Sveriges lantbruksuniversitet
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Dogs on the move – a study of the travel habits of Swedish dogs and their owners' awareness of infectious diseases.

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ABSTRACT

Sweden is at this moment spared from many zoonotic diseases encountered in Europe and the rest of the world. Travelling dogs are considered one of the potential introducers of such diseases to Sweden. The aim of this study was to investigate to what extent dogs and their owners travel outside the country and how aware they are about the zoonotic diseases they may encounter abroad. This study also attempted to find out how dog owners seek information about dog travelling and what the travellers' attitudes are to taking responsibility of preventive measures if they are not required by law, which may be the case in a nearby future. Data was collected from 185 questionnaires answered by dog owners visiting the University animal hospital in Uppsala, Sweden, during March-May 2010. The collected data shows that 24 % of the respondents have travelled or have plans to travel abroad in the company of their dog. A substantial part of them intend to travel to countries where there is a risk to encounter some of our most dreaded zoonotic diseases; rabies and *Echinococcus multilocularis* (EM). This study shows that the knowledge of EM is poor while the knowledge of rabies is relatively good. The veterinarian is considered one of the most important information sources together with the Swedish Board of Agriculture. In all, 98% of the respondents show a positive attitude towards taking responsibility of preventive measures if not required by law. The majority of them (59 %) are however sceptic against other people doing the same. This could indicate that significantly less than 98% would in fact follow recommendations of vaccination and deworming. Considering this and the poor knowledge of especially EM in relation to the travel pattern there is a considerable need for information in order to keep Sweden free of the diseases mentioned also in the future.

ABSTRACT (IN SWEDISH)

Sverige anses för närvarande vara fritt från många av de zoonotiska sjukdomar som förekommer endemiskt i Europa och resten av världen. Resande hundar är en potentiell riskgrupp som skulle kunna introducera vissa av dessa sjukdomar till Sverige. Målet med denna studie var att undersöka i vilken omfattning hundar och deras ägare reser utomlands och hur medvetna dessa hundägare är om de zoonotiska sjukdomar som de då kan komma i kontakt med. En annan målsättning är att ta reda på vad det finns för attityder till att ta ansvar för de förebyggande åtgärder som idag finns som lagkrav för att skydda landet mot smittsamma sjukdomar och som i framtiden kan komma att enbart rekommenderas. Resultaten har baserats på data från 185 enkäter som besvarats av hundägare som besökt Universitetsdjursjukhuset i Uppsala, Sverige, under perioden mars-maj 2010. Insamlade data visar att 24 % av dessa besökare antingen rest eller planerat att resa utomlands med sin hund. En betydande del av dem planerar att resa till länder där risk föreligger att komma i kontakt med några av våra mest fruktade zoonotiska sjukdomar; rabies och rävens dvärgbandmask. Kunskapen om dvärgbandmasken är näst intill obefintlig medan den för rabies är relativt god. Veterinären uppfattas tillsammans med Jordbruksverket som viktiga informationskällor. Totalt visar 98 % av dem som besvarat enkäten en positiv attityd till att ta ansvar för förebyggande åtgärder som vaccinationer och avmaskning, men 59 % är skeptiska till att andra kommer att göra detsamma. Detta skulle kunna tyda på att det är betydligt mindre än 98 % som *de facto* skulle vidta åtgärder om dessa enbart grundas på rekommendationer. Detta i kombination med de uppgivna resvanorna och de bristfälliga kunskaperna om speciellt dvärgbandmasken indikerar att det finns ett stort behov av information för att även i fortsättningen hålla Sverige fritt från de nämnda sjukdomarna.

INTRODUCTION

Sweden has been a member of the European Union (EU) since 1995. The membership contracts Sweden to follow the common rules that are set up within the union. Since Sweden has a very favourable situation concerning the absence of certain diseases the country has been exempt from some of the common rules and stricter national laws are applied instead. The Swedish laws that are referred to here are the ones concerning movement of pets over Swedish borders. EU's goal is to harmonise the "Swedish" rules with the rules applied in the rest of the union. The current requirements for transporting pet animals to and within the EU will continue until the 1st of January 2012 (Jordbruksverket, 2010).

Zoonoses are diseases that can be transmitted naturally between animals and humans. At the moment Sweden is spared from many of the zoonoses that are considered endemic in Europe and other parts of the world. Two of the zoonotic diseases that Sweden is trying to prevent from entering the country are rabies and Alveolar Echinococcosis. It is therefore important to be aware of the transmission paths of these infectious agents and to recognize the symptoms they cause. The prevalence in Europe is also very much of interest when trying to find strategies to prevent introduction to Sweden.

Rabies

Rabies is a Lyssavirus (Quinn et al 2002). It is a virus that can infect humans as well as all warm-blooded animals. Classical rabies virus (genotype 1, RABV) is responsible for the majority of these infections. In addition to RABV, there are two other types of Lyssavirus in Europe, European Bat Lyssavirus (EBLV) type 1 and 2 (corresponds to genotypes 5 and 6 within the Lyssavirus genus), which in rare cases may cause disease in humans. The majority of EBLV are detected in European bats.

Rabies is spread through contact with saliva, often via bites by infected animals. After introduction into tissues the virus travels along the peripheral nerves to the brain where it causes fatal encephalitis. The incubation time can be as long as six months and virus can be excreted before any clinical signs of infection develop.

The symptoms vary between animals and different stages are recognised – prodromal, furious and paralytic. In the prodromal stage the animal may be anxious and confused while in the furious stage it may be aggressive or excited. Behavioural changes are the most common signs of infection. In the paralytic stage salivation may be increased due to difficulties in swallowing when the pharynx gets paralysed. Vocalisation is also a common symptom.

Humans may at first feel pain in the area of the bite (Rabies-bulletin 2010). Diffuse symptoms like fever, fatigue and headache may be present followed by a furious or a paralytic stage, both fatal due to respiratory failure. Death usually occurs within a week after the first symptoms.

Echinococcus

Six different tapeworm species are included in the genus *Echinococcus*, one of them being *Echinococcus multilocularis* (EM) which can cause a serious disease in humans, called Alveolar Echinococcosis (AE) (Jenkins et al 2005) EM is a tapeworm which primarily infects the red fox (originally the arctic fox); however all wild canids are susceptible. (Moro & Schantz 2009, Urquhart et al 1996) The adult worm which inhabits the small intestine of the

fox does not cause any symptoms in this species, nor in the domestic dog to which it can be transferred and which is also considered a definitive host.

The path of transmission to the dog and other foxes is through eating small rodents who are considered intermediate hosts (Urquhart et al 1996). The intermediate hosts get infected when ingesting plants and berries contaminated with faecal material. This is also a possible pathway for transmission to humans, who are considered dead-end hosts. The sylvatic lifecycle suggests that a massive spread of the parasite might be the result if introduced to Sweden and consequently the risk of AE in humans will increase (Hallgren et al 2009).

In rodents and humans the ingested larvae of the tapeworm migrates from the intestines to the liver where they start to grow (Moro & Schantz 2009, Urquhart et al 1996). The growth can be infiltrative and invasive and systemic metastasis is possible. The congregate may grow very large but in humans the symptoms might not be evident until 15 years has passed. This delay may result in diagnose being made at a stage when it is too late to save the liver and transplantation might by then be the only option.

Another tapeworm within the same species, *Echinococcus granulosus* (EG) causes liver disease in humans but it has a different kind of lifecycle than EM, including ruminants as intermediate hosts (Moro & Schantz 2009). The definite host is primarily the domestic dog. Cases of EG have been reported in animals in Sweden several times and hence it is not comprised by the same strict national laws as EM and will not be discussed further in this study (SVA 2010).

