of its harmful properties for humans.

Regarding the question if there is a protocol for *Giardia*, it seems that 33% of the participants are aware there is a *Giardia* protocol at their shelter and do know the content of this particular protocol. 48% of the participants answered there is no protocol at all. At every shelter except for one, this question is answered with no by at least one staff member. At three shelters it is answered with both yes and no. Therefore, it can be concluded that most shelters do not have a *Giardia* protocol, or that the employees are not aware of the protocol.

The number of participants that are aware that dogs can be infected with *Giardia* by other dogs, is 100%. The number of participants that answered that humans can be infected by dogs, is 72%. People who filled in the answers cats, rabbits and sheep, are probably aware that these animals can be infected with *Giardia*. However, if one looks at the different assemblages of *Giardia* in cats, rabbits and sheep, it is not likely that they be infected by a dog, because these animals have different types of assemblages. Therefore, it is assumed that people do not know about the different types of

assemblages of *Giardia*. It is possible that the zoonotic risk of *Giardia* is overestimated by the people who filled in the questionnaire if they do not know that there are different assemblages of *Giardia*. No firm conclusion can be reached on the basis of this question, so more research is needed.

All the shelters that participated in the study would tell the owner if their dog has a *Giardia* infection. In 63,2% of these cases, both the adoption owner and the distance owner are told, and in 36,8% of the cases only the adoption owner is told. The majority of the people who filled in the questionnaire would inform owners for the reason that they should know the disease history of their pet. 68% answered they would tell the owner because *Giardia* is infectious for other pets and 44% because it is infectious for humans. Only 44% of the participants see a zoonotic risk as a reason to tell the owner about an infection. One can argue if you should tell an owner about a previous *Giardia* infection if the dog has no symptoms at that moment. Indeed, the dog could still be a carrier of *Giardia* when it leaves the shelter. Moreover, for an owner it is nice to know the history of its new pet. But on the other hand, a dog that is free of *Giardia* can easily get infected as soon as it is with its new owner, too, because *Giardia* is a common protozoa in the environment. Therefore, it remains debatable if one should tell an owner about a *Giardia* infection in the past.

5.5 Demand for information about *Giardia*

The questionnaire shows that the majority of the employees would like to have more information about *Giardia* transmission, prevalence, therapy and measures. Only 17,4% indicate that they do not require more information.

According to the answers to the knowledge questions, only a small majority knows the correct answers to most of the questions. Therefore, it can be concluded that in general the knowledge of *Giardia* among shelter staff is insufficient. Thus, providing information to shelter personnel is desirable.

5.6 Vets about therapy, business counseling, advice and guidance

As diagnostic methods, rapid in-house tests are frequently mentioned. The veterinary medicines that are mentioned are Panacur® (fenbendazole) and Metrazol® (metronidazole). Some veterinarians give a combination of both Panacur® and Metrazol®. One veterinarian makes a difference between small dogs (fenbendazole) and large dogs (metronidazole), because of the difference in costs of both medicines. All veterinarians prescribe the aforementioned medicines for five days. Dosages of 50 mg/kg once a day is mentioned for fenbendazole and either 25-30 mg/kg twice a day or 50 mg/kg once a day are mentioned for metronidazole. In the literature, for metronidazole a dosage of 50 mg/kg a day for five to seven days is advised and for fenbendazole a dosage of 50 mg/kg a day for a maximum of three days. A treatment with fenbendazole is the treatment of choice, but metronidazole is an effective alternative. One can conclude that the veterinarians apply an appropriate medicinal treatment.

80% of the veterinarians that filled in the questionnaire advice to wash the dog, which is in accordance to the recommendations found in the literature. The veterinarians only treat dogs with a clinical infection. Subclinical dogs are not treated, because the veterinarians do not test them anyway. It may be advisable to test for subclinical infections and wash these dogs as well. None of the veterinarians mentioned that they provide business counseling at the shelters. However, some mentioned that they visit the shelter, inspect the animals and give vaccinations. One veterinarian answered that he/she has never seen *Giardia* as a problem at a shelter in the thirty years that he/she works as a veterinarian.

The majority of the veterinarians give an adequate and complete advice for individual cases, i.e. isolation, clean up the faeces, treating the animals with fenbendazole or metronidazole, washing the

dogs, disinfection of the environment and retesting treated animals. One veterinarian mentioned to treat all the dogs in the shelter. Evaluating the cleaning policy in the shelter is mentioned, too. For example, this policy can be adjusted if they use a pressure washer.