Prevalence and control measures in Europe

Rabies

Rabies in animals

Rabies is reported all over the world in different kinds of animals. In Europe close to 30000 cases of rabies, including wild and domestic animals have been reported during 2007-2010 (Rabies-bulletin 2010). More than 18000 of these cases have been reported from Ukraine and the Russian Federation, a significant share reported from the non-European parts of these countries. The other countries reporting cases are Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Estonia, Hungary, Italy, Latvia, Lithuania, Moldova, Montenegro, Poland, Romania, Russian Federation, Serbia, Slovenia, Turkey and Ukraine. In Albania, Belgium, France, Germany, Spain and United Kingdom (UK) cases of RABV have been reported in domestic animals but not in wild animals. In France four out of five reported cases were imported (Rabies-bulletin 2010, The Community Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and food-borne outbreaks in the European Union in 2008 (Zoonoses report) 2010). In Germany one out of two cases was imported. In UK there was only one case reported in animals during this period and this case was imported.

In 2008 an eradication programme was implemented in all member states of the EU were RABV had been found (Zoonoses report 2010). The only member states not involved in the programme are Romania and Bulgaria. The aim is to orally vaccinate primarily foxes (and in some countries raccoon dogs) using baits. A decrease of the number of positive animals infected with RABV due to these programmes was seen during 2008, especially in the Baltic countries (Rabies-bulletin 2010). In Italy however there has been an outbreak of classical rabies virus (RABV) during the last years (WAHID 2010, Rabies-bulletin 2010). From having no cases in 2007, a few cases were reported in 2008 and during January to July 2010 almost two hundred cases of RABV were found in the country, predominantly in wild animals. The explanation to the outbreak in Italy was most likely the geographical proximity to Slovenia,

since isolates of RABV from Italian foxes was similar to isolates found earlier in Slovenia (De Benedictis et al 2008).

In Denmark, Finland, France, Germany, Hungary, the Netherlands, Poland, Romania, Russian Federation, UK and Ukraine evidence of EBLV infection in bats have been reported during 2007-2010 (Rabies-bulletin 2010). In Sweden antibodies against EBLV have been found in bats but the virus has never been detected (SVA 2010).

Rabies in humans

During the years 2001-2010 the number of European rabies cases reported in humans were thirteen (the countries from former Soviet Union excluded) (Rabies-bulletin 2010). One case was reported in Latvia and one in Romania. Five of the thirteen cases were reported in the UK and six from Germany. Most of these cases were imported (primarily from India) but one of the British cases was domestic, transmitted from a bat (Johnson et al 2005). Three of the German cases resulted from organ transplantation within Germany. The organ donor was however infected in India when bitten by a dog. During the same period, 2001-2010, as many as 78 human cases of rabies were reported from the Russian federation and Ukraine; however it is not specified to what extent these cases were reported from the European parts of the countries (Rabies-bulletin 2010).

Echinococcus multilocularis

E. multilocularis in animals

By the end of 1980 *Echinococcus multilocularis* (EM) was considered endemic in Austria, Germany, France and Switzerland (Eckert et al 2001). Nineteen years later, EM had been reported from eight more countries in central Europe, namely Belgium, Czech Republic, Denmark, Liechtenstein, Luxembourg, Poland, Slovak Republic and the Netherlands. The prevalence of EM was reported to vary from <1% to >60% in central Europe in 1999/2000.

In Norway (since 2007), Finland and Sweden (since 2006) a targeted sampling programme in foxes has been running continuously and in neither of these countries EM has been found since the programme started (Zoonoses report 2010).

A German study showed an increase in foxes infected with EM in Lower Saxony during the years from 2003 to 2005 (Berke et al 2008). In the Czech Republic, Germany, France and Switzerland positive findings of EM in foxes have been reported every year during 2006-2008 (Zoonoses report 2010). Slovakia and the Netherlands reported EM in foxes in 2007, and it is suggested that EM is increasing in these countries (Antolova et al 2008, Takumi et al 2009, Zoonoses report 2010).

Data is missing to give a clear picture of the prevalence of EM in Europe. The Office Internationale des Epizooties (OIE) is continuously reporting cases of echinococcosis in the world; however they do not differentiate *Echinococcus multilocularis* from other *Echinococcus* species. Furthermore, most countries in Europe do not have a surveillance programme. Taken together, these circumstances make it difficult to accurately estimate the prevalence of EM in Europe.

E. multilocularis in humans

In 2000 the following countries had reported cases of AE; Austria, Belgium, France, Germany, Liechtenstein, Poland and Switzerland (Eckert et al 2001). In Switzerland the incidence of infection with AE in humans was doubled from the years 1993-2000 to 2001-2005 (Schweiger et al 2007). In 2008 the member states of EU reported 891 cases of echinococcosis in humans of which at least 50 cases were caused by EM; in 22.6 % of the 891 cases the species was not specified (Zoonoses report 2010). The reporting countries, in 2008, where EM was specified were France, Germany, Hungary, Lithuania, Netherlands and Slovenia. In France, Hungary and Lithuania all the cases were considered domestic. In Germany and Slovenia around 30 % of the reported cases were domestic. In the Netherlands, as in most other countries, cases were mostly of unknown origin.

Preventive measures

In Europe the occurrence of rabies is decreasing while EM is increasing rapidly (Antolova et al 2008, Berke et al 2008, Rabies-bulletin 2010, Takumi et al 2009, Zoonoses report 2010). To protect Sweden from introduction of these two microorganisms special rules are, as previously mentioned, applied when importing pets into the country (SJVFS 2010:43). Dogs need to be vaccinated against rabies and, in contrast to many other countries in the European Union (EU), they also need to have an approved antibody titre before entering Sweden. The titre check has to be performed at least 120 days after vaccination. De-worming, affirmed by a veterinarian, is also required before transferring pets to Sweden.

In the future, current legal requirements regarding vaccination and de-worming may become abolished. Recommendations will most likely remain the same but compliance with these may become the sole responsibility of the pet owner.

Risk assessments

Travelling dogs are one of the potential introducers of zoonotic diseases to Sweden. Based on statistics on the number of rabies titre checks performed at the National Veterinary Institute (SVA)[1], it is judged that the population of travelling dogs is increasing. This institute is the only Swedish laboratory performing such tests and therefore it covers an absolute majority of the market. Despite increased competition from foreign laboratories, there was an increase in the number of rabies titre checks between 2008 and 2009, from 9990 to 10420. Dogs are to a higher extent following their owners on vacations. Adoptions of street dogs are increasing and breeding is often being executed outside the country borders. Imports of uncommon breeds are also becoming more common (Cedersmyg 2008).

At SVA, risk assessments have been made to evaluate the risk of EM being introduced in Sweden (Vågsholm 2006, Wahlström et al 2009). In the 2009 assessment it was estimated that 99 % of the dogs have to be de-wormed according to the present law for Sweden to also in the future be kept free from the parasite. Consequently the demands on the dog owners to act responsibly will be very high. Evaluation of a scenario where only 30-50 % of the dog owners would follow recommendations of de-worming if the law changes showed that approximately

[1] Louise Treiberg-Berndtsson Department of Virology, SVA, Uppsala. E-mail on 12th of March 2010.

100 infected dogs would be introduced per year. Consequently, it would only be a matter of time before EM becomes established in Sweden.

Risk assessments are made to try to evaluate the risk of introduction of certain diseases. Parameters in the risk assessment models are often based on "expert opinion" which means that they are not based on studies but on qualified guesses. A limiting factor in risk assessments regarding dog movements is that the total volume of dogs, potentially exposed to zoonotic diseases, entering Sweden is unknown, as well as their country of origin. To better inform risk assessments more data is required about these travellers.

Objective

The objective of this study is to investigate to what extent dogs and their owners (visiting an animal hospital in Uppsala, Sweden) travel outside the country and how aware they are about the zoonotic diseases they may encounter abroad. This study also attempts to find out how dog owners would seek information about dog travelling and what the travellers' attitudes are to taking responsibility of preventive measures if they are no longer required by law.

MATERIALS AND METHODS

Data collection & target population

A questionnaire survey was performed at the university animal hospital, Universitets-djursjukhuset (UDS), in Uppsala, Sweden. The inquiry was directed towards dog owners visiting the animal hospital. A total of 200 questionnaires were distributed both by staff at the UDS and by the principal investigator during the period Mars 2010 – May 2010. There was no formal selection procedure. The intention was that the questionnaires would be offered to dog owners in order of appearance until all of the questionnaires had been distributed. Some people chose not to participate in the survey. If someone declined the next dog owner in line was asked. Of the 200 questionnaires, 185 were returned. The responses were entered into a spreadsheet (Microsoft Office Excel 2003®, Microsoft Corp, Redmond, WA, USA). The questionnaire (in Swedish) is presented in appendix 1.

Data editing

Variables expressing knowledge

Four questions on facts regarding contagious diseases in dogs were included in the questionnaire (see question 15-18 in appendix 1). The questions covered aspects such as the presence in Sweden versus abroad, which of the diseases that had zoonotic aspects and for rabies and EM, also more specific facts about transmission routes and symptoms.

The answers considered to be correct are summarized in table 1 and 2.

Table 1. Answers considered to be correct for questions asked concerning presence of contagious diseases. Questionnaire survey performed at UDS in Uppsala during March-May 2010

Which diseases/disease agents are not encountered in Sweden?	Diseases/agents not encountered in Sweden
Leishmaniasis	X
Canine parvovirus	
Brucella canis	X
Rabies	X
Salmonella	
Echinococcus multilocularis (tapeworm of the fox)	X
Dirofilaria immitis (heartworm)	X
Anaplasmosis	

Table 2. Response alternatives for questions about rabies and Echinococcus multilocularis (EM) and answers considered correct. Questionnaire survey performed at UDS in Uppsala March-May 2010

What is true about Rabies/EM?		Answer considered correct	
		Rabies	EM
	Infection is spread through saliva	X	
	Infection is spread through contact	X	X
	Infection is spread via faeces		X
	Causes behavioural changes	X	
	Causes bleeding in internal organs		
	Injures the liver in humans		X
	Causes problems primarily in the gastrointestinal tract		
	Dogs infected are free from symptoms		X
	Only canines are infected		
	Several mammals can be infected including humans	X	X
	Sweden is considered free from the infectious agent	X	X
	Europe is considered free from the infectious agent		

For each question, a standardized score was calculated based on the number of correct and wrong answers. The score was calculated as: ((# correct answers/# possible correct answers) - (# incorrect answers/# possible incorrect answers)) * 100; thus resulting in a score between -100 and 100. In other words, a respondent with many correct answers and few or zero wrong answers will have a (high) positive score. Respondents "guessing at random" are expected to have a score around zero as are respondents that "tick everything". For the questions on rabies and EM, the score was both calculated on the overall responses and stratified on knowledge about presence in Sweden versus abroad, transmission routes and symptoms.

Description of travelling behaviour and definitions of risk countries

The respondents were asked about which countries they had travelled to, or planned to travel to, with their dogs. The countries stated were grouped into the regions of Scandinavia, rest of Europe (Scandinavia excluded) and rest of the world (Europe excluded). The countries stated were also classified as being risk countries for EM/rabies, or not.

We defined risk countries for rabies as countries where both domestic and wild animals (excluding bats) with rabies have been reported sometime during the last three years, 2007-2010. To decide which countries should be included the databases WAHID and the Rabies-bulletin-Europe were used.

It is difficult to define which countries are risk countries for EM. This is due to the lack of information especially during the last years. EM is, as mentioned, usually reported together with other species of *Echinococcus* which also complicates the prevalence evaluation. Countries included as risk countries in this study are countries where cases of EM has been reported in wild or domestic animals, based on information from the WHO-report from 2001 and the Community summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in the European Union in 2008.

Of all countries where rabies and EM are present, countries considered to be risk countries in this study were restricted to those countries of travel that the respondents had entered in the questionnaire.

Statistical analysis

Descriptive statistics

Frequency tables were produced for categorical variables describing the respondents and their dog experience, their travelling habits and attitudes to complying with recommendations on vaccination and de-worming. The purpose of travel and sources of information were also presented as frequency tables, by travel experience.

Number of years as dog owner, as well as knowledge of rabies, EM and infections present abroad was described by their 5^{th}, 50^{th} and 95^{th} percentiles. The latter were also described graphically, by histograms. Bar graphs where used to visualize the number of respondents with knowledge of infectious diseases encountered abroad but not in Sweden, as well as which of these that can be transmitted to man.

The geographic distribution of respondents by 3-digit postal code areas was visualized using ArcView version 9.2 (ESRI; Redlands, CA, USA).

Multivariable analysis

Associations between knowledge score and demographic characteristics (sex, age, education, dog experience and travel experience) were assessed using multivariable linear regression. Furthermore, logistic regression was used to investigate associations between "attitude to others following recommendations on deworming and vaccination (Yes, believe they will=1/No, believe they will not=0)" and the same demographic factors as described above. The same approach was used to investigate the association between reporting an information source (for the four most commonly reported sources: Board of Agriculture, Swedish Kennel Club, Veterinarian and Internet) and demographic factors.

Explanatory variables were first screened for univariable associations with the outcome of interest. Variables with a significant association at $p<0.2$ were retained for multivariable analyses. Multivariable models were reduced using backwards elimination until all remaining variables were significant at $p<0.05$. All possible two-way interactions between significant main effects were tested for, one at a time, with a strategy to retain them in the model if they were significant at $p<0.05$.

The statistical analysis was performed using Stata 10 (Stata Corp., College Station, TX, USA).

RESULTS

Descriptive statistics

The majority of the respondents were from Uppsala. The exact distribution of which areas the participants were from is shown in Figure 1.