The veterinarians supply information if necessary. The way they give this information differs per person. Some communicate directly to the owner and employees, others supply information to the manager through an information letter. One veterinarian has not provided any information yet, because he/she had never experienced a *Giardia* infection at the shelter.

It can be concluded that the veterinarians seem to use an appropriate therapy for individual cases. However, there seems to be a lack of a protocol focusing on the shelter as a whole. A search in the available literature did not produce a satisfying protocol. Therefore, future research should focus on developing such a protocol, usable for both veterinarians and shelter personnel.

5.7 Limitations

5.7.1 Questionnaire

This research is based on just twenty-five questionnaires. In addition, the research population is diverse. The population is divided into different categories, namely managers (or owners), employees, volunteers and veterinarians. The group of veterinarians, for example, is made up of five persons. Therefore, the validity of this research and the conclusions are very limited. The research group has to be more extensive to come to firm conclusions.

Another limitation is that not all given answers were useful, decreasing the number of responses even more. One of the main reasons for this is that a few questions or answers were misinterpreted. For example, when participants were asked how they would treat subclinical dogs, participants regularly remarked that such situations did not occur in their shelter, because a dog with no symptoms would not be tested. Having stated this, participants did not answer the question any further. Ideally, the questionnaire should first have been tested on a small number of shelters, to prevent interpretation errors. Based on their responses the questionnaire could have been adjusted.

At shelter 7 to shelter 10, the examination of the faecal samples was carried out by the students who took part in “the *Giardia* project” before us. This means that the questionnaires were sent after the participation of the shelter in “the *Giardia* project” and after the collection of the faecal samples. It could be that these people know more about *Giardia* because of their interest in the project. On the other hand, the answers that were given by these people did not differ from the answers in the questionnaires that were handed out at the same time that the faecal samples were taken.

Also, in some cases the questionnaire had been sent ahead, so that it could be collected when the faecal samples were taken. This was done if the people who work in shelter said that they did not have enough time to complete them in the time the faecal samples were taken. In two other cases, the questionnaire was left at the shelter and sent back later. It could be that these people did some research when they filled in the questionnaire. On the other hand, when the questionnaire was taken at the time that we were there in person, some people consulted with each other, too, even though we asked them to do this after they had filled in the questionnaire.

5.7.2 Faecal examination

In this study, faecal samples were collected from several dogs living in groups, including shelter dogs, hunting dogs and dogs that live in a senior club. Despite the fact that all of these dogs live in quite stable groups, there are certain differences between these groups. For example, hunting dogs visit a variety of different areas with the hunting society they belong to. Furthermore, these groups are

large populations. The infection pressure is slightly different within shelters compared to senior clubs for dogs. This depends on the arrangement of the population. The arrangement in a shelter depends on how often new dogs are added to the group. At the senior club, new dogs are not added to the group very often. On the other hand, these dogs return to their owner once in a while. When they are with their owner, they might get infected (for instance in dog walking areas), and this infection can be taken to the senior club with them.

In this study, faecal samples were not always collected on the same day. Therefore, samples collected from one shelter might have been one or two days old. The CSF method was performed immediately, while other methods were performed later. Even so, the faeces was immediately frozen for the SNAP test or put into the SAF for the IFA method. Consequently, the examined samples differ in age, which could affect the morphology of the cell wall of the *Giardia* cysts and thus could also affect the results.

For the detection of *Giardia*, three different detection methods were used. For the faecal samples from shelter 7 to 10, the diagnosis was made by the students before us. Like them, we found differences in prevalence with the different diagnostic methods. In one case (shelter 1), a higher prevalence was found with the IFA method than with the CSF. Only once (shelter 2), a higher prevalence was found with the CSF than with the SNAP® *Giardia* Test by IDEXX and with the IFA. With the SNAP® *Giardia* Test by IDEXX a higher prevalence has been found as well than with the CFS and IFA method.

- IFA > CSF
- CSF > IFA, SNAP® *Giardia* Test by IDEXX
- SNAP® *Giardia* Test by IDEXX > IFA, CSF

There are several factors that can influence the sensitivity of each test. An explanation for IFA > CSF could be that the IFA method is seen as the golden standard, and cysts should be easier to find with the IFA because the cyst wall is colored apple green.