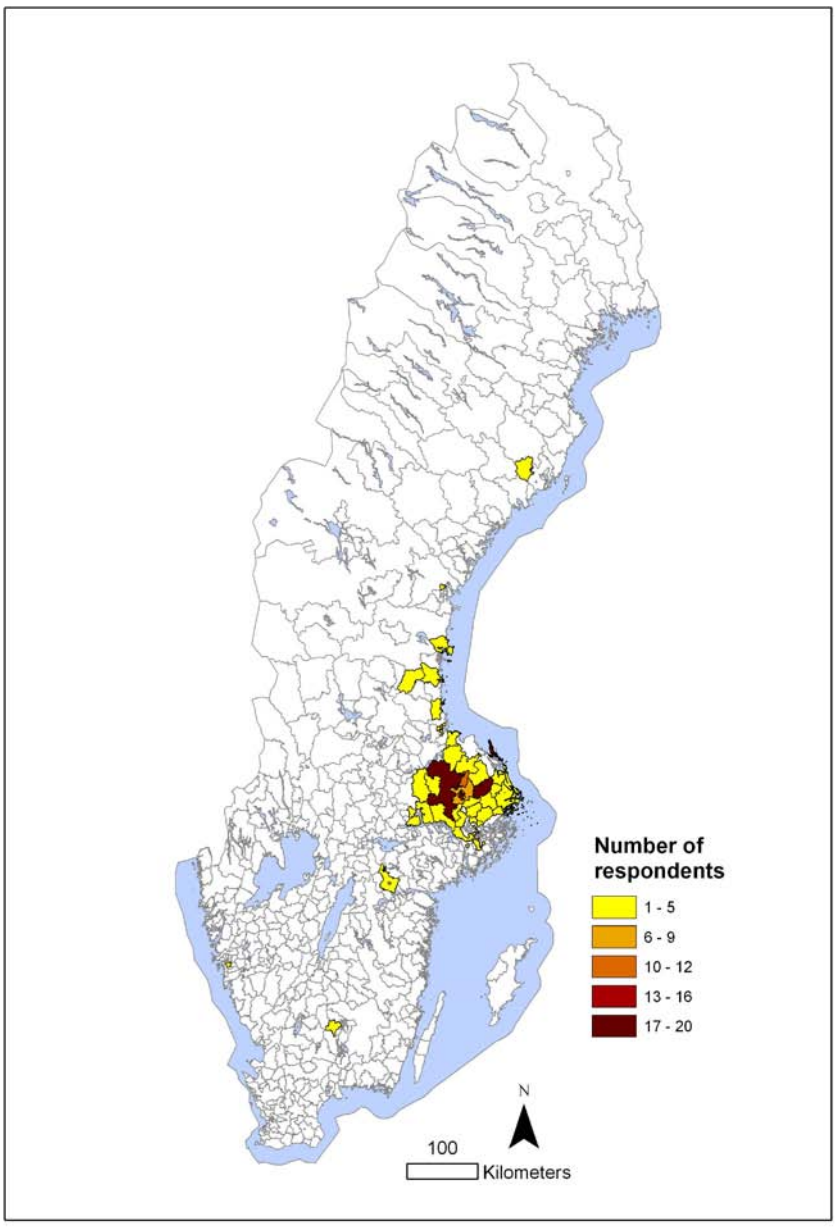

Figure 1. Map showing place of residence (by 3-digit postal code) of dog owners participating in a questionnaire survey regarding dog travel habits (n=185) carried out at the University animal hospital, Universitetsdjursjukhuset in Uppsala, Sweden, during the period March-May 2010.

Information about the respondents is presented in table 3. They were asked to state their highest education and also inform if they where veterinarians or veterinary students. Out of 99 people with a university education, four people stated they had a medical education. (Three stated they were veterinarians or veterinary students and one person stated she was a doctor

specialised in infectious diseases). Nearly 79 % of the dog owners had attended some form of dog course, principally puppy courses. The experience of dog ownership varied from 1 month to 65 years with a mean of 15.5 ±14 years. The number of dogs in each household ranged from one to eleven, with the majority (61 %) having one dog. Of the 185 persons answering the questionnaire, 22 were breeders with experience varying from 1- 44 litters.

Travel experience is presented in table 4. Of the total number of responses to questions concerning travel experience (n =181), 24 % stated that they either had travelled or planned to travel. Out of 30 respondents planning to travel with their dog, 19 had travelled before. Countries people had travelled to included Austria, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Italy, Latvia, Lithuania, Mexico, the Netherlands, New Zeeland, Norway, Poland, Russia and the United States of America. Countries people were planning to travel to include Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Great Britain, Italy, Latvia, the Netherlands, Norway and Spain.

Based on the countries of travel and the criteria for definition of a risk country, the following countries were defined as risk countries for rabies: Estonia, Hungary, Italy, Latvia, Lithuania, Mexico, Poland, Russia, and USA.

Risk countries for EM were Austria, Denmark, France, Germany, The Netherlands, Poland, Russia and USA.

Travel purposes are summarized in table 5.

Table 3. Descriptive data of respondents participating in a questionnaire survey about dog travelling at UDS in Uppsala during March-May 2010

Categorical variables	Respondents (n = 185)	
	n	%
Sex		
Man	41	22
Woman	141	76
No information	3	2
Age		
15-30	36	19
31-45	64	35
46-60	50	27
>60	35	19
Education		
Comprehensive school	24	13
Upper secondary school	62	34
University	99	51
University medical education	4	2
Number of dog courses attended		
0	39	21
1	127	69
>2	19	10

Table 3. Continued

Categorical variables	Respondents (n = 185)	
	n	%
Number of dogs in household		
1	113	61
2	39	21
3 or more	31	17
No information	2	1
Breeder		
Yes	22	12
No	159	86
No information	4	2
Actively competing with dogs		
Yes	54	29
No	130	70
No information	1	1

Continuous variables	5% pct	Median	95% pct
Years as dog owner	0.5	11.5	40

Table 4. Results of data collected from dog owners visiting UDS in Uppsala, during March-May 2010, regarding travelling experience and tendency to travel to countries defined as risk countries

	Respondents	
	n[1]	%
Has travelled	33	18 [2]
Scandinavia	26	79 [3]
Rest of Europe	11	33 [3]
Rest of the world	5	15 [3]
To country with risk of Rabies	10	30 [3]
To country with risk of EM	14	42 [3]
Plans to travel	30	17 [2]
Scandinavia	20	67 [4]
Rest of Europe	18	60 [4]
Rest of the world	0	0 [4]
To country with risk of Rabies	5	17 [4]
To country with risk of EM	16	53 [4]

[1]Respondent may have travelled to more than one country
[2]Per cent of the total number of respondents to this question (n = 181)
[3]Per cent of total number of travelling respondents (n = 33).
[4]Per cent of total number of respondent who plans to travel (n = 30).

Table 5.Results of data from questionnaire distributed to dog owners at UDS in Uppsala, during March-May 2010, regarding purposes to travel abroad accompanied by their dog

Purpose of travel	Has travelled (n = 33)		Plans to travel (n = 30)	
	n	%	n	%
Vacation	18	54.5	16	53.3
Competition	5	15.2	7	23.3
Breeding + competition	4	12.1	2	6.7
Other[1]	6	18.2	5	16.7

[1]Reasons included in this group are principally move/work/study-related

Level of knowledge

A summary of the distribution of scores for each question concerning knowledge in the questionnaire is found in table 6. The scores indicate that the knowledge of rabies is high compared to the knowledge of EM.

Table 6. Results of data from a questionnaire distributed to dog owners at UDS in Uppsala during March-May 2010 regarding their knowledge on rabies, Echinococcus multilocularis as well as infectious dog diseases that may be encountered abroad but not in Sweden

Knowledge variable	5% pct	Median	95% pct
Infection status in Sweden vs. abroad	-17	17	50
Rabies	0	51	80
Routes of transmission	-50	50	50
Symptoms	0	75	100
Presence[1]	0	50	100
EM	-33	0	33
Routes of transmission	-100	-100	50
Symptoms	-67	-33	17
Presence[1]	0	50	100

[1]Variable comprising both presence of the disease in Sweden vs. in Europe and presence in different species

Infection status and Zoonoses

The distribution of which diseases the respondents believe are infectious diseases that may be encountered abroad but not in Sweden (question 15) and which of those they think have a zoonotic aspect (question 16) are presented in figure 2a and 2b. Question 16 was answered by 110 respondents and rabies was most frequently entered as a zoonotic disease followed by EM. Rabies, EM and heartworm were the most frequently entered choices of infectious agents that the respondents thought may be encountered abroad but not in Sweden. From the answers given in question 17 and 18 the results show that 57 % of the respondents are aware of rabies being a zoonotic disease while 24% of them are aware that EM is a zoonotic agent.

The results from the multivariable analysis regarding knowledge of infection status in Sweden and abroad are given in table 7. Medical education was positively associated with knowledge of infection status as was being a woman and having more than one dog.

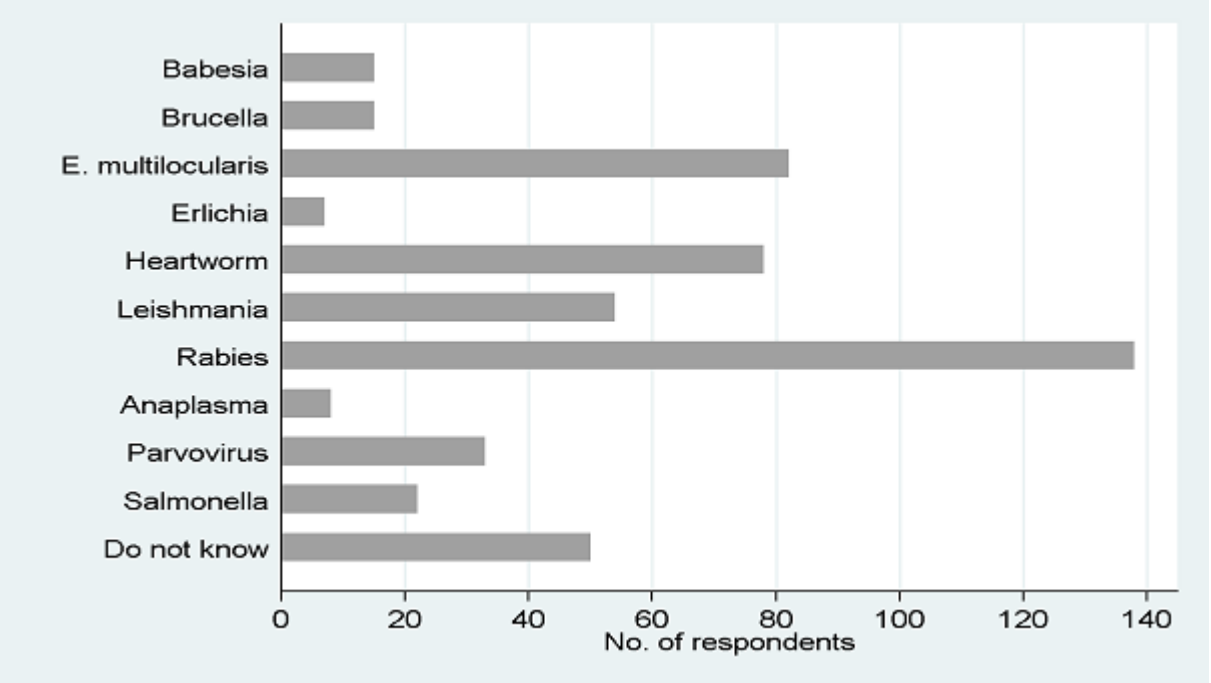

Figure 2a. Distribution of which diseases the respondents (n=184) thought were infectious diseases encountered abroad but not in Sweden. Questionnaire distributed at UDS in Uppsala during March-May 2010.

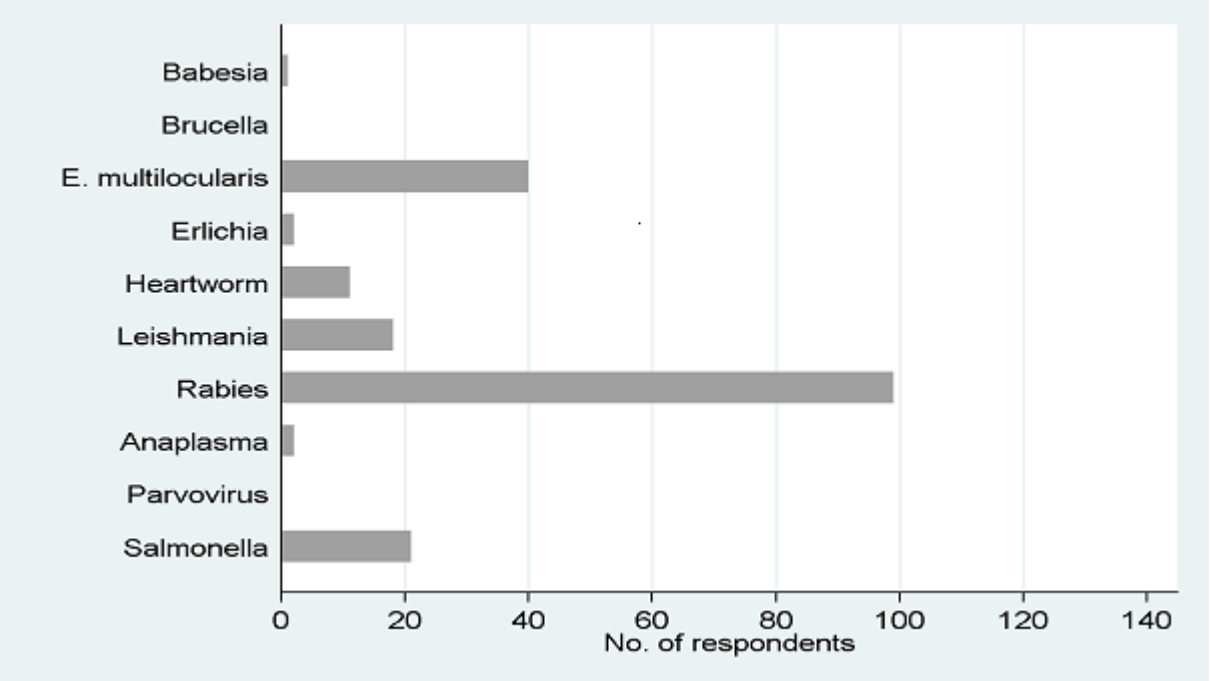

Figure 2b. Distribution of which diseases presented in figure 2a the respondents (n=110) thought were zoonotic diseases. Questionnaire distributed at UDS in Uppsala during March-May 2010.

Rabies and Echinococcus multilocularis

The distribution of scores related to the respondents' knowledge level of rabies and EM are given in figure 3a-c. Whereas the distribution for rabies is almost entirely above zero, EM scores have a median of 0, indicating that the knowledge level of the respondents is low regarding this agent. As seen in figure 3c, this is particularly true for knowledge about route of transmission.

The results from the multivariable analyses regarding knowledge of rabies and EM are given in table 7. Both age and travel experience were significantly associated with knowledge about rabies, with a higher score for younger respondents and respondents who had travelled or planned to travel. For EM, the only factor explaining the variation in knowledge was whether the respondent had travelled with his/her dog, or not, with travellers being more aware.