An explanation for CSF > IFA could be that the used IFA method was not optimal in this research, because there was a lot of debris in the wells that also colored apple green. This made it difficult to visualize the apple green cell walls of the *Giardia* cysts out of the debris. For this reason, it could be that mild infections of a *Giardia* infection have been missed. It is also possible that *Giardia* cysts have been missed because they were underneath the debris. Furthermore, the morphology of the cyst was not always as clearly visible as in the control preparation. Therefore, several times there were doubts if a *Giardia* cyst was seen or not. The presence of more than one distinctive cyst was often decisive to regard the sample as positive on *Giardia*. Perhaps the CSF was more sensitive than the IDEXX SNAP method in some cases, because the sample contained too little amount of antigen to detect *Giardia* with the SNAP test (false negative).

With the CSF and IFA method slides are visually examined for the presence of cysts. The reliability of these examinations can depend on the skills of the researcher. The IDEXX SNAP method, on the other hand, is less susceptible for inter-observer discrepancies. Moreover, the IDEXX SNAP test is less influenced by the intermittent nature of excretion of the parasite. This could explain the positive result with the SNAP test in combination with negative IFA and CSF test results. The IFA and CSF should actually have been used to examine faeces from three consecutive days. However, this is a cross-sectional study and therefore only one sample was collected at a certain moment in time. Moreover, with the examination of the CSF slides, the whole slide was examined at a low magnification. Then, four rows were examined per slide at a 400x magnification, instead of the whole slide. As a consequence, very mild infections with *Giardia* may have been missed. However, it was

not attainable to examine the whole slide at this magnification, because many specimens had to be examined.

A final point of discussion is the use of a sucrose-solution for the CSF method rather than a zinc-sulphate solution, because this method is cheaper and less harmful for the environment. Nevertheless, sucrose solutions have also been described as a highly effective solution.¹¹

Chapter 6 Conclusion

This study focused on the perception and knowledge of *Giardia* among people who work in animal shelters. The first question focused on whether people who work in animal shelters perceive *Giardia* as a problem. It can be concluded that the majority (up to 84%) of the participants who filled in the questionnaire do not see *Giardia* as a problem at their shelter. No firm connection was found between the perception of the prevalence of *Giardia* at an infected shelter or among Dutch shelters and whether people experience *Giardia* as a problem.

The second question focused on the knowledge of *Giardia* among people who work at animal shelters. The participants know the most common symptoms (e.g. diarrhea). However, vomiting is known by only 32% of the participants and just 52% of the people that filled in the questionnaire know that an infection can be asymptomatic. The transmission pathway is well-known. 100% of the participants knows that *Giardia* enters a shelter through an infected dog and 96% knows that infection occurs through faeces. Spreading through contaminated water is only known by 28%, though. The knowledge about which measures to take when a dog is infected is limited. Washing the dog is only mentioned by a few people and just a small majority knows that a *Giardia* cyst cannot survive in a dry environment. 77,3% of the people know that chlorine can disarm a *Giardia* cyst, but only one person answered quaternary ammonium compounds, which can be used as well. People know that dogs can infect other dogs and humans. It is assumed that people do not know about the different types of assemblages of *Giardia*, though.

Only a small majority of the participants knew the correct answers to most of the questions. Therefore, it can be concluded that in general the knowledge of *Giardia* among shelter staff is insufficient. Furthermore, the majority of the employees would like to receive more information about *Giardia*. Thus, providing information to shelter personnel is desirable.

There seems to be a lack of protocol and proper business guidance. Veterinarians establish an appropriate therapy for individual cases. However, there seems to be a lack of a protocol focusing on the shelter as a whole. In the literature there is a lack of an adequate, practical protocol for shelters. Shelters would probably benefit from such a protocol.

Chapter 7 Recommendation for further research

Because assemblage's A and B have been found in dogs, questions and concerns have been raised about the potentially zoonotic role of these *Giardia* assemblages. Therefore, research into the prevalence of the potentially zoonotic assemblages in dogs is required. Research about the transmission from dogs to humans and from humans to dogs is needed. A study which contains humans and dogs is necessary, such as a study with dogs and their owners.

Because of the potentially zoonotic risk, it is useful to have insight in people's knowledge about *Giardia* and their perception of *Giardia* as a zoonotic disease, particularly if this is underestimated or overestimated. For this, the prevalence of the *Giardia* assemblages in dogs and humans needs to be known.

A distinction must be made between the different types of populations and areas of the dogs to make a statement about the potential zoonotic transmission, because studies have shown that there is variation in the prevalence in different dog groups. This ranges from 4,1% to 12,3% in house dogs, whereas in breeding kennels and shelters varying percentages are mentioned from 16,8% and 49% up to 100%.^{1, 2, 13, 16, 19} Therefore, the potential zoonotic risk could vary per group and area.

If the knowledge and perception of *Giardia* among people who work in shelters is studied, their knowledge can be expanded if it appears to be insufficient or if the impact of *Giardia* is under- or overestimated.

Chapter 8 Appendix

Appendix I: The General Questionnaire

With questions about the individual dogs and about the shelter policy

The results of the questionnaires and the collected data are not discussed in this paper.

Data requested for each individual dog

The staff of the animal shelters were asked to provide the following data for each individual dog:

- Name/number of the dog
- Gender (male/female)
- Age
- Breed
- The presence of clinical symptoms of Giardiasis
(for instance weight loss, intermittent or continuous diarrhea)
- Current treatments of the dog
- Date of entrance in the animal shelter
- Origin of the animal (stray/'offered for adoption')
- Section within the establishment/shelter

Questionnaire about the kennel/shelter

- 1). How many dogs are housed in the animal shelter/kennel?
- 2). What is the group size of dogs in the kennel? (individual housing or housing in groups)
- 3). How does the kennel look (materials used, interior etc.)
- 4). Are the dogs taken outside? (in what ways and how often?)
- 5). Do all dogs have a free entrance to an outdoor kennel?
- 6). Are there playing fields present and how do they look? (grass, soil, concrete, fence etc.)
- 7). Have there been any infections with gastrointestinal parasites in the last 3 months? (if yes, which parasites?)
- 8). Hygiene policy and protocol used for cleaning and disinfection of the housing facilities:
 - a. Frequency of removal of faeces (also from the outdoor playing fields)
 - b. Which detergents and disinfectants are used?
 - c. Frequency of cleaning and disinfection
- 9). Anthelmintic treatments used:
 - a. Which?
 - b. When are they used? (upon entrance?)
 - c. Frequency
- 10). Are there other animal species housed at the animal shelter? Which species?
- 11). How many puppies are present in the animal shelter?
- 12). Are the puppies housed separately from the adult dogs?

Appendix II: The Protocol of the Centrifuge Sedimentation Flotation Method

The CSF method was performed on fresh faecal samples (not older than four days after collecting them from the shelter floor). All samples are investigated separately (not pooled).

Procedure:

- 1) Put 3-5 g of the sample in 50-70 ml water using a mortar and jack screw.
- 2) Strain the suspension using a sieve in order to withhold large debris.
- 3) Swivel the sieved suspension and pour it into a centrifuge tube.
- 4) Centrifuge for 2 minutes at 3000 rpm.
- 5) Pour the supernatant off.
- 6) Add a small amount of sucrose solution and vortex it.
- 7) Fill the tube containing the vortex supernatant and sucrose further with the sucrose solution until a positive meniscus is formed.
- 8) Place a cover glass on the top of the meniscus.
- 9) Centrifuge for 2 minutes at 3000 rpm.
- 10) Remove the cover glass from the tube and place it on a microscope slide.
- 11) Examine the entire microscope slide at 10x magnification for nematode eggs and other parasite eggs.
- 12) For the examination of *Giardia* in the microscope slide, use 20x (for the trained eye) or 40x magnification.
- 13) Examine at least 4 rows in the microscope slide for the detection of *Giardia* cysts. There must be a reasonable distance between the four examined rows.
- 14) The slide is considered positive if the correct morphology and size of *Giardia* is seen in the microscope slide.

Appendix III: Protocol of the Immuno-Fluorescence Assay

After Geurden, 2008 (a Bayesian evaluation of three diagnostic assays for the detection of *G. duodenalis* in symptomatic and asymptomatic dogs)

Preserve of the faecal samples

- Put 1 part faeces with at least 3 parts 10% SAF in a storage tube.
- Mix the faeces with the SAF solution using the vortex.
- Swivel the suspension for optimal distribution of the SAF solution and the faeces.

Preparation

- Bring the Merifluor *Cryptosporidium/Giardia* kit to room temperature before use (half an hour in advance).
- Prepare the wash buffer: mix 5 ml wash buffer with 95 ml aquadest.