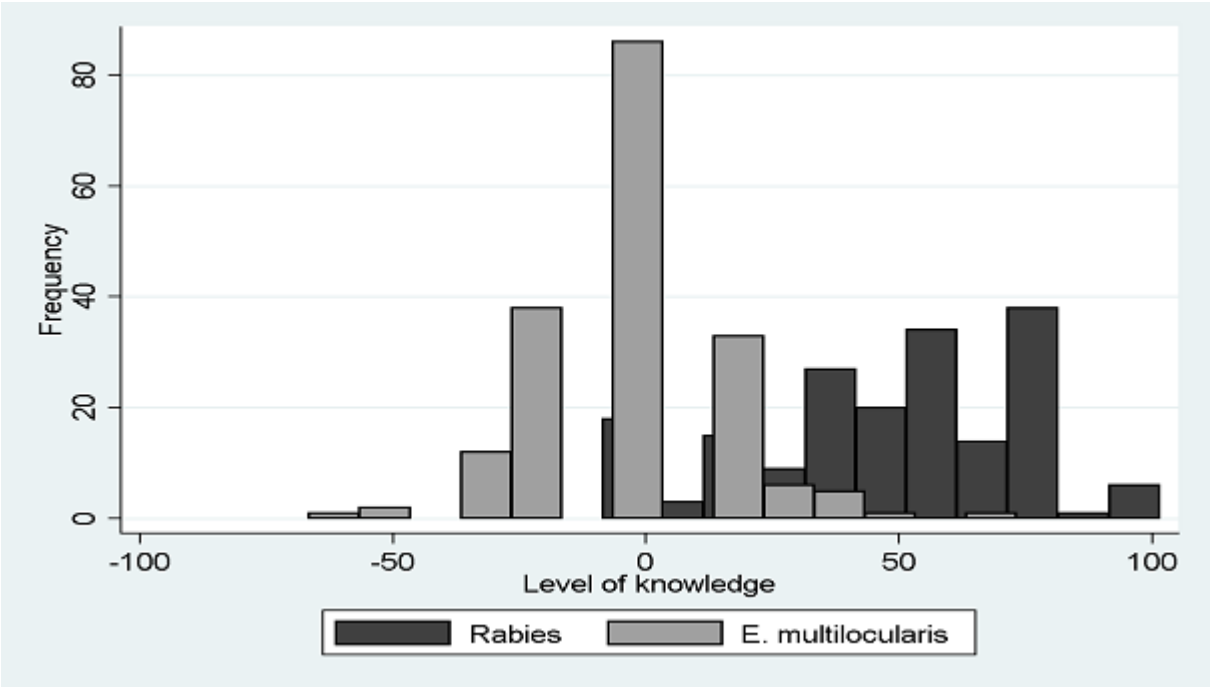

Figure 3a. The distribution of scores reflecting the respondents' general knowledge level of rabies and EM. Data collected via questionnaire distributed at UDS in Uppsala during March-May 2010.

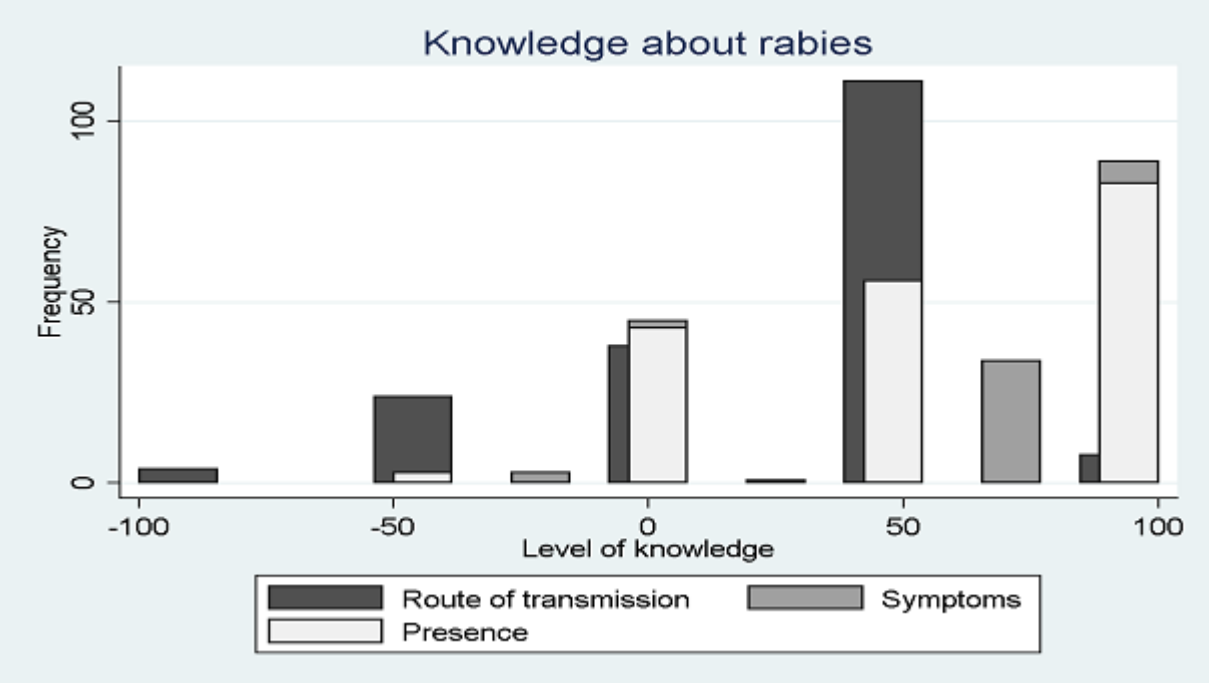

Figure 3b. Distribution of scores reflecting the respondents' knowledge level of rabies divided into different knowledge areas. Data collected via a questionnaire distributed at UDS in Uppsala during March-May 2010.

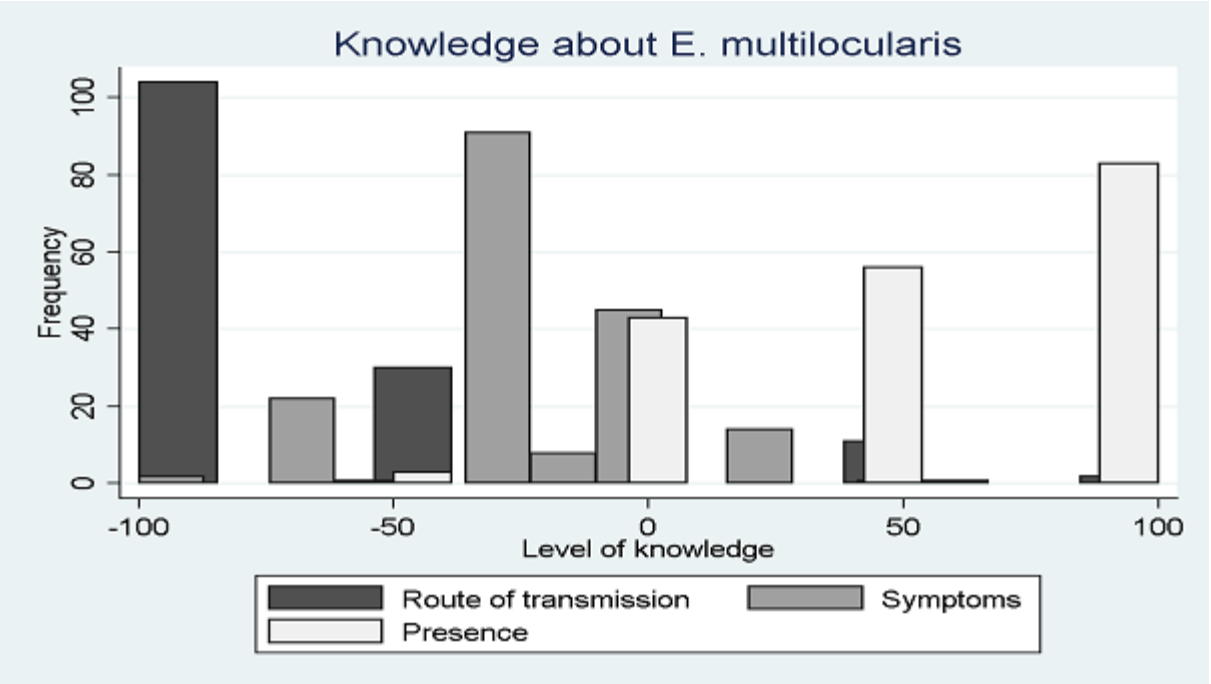

Figure 3c. Distribution of scores reflecting the respondents' knowledge level of Echinococcus multilocularis divided into different knowledge areas. Data collected via a questionnaire distributed at UDS in Uppsala during March-May 2010.