Procedure

- Resuspend the suspension by vortexing it thoroughly.
- After that, swivel the suspension for an optimal suspension.
- Pour the suspension through a tea strainer, which will withhold the large debris.
- Swirl the sieved suspension and collect it in a centrifuge tube.
- When the volume in the tubes is very different, it can be filled up with aquadest so that the volume of each centrifuge tube is equal.
- Centrifuge for 5 minutes at 3000 rpm.
- Pour the supernatant off.
- Use aquadest to fill up to a total volume of 1 ml.
- Resuspend using the vortex.
- Use a transfer loop to transfer a drop of positive and negative control to a treated IFA slide well. Spread the specimen over the entire well. Do not scratch the treated surface of the slide.
- Do the same for the faecal material.
- Let the slides dry at room temperature for about 30 minutes.
- After 30 minutes of drying, place one drop of Detection Reagent in each well.
- Subsequently, place one drop of Counterstain in each well.
- Mix these drops with a glass applicator stick and spread it over the entire well. Do not scratch and use a new glass applicator stick for every well.
- Protect the slides from light by putting them in a box, and put them in an incubator (30°C).
- Rinse the slides off with the wash buffer, using a pipette, until the Detection Reagent and Counterstain are removed.
- The excess buffer can be removed by tapping the slide on a clean paper towel.
- Add a drop of Mounting Medium to each well.
- At least cover the slide with a coverslip (use a large coverslip that covers all the three well at one slide)
- Examine each well under the immunofluorescence microscope with a magnification of 10x. Use the 40x magnification for zooming in.
- The wall of the *Giardia* has an apple green color. If at least one *Giardia* cyst is found in the slide, the sample is considered to be positive.

Appendix IV: Protocol IDEXX SNAP-test *Giardia*

Preparation

- The components of the test kit must be at room temperature before use. To that end, remove the test kit from the fridge half an hour prior to use.
- Since the faecal samples were frozen, they need to be defrosted before for testing. Remove them from the freezer a day before testing.

Test procedure

1. Swab sample and place swab tip into tube. Bend bulb to break seal and release conjugate.
2. Squeeze and release bulb 3 times to mix sample and conjugate.
3. Squeeze bulb to dispense 5 drops into the sample well of a SNAP device
4. When color first appears in the activation circle, press firmly to activate. You will hear a distinct “snap.”
5. Read the test result 8 minutes from the time of activation.



Appendix V Questionnaire *Giardia*

Questionnaire *Giardia*

Name shelter/kennel:

Number shelter/kennel:

Function in the shelter/kennel:

- Vet
- Manager of the shelter/kennel
- Employee
- Volunteer
- Otherwise

Achieved diplomas/certificates:

- Veterinary medicine
- Para-veterinary
- Authorized veterinary assistant
- Proof of Competence Dogs and Cats Decision
- Animal caretaker
- Otherwise.....

1). Do you experience *Giardia* as a problem/risk at your shelter/kennel?

(Please choose one of the options)

- Yes: (choose the most important reason for you from the following list)
 - There are regularly dogs with *Giardia* symptoms
 - Dogs are frequently tested positive
 - Giardia* is common in domestic dogs
 - Otherwise
- No: (choose the most important reason for you from the following list)
 - There are dogs that are tested positive, but not many
 - There are sometimes symptoms of *Giardia*, but this is very limited
 - It is not widely distributed in the kennel
 - It is not common in dogs in the Netherlands
 - Otherwise

2). How high do you think the prevalence of *Giardia* is in shelters in the Netherlands? (In other words: how many shelters in the Netherlands are infected?)

- 0-20 %
- 20-40%
- 40-60%
- 60-80%

- 80-100%

3). If there is a *Giardia* infection at a shelter, how many dogs are infected then?

- 0-20 %
- 20-40%
- 40-60%
- 60-80%
- 80-100%

4). When a new dog arrives at a shelter/kennel, will this dog be tested on *Giardia* as a standard procedure?

- Yes Why?
 - Because if the animal is tested positive for *Giardia*, measures can be taken for that particular animal
 - To take measures to prevent spreading of *Giardia* to other animals
 - For the safety of the shelter staff
 - Otherwise.....
- No Why?
 - Too expensive
 - It is not really a problem, so it is not necessary
 - Too labor-intensive/logistically not viable
 - Otherwise.....

If no, would you like to test for *Giardia*? And why?

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5). How does *Giardia* enter shelters/kennels?

(Multiple answers can be checked)

- By dogs
- Through contact with careers/visitors
- Via food
- Via pests
- Via footwear/walking
- Otherwise.....

6). A dog with a *Giardia* infection:

(Multiple answers can be checked)

- Can have symptoms of diarrhea
- May vomit
- Often has a high temperature (fever)

- May lose weight
- May have flatulence
- Does not need to show symptoms
- Otherwise.....
- No idea

7). Is there a protocol at your company/shelter against a *Giardia* infection?

- No idea
- Yes
 - I am not familiar with the content
 - I am familiar with the content
- No

8). When there is a dog with a *Giardia* infection at your company, the following measures will be taken:

(Multiple answers can be checked)

<input type="checkbox"/> 1). This dog:	<input type="radio"/> In quarantine <input type="radio"/> Treat with medication <input type="radio"/> Wash with shampoo <input type="radio"/> Retest
<input type="checkbox"/> 2). Contact dogs at the department:	<input type="radio"/> In quarantine <input type="radio"/> Treat with medication <input type="radio"/> Wash with shampoo <input type="radio"/> Test for <i>Giardia</i>
<input type="checkbox"/> 3). All dogs in the shelter/kennel :	<input type="radio"/> Isolate/in quarantine <input type="radio"/> Treat with medication <input type="radio"/> Wash with shampoo <input type="radio"/> Test for <i>Giardia</i>
<input type="checkbox"/> 4). No treatment	

9). At the end of a *Giardia* infection:

(Choose one of the options please)

- Dogs should be washed, because *Giardia* can stick to the fur of an animal
- It is not necessary to wash because the washing does not remove the parasite from the dog's coat.
- Washing is not necessary because *Giardia* is an intestinal parasite

10). How does spreading of *Giardia* occur between dogs in a shelter?

(Multiple answers can be checked)

- Through contact with infected faeces
- By drinking contaminated water
- Through tick bites
- By fleas
- Via contaminated soil

11). Suppose: a dog with a *Giardia* infection has contact with the options below.

Who can become infected with *Giardia* (from the below given options) by a dog infected with *Giardia*?

(Multiple answers can be chosen)

- Dogs
- Humans
- Cats
- Rabbits
- Sheep
- No idea

12). *Giardia* has more difficulty surviving in:

(Choose one of the options)

- A damp environment
- A dry environment
- There is no difference between a dry and a damp environment
- No idea

13). To disarm *Giardia* in the environment:

(Multiple answers can be checked)

- A high pressure cleaner
- All Purpose Cleaner
- Chlorine
- Alcohol
- Ammonia
- Steam cleaner
- A specific product, please fill in name.....

14). When a dog that doesn't show *Giardia* symptoms, is tested positive for *Giardia*:

(Multiple answers can be checked)

- Placed in quarantine:
 - Only this dog
 - All dogs of the department
 - The whole shelter/kennel
 - No dog is placed in quarantine
- Diagnosis applied to:
 - Only this dog (retested)
 - The entire department tested

- The whole shelter/kennel tested
- Treated with medication:
 - Only this dog
 - All dogs in the department
 - All dogs in the shelter
- Washed:
 - Only this dog
 - All dogs in the department
 - The whole shelter/kennel
- It is not necessary to take measures

15). Is the old/new owner informed that their dog has/had a *Giardia* infection?

- The adoption owner will be told
- The distance owner will be told
- Both the adoption owner and the distance owner (owner who offered their animal for adoption) are told
- Neither owner is told

Why?

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16). In your opinion, should the owner be told if a dog has/had a *Giardia* infection?

- No (multiple answers can be checked)
 - It is not necessary if a dog has no problems
 - *Giardia* is not contagious to humans, so there is no need to tell the owner
 - Even if the dog does show mild symptoms, it is not contagious to humans
 - Other pets are not easily infected with *Giardia* so it is not necessary to tell the owner
 - Not yet thought about
- Yes (multiple answers can be checked)
 - *Giardia* can infect other pets
 - *Giardia* can also infect humans, so it is important to tell the owner
 - The owner should know about the case history of the dog

17). Would you like to receive more information about *Giardia*?

(multiple answers can be chosen)

- About transmission
- About prevalence
- About disease control

- I do not want more information about *Giardia*

Additional questions for veterinarians

1). Which diagnostic method do you use to detect a *Giardia* infection?

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**2). Which veterinary medicinal products do you use for a dog with a *Giardia* infection?
And do you make a difference between a subclinal and a clinical infection?.....**

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3). To which schedule do you adhere for this drug/these drugs? (Time/frequency/dose/repeat)

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4). Do you offer business assistance? (Frequency/duration per visit)

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5). Which advice is given to a shelter with a *Giardia* problem?

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6). Do you educate people about *Giardia* as a zoonotic disease and as a problem for dogs?.....

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Chapter 9 References

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