Table 7. Results from three multivariable linear regression models describing associations between level of knowledge and demographic characteristics. Questionnaire survey performed at UDS in Uppsala during March-May 2010

Outcome				
Variables		β	95% CI	p
Knowledge of infection status in Sweden versus abroad				
Intercept		8.4	-2.0, 18.8	0.113
Sex				0.013
	Woman	0		
	Man	-10.8	-19.3, -2.3	0.013
Number of dogs owned				0.020
	1 dog	0		
	2 dogs	9.5	0.7, 18.3	0.034
	≥ 3 dogs	11.2	1.6, 20.7	0.022
Education				0.028
	Comprehensive school	0		
	Upper secondary school	6.7	-4.8, 18.1	0.252
	University	7.8	3.2, 18.8	0.163
	University Medical education	39.2	13.7, 64.8	0.003
Knowledge of Rabies				
Intercept		53.7	48.2, 59.2	<0.001
Age				<0.001
	15-45	0		
	>45	-14.6	-23.1, -8.0	<0.001
Travel experience				0.041
	Has not travelled	0		
	Has travelled	9.1	0.4, 17.9	0.041
Knowledge of EM				
Intercept		-2.6	-5.6, 0.5	0.100
Travel experience				0.025
	Has not travelled or planned to travel	0		
	Has travelled or has planned to travel	7.1	0.9, 13.3	0.025

Information sources

Respondents were asked to give their main sources of information in relation to dog travelling. Their responses are presented in table 8, by travel experience. Non-travellers regard the veterinarian as an important information source to a significantly higher degree (p = 0.017) than people who has travelled or has plans to travel.

Table 8. Responses to a questionnaire directed to dog owners, visiting UDS in Uppsala in March-May 2010, regarding attitudes towards taking responsibility of preventive measures like vaccination and de-worming if they are not required by law

Information source	Information seekers							
	Non traveller but plans to (n = 11)		Traveller (n = 33)		Non traveller (n = 137)		Total (n=181)	
	n[1]	%	n[1]	%	n[1]	%	n[1]	%
Board of Agriculture	2	18.2	19	57.6	56	40.1	77	42.5
SVA	1	9.1	3	9.1	4	2.9	8	4.4
SKK	1	9.1	2	6.1	12	8.8	15	8.2
Veterinary clinic	4	36.4	8	24.2	66	48.2	78	43.1
Insurance company	1	9.1	0	0	6	4.4	7	3.9
Internet	3	27.3	5	15.2	13	9.5	21	11.6
Breeder	1	9.1	1	3.0	3	2.2	5	2.8
Embassy	0	0	0	0	2	1.5	2	1.1
Pharmacy	0	0	0	0	1	0.7	1	0.5
Agr. Dep.	0	0	1	3.0	0	0	1	0.5
Friend	0	0	0	0	1	0.7	1	0.5
Swe. Ass.	0	0	0	0	1	0.7	1	0.5

[1]One respondent may have reported more than one source of information.

SKK = Swedish kennel club, Agr. Dep = Agricultural department on destination, Friend = friend who has travelled, Swe. ass. = Swedish assistance dog association

Attitudes

Descriptive statistics on the responses regarding attitude to following recommendations on preventive measures, in case the legal requirements would be abolished, are given in table 9. The results of the multivariable analysis are presented in table 10. Men were almost three times more likely to state an attitude indicating they believe people in general would follow recommendations even if they were not compulsory by law. Similarly, respondents with a lower education were three times more likely to state a trusting attitude in this respect, compared to people with a university degree.

Table 9. Results of data collected in questionnaire directed to dog owners, visiting UDS in Uppsala in March-May 2010, regarding attitudes towards taking responsibility of preventive measures like vaccination and de-worming if they are not required by law

Question/answer	Respondents	
	n[1]	%
Willingness to follow recommendations?		
Yes,	175	98[2]
wants to protect the dog	163	94[3]
wants to protect one self	113	65[3]
wants to protect the country	156	90[3]
other reason	1	1[3]
No,	4	2[2]
because of cost	2	50[4]
because time consuming	1	25[4]
because risk is overrated	1	25[4]
other reason	2	50[4]
Will others follow the recommendations?		
Yes	72	41
No	104	59

[1]One respondent may have given more than one reason pro or against taking responsibility of preventive measures.

[2]The total number of respondents was 179 dog owners.

[3]Per cent out of those positive to follow recommendations.

[4]Per cent out of those negative to follow recommendations

Table 10. Results from a logistic regression model of dog owners' attitudes towards other people following recommendations of preventive measures like vaccination and de-worming if they are not required by law. Questionnaire survey performed at UDS in Uppsala during March-May 2010

Outcome				
Variables		OR	95% CI	p
Believe that others will follow recommendations (Yes=1)				
Sex				0.006
	Woman	0		
	Man	2.74	1.3, 5.7	0.006
Education				0.027
	University	0		
	Upper secondary school	1.79	0.9, 3.5	0.087
	Comprehensive school	3.21	1.3, 8.2	0.015

DISCUSSION

Dog travelling is considered to be increasing and this study has shown that 18 % of the dog owners participating in the survey have at some time travelled with their dog. About the same proportion, 17 %, plan to travel with their dog. These groups together constitute 24 % of the respondents. The most common reason to travel with the dog is vacation. This should not be considered a problem as long as the dogs are vaccinated and de-wormed as the law requires. However, people need to be aware of diseases like rabies and Alveolar Echinococcosis in order to be motivated to follow recommendations on prevention. This is especially important since people seem to travel or plan to travel to countries where the risk to encounter these diseases is high. More than 50 % of the respondents in this study who planned to travel with their dog intended to visit countries were EM is considered endemic in the wildlife population. Seventeen per cent of them plan to visit countries where there is a risk to encounter animals infected with rabies.

One objective in this study was to find out how aware people are about zoonotic diseases they may encounter abroad. This aspect was well reflected in the separate questions on rabies and EM. Of the respondents 57 % (n = 182) were aware that rabies is a zoonotic diseases while only 24 % is aware of EM being the same. None of the respondents were aware that brucellosis is a disease that can be transmitted from dogs to humans. Rabies is the most frequently named zoonotic disease followed by EM. This could however be influenced by the fact that separate questions were asked about these two agents and that the respondents because of that concluded that they were extra important. However more than half of the respondents who thought EM was a disease encountered abroad but not in Sweden had not named EM as a zoonotic agent. We believe it is important to notice this low awareness since the zoonotic aspect ought to be a major factor of motivation when the dog owner decides to follow recommendations of de-worming or not. It is possible that one question in the questionnaire (question 16) was misinterpreted, as it was conditional on the responses in the previous question. Because of this no score was calculated on how many correct and incorrect answers were given by each respondent. We believe however that it was understood that the respondent was supposed to name zoonotic diseases they were aware of and hence the previous conclusions can still be drawn.

People seem to know more about rabies than they do about EM. For rabies there is a positive picture with a majority of correct answers. However, for EM, the respondents have almost as many wrong answers as correct. This fact is troubling since the same respondents, as mentioned, seem to travel or plan to travel to a high extent to those countries defined as risk countries for EM. What is even more troubling is that they seem to be unaware of how this parasite can be transmitted to their dog and to themselves. People who have travelled or have plans to travel with their dog have a significantly better general knowledge of EM than do people who have no travelling experience. The same applies for the general knowledge of rabies. This suggests that the information sources that people turn to when they plan to travel are in fact informative. People who have travelled with their dog see the Board of Agriculture as their main source of information while respondents who have not travelled see the veterinarian as their most important information source. Considering this the veterinarians have a big responsibility in informing and keeping themselves updated on the current regulations. People who have travelled or have plans to travel see the veterinarian as significantly less important in this aspect. This could be because the veterinarian has disappointed the information seekers in the past or that they merely have been recommended by the veterinarian earlier to contact the Board of Agriculture for further information. Whatever the source of information we believe that the most important factor to keep Sweden

free from these diseases is the motivation to look for the information and also in this aspect the veterinarian plays a significant role.

Age seems to be a factor of importance when looking at the knowledge of rabies. People younger than 45 years know more about rabies than older people. One reason for this may be that younger people travel more (even without their dog) to countries where rabies is a problem and hence are more informed about the disease. The fact that people are more aware of rabies than of EM probably has many reasons, one being that EM does not cause any symptoms in the dog or fox as do rabies and this of course makes it impossible to people to observe it. Another reason is probably the often dramatic and quick development of disease when bitten by a rabies infected dog compared to the very long incubation time of up to 15 years for Alveolar Echinococcosis. This makes EM less likely to be talked about in the media and hence less likely for people to be aware of.

To find out about people's attitudes to following recommendations concerning preventive measures (like vaccination and deworming), if they were not required by law, was another objective of this study. The respondents were asked to judge their own as well as other people's sense of responsibility. Ninety-eight per cent of the respondents said they were positive to taking responsibility for preventive measures even when not required to do so by law. However only 41 % of the respondents thought others would follow the recommendations of prevention. Considering that some respondents can be sensitive to questions on compliance (in particular those who would not comply) we want to interpret these figures with caution. A conservative approach is to suggest that those who have responded that they themselves would follow recommendations and who also thought others would do so is closer to the actual percentage of people who would in fact follow the recommendations. This could mean that only around 40 % of the dog owners would do what they were recommended to do. This correlates well with the 30-50 % scenario that was previously evaluated in one of the risk assessments carried out at SVA (Wahlström et al 2009). Our study showed that men and respondents with a lower level of education were significantly more inclined to believe in other people's sense of responsibility than women and respondents with a higher level of education. Possibly highly educated people have been trained to have a more critical attitude.

The respondents were asked to give reasons (prewritten alternatives) as to why they were for or against following recommendations. Perhaps the prewritten alternatives affected the chosen standpoint, suggesting that the outcome of as many as 98 % positive to prevention may have been lower if no alternatives had been given. Most people wanted to protect their dog (94 %) or their country (90 %); less people were interested in protecting themselves (65 %). It has been shown before that people living in rabies free areas are less inclined to consider rabies a health risk than people living in areas where rabies is endemic (McGuill et al 1997). Those who were not going to follow recommendations gave the reasons laziness and cost as primary reasons not to do so.

The actual compliance with the current regulations is poorly understood, and the current frequency of controls at the border may be insufficient for people in general to understand the importance of them. Possibly it would be motivating for people to see that there is a national interest in this respect, and one way for the authorities to express this could be to increase the control frequency at the country borders until January 1st 2012 when the law expires.

In conclusion we think that more information about especially AE/EM is required to keep Sweden free from this serious zoonotic disease also in the future. The veterinarian will play an important part in this aspect. Since Swedes have a habit of eating berries in the forest without rinsing them AE should also be addressed by human physicians when advising people

before travelling. This would elevate the awareness of this disease and make it a topic of conversation in the whole society and perhaps elevate the motivation to prevent entrance.

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APPENDIX 1

1. **Är Du som besvarar enkäten:**

   Man Kvinna

2. **Ange ditt postnummerområde**.....

3. **Hur gammal är Du?**

   15-30 31-45 46-60 61-75 76-90

4. **Vad har Du för <u>högsta</u> utbildning? Kryssa för ett alternativ.**
   <u>OBS!</u> Om du är veterinär eller veterinärstudent ange detta på den tomma raden.

   ☐ Grundskola

   ☐ Gymnasium

   ☐ Högskola/Universitet

   …….…….

5. **Har Du deltagit i någon hundkurs motsvarande alternativen nedan? Du kan kryssa mer än ett alternativ.**

   ☐ Valp-, Lydnad-, Spår- och/eller Agilitykurs

   ☐ Uppfödarutbildning

   ☐ Hundinstruktörsutbildning

6. **Hur länge har Du varit hundägare?**.....

7. **Hur många hundar äger Du?**.....

8. **Tävlar Du aktivt med din/-a hund/-ar? (ex. lydnad, utställning, jaktprov etc)**

   Ja

   Nej

9. **Är Du uppfödare/kennelägare?**

   Ja, hur många kullar har du haft?.....

   Nej

10. **Har Du någon gång rest utomlands med hunden/-arna?**

    Ja, till vilka länder?.....

    Nej

11. **Om ja, vad var ändamålet för resan?**

    - ☐ Semesterresa
    - ☐ Avel
    - ☐ Tävling
    - ☐ Annat, vad?.....

12. Vart skulle Du vända Dig om Du ville ha information om vad Du bör tänka på inför en resa utomlands med Din/-a hund/-ar?

……...

13. Planerar Du någon resa utomlands <u>med hund</u> under detta år?

Ja, till vilket land?.....

Nej

14. Om ja, vad är ändamålet för resan?

☐ Semesterresa

☐ Avel

☐ Tävling

☐ Annat, vad?.....

15. Vet Du vilka av följande sjukdomar som kan drabba Din hund utomlands <u>och som i dagsläget ej finns i Sverige</u>?

☐ Leishmaniasis

☐ Hundpest

☐ Erlichia canis

☐ Babesios

☐ Rabies

☐ Salmonella

☐ Rävens dvärgbandmask

☐ Hjärtmask

☐ Brucellos ☐ Anaplasmos

☐ Nej, jag känner inte till vilka av dessa sjukdomar man i dagsläget enbart riskerar att träffa på utomlands

16. Vet Du om någon/några av sjukdomarna Du kryssade för i föregående fråga kan smitta mellan Din hund och Dig själv?

Ja, vilka?.....

Nej

17. Vad av följande anser Du vara sant när det gäller sjukdomen Rabies?
<u>Kryssa för alla alternativ som Du anser vara riktiga.</u>

☐ Smittar via saliv ☐ Smittar via beröring/kontakt

☐ Smittar via avföring ☐ Orsakar beteendestörningar

☐ Orsakar blödningar i inre organ ☐ Orsakar skador på levern hos människa

☐ Orsakar främst mag/tarmbesvär ☐ Hundar som smittas är symptomfria

☐ Drabbar endast hunddjur ☐ Drabbar flera däggdjur inkl människa

☐ Sverige anses fritt från smittämnet ☐ Europa anses fritt från smittämnet

18. Vad av följande anser Du vara sant när det gäller sjukdomen blåsmasksjuka som orsakas av en parasit kallad Rävens dvärgbandmask (Echinococcus multilocularis)? <u>Kryssa för alla alternativ som Du anser vara riktiga.</u>

☐ Smittar via saliv ☐ Smittar via beröring/kontakt

☐ Smittar via avföring ☐ Orsakar beteendestörningar

☐ Orsakar blödningar i inre organ ☐ Orsakar skador på levern hos människa

☐ Orsakar främst mag/tarmbesvär ☐ Hundar som smittas är symptomfria

☐ Drabbar endast hunddjur ☐ Drabbar flera däggdjur inkl människa

☐ Sverige anses fritt från smittämnet ☐ Europa anses fritt från smittämnet

19. Enligt svensk lag är man idag skyldig att vaccinera och avmaska sin hund för att motverka vissa sjukdomar innan de får föras tillbaka in i Sverige efter en resa. Om denna lag inte fanns tror Du att <u>Du</u> ändå skulle vaccinera/avmaska Din hund vid eventuell resa?

Ja

Nej

Om Ja, varför? (kryssa i en eller flera rutor)

☐ För att skydda hunden

☐ För att skydda dig själv

☐ För att skydda andra dvs att förhindra att en ny smitta införs till landet

☐ Annat, vad?.....

Om Nej, varför inte? (kryssa i en eller flera rutor)

☐ Kostnad

☐ Tidskrävande procedur

☐ Bedömer risken att drabbas (gäller både hunden och Dig själv) som överdriven

☐ Annat, vad?.....

20. Tror du att de flesta hundägarna skulle efterleva rekommendationerna om vaccination/avmaskning även utan tvingande lagkrav?

☐ Ja, jag tror de flesta skulle vaccinera/avmaska sin hund vid utlandsresa!

☐ Nej, jag tror många skulle avstå att vaccinera/avmaska sin hund vid utlandsresa!